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

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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. Abundance estimates of juvenile Chinook salmon and steelhead migrants were higher in 2016 than 2015 and similar to estimates over the last 10 years in our four study streams, except for juvenile steelhead migrants in the Upper Grande Ronde River where we had to shorten our spring trapping season.

Combining spring Chinook salmon migrant 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 11,532 for the 2014 brood year, for productivity of 12 smolts per spawner. We estimated that in Lostine River the number of spring Chinook salmon smolt equivalents leaving Lostine River was 26,440 for the 2014 brood year, for productivity of 18 smolts per spawner. We estimated that in Minam River the number of spring Chinook salmon smolt equivalents leaving Minam River was 39,560 for the 2014 brood year, for productivity of 36 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 19,252 for the 2014 brood year, for productivity of 20 smolts per spawner.

The relationship between number of Chinook salmon spawners and productivity as measured as smolts per spawner continues to show that at higher spawner densities, as seen in 2014, the productivity decreases. 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 near the trend line in Catherine Creek and the Minam and Lostine rivers and below the trend line in the Upper Grande Ronde River where we had a shortened spring trapping season. 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 117 surveys in the Upper Grande Ronde River (UGRR) basin and 109 surveys in the Joseph Creek basin from 14 March through 08 June 2016 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 58.2 km (65%) of an estimated 892 km of available steelhead spawning habitat. In Joseph Creek, we surveyed 26 sites encompassing 52.7 km (13.7%) of the 384 km of available spawning habitat.

During these surveys we observed 128 steelhead redds and three live steelhead in the UGRR basin and 177 redds and 18 live steelhead in the Joseph Creek basin. We observed zero carcasses in UGRR basin and one carcasses in the Joseph Creek basin.

On 18.7 km of Deer Creek, 63 redds, nine live steelhead, and zero carcasses were observed while surveying. However, we encountered 31 steelhead carcasses at the weir and 22 kelts that were passed downstream of the weir. Of these 53 adult steelhead all were marked with a left operculum punch (LOP) received in the Big Canyon fish trap. A total of 82 wild-origin adult steelhead were passed above a permanent weir on Deer Creek, resulting in 1.3 fish:redd ratio for the 2016 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 2,572 (95% C.I.: 1,548–3,596) and 1,663 (95% C.I.: 924–2,402) 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, and continued higher in 2015. The 2016 estimates were close to the long-term average. This was the fourth GRTS-based steelhead spawning ground survey in Joseph Creek, and estimates dropped from last year's high (~3,000 fish), to ~1,650 fish. This is the last year in which we will conduct GRTS surveys in Joseph Creek.

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

Salmonids were observed at 49 of the 53 surveyed CHaMP sites in 2016. Three sites went dry early in the summer, and were not surveyed for fish. West Fork Ladd Creek was surveyed but had no fish of any taxa.

Steelhead were most widely distributed of the salmonids, and found in every surveyed stream except WF Ladd Creek. Chinook were more restricted in their distribution, mostly found in mainstem Grande Ronde River and Catherine Creek. In past years many Chinook were observed in mouths of smaller tributaries, but this was not observed in 2016.

Overall counts for both species were down from last year. We observed 3,437 juvenile Chinook and 4,765 juvenile steelhead at all sites. Most individuals were in the age zero size category, which is typical.

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 collects genetic samples from juvenile Chinook salmon and provides them to NOAA Fisheries for the Columbia Basin-wide Relative Reproductive Success (RSS) study, project 1989-096-00. This project provides data for the Interior Columbia Technical Recovery Team (ICTRT) spring Chinook salmon life cycle model.

Objectives for FY16:

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

9. 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.

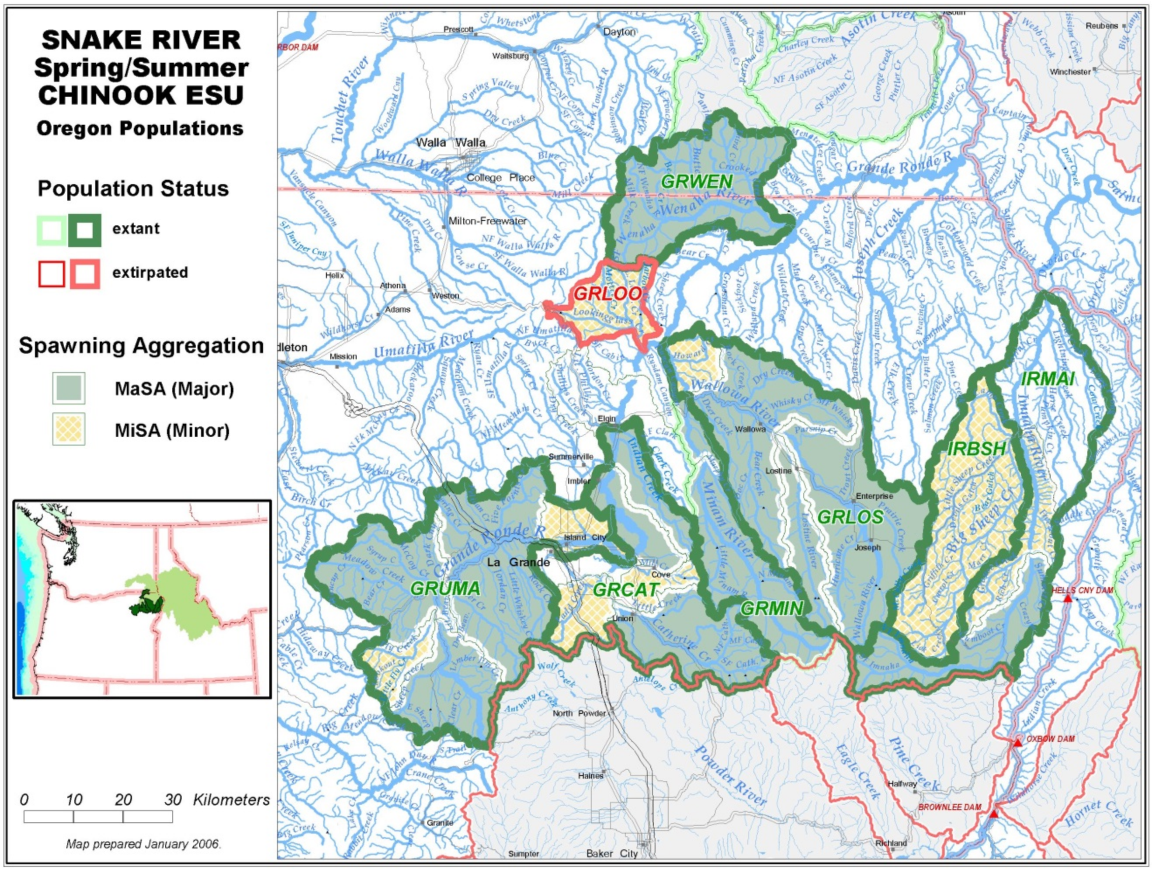

Figure 1. Map of the Grande Ronde-Imnaha spring Chinook salmon MPG with individual Chinook salmon populations identified. This project monitors these populations within this MPG: Upper Grande Ronde River (GRUMA), Catherine Creek (GRCAT), Minam River (GRMIN), Lostine River (GRLOS), and Imnaha River (IRMAI).

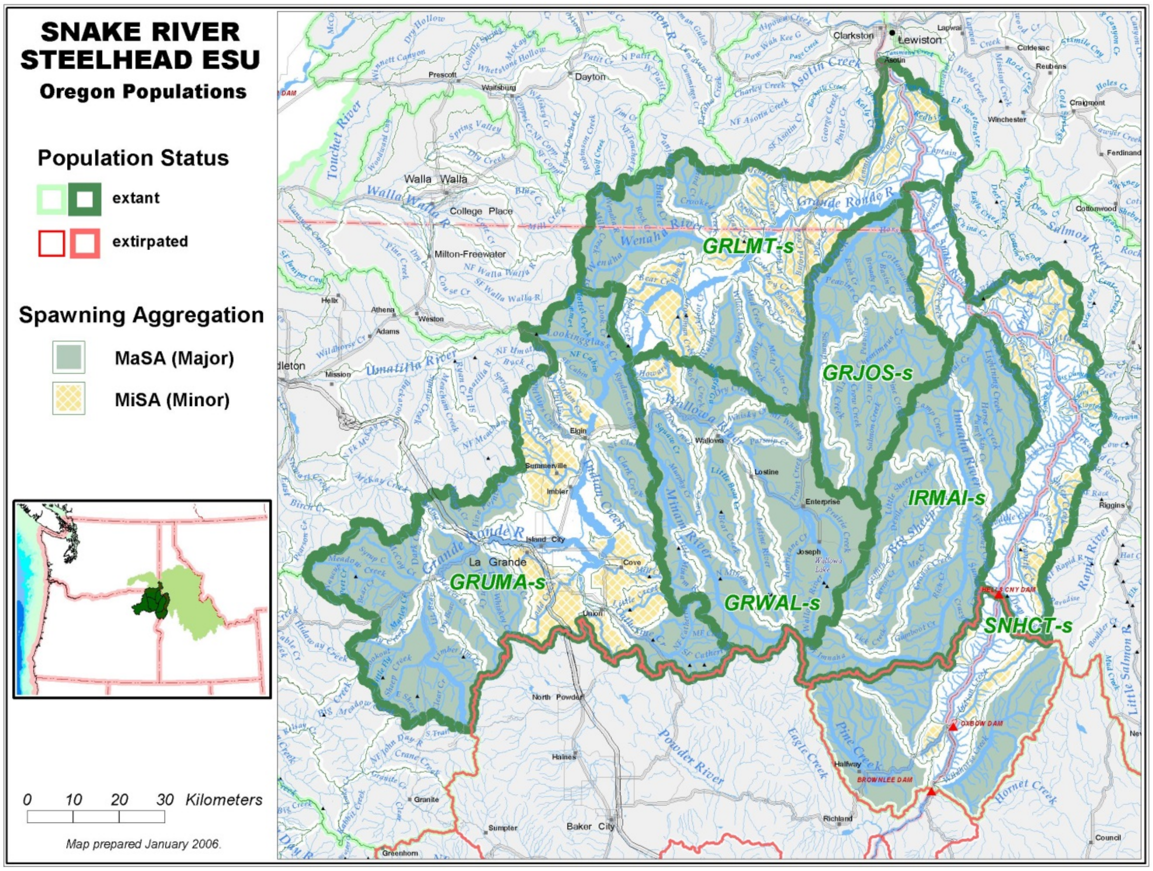

Figure 2. Map of the Grande Ronde-Imnaha steelhead MPG with individual steelhead populations identified. This project monitors these populations within this MPG: Upper Grande Ronde River (GRUMA-s), Wallowa River (GRWAL-s), and Joseph Creek (GRJOS-s).

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.

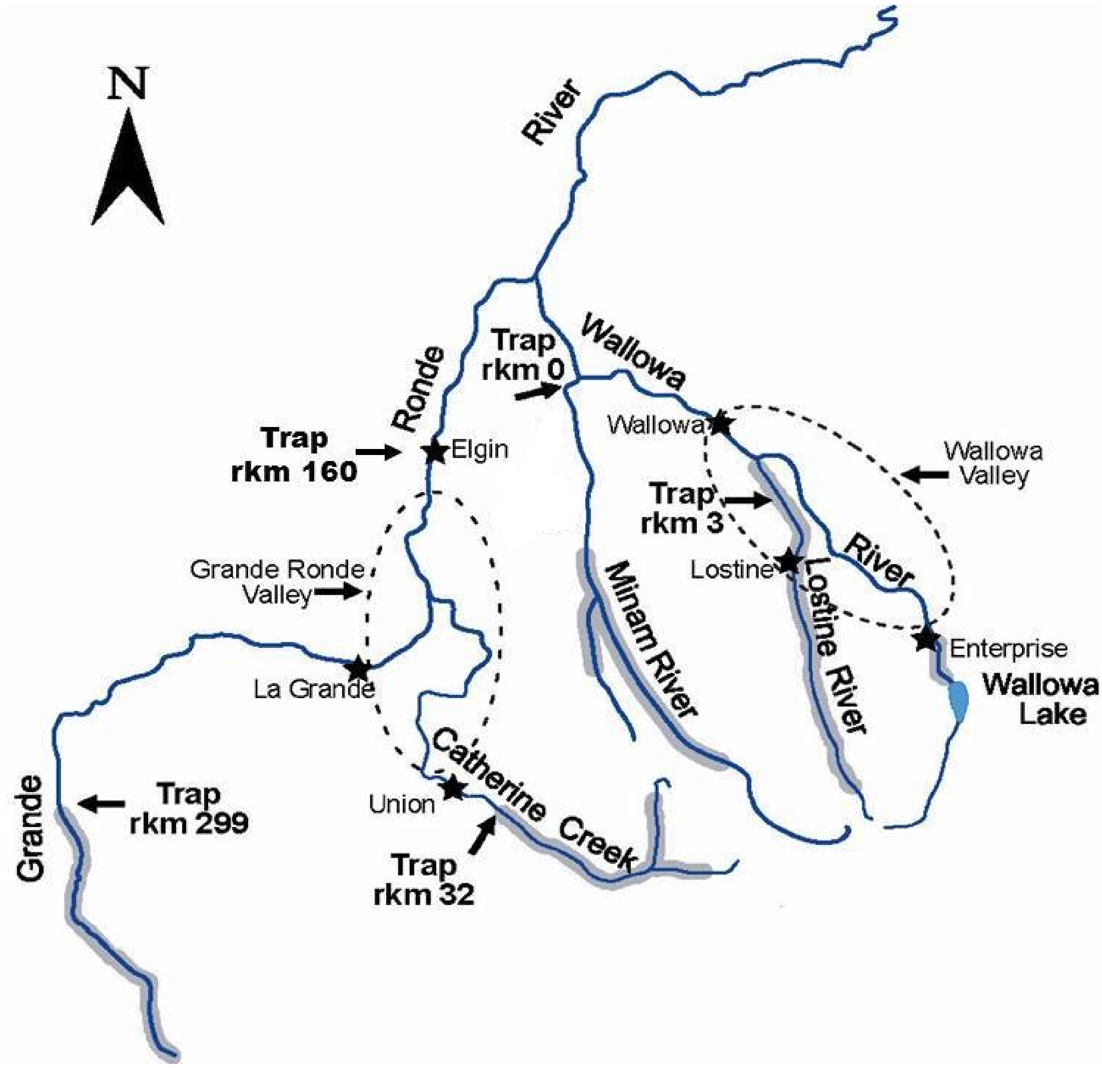

Figure 3. Locations of rotary screw fish traps in Grande Ronde River Subbasin during the study period. Shaded areas delineate spring Chinook salmon spawning and upper rearing areas. Dashed lines indicate Grande Ronde and Wallowa river valleys.

Results
Spring Chinook Salmon

We estimated a minimum of 26,818 ± 2,886 juvenile spring Chinook salmon emigrated from Catherine Creek upper rearing areas during MY 2016 (Figure 4). Based on total minimum estimate, 85% (22,743 ± 2,809) migrated early and 15% (4,075 ± 664) migrated late.

We estimated a minimum of 57,275 ± 8,210 juvenile spring Chinook salmon emigrated from Lostine River during MY 2016 (Figure 5). Based on the minimum estimate, 85% (48,509 ± 8,166) of juvenile spring Chinook salmon migrated early, while 15% (8,766 ± 849) migrated late.

We estimated a minimum of 66,846 ± 6,978 juvenile spring Chinook salmon emigrated from Minam River during MY 2016 (Figure 6). Based on the minimum estimate, 68% (45,379 ± 5,988) of juvenile spring Chinook salmon migrated early and 32% (21,467 ± 3,582) migrated late.

We estimated a minimum of 22,353 ± 2,261 juvenile spring Chinook salmon emigrated from upper Grande Ronde River during MY 2016 (Figure 7). The spring trap season ended prematurely on 9 April 2016, thereby missing a portion of the late migrants. Based on the minimum estimate, 29% (6,423 ± 352) of juvenile spring Chinook salmon migrated early and 71% (15,930 ± 2,234) migrated late.

The middle Grande Ronde River trap at Elgin fished for fished for 82 d between 26 February 2016 and 3 June 2016. We estimated a minimum of 30,600 ± 3,288 juvenile spring Chinook salmon emigrated from upper rearing areas.

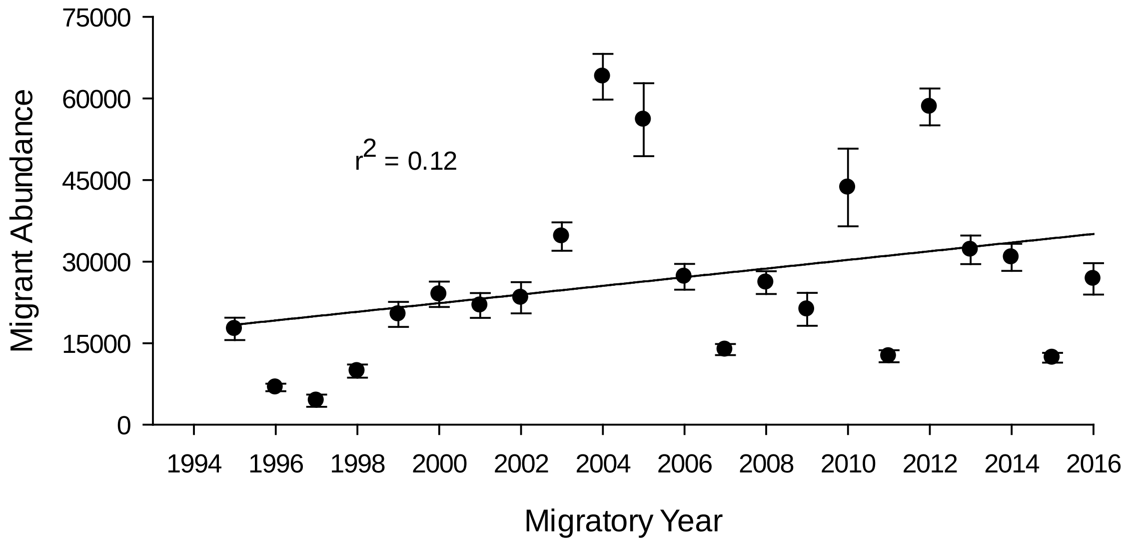

Figure 4. Spring Chinook salmon migrant abundance estimates at the Catherine Creek trap site by migratory year. Error bars are 95% confidence intervals.

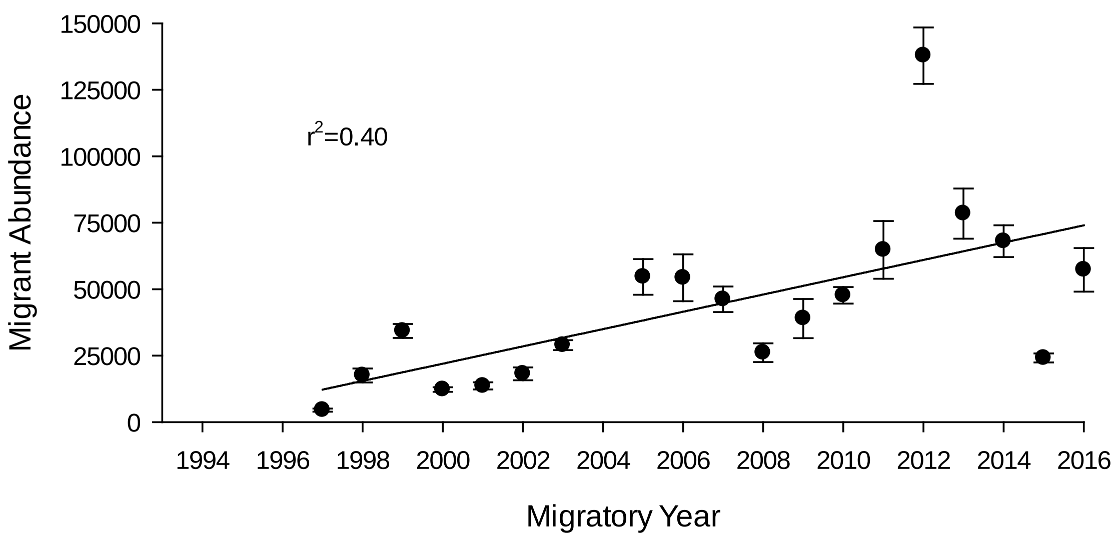

Figure 5. Spring Chinook salmon migrant abundance estimates at the Lostine River trap site by migratory year. Error bars are 95% confidence intervals.

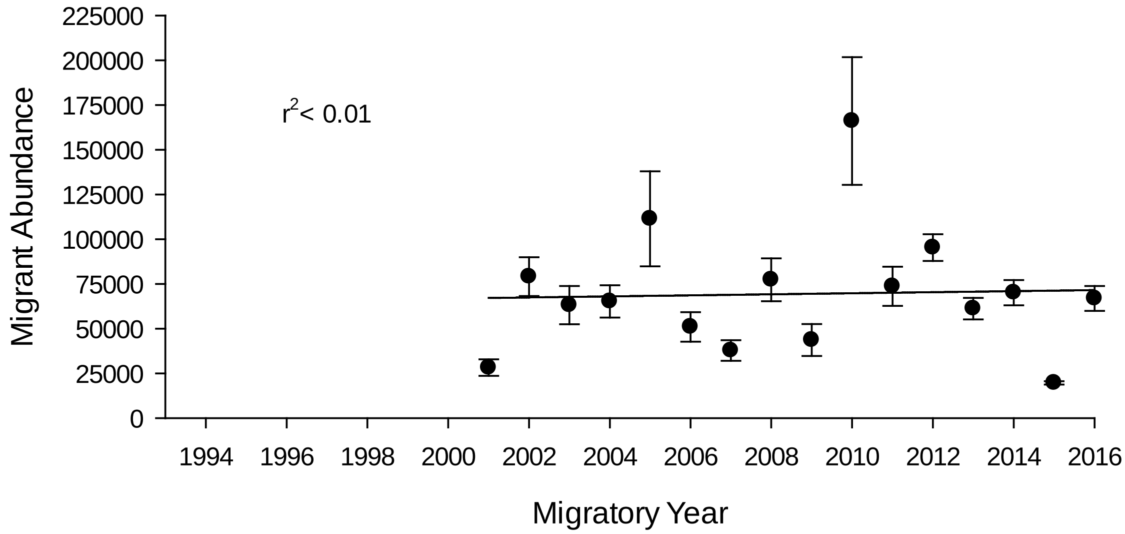

Figure 6. Spring Chinook salmon migrant abundance estimates at the Minam River trap site by migratory year. Error bars are 95% confidence intervals.

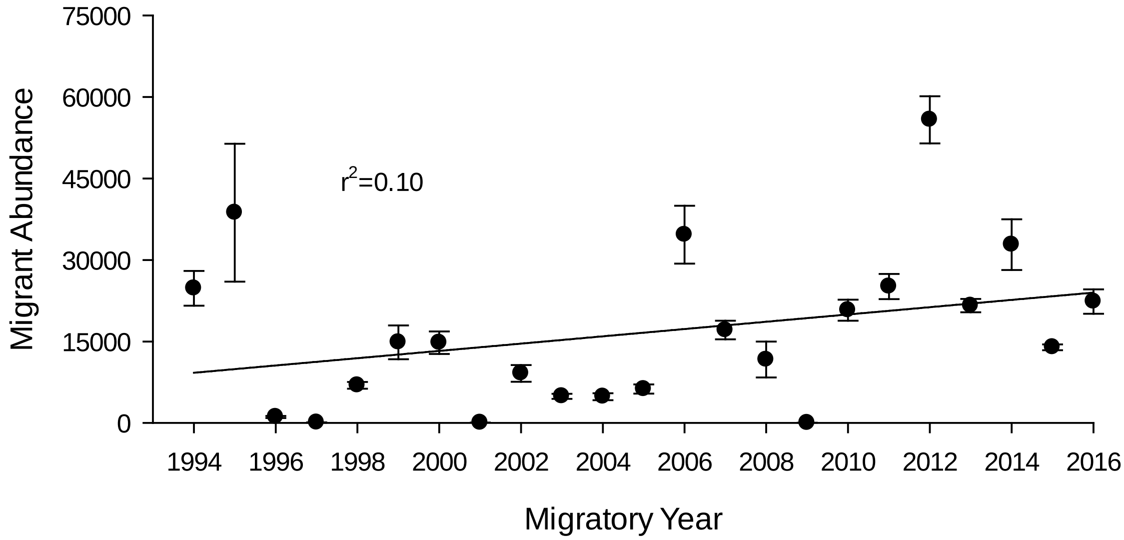

Figure 7. Spring Chinook salmon migrant abundance estimates at the upper Grande Ronde River trap site by migratory year. Error bars are 95% confidence intervals.

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 2016 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). The data from 2015 generally supports this trend, as the lower number of migrants in 2015 is associated with larger migrants, relative to the last several years.

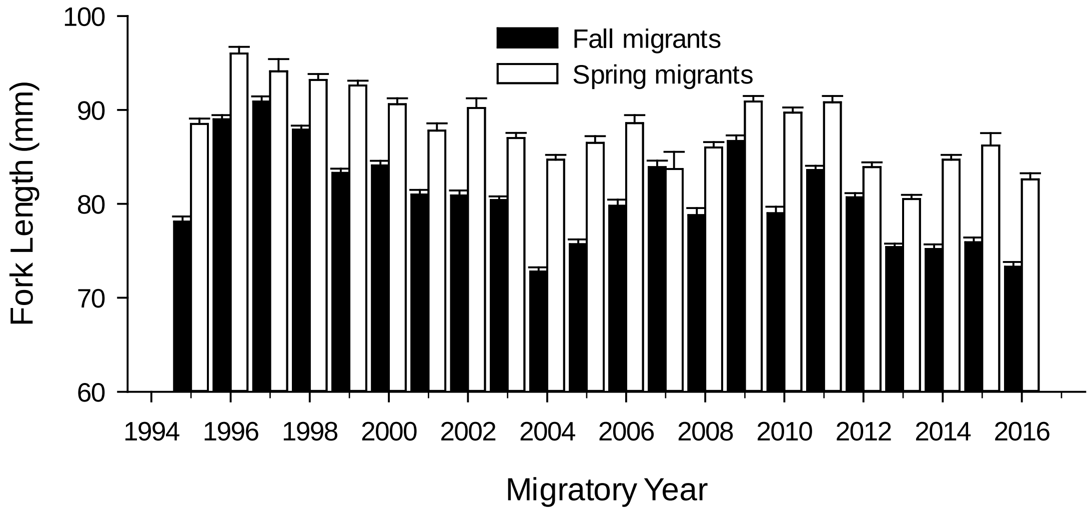

Figure 8. Fork length of spring Chinook salmon migrants captured at the Catherine Creek rotary screw trap by migratory year. Error bars are 95% confidence intervals.

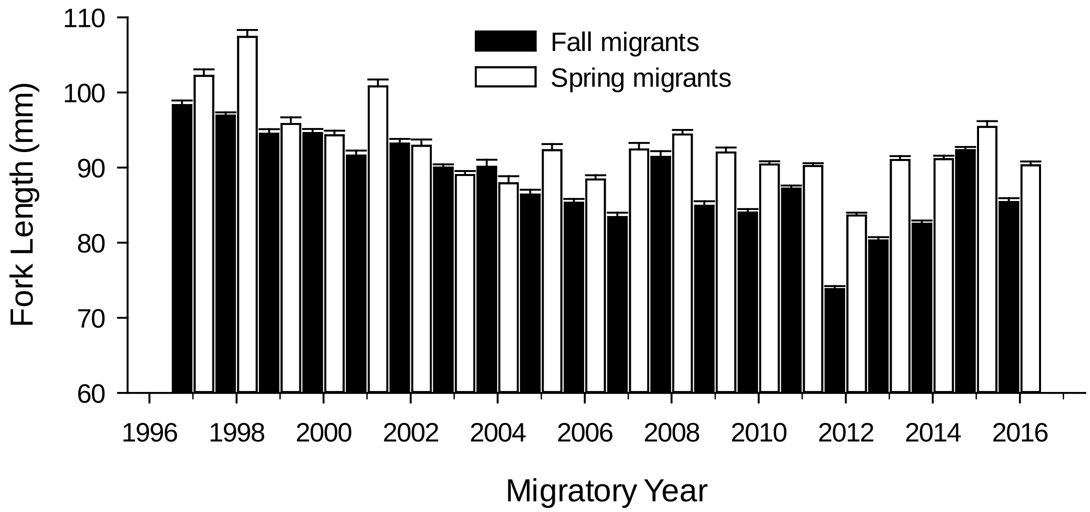

Figure 9. Fork length of spring Chinook salmon migrants captured at the Lostine River rotary screw trap by migratory year. Error bars are 95% confidence intervals.

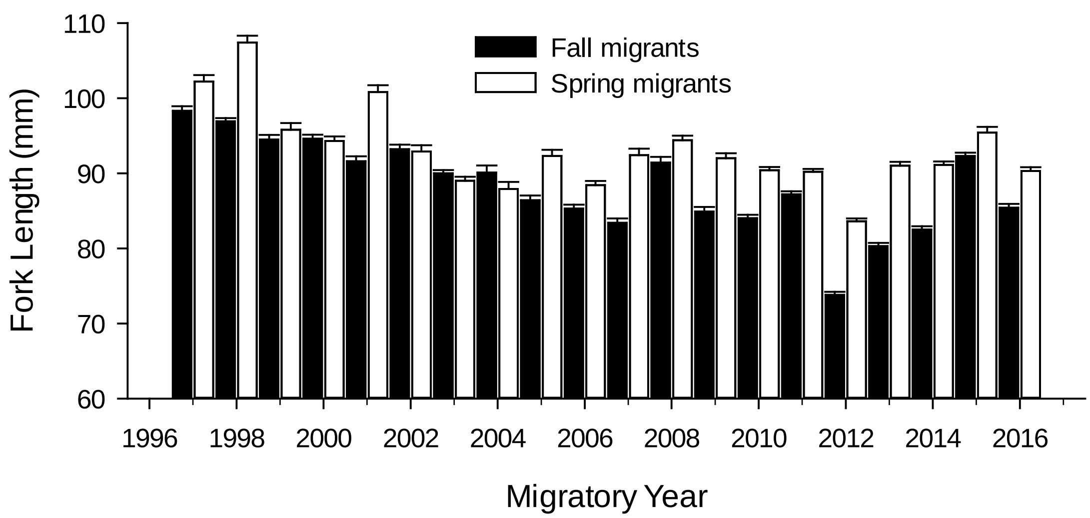

Figure 10. Fork length of spring Chinook salmon migrants captured at the Minam River rotary screw trap by migratory year. Error bars are 95% confidence intervals.

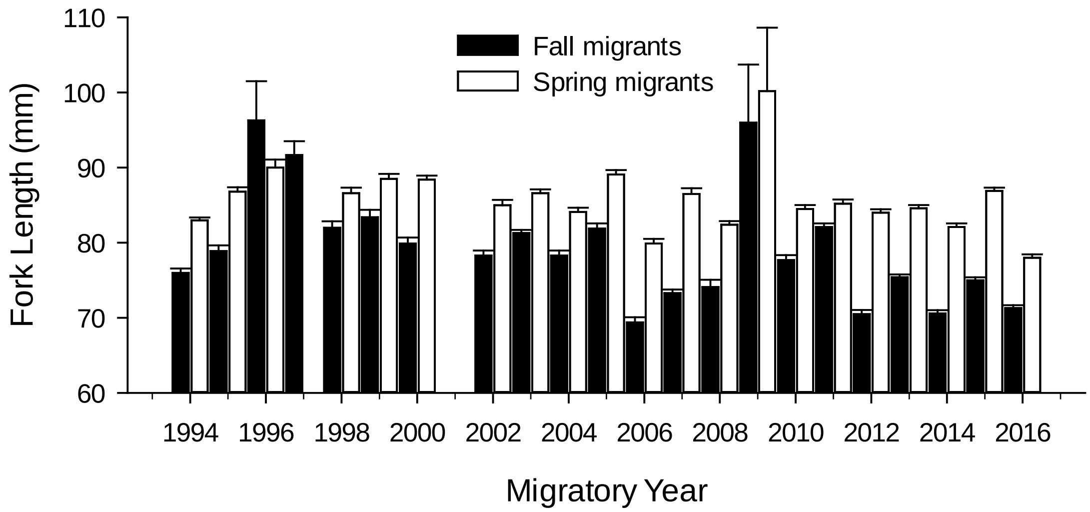

Figure 11. Fork length of spring Chinook salmon migrants captured at the upper Grande Ronde River rotary screw trap by migratory year. Error bars are 95% confidence intervals.

Survival probabilities to Lower Granite Dam for parr tagged during summer 2015 were 0.032 for Upper Catherine Creek, 0.131 for Imnaha, 0.081 for Lostine, 0.124 for Minam, and 0.076 for upper Grande Ronde river populations (Figure 12). Insufficient detections precluded survival probability estimation for Lower Catherine Creek summer tagged parr which likely indicates very low survival of this tag group. Generally, survival probabilities during MY 2016 fell within ranges previously reported.

Catherine Creek fall, winter, and spring tag group survival probabilities to Lower Granite Dam were 0.060, 0.077 and 0.183, respectively. Survival probabilities for Lostine River fall, winter, and spring tag groups were 0.188, 0.199, and 0.516, respectively. Probability of survival for the middle Grande Ronde River spring tag group was 0.572. Survival probabilities for Minam River fall and spring tag groups were 0.185 and 0.464, respectively. Upper Grande Ronde River fall, winter, and spring tag group survival probabilities to Lower Granite Dam were 0.120, 0.048, and 0.232, 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).

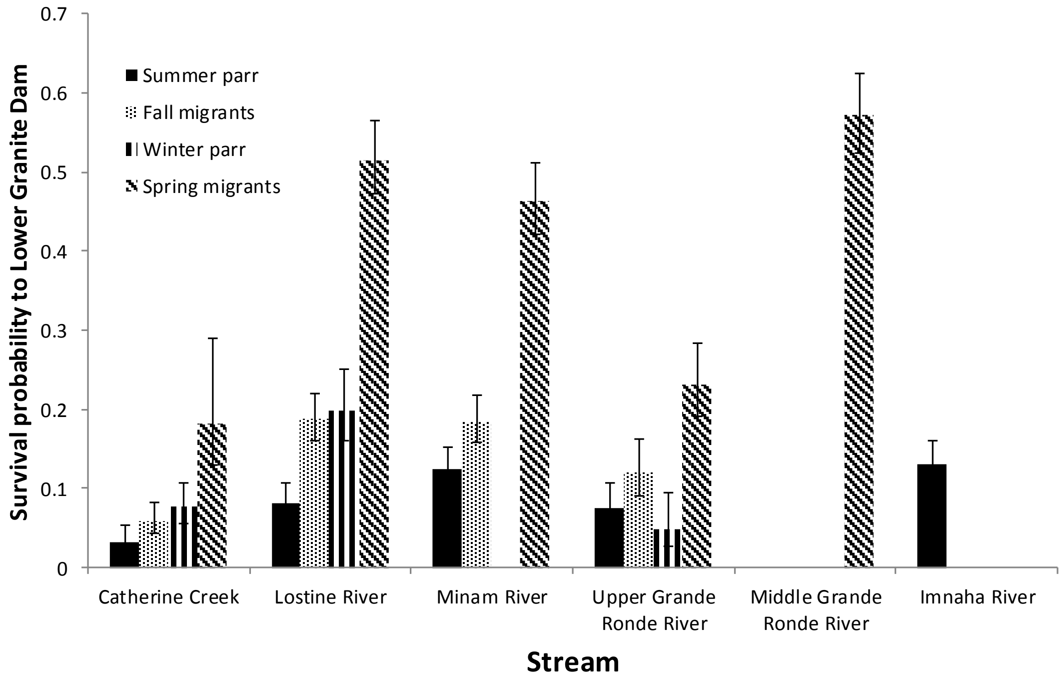

Figure 12. Survival probability to Lower Granite Dam of juvenile spring Chinook salmon PIT tagged at various life stages for the 2016 migratory year. Error bars are 95% confidence intervals.

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 2016 we estimated 11,532 smolt equivalents from Catherine Creek, 26,440 smolt equivalents from Lostine River, 39,560 smolt equivalents from Minam River, and 19,252 smolt equivalents from upper Grande Ronde River (Figure 13). Our estimate for upper Grande Ronde River smolt equivalents is not adjusted for the shortened trap operation in spring 2016.

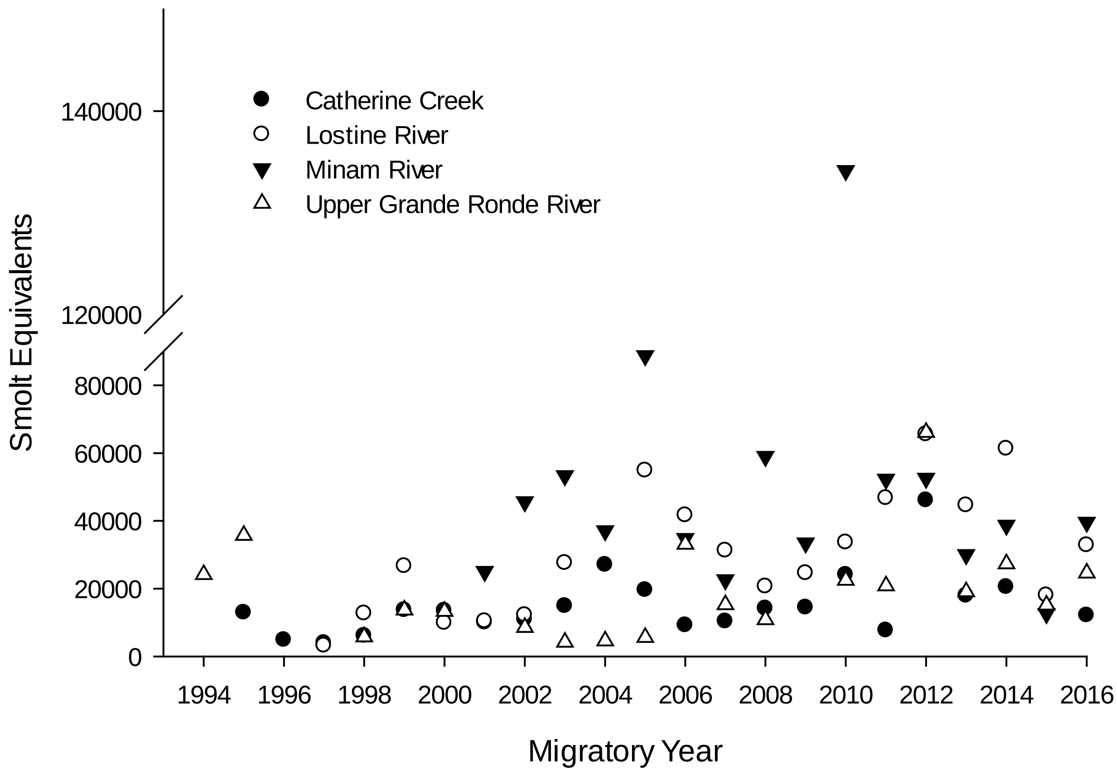

Figure 13. Spring Chinook salmon smolt equivalents produced from redds upstream of rotary screw traps in four study streams by migratory year.

Estimated productivity of spring Chinook salmon in Catherine Creek was 12 smolts per spawner for the 2014 brood year (2016 migratory year, Figure 14). Estimated productivity of spring Chinook salmon in Lostine River was 18 smolts per spawner for the 2014 brood year (2016 migratory year, Figure 15). Estimated productivity of spring Chinook salmon in Minam River was 36 smolts per spawner for the 2014 brood year (2016 migratory year, Figure 16). Estimated productivity of spring Chinook salmon in upper Grande Ronde River was 20 smolts per spawner for the 2014 brood year (2016 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).

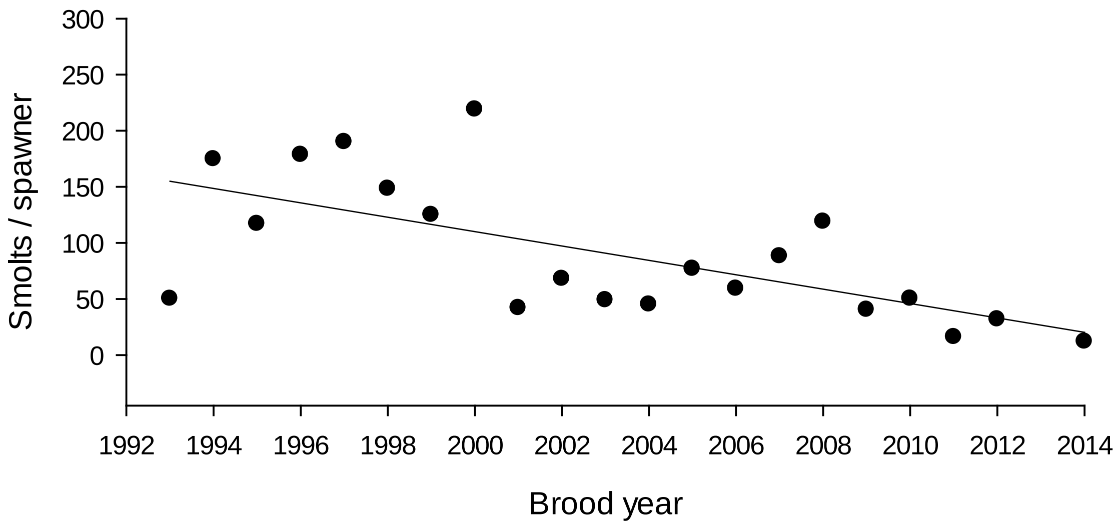

Figure 14. Spring Chinook salmon smolt equivalents produced per spawner in Catherine Creek by brood year. No estimate for brood year 2013.

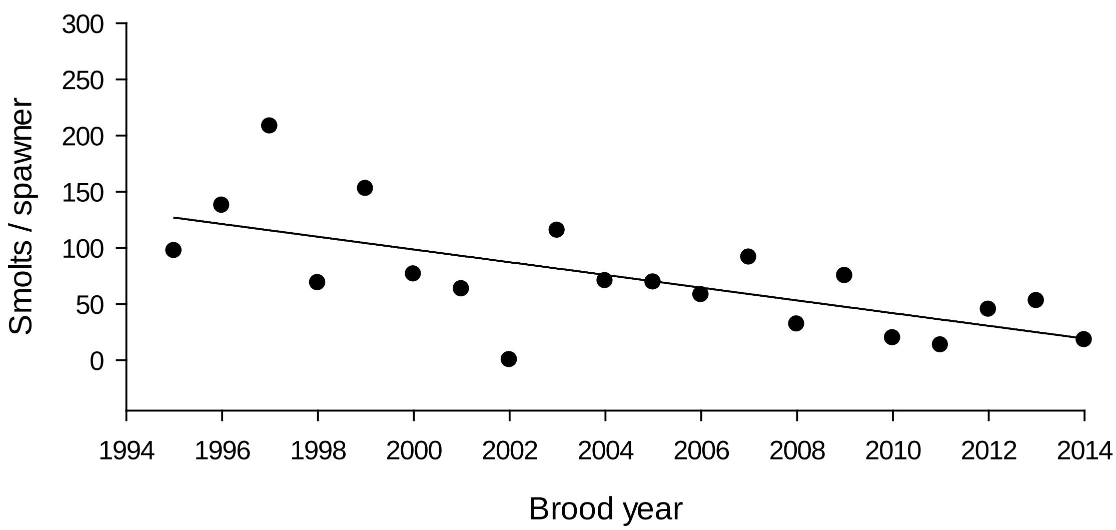

Figure 15. Spring Chinook salmon smolt equivalents produced per spawner in Lostine River by brood year.

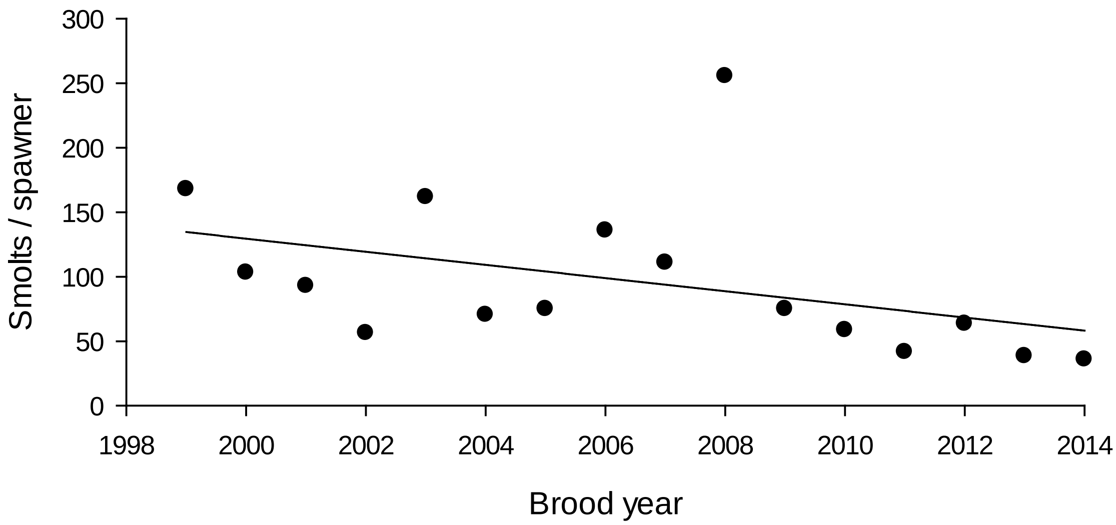

Figure 16. Spring Chinook salmon smolt equivalents produced per spawner in Minam River by brood year.

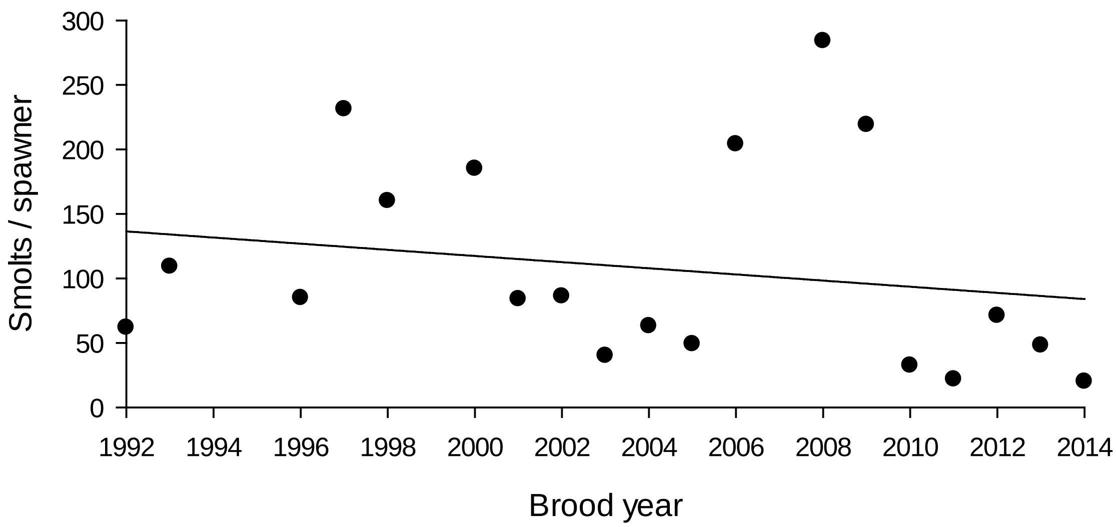

Figure 17. Spring Chinook salmon smolt equivalents produced per spawner in upper Grande Ronde River by brood year.

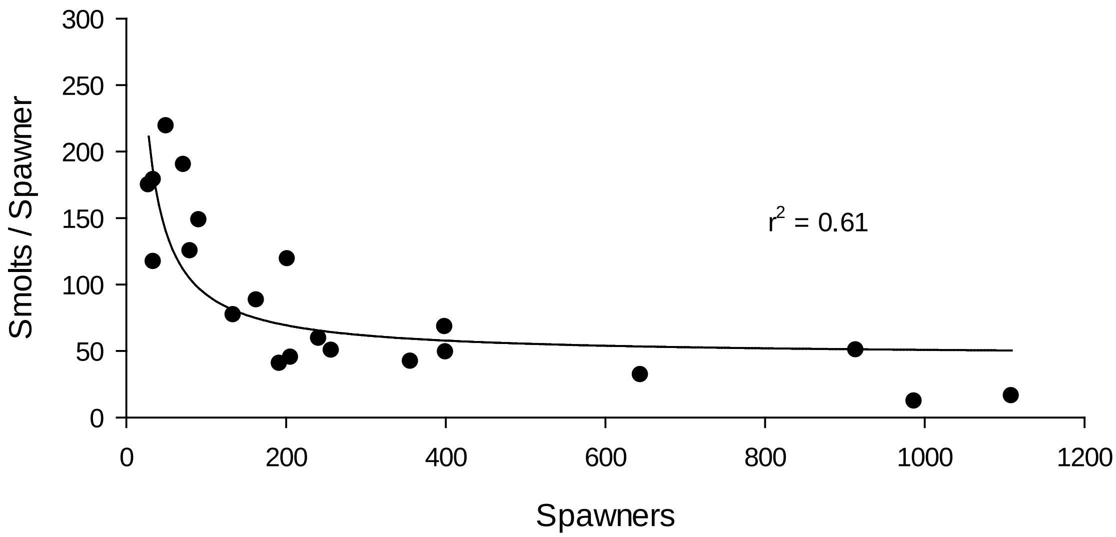

Figure 18. Spring Chinook salmon smolt equivalents produced per spawner in Catherine Creek by number of spawners.

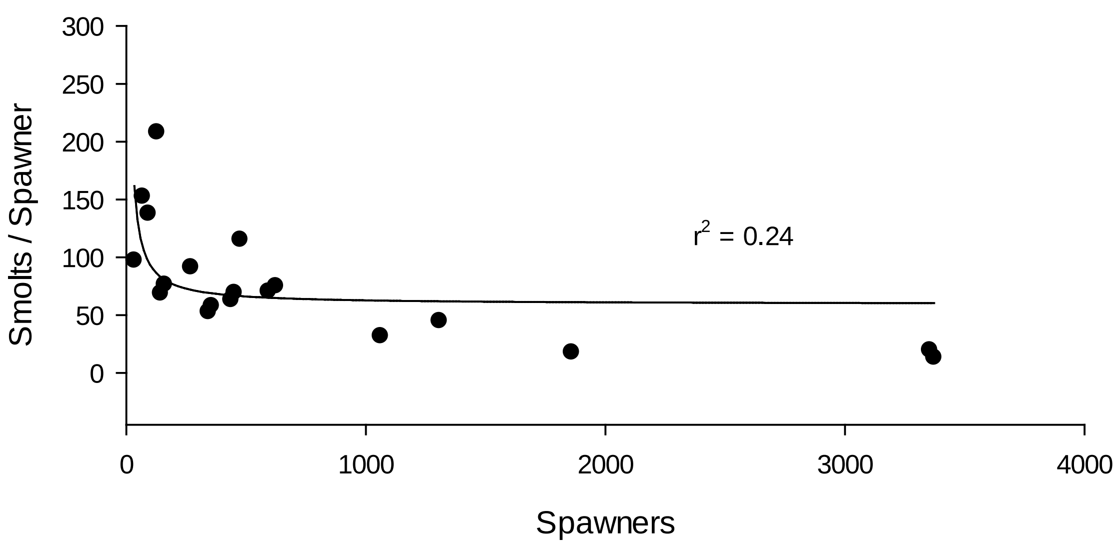

Figure 19. Spring Chinook salmon smolt equivalents produced per spawner in Lostine River by number of spawners.

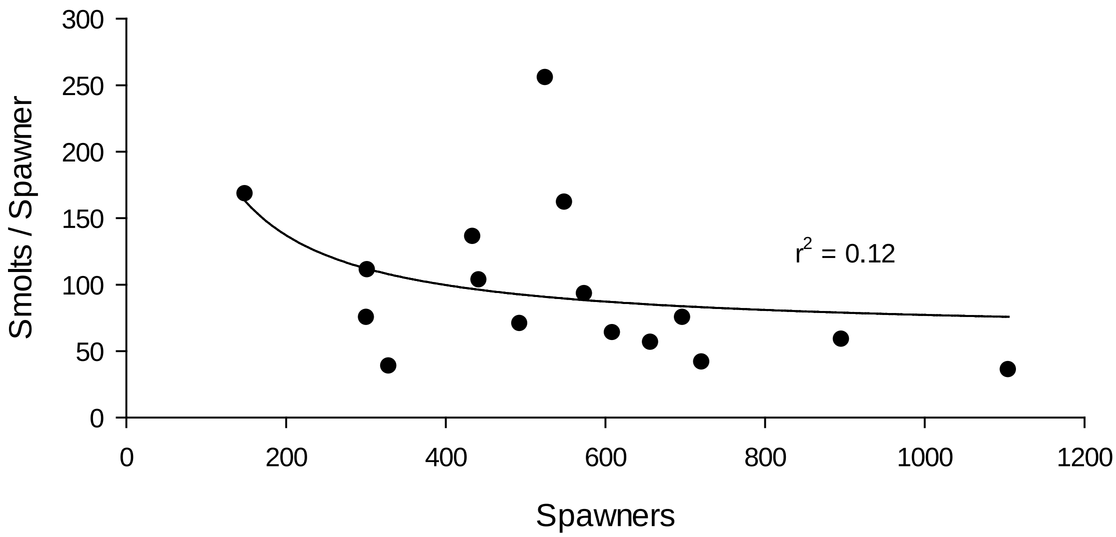

Figure 20. Spring Chinook salmon smolt equivalents produced per spawner in Minam River by number of spawners.

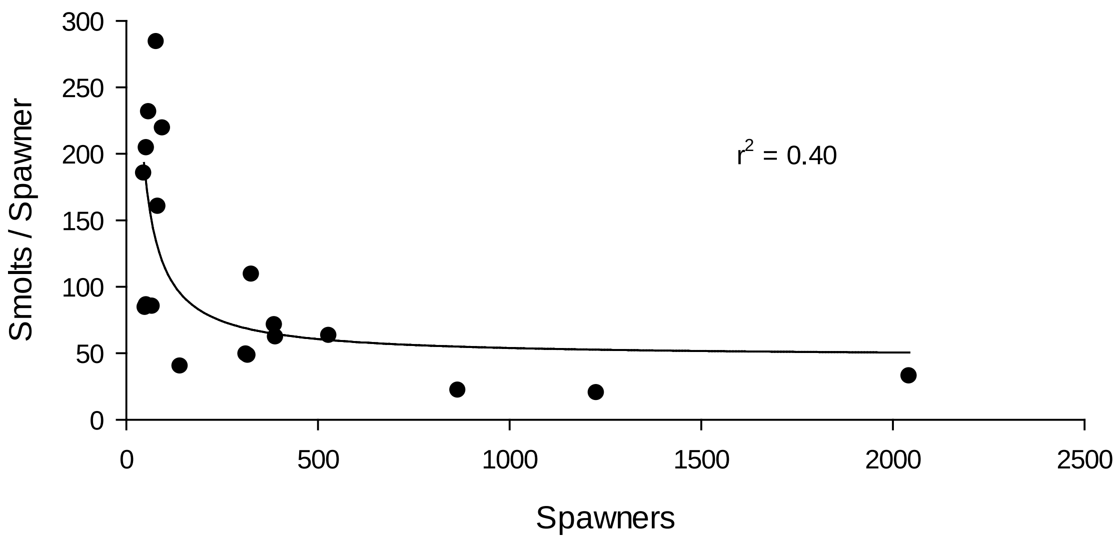

Figure 21. Spring Chinook salmon smolt equivalents produced per spawner in upper Grande Ronde River by number of spawners.

Steelhead
We estimated a minimum of 15,998 ± (95% CI, 1,484) juvenile steelhead migrated from Catherine Creek upper rearing areas during MY 2016 (Figure 22). Based on total minimum abundance estimate, 41% (6,605 ± 880) migrated early and 59% (9,393 ± 1,195) migrated late. MY 2016 proportion of juvenile steelhead emigrating from upper rearing areas as late migrants (59%) is within those proportions previously reported during 1997-2015.

We estimated a minimum of 15,622 ± 2,553 juvenile steelhead emigrated From Lostine River upper rearing areas during MY 2016 (Figure 23). Based on total minimum abundance estimate, 67% (10,939 ± 1,530) of juvenile steelhead migrated early and 33% (5,392 ± 2,043) migrated late. MY 2016 proportion of juvenile steelhead emigrating from upper rearing areas as late migrants (33%) is within those proportions previously reported during 1997-2015.

We estimated a minimum of 56,532 ± 15,668 juvenile steelhead migrated from Minam River rearing areas during MY 2016 (Figure 24). Based on total minimum abundance estimate, 32% (18,360 ± 3,606) migrated early and 68% (38,1725 ± 15,247) migrated late. Proportion of juvenile steelhead emigrating as late migrants, during MY 2016, is consistent with proportions from previous migration years.

We estimated a minimum of 6,033 ± 946 juvenile steelhead emigrated from upper rearing areas of upper Grande Ronde River during MY 2016, which is within estimates from previous migration years (Figure 25). Based on total minimum abundance estimate, 15% (906 ± 138) were early migrants and 85% (5,127 ± 936) 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 82 d between 26 February 2016 and 3 June 2016. We estimated a minimum of 48,239 ± 5,542 juvenile steelhead emigrated from upper rearing areas.

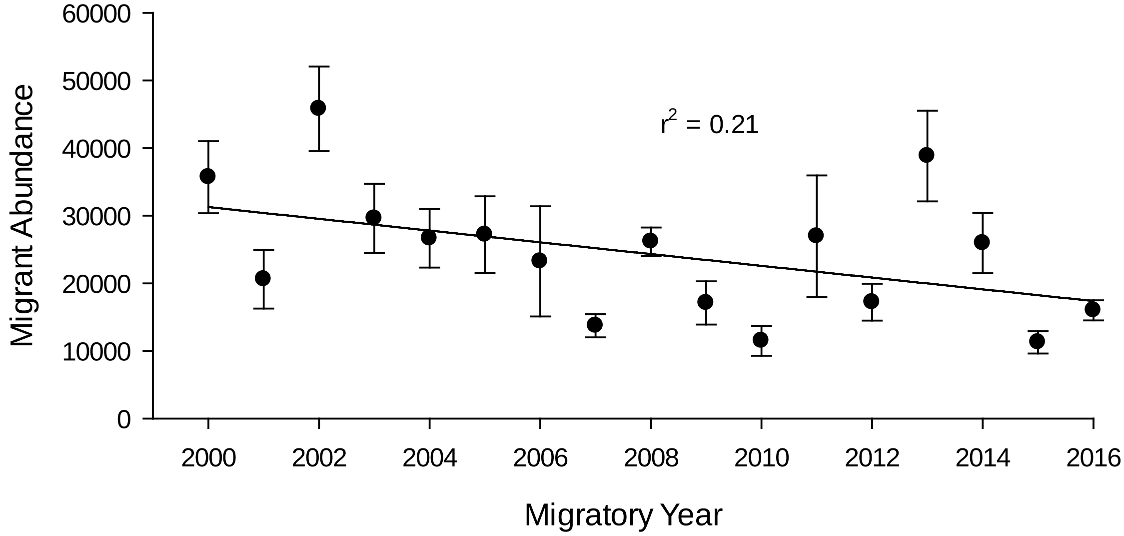

Figure 22. Steelhead migrant abundance estimates at the Catherine Creek trap site by migratory year. Error bars are 95% confidence intervals.

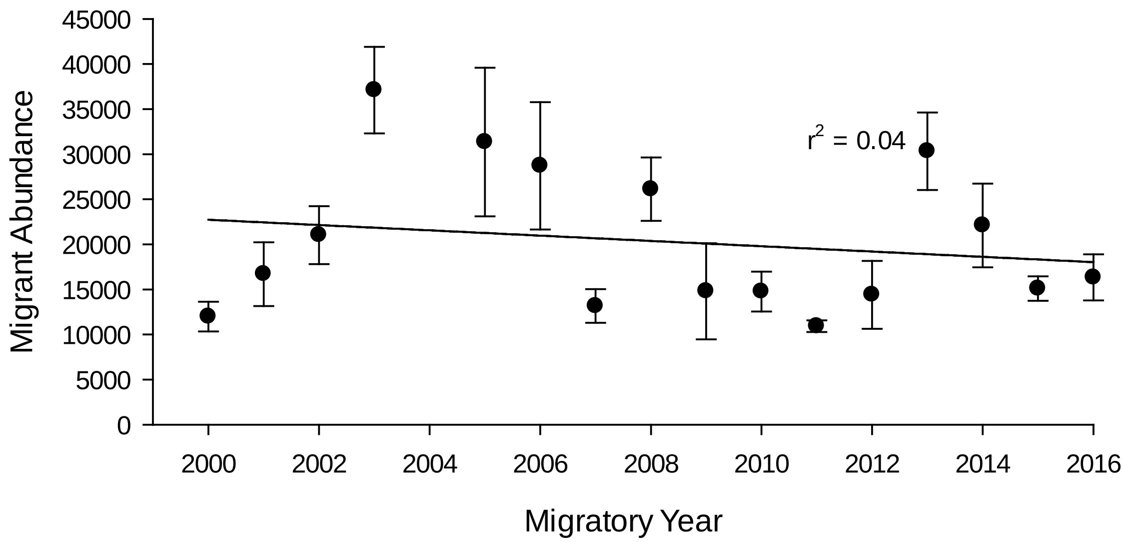

Figure 23. Steelhead migrant abundance estimates at the Lostine River trap site by migratory year. Error bars are 95% confidence intervals.

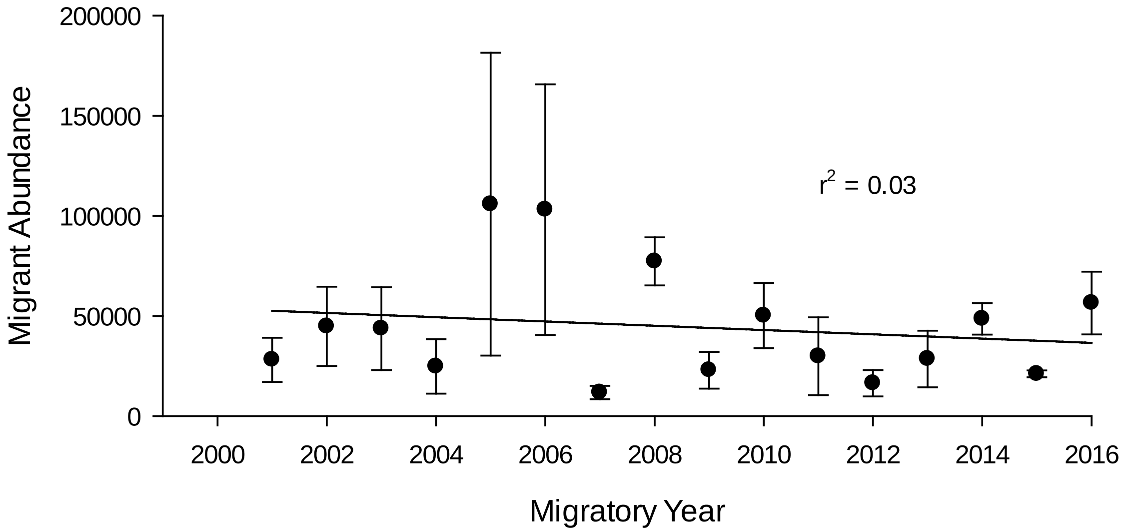

Figure 24. Steelhead migrant abundance estimates at the Minam River trap site by migratory year. Error bars are 95% confidence intervals.

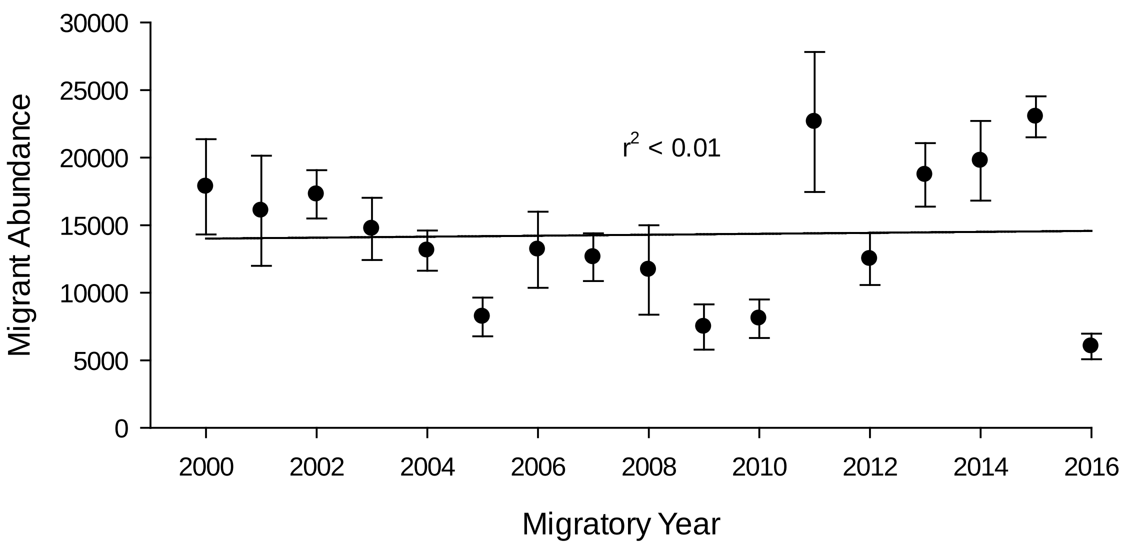

Figure 25. Steelhead migrant abundance estimates at the upper Grande Ronde River trap site by migratory year. Error bars are 95% confidence intervals.

Summer steelhead collected at trap sites during MY 2016 comprised five age-groups. Early migrants ranged from 0 to 3 years of age, while late migrants ranged from 1 to 4 years of age (Table 1). Majority of Lostine River early migrants were age 0 (37.6%) and age 1 (37.6%), while majority of Catherine Creek (51.6%) and upper Grande Ronde River (63.8%) early migrants were age 1, and majority of Minam River (75.5%) early migrants were age 0. Majority of Catherine Creek (81.9%), Lostine River (55.5%), and Minam River (46.1%) late migrants were age 1, while majority of middle Grande Ronde River (61.3%) and upper Grande Ronde River (51.5%) late migrants were age 2 (Table 1).

Table 1. Age structure of early and late steelhead migrants collected at trap sites during MY 2015. 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	37.2	51.6	11.0	0.3	0.0
Lostine River	37.6	37.6	24.6	0.2	0.0
Minam River	75.5	11.3	12.4	0.8	0.0
Upper Grande Ronde River	16.9	63.8	17.8	1.5	0.0
Late					
Catherine Creek	0.0	81.9	17.2	0.9	0.0
Lostine River	0.0	55.5	37.0	7.6	0.0
Minam River	0.0	46.1	27.6	25.1	1.3
Upper Grande Ronde River	0.0	29.3	51.5	19.2	0.0
Early and Late[a]					
Middle Grande Ronde River	0.0	22.7	61.3	15.6	0.3

[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 2015 ranged from 0.096 to 0.248 for all four spawning tributaries (Figure 26). Probabilities of migration and survival, for larger steelhead (FL ≥ 100 mm) tagged during spring 2016, ranged from 0.200 to 0.598 for all five populations studied (Figure 26). Generally, probabilities of migration and survival, during spring 2016, were similar for all five populations studied compared to previous years. The probability of migration and survival for Lostine River steelhead (FL ≥ 100 mm) tagged in spring 2016 was the lowest compared to previous years.

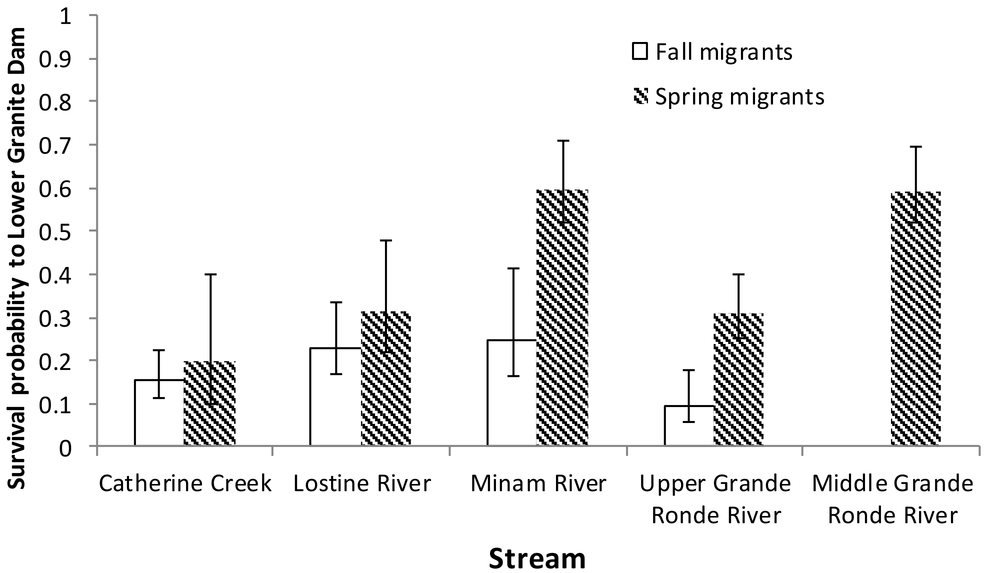

Figure 26. Probability of surviving and migrating, in the first year to Lower Granite Dam, for steelhead PIT-tagged at screw traps on Catherine Creek and Lostine, middle Grande Ronde, Minam, and upper Grande Ronde rivers during fall 2015 and spring 2016 (MY 2016). Catherine Creek and upper Grande Ronde River early migrants overwinter upstream of middle Grande Ronde River trap site, so no fall tag group was available for that site.

Conclusions

In 2016, we saw moderate numbers of juvenile spring Chinook salmon from all of our study streams, resulting from the high number of spawners in 2014. We saw smaller spring Chinook salmon spring migrants at higher spawner densities, which typically results in lower survival to Lower Granite Dam. The estimated survival to Lower Granite Dam was on the low end of the range for fall and the spring migrants from the Grande Ronde Basin populations. The lower survival of the out-migrants results in low estimates of smolts/spawner, one indicator of the VSP parameter productivity. 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 near the trend line in Catherine Creek and the Minam and Lostine rivers and below the trend line in the Upper Grande Ronde River where we had a shortened spring trapping season. 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.

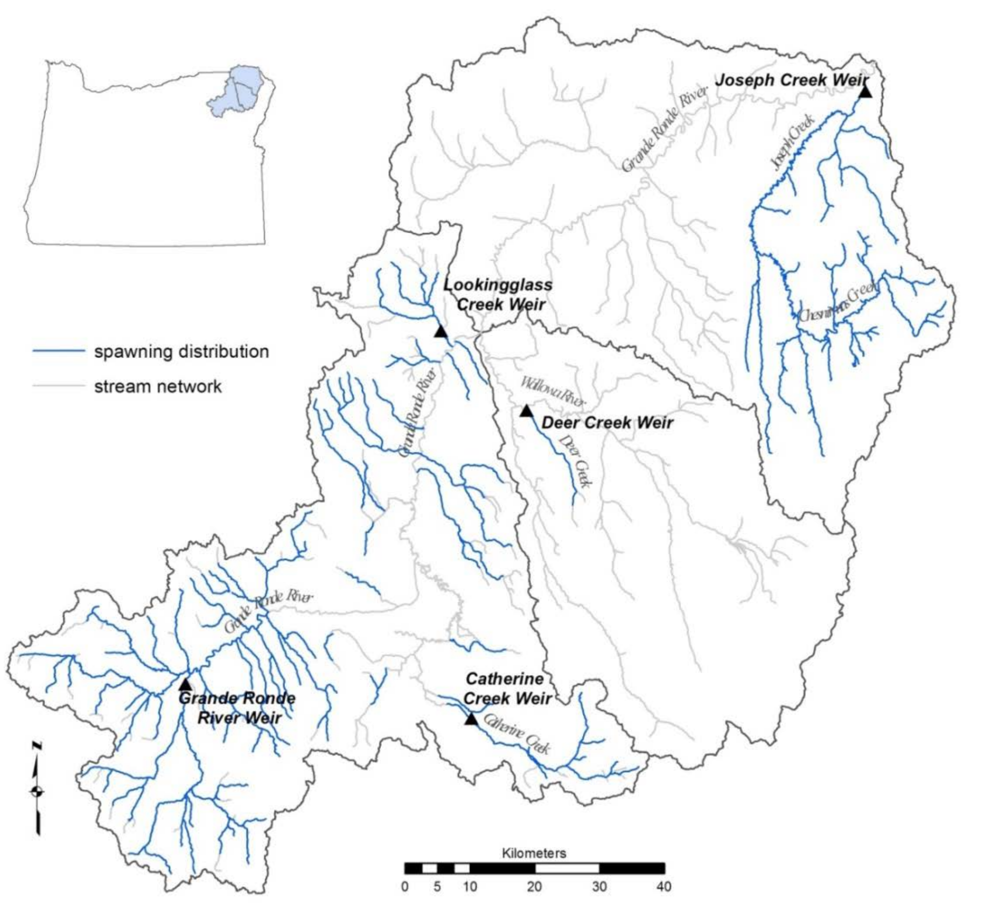

Figure 27. Grande Ronde River basin, divided by 4th order HUC. Steelhead distribution highlighted in blue for Joseph and UGRR subbasins.

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 58.2 km of an estimated 892 km (6.5 %) available steelhead spawning habitat (Appendix Table B12). One site was not surveyed due to persistent high discharge and water clarity. This site was not included in our calculations. Stream classification for the 29 surveyed sites was distributed evenly (10 sites in source classification, 8 in transport, and 11 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 117 surveys in the UGRR basin in 2016, with a mean interval of 14.5 days between surveys. A total of 128 steelhead redds were observed at 22 of the 29 sites (Appendix Table B14). Redds were evenly distributed among stream classifications: 38 (30%) were found in source areas, 44 (34%) in transport, and 46 (36%) in depositional reaches. A total of three, live adult steelhead were observed in the UGRR (Appendix Table B16). Of these fish two were of wild origin and one was of unknown origin. No caracasses were found in the UGR.

Twenty-six sites were surveyed in Joseph Creek and tributaries (Figure 29), encompassing 52.7 km of an estimated 384 km (13.7 %) available spawning habitat (Appendix Table B13), all of which were above the weir. Stream classification for the 26 sites was random with 11 sites surveyed in source classification, eight in transport, and seven in depositional.

A total of 109 surveys were completed in the Joseph Creek basin, with a mean interval of 13.9 days between surveys. We found 177 steelhead redds at 19 of the 26 sites (Appendix Table B15). More redds were found in the source stream classification (n=82, 46%) than depositional or transport reaches (n=34, 19%) and (n=61, 34%) and respectively). Eighteen live adult steelhead were observed at seven sites (Appendix Table B17), and one wild origin female carcass was observed (Appendix Table B18). No adipose-clipped hatchery fish were observed during our Joseph Creek surveys.

We conducted four 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. On 18.7 km of Deer Creek, 63 redds, nine live steelhead, and zero carcasses were observed during survey visits. However, we encountered 31 steelhead carcasses at the weir and 22 kelts that were passed downstream of the weir. Of these 53 adult steelhead all were marked with a left operculum punch (LOP) received in the Big Canyon fish trap.

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 17 March in the UGRR, March 08 Joseph Creek basins (Appendix Figure B21) and 31 March in Deer Creek (Appendix Figure B22). The last redds were observed on 08 June in the UGRR, 01 June in Joseph Creek and 23 May in Deer Creek. By 20 April 48% of the total redds in the UGRR basin were observed. By 20 April 59% of the total redds in the Joseph Creek basin were observed. By 27 April, 89% of the total redds were observed on Deer Creek. Onset of redd building was similar among basins as well as peak redd observations. Although onset of redd building was similar among basins, peak redd observations occurred slightly later in Joseph Creek than UGRR, 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.

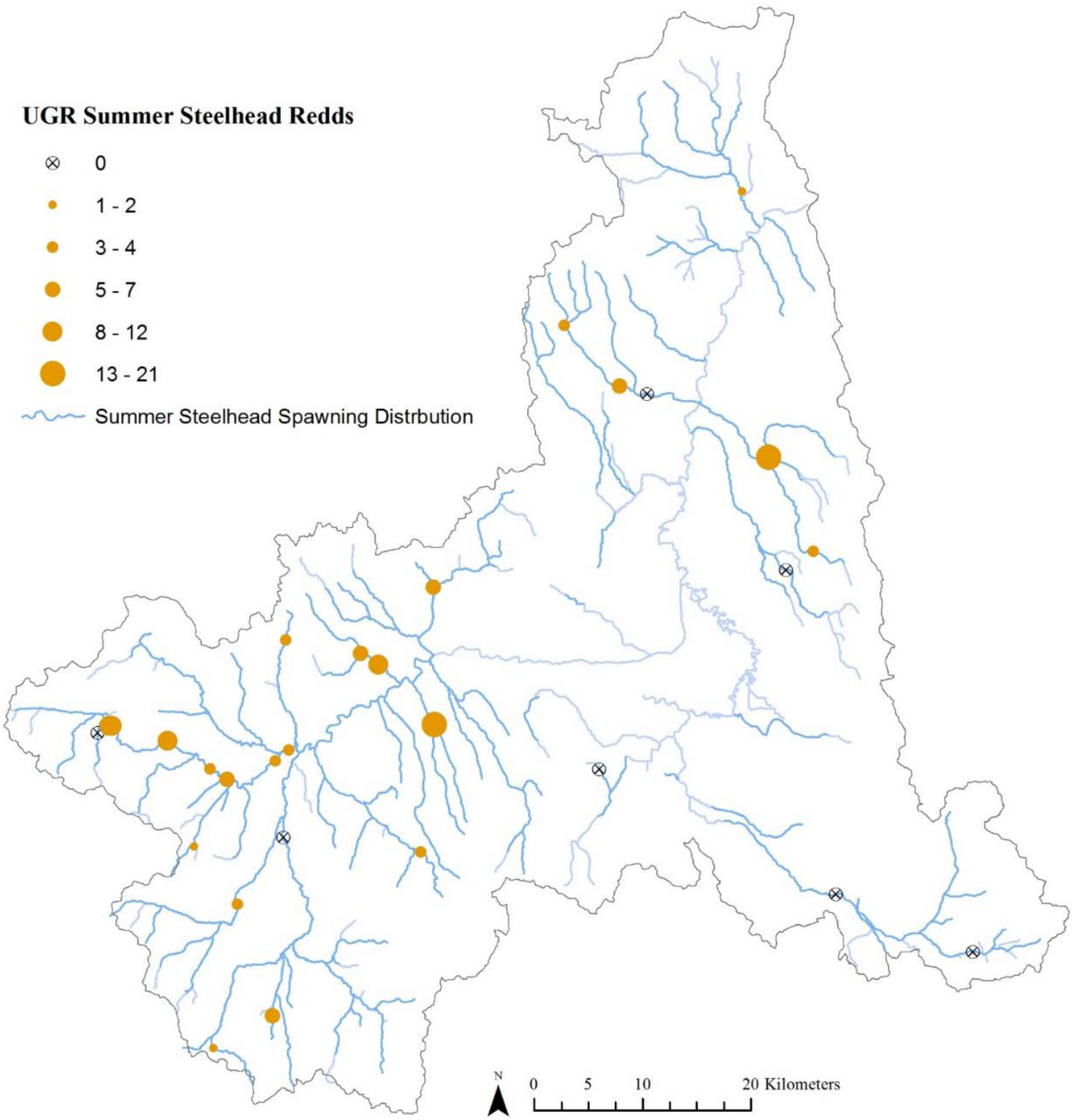

Figure 28. Map of the Upper Grande Ronde River basin displaying count of redds observed at each site in 2016. The two sites not surveyed were due to continual high flows and dangerous wading conditions.

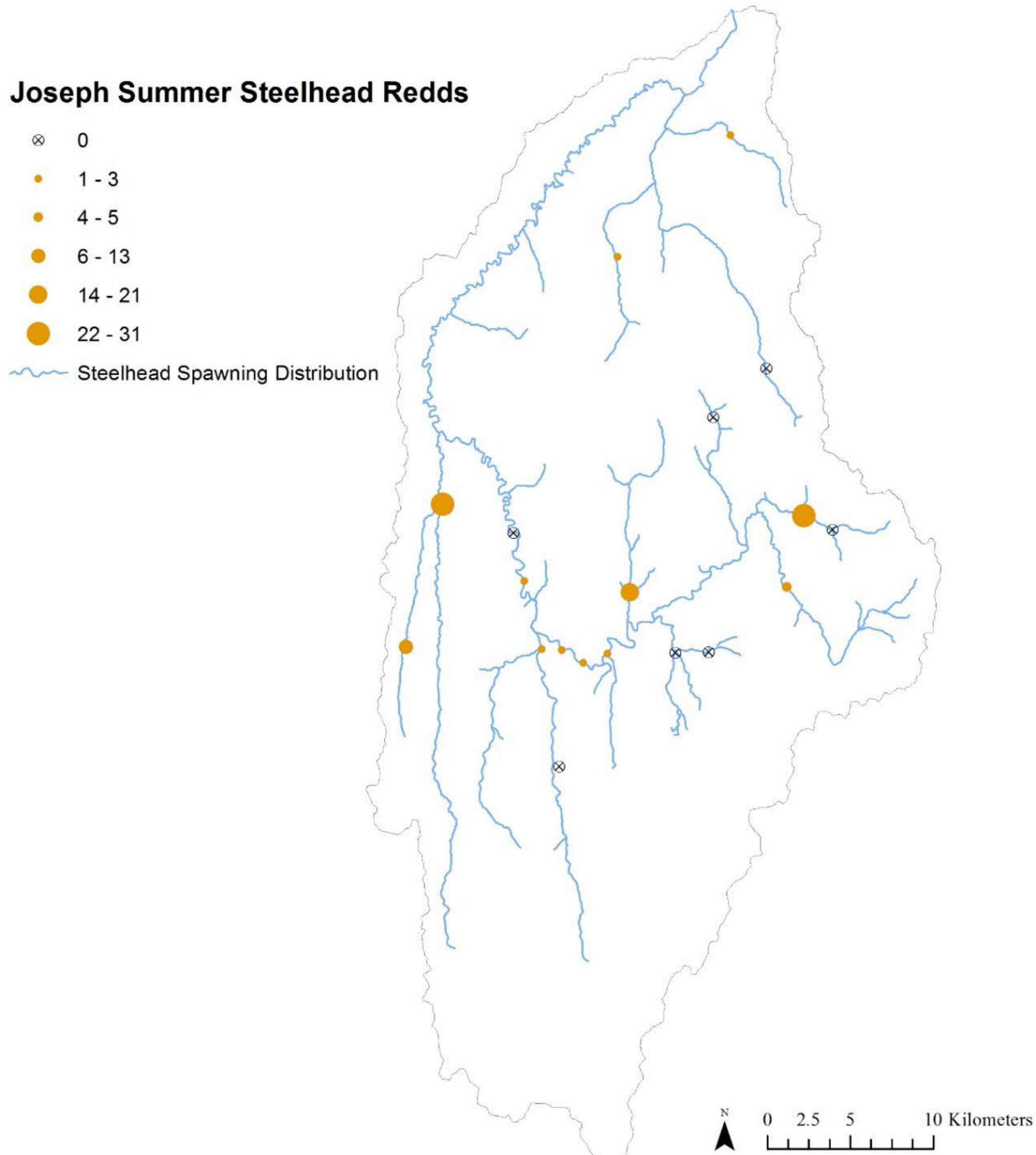

Figure 29. Map of the Joseph Creek basin showing count of redds observed at each site in 2016.

Conclusions

Water clarity during surveys was moderate in both the UGRR and Joseph Creek basins throughout most of the season. Water clarity and our ability to observe redds generally improved as the season progressed. Restriction of snow to higher elevations, low precipitation, and moderate to low flows in March resulted in early access to most sites and good visibility. Flows were generally higher, and persisted longer in Lookingglass, Deer, and Catherine creeks, and other tributaries flowing from the Wallowa Mountains due to their high elevation headwaters. Our protocol indicates that surveys should be conducted at two week intervals and we achieved this in the UGRR and Joseph Creek basins.

The efficiency of our surveys on larger tributaries (i.e. Lookingglass and Catherine creeks) was poor. Even when we were able to survey the stream, we were often unable to cross or even walk in the channel for significant stretches. This may explain why only one redd was observed in Lookingglass Creek and zero redds in Catherine Creek, despite hundreds of steelhead being captured at their respective fish weirs (Appendix Table B20). One site on Catherine Creek near the town of Union was too high throughout the entire spawning season that we were unable to successfully.

The fish:redd ratio from Deer Creek correlated strongly with the total water volume from UGRR (Appendix Figure 23). This suggests that the use of fish:redd is an appropriate method to compensate for our ability to successfully observe redds throughout the basin based on water conditions.

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 (Appendix Figure B22). 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 (Appendix Figure B21). This lag period was also observed 2012 -2014 (Dobos et al. 2012, Fitzgerald et. al 2013, Banks et al. 2014), the first three 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 March and early April. Surveyors recorded water clarity (scale 1-3) at each survey event, and water clarity did improve substantially in Joseph Creek by early 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 1.30 (82/63) was generated using the number of fish passed above the weir at Deer Creek and the number of redds observed there in 2016.

Using this ratio and a single weight value for all stream classifications (30.8), 2,572 adult steelhead (95% C.I.: 1,548–3,596) escaped into the UGRR basin and naturally spawned. No adipose-clipped hatchery fish were observed during surveys on the UGRR. Using this same method with a weight value of 14.8, 1,663 adult steelhead (95% C.I.: 924–2,402) escaped into the Joseph Creek basin (Appendix Table B19; Figure 30).

Using the weight values for each strata, source (41.18), transport (30.33), and depositional (19.7), we estimated that 2,558 (95% CI, 1,284–5,513) adult steelhead for the UGRR population (Appendix Table B21). For Joseph Creek estimates changed by only one fish: using the weight values for each strata, source (14.45), transport (14.38), and depositional (15.86), we estimated that 1,651 (95% CI, 914–2,389) adult steelhead returned to spawn (Appendix Table B22).

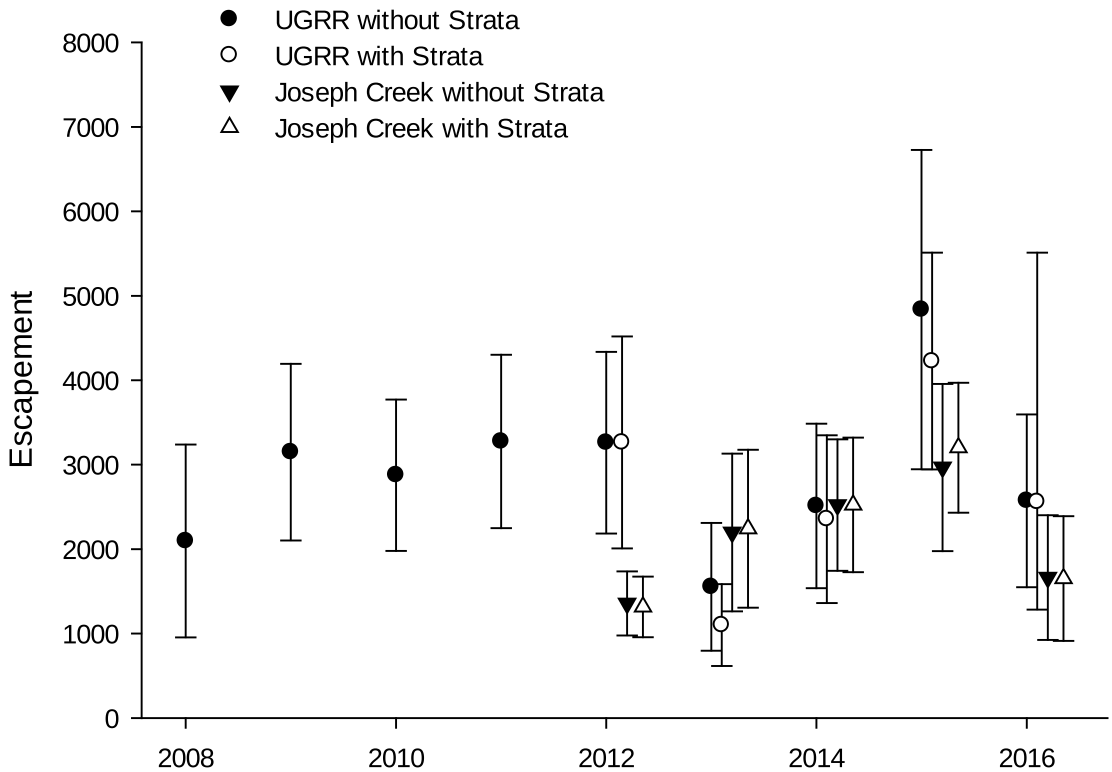

Figure 30. Escapement estimates with 95% confidence intervals for steelhead in the Upper Grande Ronde River basin using a single weight value, 2008−2014 and using strata weights for the three classifications of stream type for UGRR and Joseph Creek, 2012−2016.

Conclusions

Population-scale escapement estimates had relatively poor precision for both Joseph Creek and UGRR (95% CI ~40% of the estimate). This is similar to last year's precision estimate of ~39% of estimate. Confidence intervals have consistently been 31–55% of the UGRR escapement estimate since 2008 (Appendix Table B21). 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 2016, we observed zero redds at 24% of our UGRR basin sites, and 27% 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 sixth year of attempting to correlate redd locations with stream classifications. Redd observations were highest in source reaches for both UGRR and Joseph Creek. 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

Fifty-three habitat and fish monitoring locations were chosen within the UGRR sub-basin for 2016. Site locations were generated with the generalized random tessellated stratification (GRTS) design for the sixth year of the Columbia Habitat Monitoring Program (CHaMP) (Bouwes et al. 2011). Within the UGRR sub-basin, CHaMP sites were split into two groups based on spawning and rearing distributions of Chinook salmon and summer steelhead. Only streams within the known (or assumed) anadromous fish spawning distribution were eligible for selection. Habitat metrics were assessed at all 53 sites using CHaMP protocols (Bouwes et al. 2011). Two crews completed habitat surveys, one from Oregon Department of Fish and Wildlife (ODFW) and the other from the Columbia River Inter-Tribal Fish Commission (CRITFC). Site length varied based on stream size and was approximately 20 times the bankfull width (minimum 120 m, maximum 600 m). All outputs from CHaMP habitat surveys are housed in a central database available at www.champmonitoring.org. Habitat data are not reported here.

Fifty of the 53 sites (Appendix Table B23) were surveyed for juvenile salmonids via either a single-pass snorkel protocol (White et al. 2012) or single-pass backpack electrofishing. One site in W. Chicken Creek had too little water to sample (CBW05583-294202), and two other sites (Little Whiskey and Phillips Creeks, ORW03446-130904 and ORW03446-157422) were dry. Staff from ODFW and CRITFC completed fish surveys. Most streams were snorkeled, however, a handful of streams were too small to effectively snorkel, and single-pass electrofishing was used instead. In 2016, 44 sites were snorkeled, and 6 were electrofished (Appendix Table B23). All fish sampling occurred from late July – late August, with most sampled from July 25 – August 15. This is a departure from past efforts, as sample timing was condensed to increase comparability between sites.

Snorkel Methodology

Single pass snorkel surveys were completed in the UGRR and Minam River sub-basins in July and August 2016. Protocols followed White et al. 2012. Briefly, one or two snorkelers (side by side) began the survey at the bottom of site and attempted to identify, enumerate and estimate size class of all Chinook salmon, steelhead, and bull trout observed while moving upstream. Size classes were set to reflect length-at-ages for each species (Chinook salmon: <100mm = Age 0, >100mm = Age 1+; *O. mykiss* and bull trout: <80mm = Age 0, 80 – 130mm = Age 1, 130 – 200mm = Age 2, >200 = Age 3+). No attempt was made to differentiate resident from anadromous *O. mykiss,* and all were classified as steelhead. Also, the relative abundance of all fish taxa observed was estimated as dominant (>50% of all fish observed), common (10 – 49%) or rare (<10%). Fish data were collected by habitat unit number and type, which was first determined during the CHaMP habitat surveys. Wetted channel area of each unit was determined during habitat surveys as well. All pools were surveyed (or attempted in small streams), while runs and fast water units were sometimes subsampled (large sites) or not sampled (small, shallow streams).

Metrics calculated for snorkel surveys included: total count of Chinook and steelhead, fish density (both areal and linear) for the whole site, fish density per habitat unit area (total and by size/age class). Raw fish counts were generated by the field crews. Salmonid abundance was estimated from these counts on a channel unit basis from mark/recapture-derived correction factors for fish observability (Horn et al. 2015, formulae below). Densities were calculated by dividing estimated abundance by linear and areal size of each channel unit, extracted from habitat surveys in the same year. For sites with sub- or unsampled channel units, site level abundance was expanded under the assumption that mean density for the sub- or unsampled units was the same as the sampled units of the same type at that site. Fish densities were compared by habitat unit type using Kruskal-Wallis Rank Sum ANOVA and Dunn's tests (alpha=0.05).

Mainstem Sites ("large" streams): Ln(Pop. Est.) = .73351 * Ln(Snkl.Cnt.) + 2.1879

Tributaries ("small" streams): Ln(Pop. Est.) = 0.73351 * Ln(Snkl.Cnt.) + 1.58159

Electrofishing Methodology

Selected CHaMP sites were electrofished with a single backpack electrofishing unit (Smith-Root model LR-20) during base flow periods (late July 2016). These sites were very small (wetted width usually <2m), preventing any effective snorkel sampling. Direct electrical 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 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 et al. 2012).

$$\text{All Unit Types} \quad Pop.Est. = 2.4701 * Efish\ Count$$

Results

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). Counts were generally low in 2016, with only 3,437 juvenile Chinook observed during snorkel surveys. Over 99% were in the <100 mm size categories (age 0), while the remaining 1% were above 100mm. Chinook were most abundant in mainstem UGRR, Lookinglass and Catherine creeks (Figure 32), with fewer observed in the larger tributaries like Sheep Creek, and Fly Creek. There were fewer observations of Chinook in small tributaries than in 2015. None were observed in Clark Creek, where we have seen juvenile and adult Chinook over the past three years.

Steelhead were more widely distributed than Chinook (Figure 33), with individuals observed at most sites in 2016. Counts were generally higher than Chinook at sites other than Catherine Creek and upper reaches of UGRR. A total of 4,765 juvenile-sized individuals were observed in 2016. Approximately 2/3 of the steelhead observed were in the size classes <50mm and 50-79mm. 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.

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.*), smallmouth bass (*Micropterous dolimeau*), and sunfish (*Lepomis spp.)* (Appendix Table B25). Bull trout were only observed in Catherine Creek (mainstem, north and south forks), Lookingglass Creek, 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.

Of significant note was the observation of a smallmouth bass at site dsgn4-000205 on the Grande Ronde River. This is the first such observation this far upstream. There are many smallmouth bass in Grande Ronde River downstream of La Grande, but to our knowledge, none have been observed upstream of there. The observation was approximately 2km upstream of the confluence between UGRR and Spring Creek.

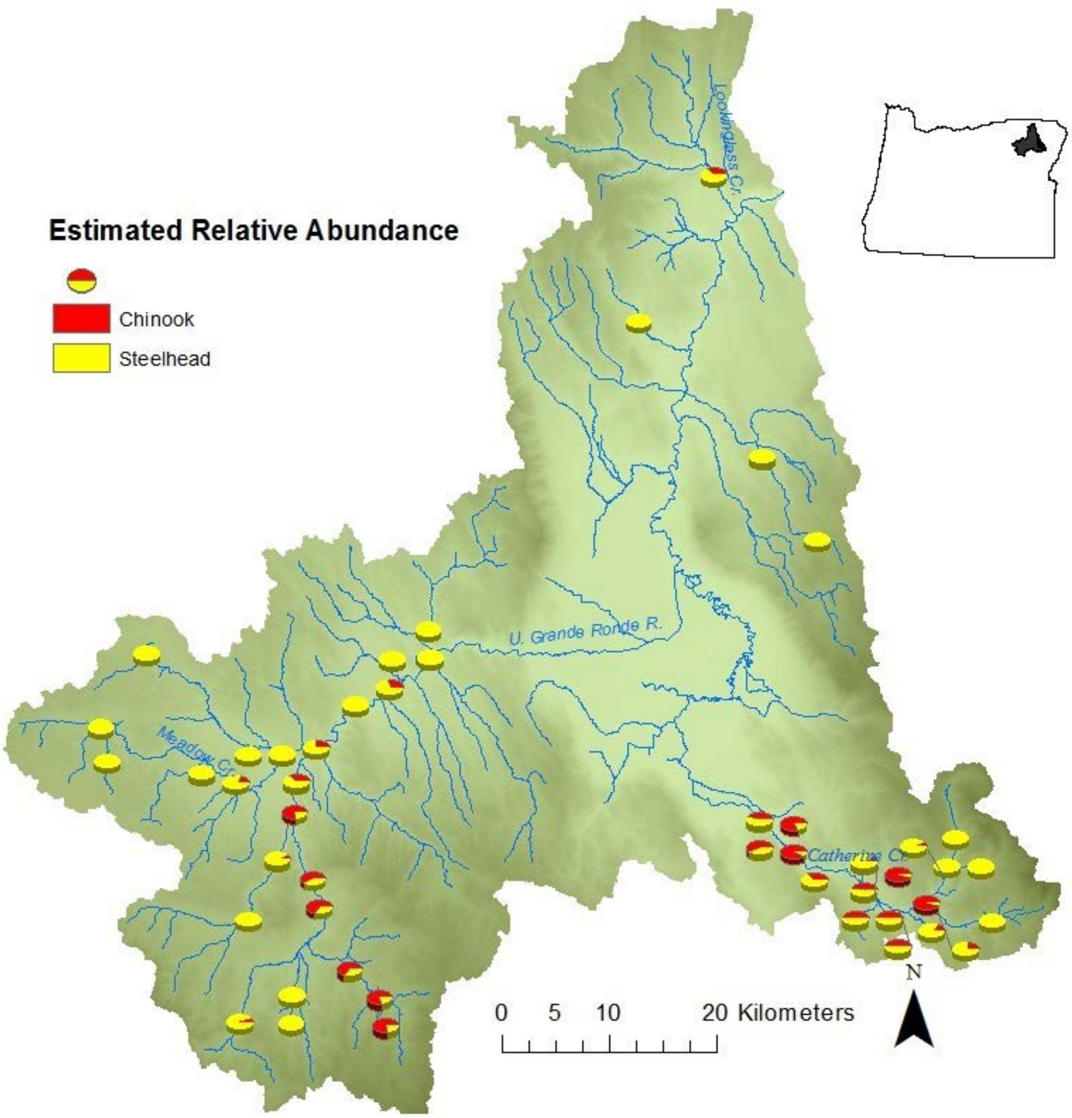

Figure 31. Proportional distribution of juvenile steelhead and Chinook salmon observed via snorkel and electrofishing surveys, 2016.

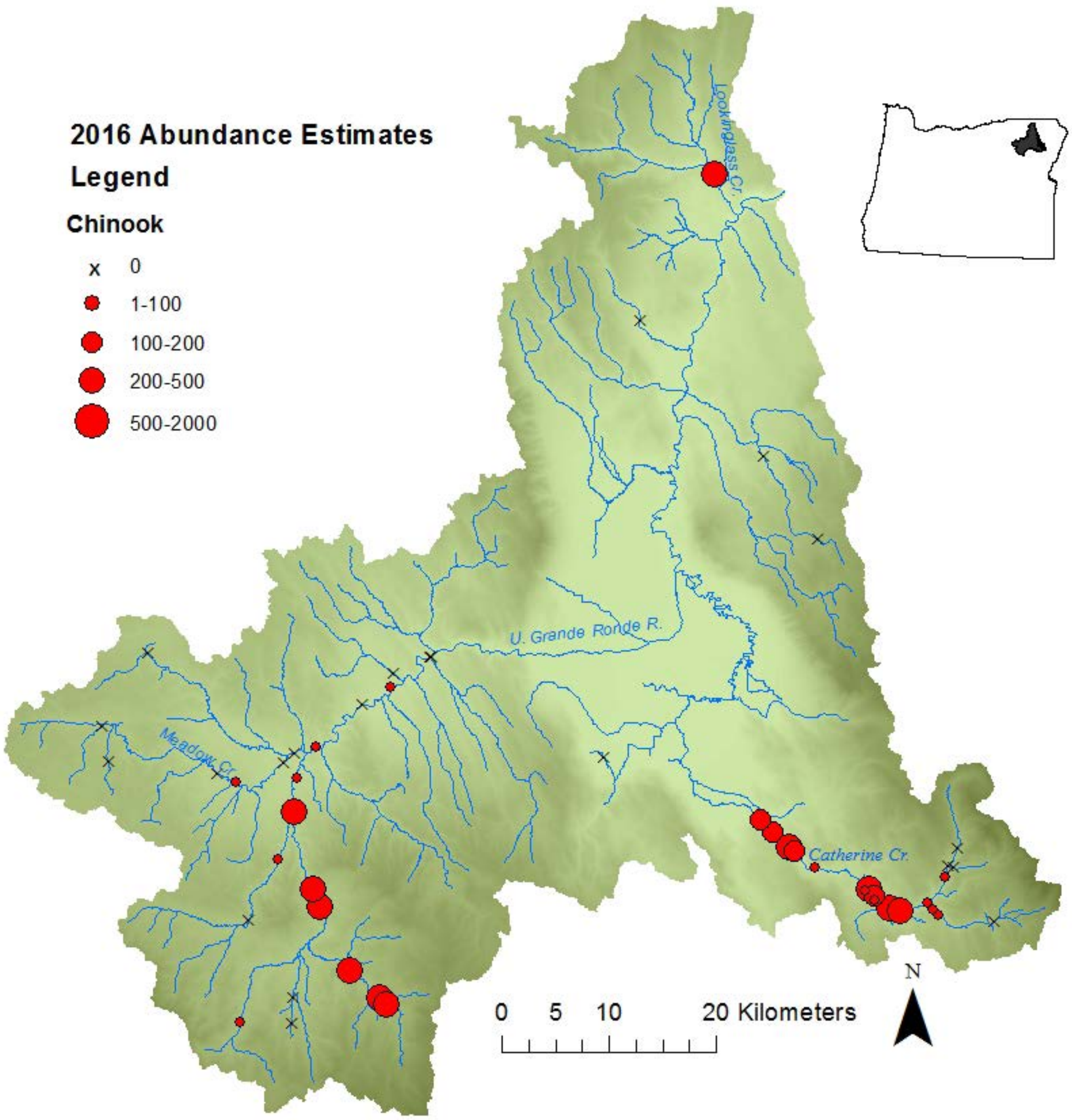

Figure 32. Spatial distribution and site level abundance estimates of Chinook salmon observed during snorkel and electrofishing surveys of the UGRR basin, 2016. Concentric circles indicate repeat snorkel surveys.

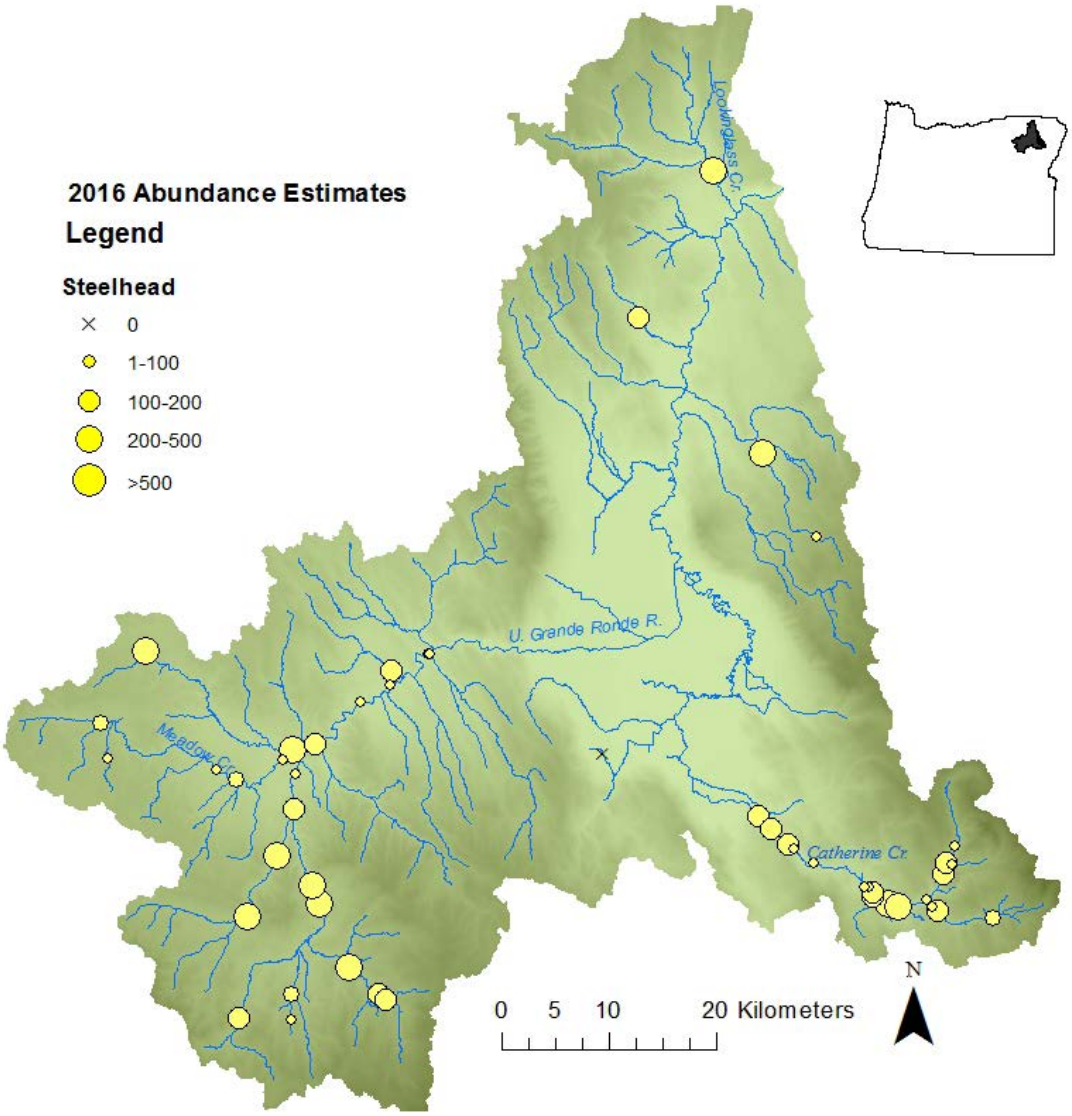

Figure 33. Spatial distribution and site level abundance estimates of steelhead observed during snorkel surveys of the UGRR basin, 2016. Concentric circles indicate repeat snorkel surveys.

Conclusions

Fish distribution was typical for summer rearing, with Chinook mostly occupying the larger/mainstem streams with appropriate water temperatures and steelhead widespread throughout the stream network. Of note was the lack of juvenile Chinook in the lower reaches of many small tributaries. Small streams including Clark, W. Chicken and Rock Creeks have harbored Chinook in the last two years, but they were absent in 2016 surveys.

Perhaps significant was the first smallmouth bass observation in the UGRR by this project, approximately 2 km upstream of the confluence with Spring Creek. Smallmouth bass have been present for decades in the Grande Ronde River Valley, and it is expected that they would expand their range upstream if conditions were appropriate. Preferred growth temperatures for smallmouth bass range from 26-31°C (Jobling 1981). Summer temperatures at sites near the observed fish regularly reach the upper 20's in July and August. Additionally, there are large numbers of non-salmonid forage fish in this reach, and relatively low gradient. We expect to encounter smallmouth bass in these reaches in future surveys. We have not observed smallmouth bass in any reach that has high densities of juvenile salmonids during summer rearing.

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. One site appears to be outside of salmonid rearing distribution. This was the second survey for a site in West Fork Ladd Creek on Ladd Marsh Wildlife Management Area. This site has also been surveyed for spawning steelhead in the same years. No fish of any taxa have been observed on this portion of WF Ladd Creek. Gradient and water volume are very low, and water temperatures reach near 30°C. We now believe this stream reach is outside of steelhead distribution and should not be sampled in the future.

This is the first year in which fish surveys were grouped closely in time across all sites. In years past surveys were spread from June – September. This year we attempted almost all surveys within a one month window from late July to late August. Overall fish counts were lower than in previous years, but we do not believe the timing of surveys is to blame. Juvenile *O. mykiss* are large enough by the end of July to accurately identify during snorkeling. They do appear to spend more time on the stream margins (which are harder to snorkel survey) than larger *O. mykiss* and Chinook, but habitat use observations (Chris Horn, ODFW, unpublished data) suggest this pattern holds later into summer.

Adaptive Management and Lessons Learned

Results of this project are used by the Grande Ronde Basin Atlas and Expert Panel process to inform habitat restoration in the Grande Ronde River basin funded by Bonneville Power Administration and Bureau of Reclamation. Juvenile salmonid density and spatial distribution and life history study results help identify critical reaches for habitat restoration actions. The density dependence relationship between Chinook salmon spawner abundance and smolt production illustrates the need to increase carrying capacity and associated juvenile production in the Chinook salmon populations in the basin.

Combining the juvenile salmonid density and spatial distribution with CHaMP (project 2011-006-00) habitat data is used to evaluate the effectiveness of habitat restoration actions and inform future habitat actions.

Over the long term, the results of our population status and trend monitoring will show the fish response to habitat restoration actions and the effectiveness of the spring Chinook salmon hatchery supplementation program.

We provide summarized juvenile Chinook salmon and steelhead survival and abundance data and steelhead spawner data to NOAA Fisheries for the AMIP Life Cycle Model.

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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/). Datasets were uploaded to the Oregon Department of Fish and Wildlife's Natural Resource Information Management Program Data Clearinghouse at https://nrimp.dfw.state.or.us/RecPlan/default.aspx?p=202&XMLname=1175.xml .

Juvenile spring Chinook salmon and steelhead abundance and survival data, steelhead spawner data, and steelhead and spring Chinook salmon parr density and distribution data are provided to the Grande Ronde River Basin Atlas and Expert Panel processes to inform the habitat restoration planning and implementation.

Appendix B: Detailed Results

Juvenile Spring Chinook Salmon and Summer Steelhead Life History Monitoring

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 2015 and 2016.

Migration year and stream	Tagging Dates	Number PIT-tagged	Distance to Lower Granite Dam (km)
2016 (*Summer 2015)*			
Upper Catherine Creek	20 Jul–22 Jul	1,000	371–383
Lower Catherine Creek	14 Jul–16 Jul	999	356–359
Imnaha River	29 Jul, 10–12 Aug	999	221–233
Lostine River	23–24 Jul, 27–28 Jul	997	271–308
Minam River	17 Aug–20 Aug	994	276–290
Upper Grande Ronde	24 Aug–26 Aug	999	418–428
2017 (*Summer 2016)*			
Upper Catherine Creek	18 Jul, 25–27 Jul	996	371–383
Lower Catherine Creek	18 Jul–21 Jul	998	356–359
Imnaha River	3 Aug, 8–9 Aug	999	221–233
Lostine River	21 July, 28 July, 1–2 Aug	999	271–308
Minam River	15 Aug–18 Aug	994	276–290
Upper Grande Ronde	22 Aug–23 Aug	996	418–428

Appendix Table B-2. Juvenile spring Chinook salmon catch at five general trap locations in Grande Ronde River Subbasin during MY 2016. Early migration period starts 1 July 2015 and ends 28 January 2016. Late migration period starts 29 January and ends 30 June 2016. 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	10 Sep 15–18 Nov 15	69 (99)	11,584
	Late	26 Feb 16–21 Jun 16	100 (85)	526
Lostine River	Early	8 Sep 15–28 Jan 16	91 (64)	6,577
	Late	29 Jan 15–7 Jun 16	105 (80)[a]	1,486[a]
			8 (6)[b]	111[b]
Middle Grande Ronde River	Late	26 Feb 16–3 Jun 16	82 (83)	1,728
Minam River	Early	9 Sep 15–21 Nov 15	72 (97)	16,519
	Late	3 Mar 16–8 Jun 16	86 (86)	1,758
Upper Grande Ronde River	Early	17 Sep 15–18 Nov 15	38 (63)	4,172
	Late	27 Feb 16–10 Apr 16	41 (95)[a]	5,171[a]

[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 2016. 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)	1,098	64.35	0.23	46	99	997	65.45	0.21	55	86
Summer (lower)	1,037	66.64	0.20	46	89	998	67.19	0.19	55	89
Early migrants	1,220	73.27	0.26	49	125	699	72.48	0.31	55	104
Winter	578	80.74	0.34	55	104	570	80.77	0.34	55	104
Late migrants	476	82.64	0.33	60	105	462	82.56	0.33	60	103
Lostine River										
Summer	997	66.72	0.30	55	100	997	66.72	0.30	55	100
Early migrants	1,546	85.43	0.26	53	127	1,198	85.76	0.28	57	127
Winter	612	77.45	0.27	60	102	598	77.47	0.27	60	102
Late migrants	1,229	90.34	0.25	53	135	891	90.41	0.28	63	128
Middle Grande Ronde River										
Spring emigrants	1,327	97.66	0.28	68	135	796	93.43	0.31	68	116
Minam River										
Summer	994	66.91	0.24	55	94	994	66.91	0.24	55	94
Early migrants	1,515	77.56	0.27	48	120	1,089	77.98	0.31	55	112
Late migrants	864	85.22	0.30	63	132	746	85.17	0.32	66	132
Upper Grande Ronde River										
Summer	1,175	60.42	0.18	44	94	997	61.64	0.17	55	84
Summer Migrants	932	71.28	0.20	53	89	699	71.48	0.23	55	89
Early migrants	381	70.50	0.37	56	95	331	70.85	0.41	56	95
Winter	920	77.97	0.23	58	101	600	78.13	0.29	58	95
Late migrants	1,098	64.35	0.23	46	99	997	65.45	0.21	55	86

Appendix Table B- 4. Weights of juvenile spring Chinook salmon collected from study streams during MY 2016. 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)	1,000	3.26	0.04	1.6	12.7	997	3.24	0.03	1.6	7.5
Summer (lower)	999	3.70	0.03	1.9	9.4	998	3.70	0.03	1.9	9.4
Early migrants	1,217	4.30	0.05	1.1	15.5	699	4.16	0.05	1.7	9.7
Winter	578	5.50	0.07	1.5	11.5	570	5.50	0.07	1.5	11.5
Late migrants	476	6.06	0.08	2.3	15.1	462	6.04	0.08	2.3	12.8
Lostine River										
Summer	996	3.53	0.06	1.1	11.8	996	3.53	0.06	1.1	11.8
Early migrants	1,546	6.95	0.07	1.6	24.2	1,198	7.00	0.07	1.7	21.8
Winter	612	4.80	0.05	2.1	10.7	598	4.81	0.05	2.1	10.7
Late migrants	1,229	8.00	0.07	1.5	24.5	891	8.00	0.08	3.0	21.7
Middle Grande Ronde River										
Spring emigrants	1,327	10.00	0.09	2.8	23.7	796	8.51	0.09	2.8	16.4
Minam River										
Summer	987	3.42	0.04	1.4	10.3	987	3.42	0.04	1.4	10.3
Early migrants	1,515	5.05	0.06	1.2	16.4	1,089	5.09	0.06	1.6	14.1
Late migrants	864	6.62	0.08	2.4	26.6	746	6.63	0.09	2.6	26.6
Upper Grande Ronde River										
Summer	1,004	2.71	0.03	1.6	10.3	997	2.69	0.02	1.6	6.8
Early migrants	912	3.68	0.03	1.2	6.7	699	3.72	0.03	1.6	6.7
Winter	381	3.68	0.06	1.8	8.0	331	3.74	0.07	1.8	8.0
Late migrants	920	4.62	0.04	1.7	9.6	600	4.68	0.05	1.7	8.2

Appendix Table B- 5. Survival probability to Lower Granite Dam of juvenile spring Chinook salmon tagged during summer 2015 and detected at Columbia and Snake river dams during 2016.

Stream	Number PIT-tagged and released	Survival probability (95% CI)
Upper Catherine Creek	997	0.032 (0.020–0.053)
Lower Catherine Creek	998	(a)
Imnaha River	999	0.131 (0.106–0.162)
Lostine River	997	0.081 (0.062–0.107)
Minam River	994	0.124 (0.101–0.153)
Upper Grande Ronde River	997	0.076 (0.056–0.107)

[a] Data were insufficient to calculate a survival probability.

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 2015 to spring 2016 and detected at dams during 2016.

Stream and tag group	Number PIT-tagged and released	Survival probability (95% CI)
Catherine Creek		
Fall (trap)	699	0.060 (0.043–0.083)
Winter (above trap)	570	0.077 (0.055–0.106)
Spring (trap)	462	0.183 (0.129–0.289)
Lostine River		
Fall (trap)	1,198	0.188 (0.161–0.220)
Winter (above trap)	598	0.199 (0.160–0.251)
Spring (trap)	891	0.516 (0.472–0.565)
Middle Grande Ronde River		
Spring (trap)	796	0.572 (0.524–0.624)
Minam River		
Fall (trap)	1,090	0.185 (0.158–0.217)
Spring (trap)	747	0.464 (0.421–0.511)
Upper Grande Ronde River		
Fall (trap)	699	0.120 (0.090–0.163)
Winter (above trap)	331	0.048 (0.026–0.095)
Spring (trap)	600	0.232 (0.192–0.283)

Appendix Table B- 7. Juvenile steelhead catch at five general trap locations in Grande Ronde River Subbasin during MY 2016. Early migration period starts 1 July 2015 and ends 28 January 2016. Late migration period starts 29 January and ends 30 June 2016. 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	10 Sep 15–18 Nov 15	69 (99)	1,756
	Late	26 Feb 16–21 Jun 16	100 (85)	1,058
Lostine River	Early	8 Sep 15–28 Jan 16	91 (64)	726
	Late	29 Jan 15–7 Jun 16	105 (80)[a]	226[a]
			8 (6)[b]	13[b]
Middle Grande Ronde River	Late	26 Feb 16–3 Jun 16	82 (83)	2,075
Minam River	Early	9 Sep 15–21 Nov 15	72 (97)	3,144
	Late	3 Mar 16–8 Jun 16	86 (86)	787
Upper Grande Ronde River	Early	17 Sep 15–18 Nov 15	38 (63)	381
	Late	27 Feb 16–10 Apr 16	41 (95)	1,086

[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 2016. 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	37.2	51.6	11.0	0.3	0.0
Lostine River	37.6	37.6	24.6	0.2	0.0
Minam River	75.5	11.3	12.4	0.8	0.0
Upper Grande Ronde River	16.9	63.8	17.8	1.5	0.0
Mean	47.2	36.6	15.7	0.6	0.0
CV (%)	51.9	61.7	39.4	110.1	0.0
Late					
Catherine Creek	0.0	81.9	17.2	0.9	0.0
Lostine River	0.0	55.5	37.0	7.6	0.0
Minam River	0.0	46.1	27.6	25.1	1.3
Upper Grande Ronde River	0.0	29.3	51.5	19.2	0.0
Mean	0.0	55.4	31.4	12.8	0.3
CV (%)	0.0	39.7	46.4	85.5	196.5
Early and Late[a]					
Middle Grande Ronde River	0.0	22.7	61.3	15.6	0.3

[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 2016 and subsequently arriving at Lower Granite Dam (LGD) during spring 2016.

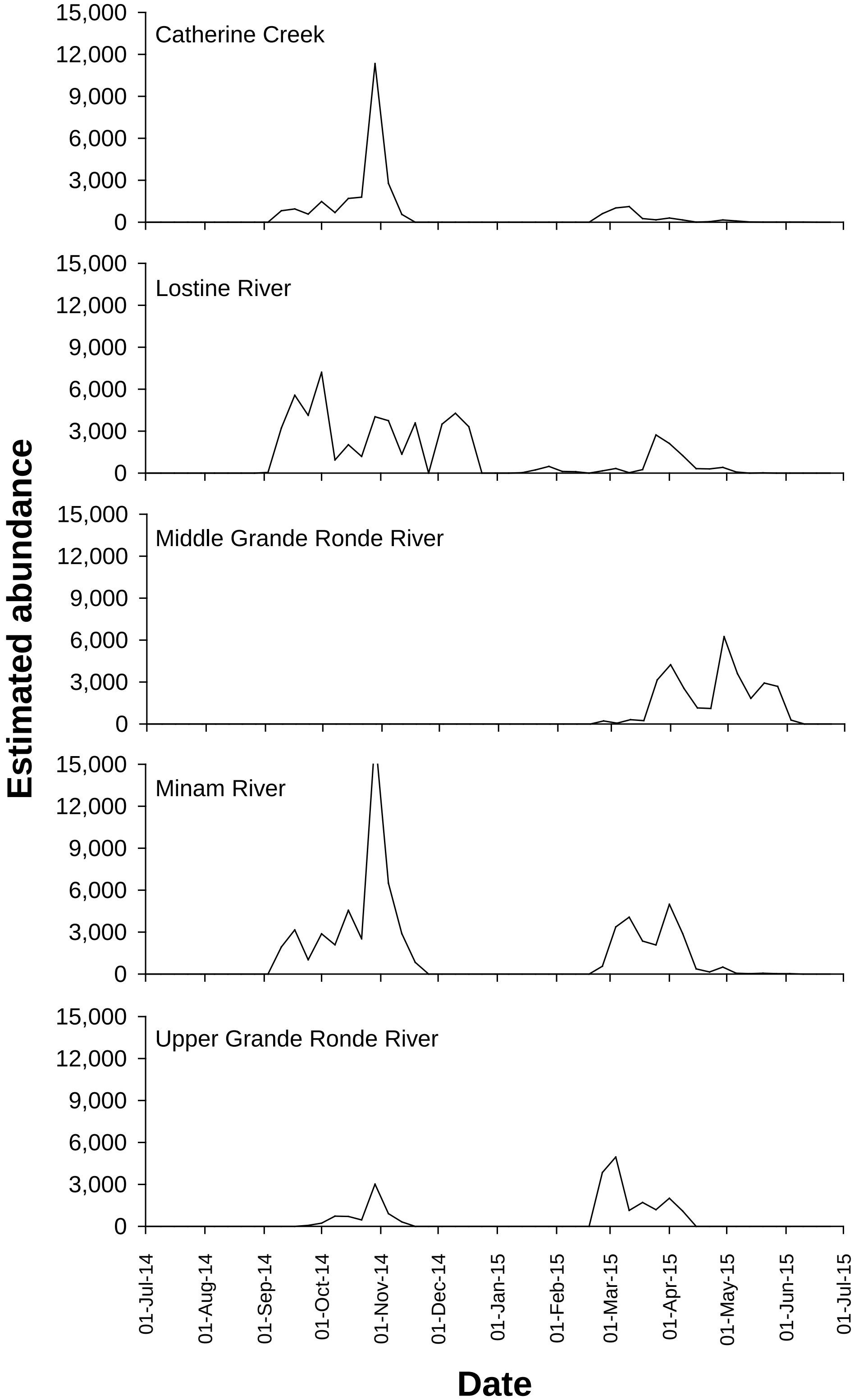
Stream	Distance to LGD (km)	Number detected	Travel time (d) Median	Min	Max
Catherine Creek	362	9	22	7	68
Lostine River	274	16	16	4	43
Middle Grande Ronde River	258	166	11	3	71
Minam River	245	92	20	4	70
Upper Grande Ronde River	397	58	36	6	80

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 2015 and spring 2016 (MY 2016). 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.

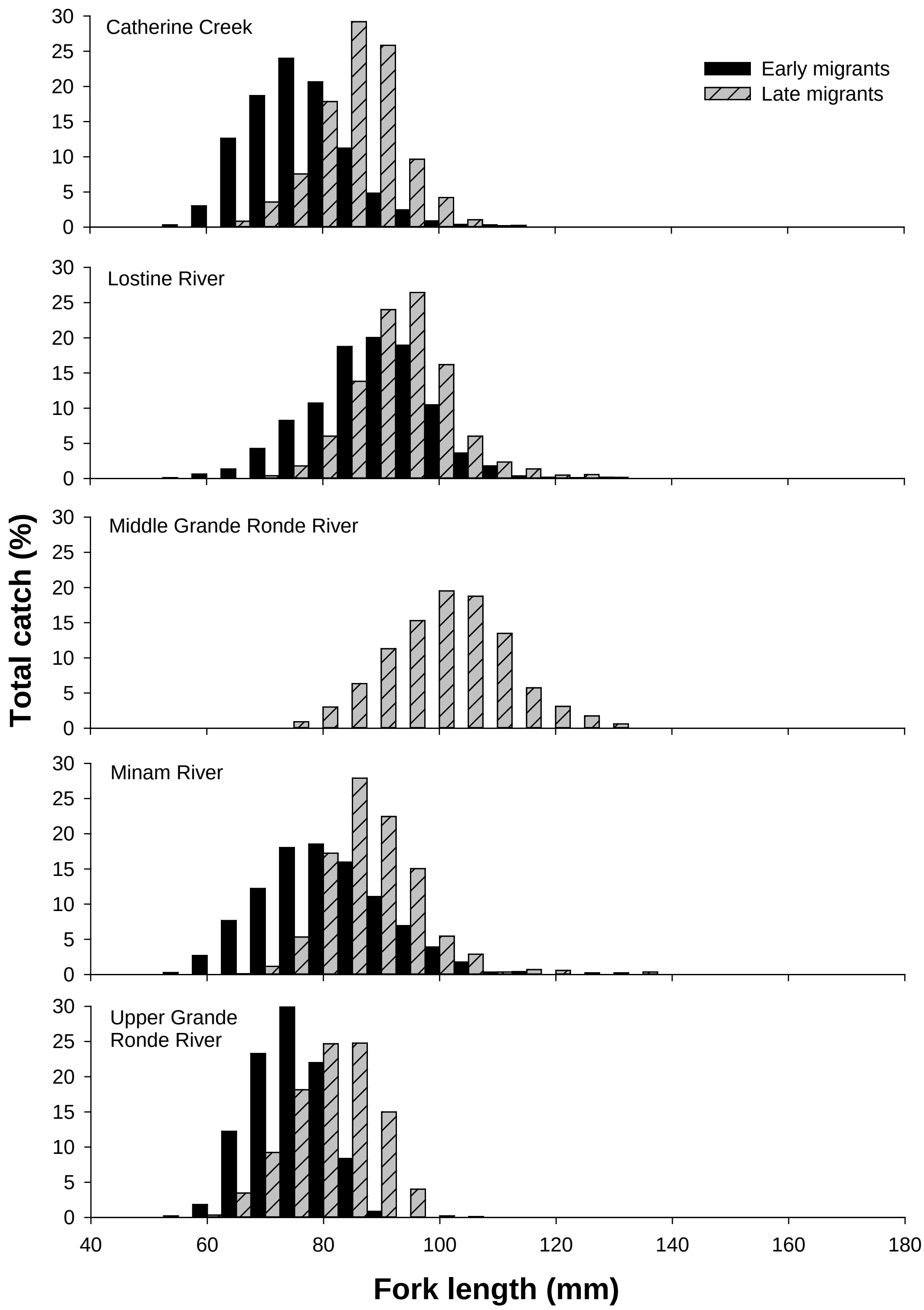
Season and location tagged	Number tagged	Number detected	Probability of surviving and migrating in the first year (95% CI)
Fall			
Catherine Creek	454	53	0.154 (0.112–0.224)
Lostine River	361	63	0.227 (0.168–0.334)
Minam River	159	30	0.248 (0.164–0.413)
Upper Grande Ronde River	248	21	0.096 (0.059–0.178)
Spring (FL ≥ 100 mm)			
Catherine Creek	192	20	0.200 (0.101–0.399)
Lostine River	107	29	0.317 (0.218–0.479)
Middle Grande Ronde River	787	324	0.595 (0.519–0.696)
Minam River	332	158	0.598 (0.513–0.708)
Upper Grande Ronde River	499	118	0.312 (0.251–0.399)

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 2016. Italicized headings represent smolt age at time detections were recorded at a dam. Means are weighted by sample size (*n*).

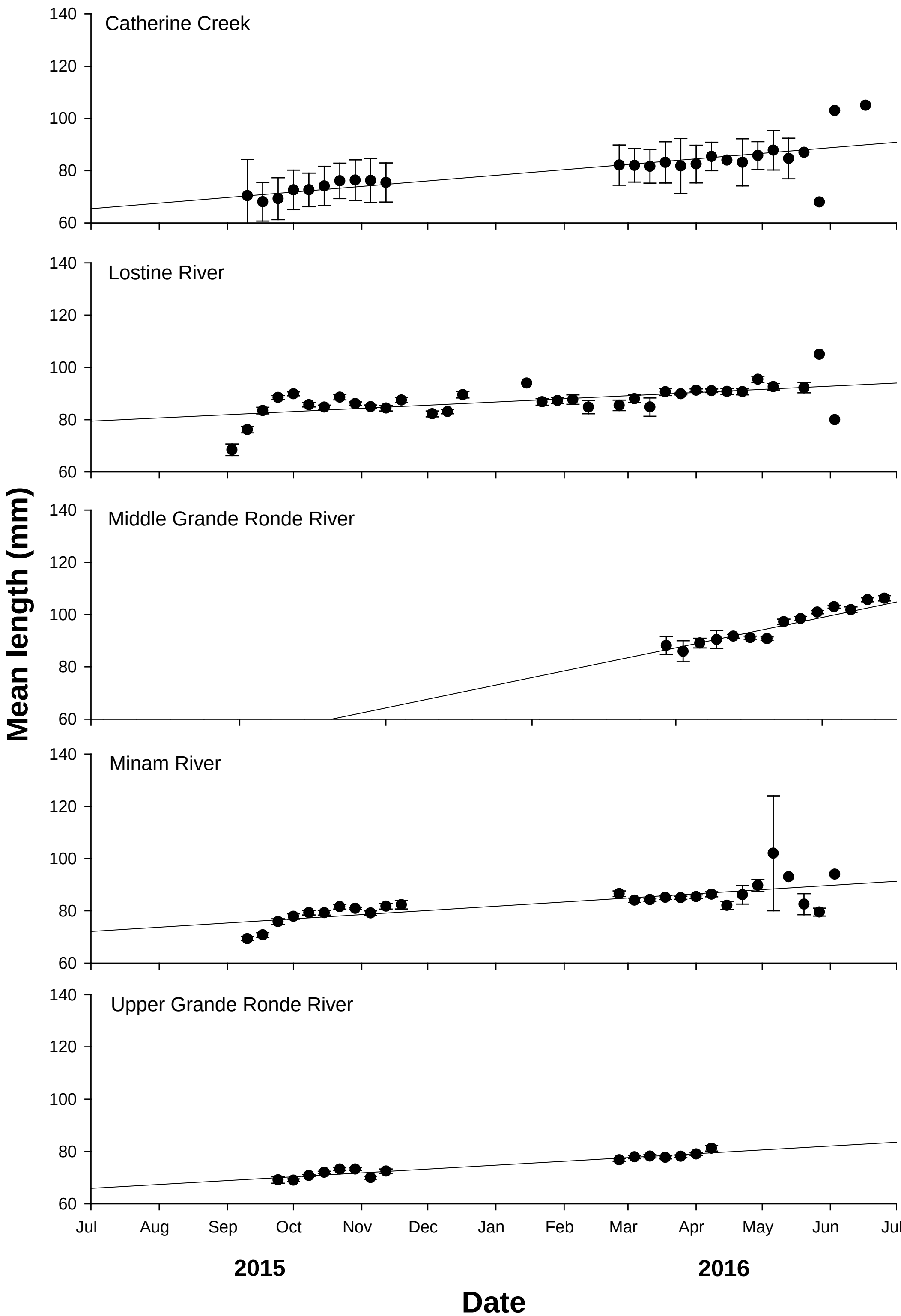
Trap site	*n*	Age-0 *Age-1 smolt*	Age-1 *Age-2 smolt*	Age-2 *Age-3 smolt*	Age-3 *Age-4 smolt*
PIT tagged fish with known age (%)					
Catherine Creek	175	28.6	48.0	22.3	1.1
Lostine River	252	32.1	38.1	29.4	0.4
Minam River	209	34.4	30.6	32.5	2.4
Upper Grande Ronde River	94	17.0	52.1	27.7	3.2
Mean		30.0	40.1	28.4	1.5
CV (%)		25.8	24.2	15.1	82.9
PIT tagged fish detected at dams (%)					
Catherine Creek	9	0.0	44.4	55.6	0.0
Lostine River	28	0.0	67.9	32.1	0.0
Minam River	23	0.0	52.2	43.5	4.3
Upper Grande Ronde River	8	0.0	50.0	50.0	0.0
Mean		0.0	57.4	41.2	1.5
CV (%)		0.0	17.5	24.4	147.8



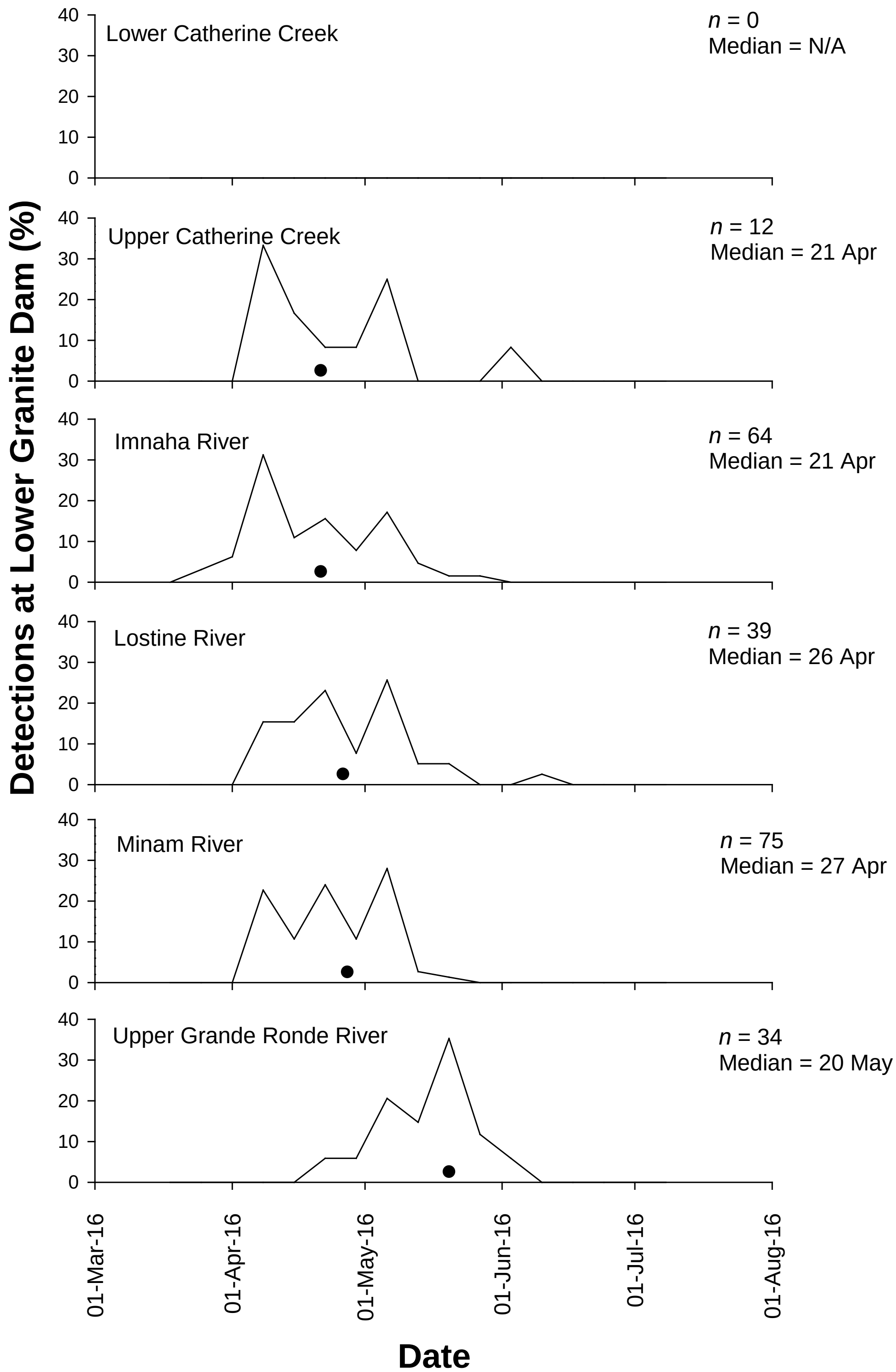
Appendix Figure B-1. Estimated migration timing and abundance for juvenile spring Chinook salmon migrants sampled by rotary screw traps during MY 2016.



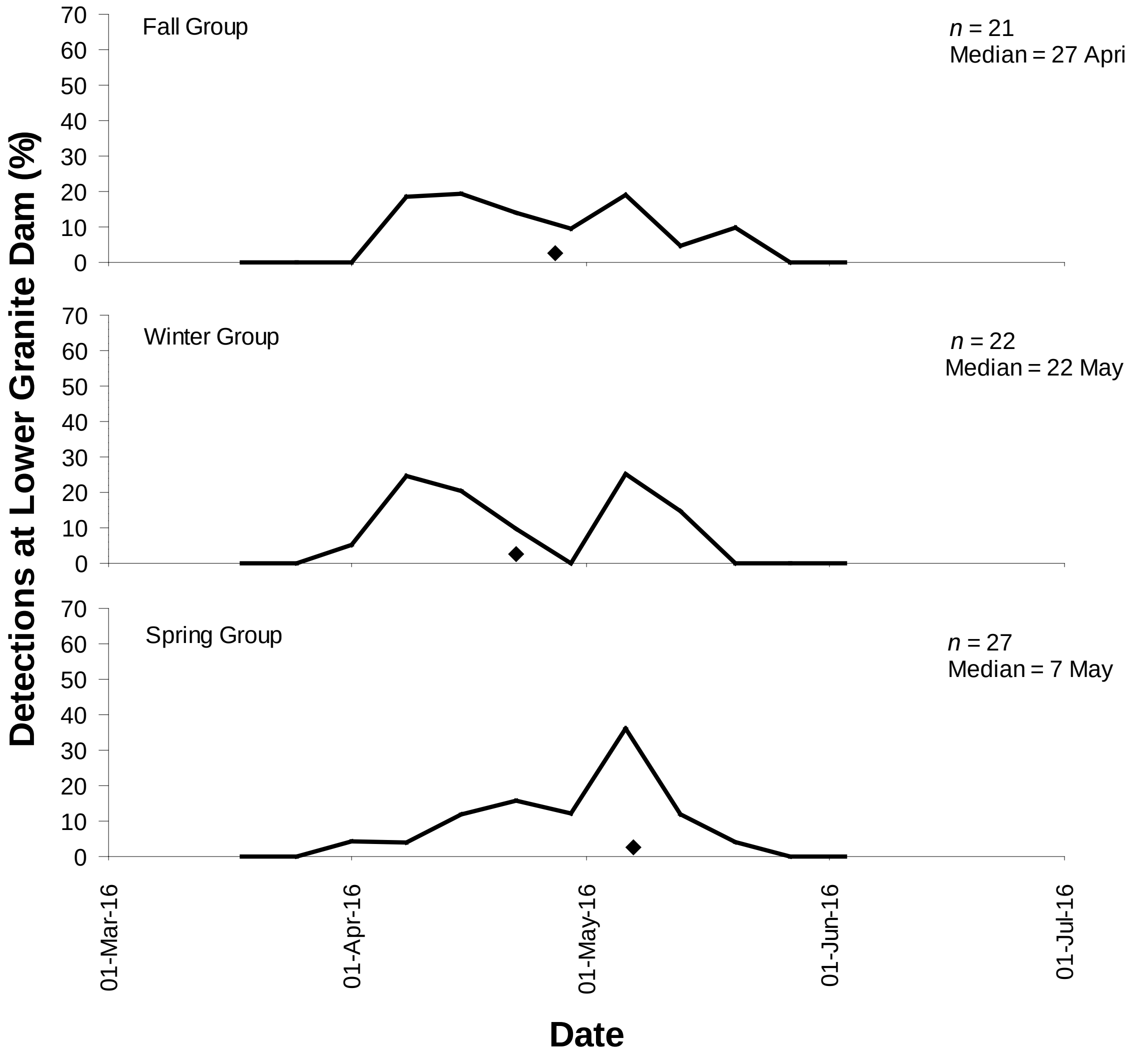
Appendix Figure B-2. Length frequency distribution (fork length) of early and late migrating juvenile spring Chinook salmon captured at Catherine Creek (rkm 32), Lostine (rkm 3), middle Grande Ronde (rkm 160), Minam (rkm 0), and upper Grande Ronde (rkm 299) river traps during MY 2016.



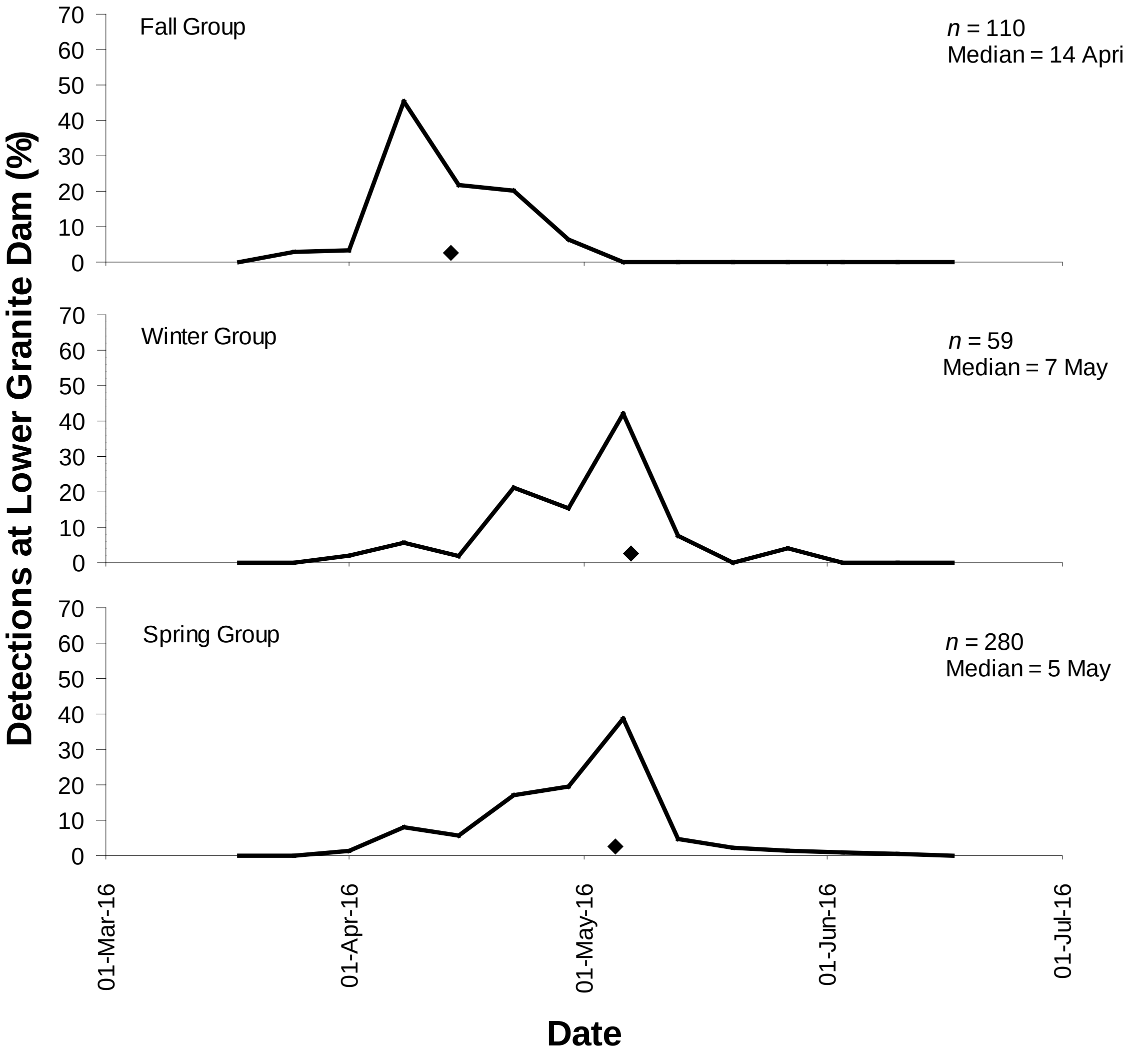
Appendix Figure B-3. Weekly mean fork lengths and associated standard error for spring Chinook salmon captured by rotary screw traps in Grande Ronde River Subbasin during MY 2016.



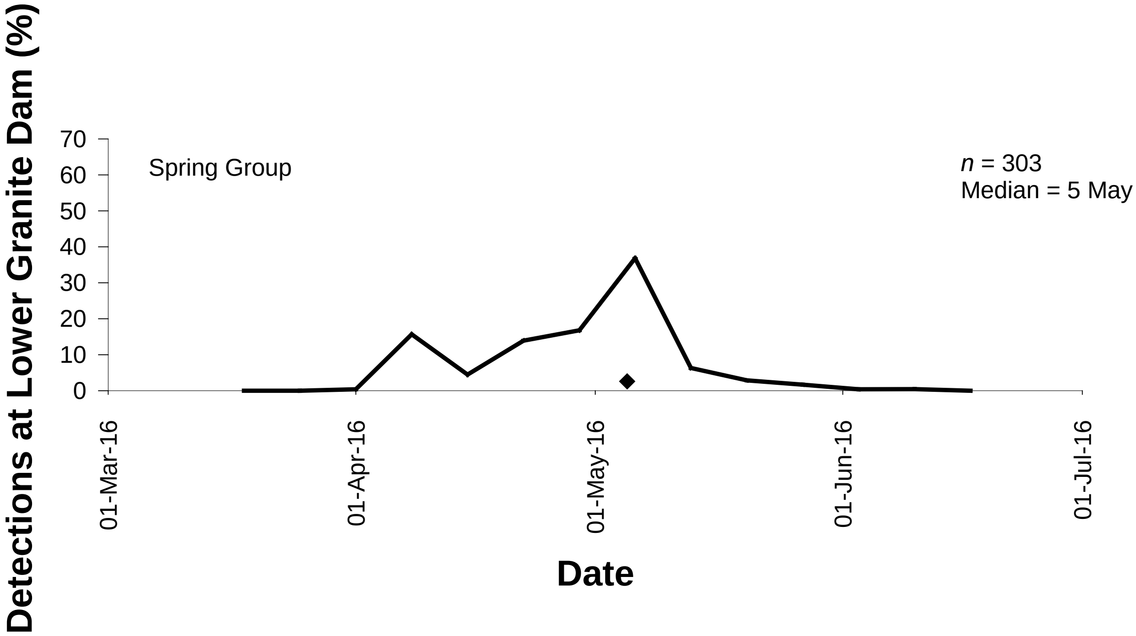
Appendix Figure B-4. Dates of arrival, during 2016 at Lower Granite Dam, of spring Chinook salmon PIT-tagged as parr in Catherine Creek and Imnaha, Lostine, Minam, and upper Grande Ronde rivers during summer 2015. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ♦ = median arrival date.



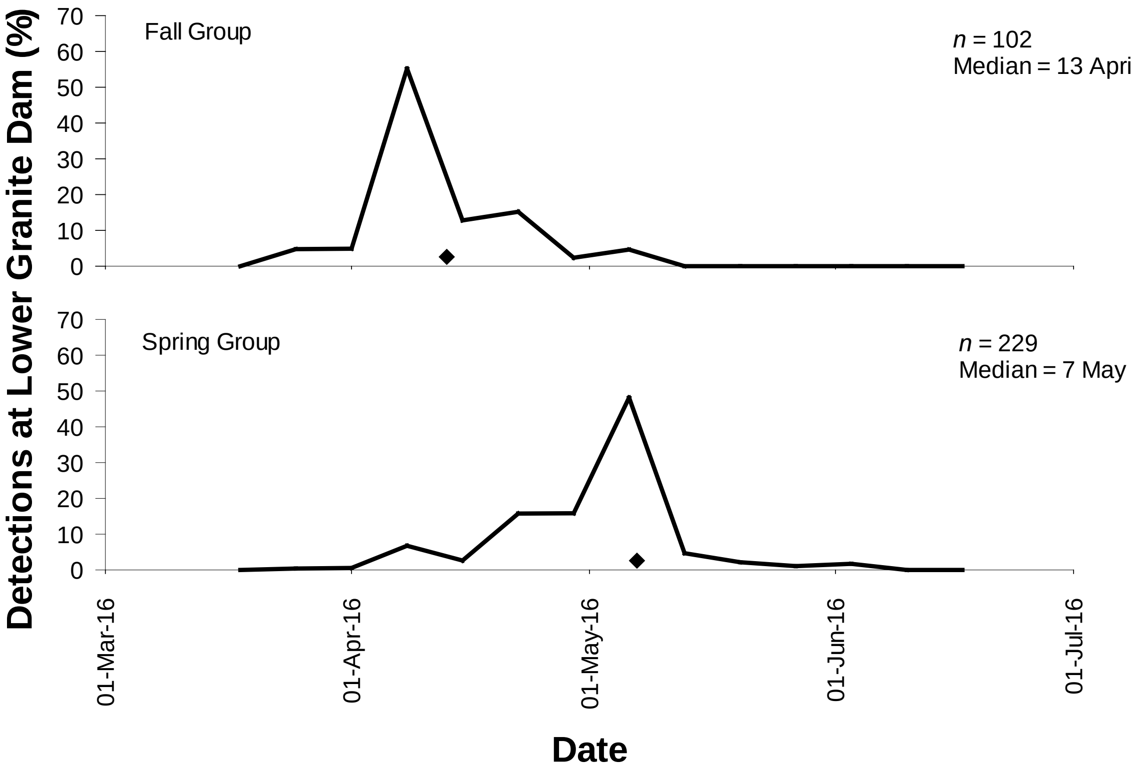
Appendix Figure B-5. Dates of arrival, during 2016 at Lower Granite dam, for fall, winter, and spring tag groups of juvenile spring Chinook salmon PIT-tagged from Catherine Creek. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ◆ = median arrival date.



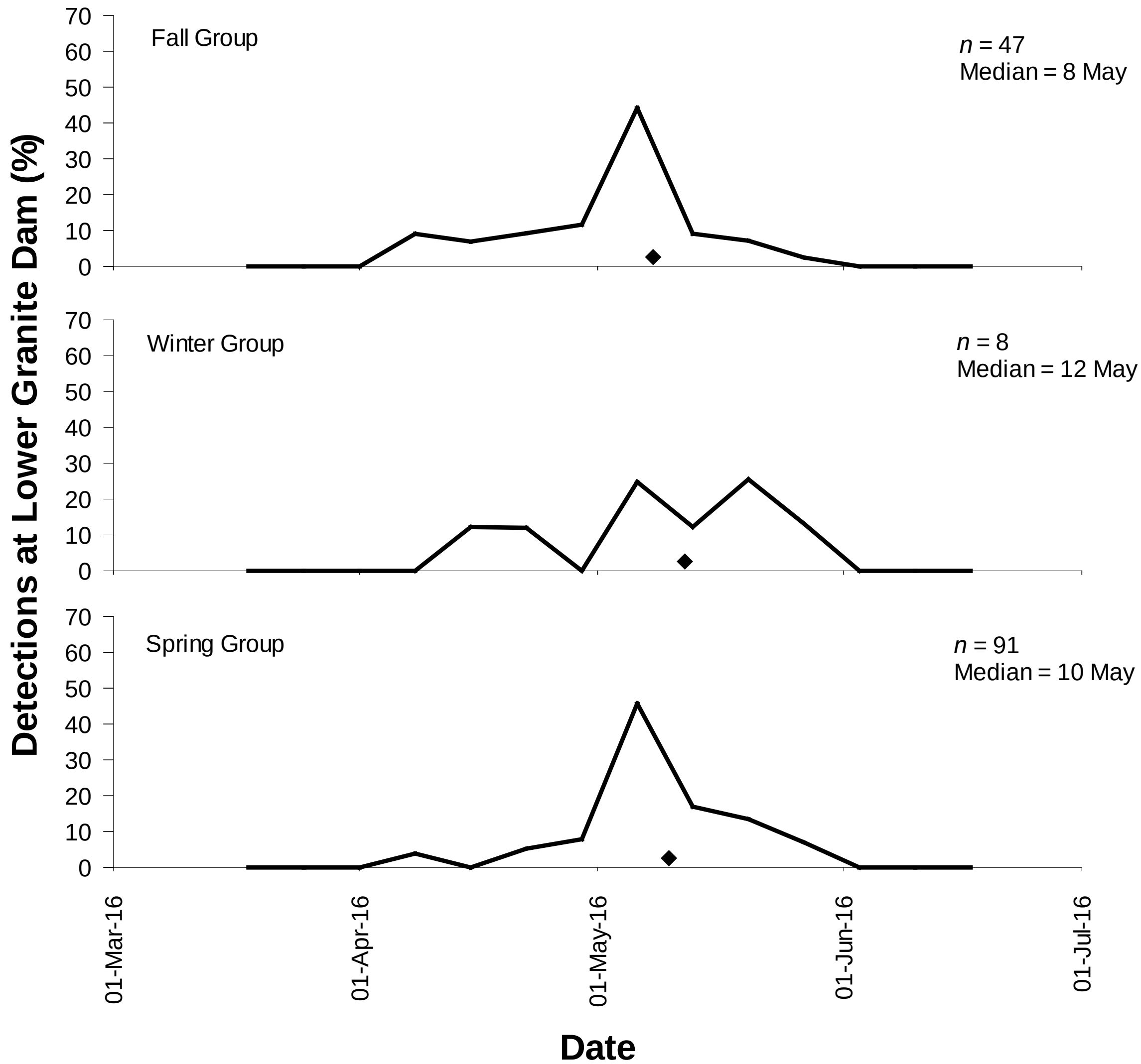
Appendix Figure B-6. Dates of arrival, during 2016 at Lower Granite dam, for fall, winter, and spring tag groups of juvenile spring Chinook salmon PIT-tagged from Lostine River. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ◆ = median arrival date.



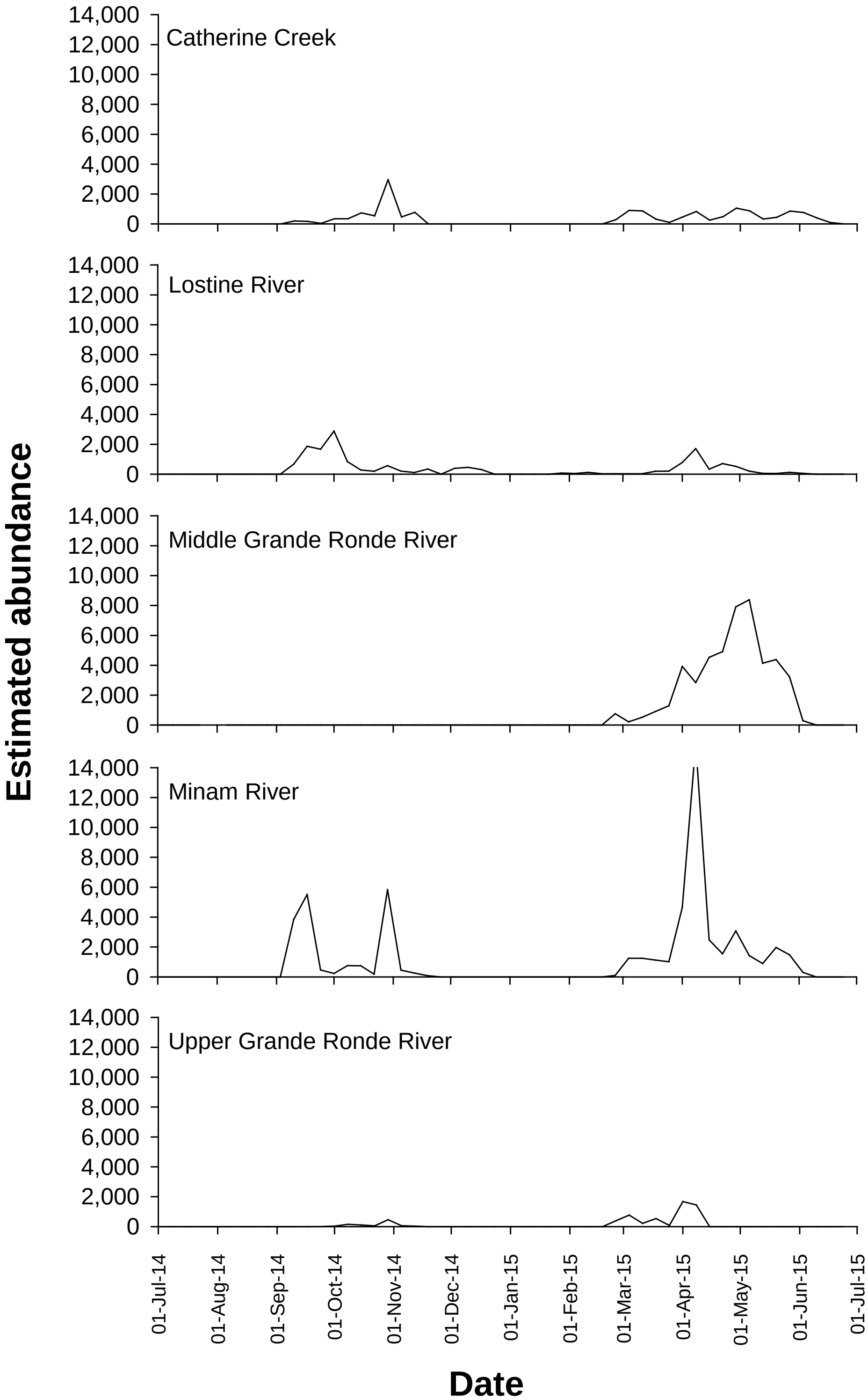
Appendix Figure B-7. Dates of arrival, during 2016 at Lower Granite dam, for the spring tag group of juvenile spring Chinook salmon PIT-tagged from middle Grande Ronde River. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ◆ = median arrival date.



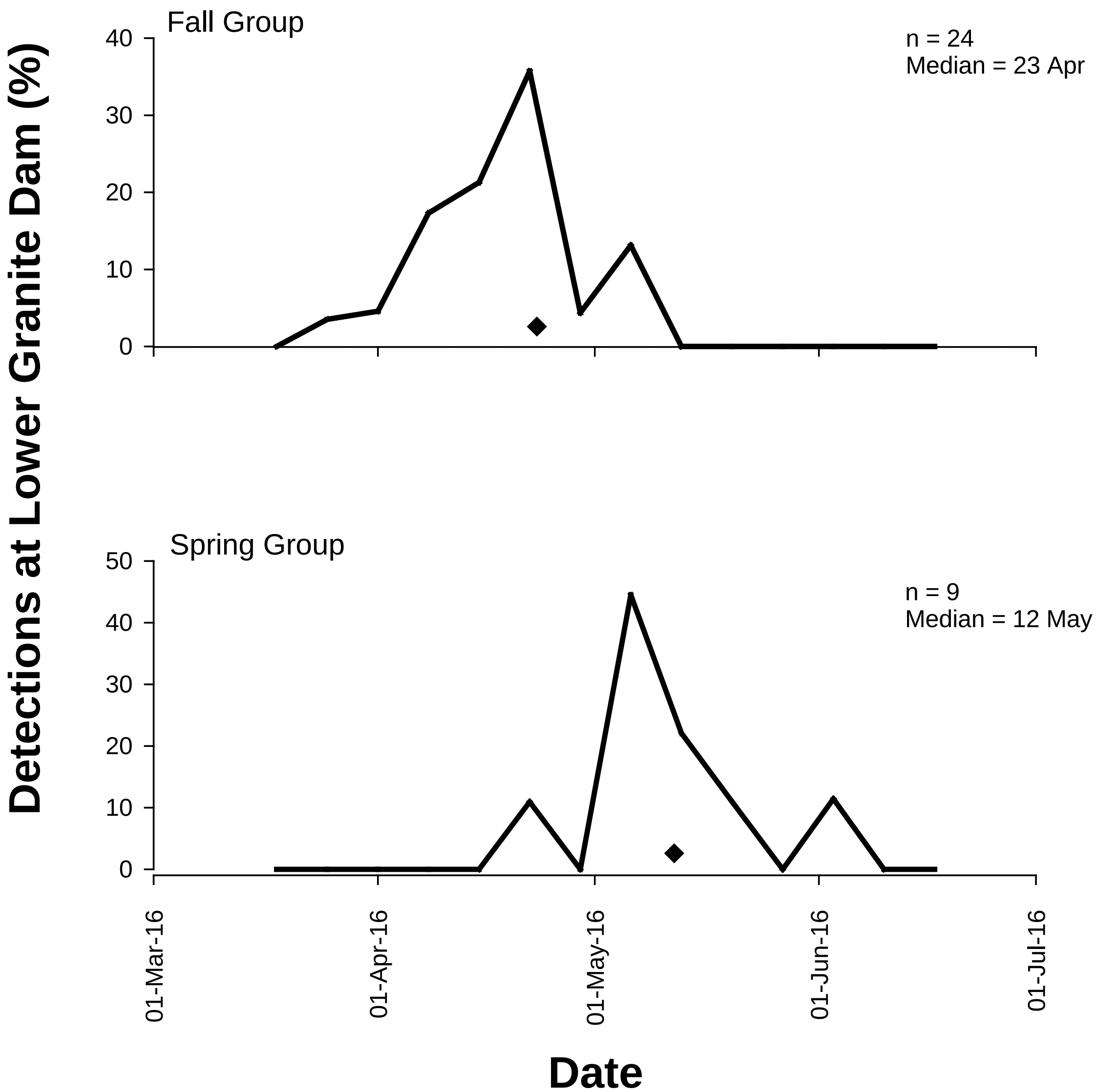
Appendix Figure B-8. Dates of arrival, during 2016 at Lower Granite dam, for fall and spring tag groups of juvenile spring Chinook salmon PIT-tagged from Minam River. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ♦ = median arrival date.



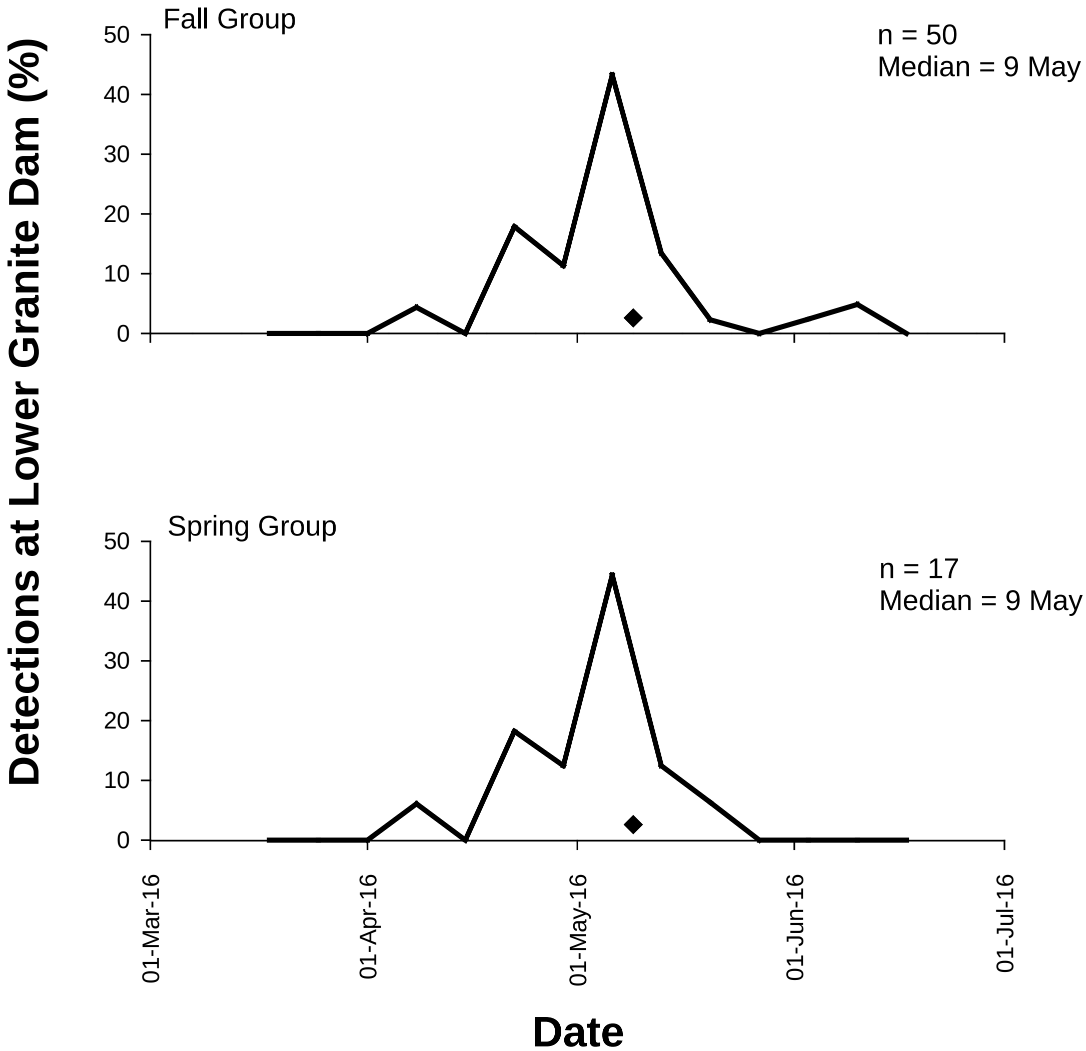
Appendix Figure B-9. Dates of arrival, during 2016 at Lower Granite dam, for fall, winter, and spring tag groups of juvenile spring Chinook salmon PIT-tagged from upper Grande Ronde River. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ♦ = median arrival date.



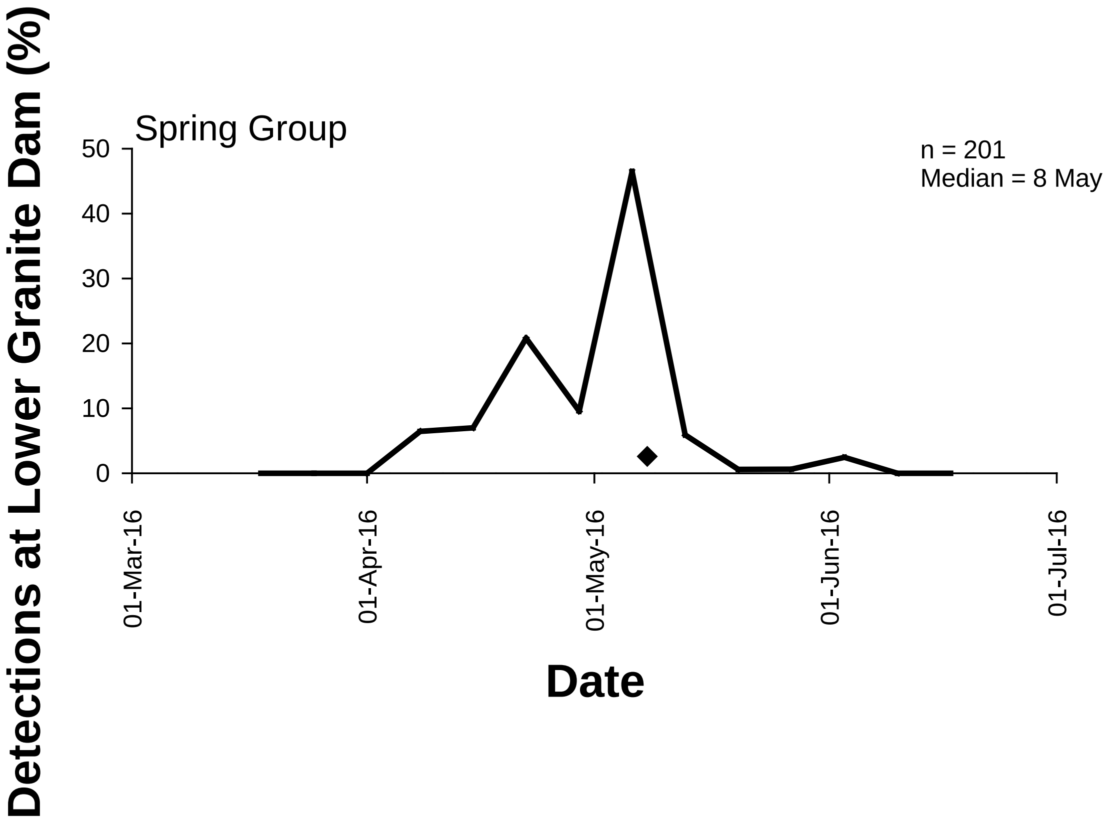
Appendix Figure B-10. Estimated migration timing and abundance of juvenile summer steelhead migrants captured by rotary screw trap during MY 2016.



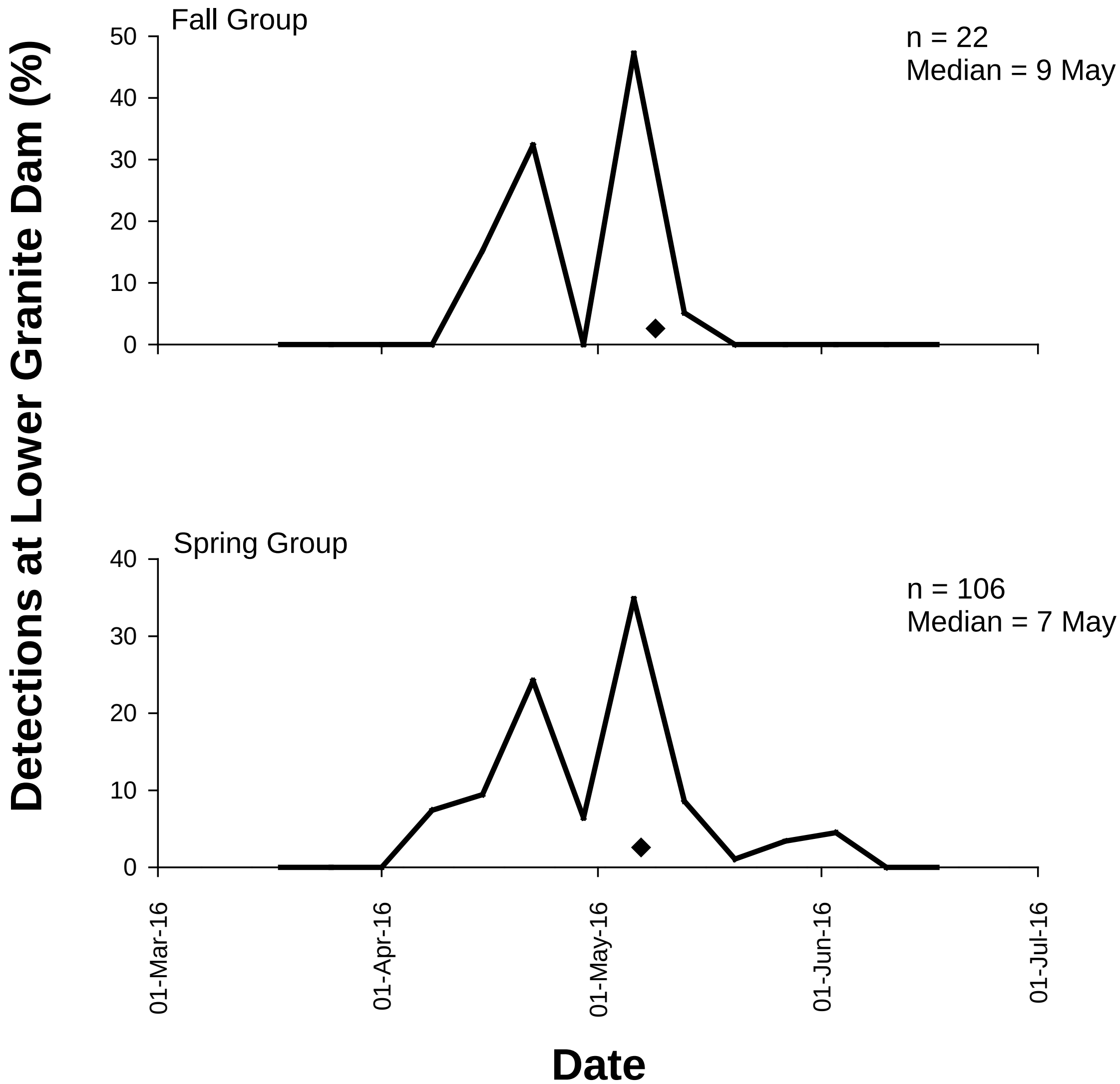
Appendix Figure B-11. Dates of arrival, in 2016, at Lower Granite Dam for fall and spring tag groups of steelhead PIT-tagged from Catherine Creek, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



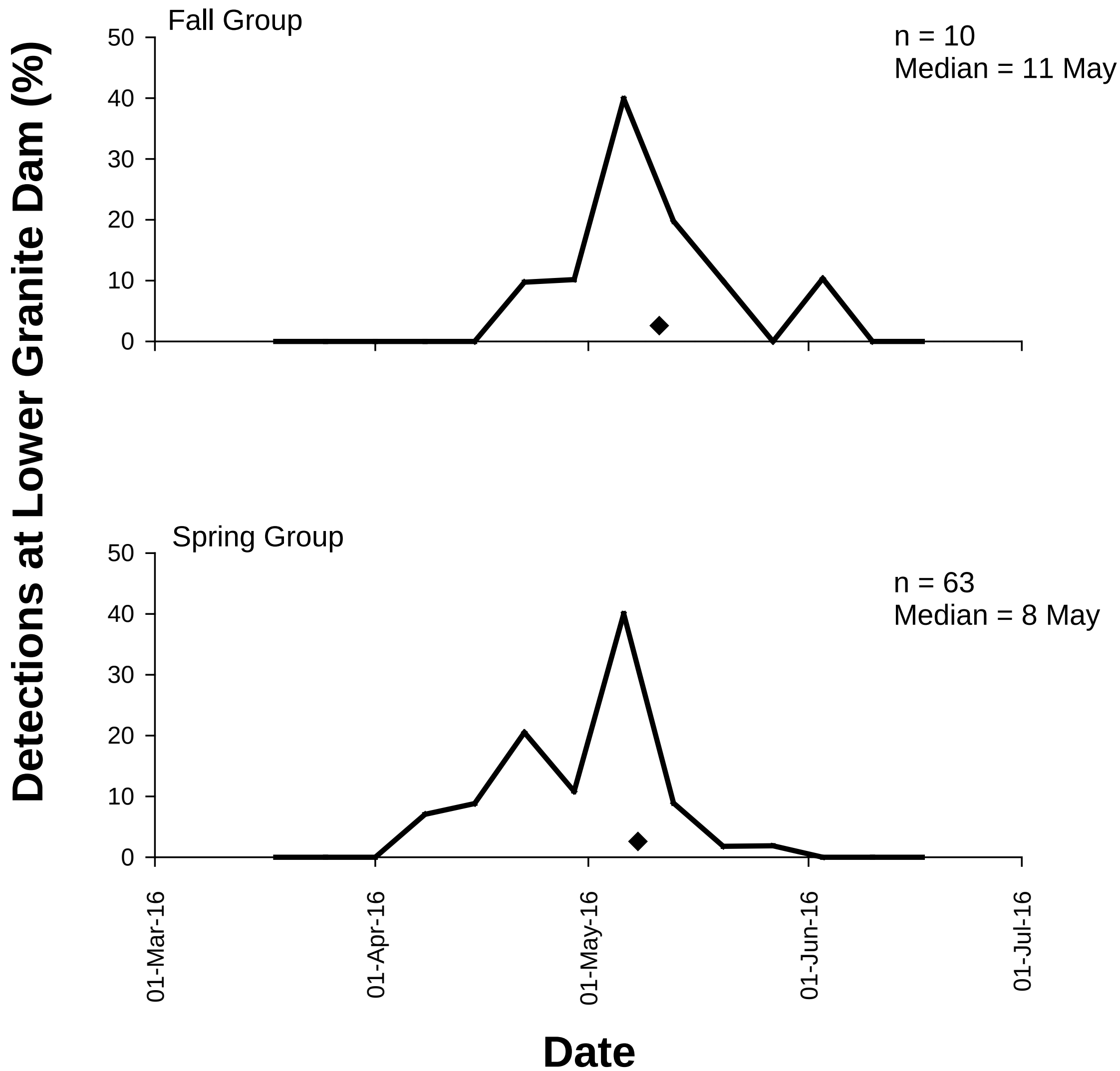
Appendix Figure B-12. Dates of arrival, in 2016, at Lower Granite Dam for fall and spring tag groups of steelhead PIT-tagged from Lostine River, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



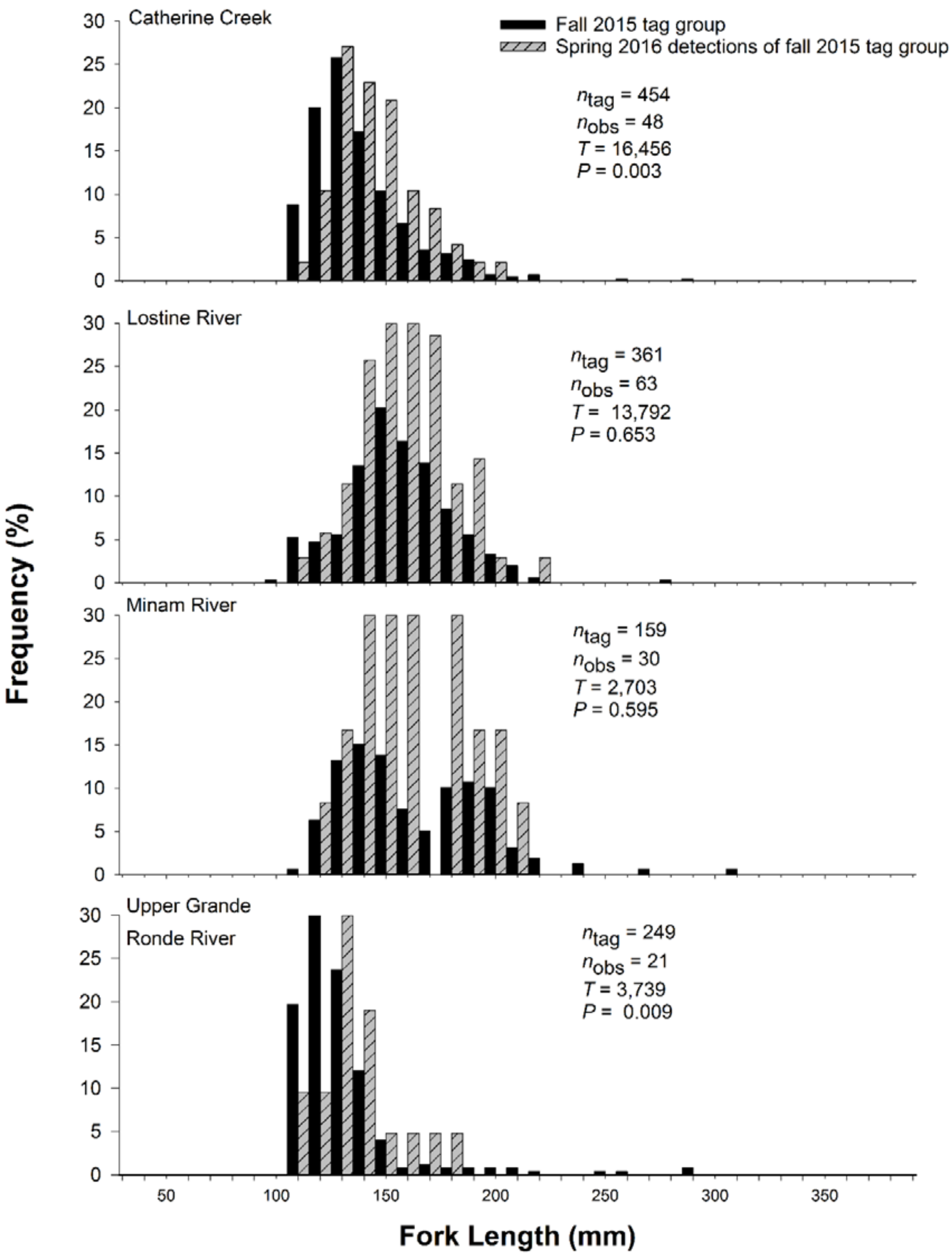
Appendix Figure B-13. Dates of arrival, in 2016, at Lower Granite Dam for spring tag group of steelhead PIT-tagged from middle Grande Ronde River, and expressed as a percentage of total detected for the group. Detections were expanded for spillway flow. ♦ = median arrival date.



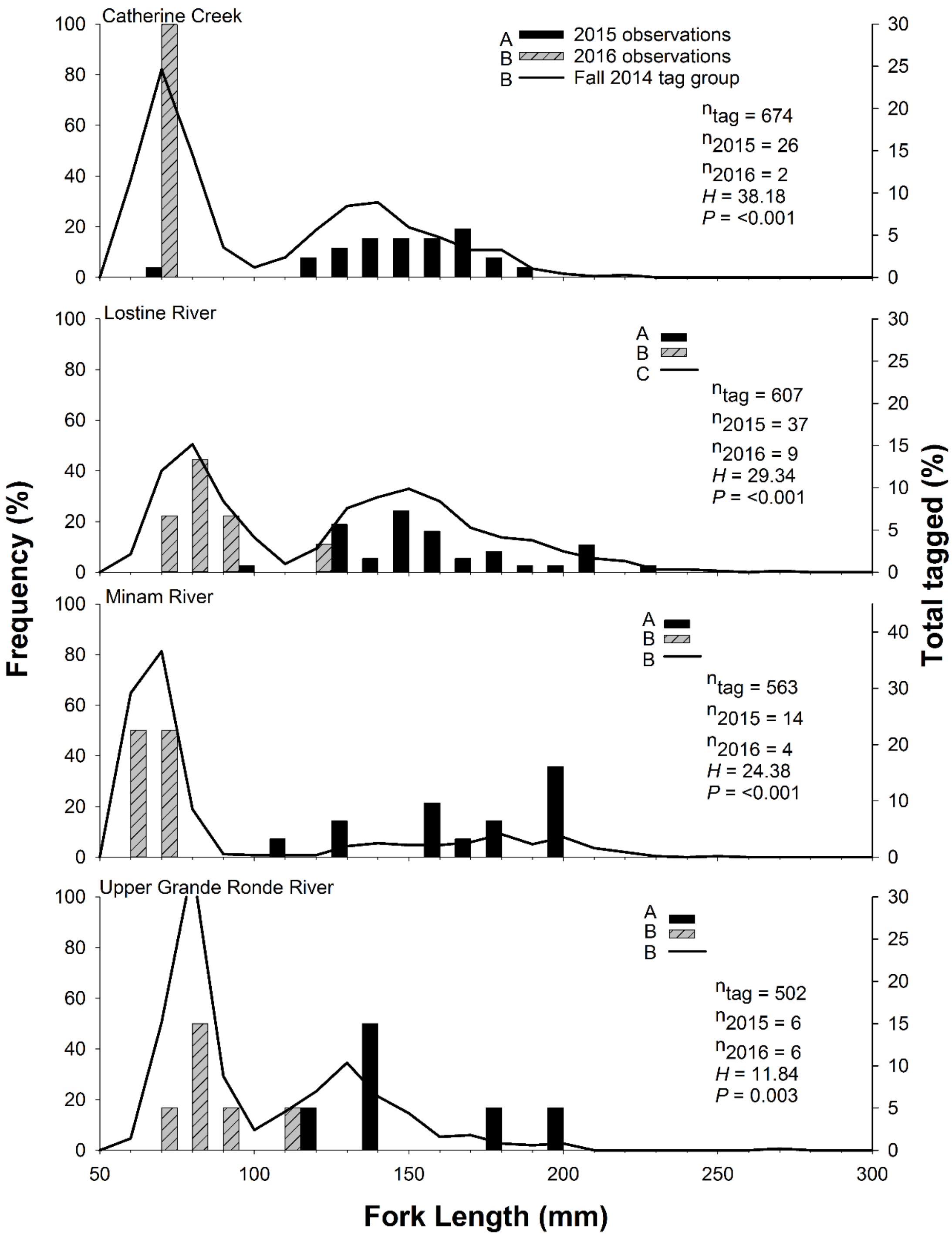
Appendix Figure B-14. Dates of arrival, in 2016, at Lower Granite Dam for fall and spring tag groups of steelhead PIT-tagged from Minam River, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



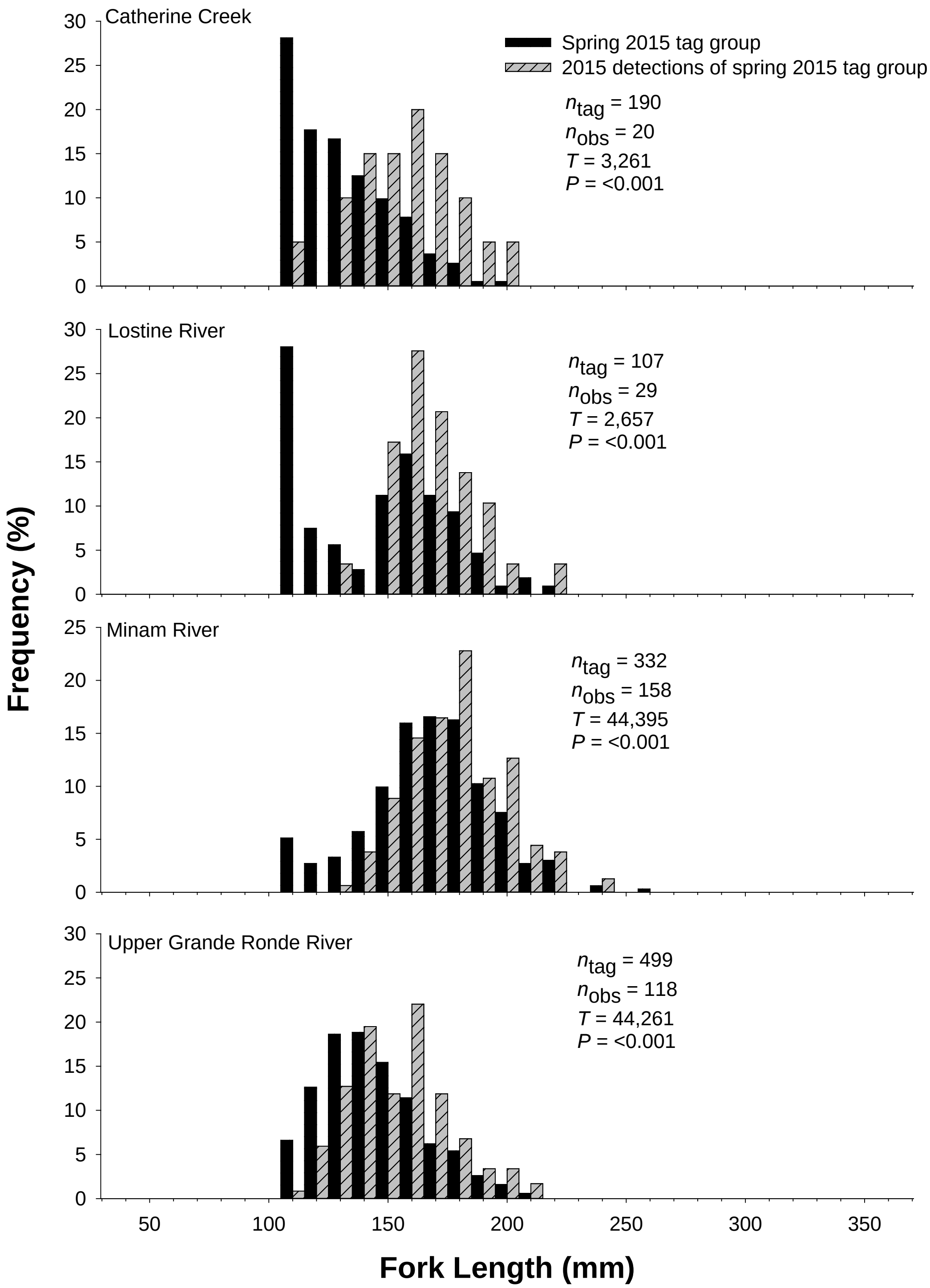
Appendix Figure B-15. Dates of arrival, in 2016, at Lower Granite Dam for the fall and spring tag groups of steelhead PIT-tagged from upper Grande Ronde River, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



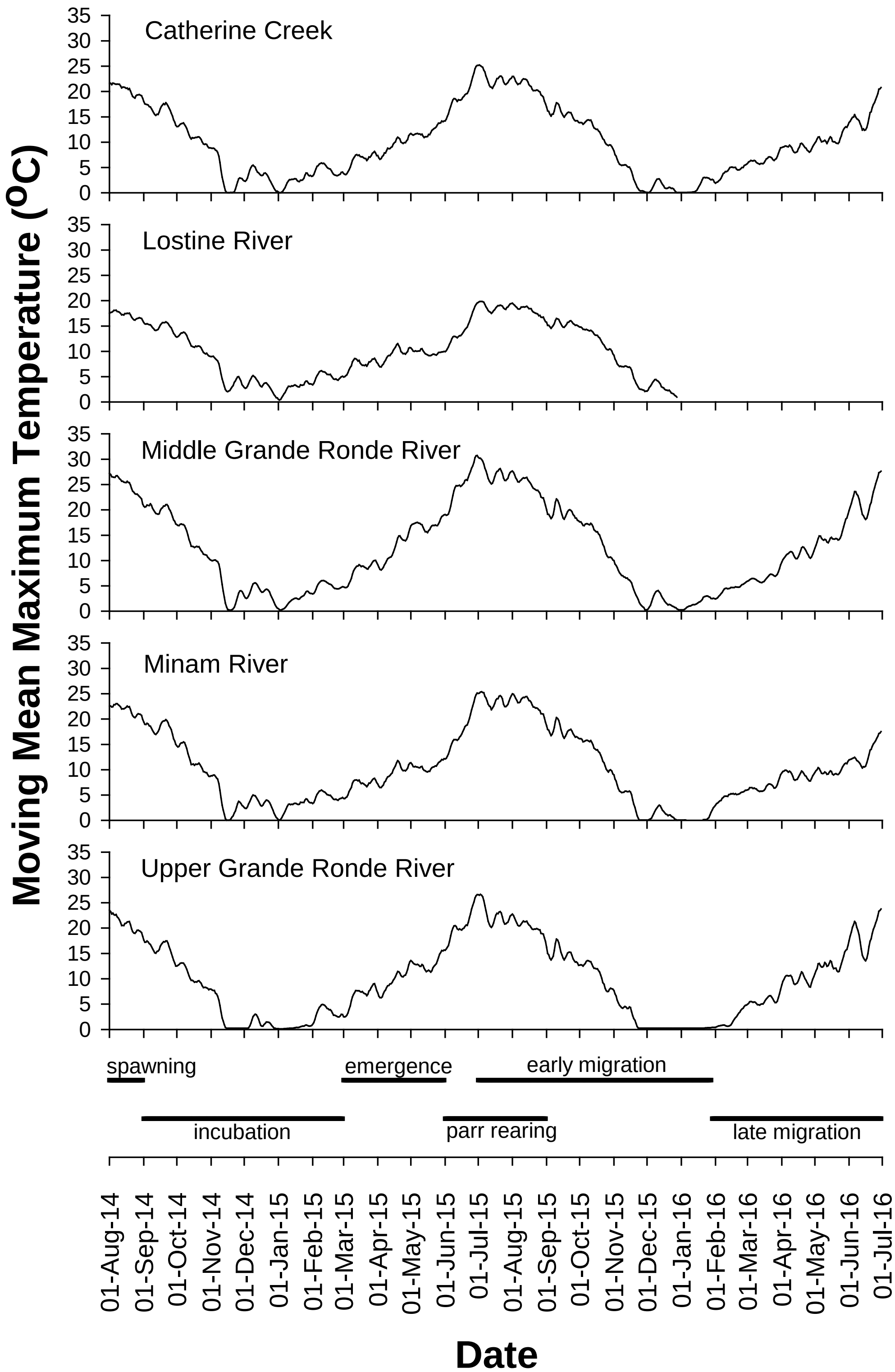
Appendix Figure B-16. Length frequency distributions for all steelhead PIT-tagged at screw traps during fall 2015 and those subsequently observed at Snake or Columbia river dams during spring 2016. Fork lengths are based on measurements taken at time of tagging. Frequency is expressed as percent of total number tagged (n_{tag}). 'n_{obs}' is number detected.



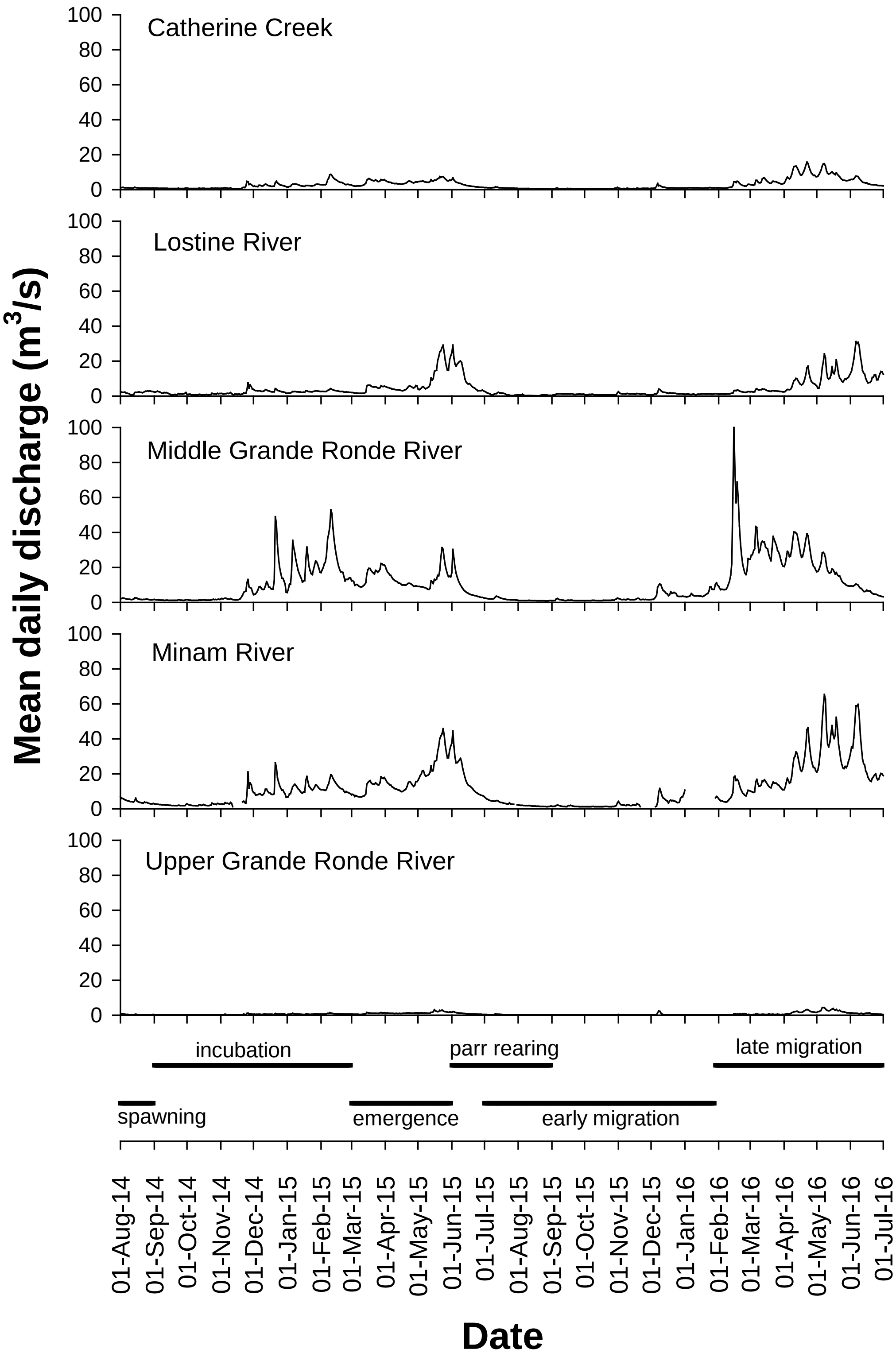
Appendix Figure B-17. Length frequency distributions for steelhead PIT-tagged at screw traps during fall 2014, and those subsequently observed at Snake or Columbia river dams during 2015 and 2016. Frequency is expressed as percent of total number tagged. 'H' is the test statistic for the Kruskal–Wallis 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 2016, and those subsequently observed at Snake or Columbia river dams during spring 2016. 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 2016. 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 2016. 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, 2016.

Site ID	Stream	Panel	Stream Classification	Survey Distance (km)	Upstream Latitude	Upstream Longitude	Downstream Latitude	Downstream Longitude
CBW05583-013882	Peet Creek	Panel 3	Source	2.10	45.26007	-118.614613	45.27758	-118.616047
CBW05583-252730	Meadow Creek	Panel 3	Depositional	1.98	45.24506	-118.423222	45.25662	-118.406089
dsgn4-000094	Fly Creek	Panel 3	Transport	2.01	45.12082	-118.454013	45.13670	-118.447670
dsgn4-000161	South Fork Catherine Creek	Panel 3	Source	1.97	45.10680	-117.560751	45.10510	-117.582950
dsgn4-000213	Meadow Creek	Panel 3	Depositional	1.97	45.25668	-118.405956	45.26586	-118.390169
ORW03446-010424	Dark Canyon Creek	Panel 3	Transport	2.17	45.37531	-118.390198	45.35762	-118.396042
ORW03446-018904	Spring Creek	Annual	Transport	2.39	45.34725	-118.307330	45.33805	-118.286129
ORW03446-025816	Ladd Creek	Panel 3	Transport	1.07	45.24570	-118.018638	45.25399	-118.024474
ORW03446-036920	Indian Creek	Random	Source	2.03	45.40778	-117.799460	45.42154	-117.806760
ORW03446-051964	Catherine Creek	Panel 3	Depositional	2.17	45.14295	-117.723370	45.15211	-117.744435
ORW03446-059352	Clark Creek	Annual	Depositional	1.84	45.50022	-117.819943	45.51500	-117.828889
ORW03446-079752	Grande Ronde River	Annual	Depositional	1.99	45.17927	-118.389368	45.19335	-118.395185
ORW03446-084462	Lookingglass Creek	Panel 3	Depositional	1.56	45.74738	-117.871155	45.73620	-117.863077
ORW03446-092632	Spring Creek #3	Random	Source	2.07	45.35952	-118.323000	45.34736	-118.307429
ORW03446-095416	Meadow Creek	Random	Transport	1.97	45.27111	-118.590680	45.28292	-118.598773
ORW03446-095704	Beaver Creek	Panel 3	Transport	2.00	45.17138	-118.217880	45.18258	-118.233143
ORW03446-101102	Phillips Creek	Annual	Depositional	2.30	45.56971	-117.993709	45.56694	-117.973246
ORW03446-101560	Meadow Creek	Annual	Transport	1.97	45.29236	-118.612176	45.28316	-118.602238
ORW03446-102024	East Sheep Creek	Panel 3	Source	1.95	45.01283	-118.450759	45.01652	-118.472414
ORW03446-118408	West Chicken Creek	Annual	Source	1.95	45.02682	-118.403583	45.04449	-118.403882
ORW03446-120904	Burnt Corral Creek	Annual	Source	2.13	45.17401	-118.516512	45.18431	-118.499661
ORW03446-125832	Meadow Creek	Annual	Depositional	2.17	45.26362	-118.551468	45.27139	-118.533272
ORW03446-130904	Little Whiskey Creek	Panel 3	Source	1.78	45.27513	-118.209089	45.28907	-118.219059
ORW03446-131128	Clark Creek	Panel 3	Source	1.94	45.42778	-117.754936	45.43719	-117.774760
ORW03446-139144	Meadow Creek	Panel 3	Depositional	1.96	45.24724	-118.479667	45.24037	-118.462321
ORW03446-147928	Five Points Creek	Annual	Depositional	2.36	45.41072	-118.201787	45.40341	-118.222762
ORW03446-150408	Meadow Creek	Random	Depositional	2.25	45.26082	-118.498800	45.24885	-118.482690
ORW03446-157422	Phillips Creek	Panel 3	Transport	1.98	45.58136	-118.024369	45.57275	-118.006014
ORW03446-177134	East Phillips Creek	Annual	Source	2.20	45.63454	-118.055699	45.62304	-118.072221

Appendix Table B-13. Steelhead spawning ground survey characteristics, location and stream classification for sites in the Joseph Creek basin, 2016.

Site ID	Stream	Panel	Stream Classification	Survey Distance (km)	Upstream Latitude	Upstream Longitude	Downstream Latitude	Downstream Longitude
CBW05583-002175	Crow Creek	Annual	Transport	2.07	45.69023	-117.150370	45.70545	-117.15186
CBW05583-007682	Joseph Creek	Panel 2	Depositional	1.93	45.75829	-117.17381	45.76882	-117.17566
CBW05583-022018	Cottonwood Creek	Panel 2	Source	1.95	45.84475	-116.97982	45.85937	-116.96811
CBW05583-051026	Unnamed trib to Alder	Annual	Source	1.69	45.69084	-117.011250	45.70425	-117.02264
CBW05583-061375	Swamp Creek	Panel 2	Transport	2.00	45.76823	-117.233080	45.78399	-117.22899
CBW05583-062978	Chesnimnus Creek	Panel 2	Transport	1.75	45.72751	-116.949718	45.73944	-116.96217
CBW05583-103938	Unnamed Tributary	Panel 2	Source	1.91	45.84640	-117.029376	45.83164	-117.01898
CBW05583-112130	Devils Run Creek	Annual	Source	2.02	45.78225	-116.969200	45.78081	-116.98547
CBW05583-120658	Crow Creek	Panel 2	Transport	2.06	45.62649	-117.13800	45.64198	-117.14323
CBW05583-141826	Basin Creek	Annual	Source	2.12	45.91900	117.059000	45.93269	-117.05829
CBW05583-155138	Joseph Creek	Panel 2	Depositional	2.07	45.73329	-117.159764	45.74244	-117.16532
CBW05583-157522	Chesnimnus Creek	Panel 2	Depositional	2.28	45.70261	-117.101747	45.69801	-117.11955
CBW05583-167426	Chesnimnus Creek	Annual	Depositional	2.44	45.75440	-116.998440	45.75067	-117.01907
CBW05583-169810	Chesnimnus Creek	Annual	Transport	2.08	45.71144	-116.911870	45.65759	-116.92303
CBW05583-187906	Peavine Creek	Panel 2	Source	2.17	45.75514	-117.083208	45.73627	-117.08356
CBW05583-227263	Davis Creek	Panel 2	Transport	2.15	45.68828	-117.260646	45.70665	-117.25699
CBW05583-231250	Salmon Creek	Panel 2	Transport	2.02	45.68697	-117.053312	45.70391	-117.04851
CBW05583-265730	TNT Gulch	RP 2	Source	2.09	45.75381	-116.918992	45.77061	-116.92672
CBW05583-301570	Cottonwood Creek	Annual	Source	1.88	45.93356	-117.052350	45.94326	-117.05991
CBW05583-310786	Chesnimnus Creek	Panel 2	Depositional	1.90	45.70934	-117.091207	45.70310	-117.10101
CBW05583-389247	Chesnimnus Creek	Annual	Depositional	1.94	45.69840	-117.121006	45.70513	-117.13607
CBW05583-408066	Summit Creek	Panel 2	Source	1.83	45.79374	-116.946766	45.77793	-116.94913
CBW05583-493394	Salmon Creek	Annual	Transport	1.92	45.70401	-117.049560	45.71857	-117.05021
CBW05583-510466	Broady Creek	Panel 2	Source	2.15	45.90052	-117.091864	45.91843	-117.09353
CBW05583-515586	Chesnimnus Creek	Annual	Depositional	2.40	45.73674	117.033240	45.73187	-117.05089
CBW05583-527618	Horse Creek	Panel 2	Source	1.92	45.97595	-116.986910	45.98423	-117.00566

Appendix Table B-14. Completion dates and general results for redd surveys in the Upper Grande Ronde River basin, 2016.

Short Site ID	Stream	Mean No. days between surveys	Redd Count	1st Survey	2nd Survey	3rd Survey	4th Survey	5th Survey	6th Survey	7th Survey
CBW05583-013882	Peet Creek	12.7	0	4/14/2016	5/5/2016					
CBW05583-252730	Meadow Creek	12.7	3	3/31/2016	4/18/2016	5/4/2016	5/18/2016	5/26/2016		
dsgn4-000094	Fly Creek	14.3	3	5/5/2016	5/19/2016	5/31/2016				
dsgn4-000161	South Fork Catherine Creek	15.0	0	5/12/2016	5/24/2016					
dsgn4-000213	Meadow Creek	13.5	2	3/31/2016	4/18/2016	5/4/2016	5/18/2016	5/26/2016		
ORW03446-010424	Dark Canyon Creek	14.5	3	4/11/2016	4/25/2016	5/9/2016	5/24/2016			
ORW03446-018904	Spring Creek	13.3	9	3/14/2016	3/28/2016	4/11/2016	4/25/2016	5/9/2016	5/24/2016	
ORW03446-025816	Ladd Creek	14.0	0	3/28/2016	4/13/2016	4/28/2016	5/10/2016	5/23/2016		
ORW03446-036920	Indian Creek	16.0	0	5/25/2016	6/6/2016					
ORW03446-051964	Catherine Creek	0.0	0	5/24/2016						
ORW03446-059352	Clark Creek	14.2	16	3/21/2016	4/5/2016	4/21/2016	4/28/2016	5/12/2016	5/24/2016	6/8/2016
ORW03446-079752	Grande Ronde River	14.0	0	5/3/2016	5/18/2016	6/1/2016				
ORW03446-084462	Lookingglass Creek	14.3	1	5/24/2016	6/7/2016					
ORW03446-092632	Spring Creek	13.2	5	3/14/2016	3/28/2016	4/22/2016	4/25/2016	5/9/2016	5/24/2016	
ORW03446-095416	Meadow Creek	13.5	9	4/4/2016	4/20/2016	5/2/2016	5/16/2016	5/31/2016		
ORW03446-095704	Beaver Creek	15.6	2	5/12/2016	5/24/2016					
ORW03446-101102	Phillips Creek	14.2	0	3/21/2016	4/11/2016	4/28/2016	5/10/2016	5/24/2016		
ORW03446-101560	Meadow Creek	16.2	12	4/4/2016	4/20/2016	5/2/2016	5/16/2016	5/31/2016		
ORW03446-102024	East Sheep Creek	17.8	1	4/18/2016	5/4/2016	5/19/2016	6/2/2016			
ORW03446-118408	West Chicken Creek	14.5	5	4/8/2016	5/5/2016	5/19/2016	6/1/2016			
ORW03446-120904	Burnt Corral Creek	14.5	1	4/8/2016	4/18/2016	5/4/2016	5/19/2016			
ORW03446-125832	Meadow Creek	14.0	8	4/4/2016	4/20/2016	5/2/2016	5/16/2016	5/31/2016		
ORW03446-130904	Little Whiskey Creek	14.0	21	3/17/2016	4/6/2016	4/19/2016	5/19/2016			
ORW03446-131128	Clark Creek	14.2	2	4/26/2016	5/9/2016	5/25/2016	6/6/2016			
ORW03446-139144	Meadow Creek	15.4	5	4/7/2016	4/19/2016	5/3/2016	5/17/2016	6/1/2016		
ORW03446-147928	Five Points Creek	18.7	7	4/19/2016	5/4/2016	5/13/2016	6/1/2016			
ORW03446-150408	Meadow Creek	17.8	4	4/7/2016	4/19/2016	5/3/2016	5/17/2016	6/1/2016		
ORW03446-157422	Phillips Creek	13.7	6	3/30/2016	4/11/2016	4/28/2016	5/10/2016	5/24/2016		
ORW03446-177134	East Phillips Creek	15.5	3	4/28/2016	5/12/2016	5/26/2016				

Appendix Table B-15. Completion dates and general results for redd surveys in the in the Joseph Creek basin, 2016.

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
CBW05583-002175	Crow Creek	5	13.8	1	3/9/2016	3/22/2016	4/6/2016	4/19/2016	5/3/2016	
CBW05583-007682	Joseph Creek	3	12.0	0	4/11/2016	4/21/2016	5/5/2016			
CBW05583-022018	Cottonwood Creek	1	N/A	0	5/31/2016					
CBW05583-051026	Unnamed trib to Alder	5	13.5	0	3/16/2016	3/28/2016	4/12/2016	4/25/2016	5/9/2016	
CBW05583-061375	Swamp Creek	2	17.0	31	4/28/2016	5/15/2016				
CBW05583-062978	Chesnimnus Creek	6	13.4	5	3/10/2016	3/23/2016	4/5/2016	4/19/2016	5/2/2016	5/16/16
CBW05583-103938		1	N/A	0	5/2/2016					
CBW05583-112130	Devils Run Creek	5	17.3	21	3/24/2016	4/7/2016	4/20/2016	5/4/2016	6/1/2016	
CBW05583-120658	Crow Creek	5	13.8	0	3/9/2016	3/22/2016	4/6/2016	4/19/2016	5/3/2016	
CBW05583-141826	Basin Creek	5	13.8	1	3/8/2016	3/21/2016	4/4/2016	4/18/2016	5/2/2016	
CBW05583-155138	Joseph Creek	3	12.0	2	4/11/2016	4/21/2016	5/5/2016			
CBW05583-157522	Chesnimnus Creek	3	12.0	2	4/11/2016	4/21/2016	5/5/2016			
CBW05583-167426	Chesnimnus Creek	6	14.0	20	3/17/2016	3/29/2016	4/7/2016	4/20/2016	5/4/2016	5/26/16
CBW05583-169810	Chesnimnus Creek	6	13.4	10	3/10/2016	3/23/2016	4/6/2016	4/19/2016	5/3/2016	5/16/16
CBW05583-187906	Peavine Creek	6	12.3	18	3/14/2016	3/23/2016	4/7/2016	4/20/2016	5/4/2016	5/24/16
CBW05583-227263	Davis Creek	5	13.5	13	3/31/2016	4/14/2016	4/25/2016	5/11/2016	5/24/2016	
CBW05583-231250	Salmon Creek	5	13.5	0	3/16/2016	3/28/2016	4/12/2016	4/25/2016	5/9/2016	
CBW05583-265730	TNT Gulch	3	13.5	0	4/6/2016	4/20/2016	5/3/2016			
CBW05583-301570	Cottonwood Creek	6	14.0	13	3/8/2016	3/21/2016	4/4/2016	4/18/2016	5/2/2016	5/17/16
CBW05583-310786	Chesnimnus Creek	4	14.0	2	3/29/2016	4/11/2016	4/26/2016	5/10/2016		
CBW05583-389247	Chesnimnus Creek	4	14.7	3	4/11/2016	4/21/2016	5/5/2016	5/25/2016		
CBW05583-408066	Summit Creek	4	16.0	25	4/14/2016	4/26/2016	5/11/2016	6/1/2016		
CBW05583-493394	Salmon Creek	5	13.5	1	3/16/2016	3/28/2016	4/12/2016	4/26/2016	5/9/2016	
CBW05583-510466	Broady Creek	1	N/A	3	4/1/2016					
CBW05583-515586	Chesnimnus Creek	5	14.3	5	3/29/2016	4/11/2016	4/26/2016	5/10/2016	5/25/2016	
CBW05583-527618	Horse Creek	5	14.3	1	3/7/2016	3/21/2016	4/4/2016	4/18/2016	5/3/2016	

Appendix Table B-16. Locations, dates, and characteristics of live steelhead observations in the UGRR and Deer Creek basins, 2016.

Site ID	Stream	Observation Date	Fin Clip	On/Off Redd
ORW03446-095704	Beaver Creek	5/12/2016	No	Off
ORW03446-101560	Meadow Creek	4/20/2016	No	Off
ORW03446-118408	West Chicken Creek	4/8/2016	Unk	On
Deer3-0	Deer Creek	4/13/2016	Unk	Off
Deer3-0	Deer Creek	4/13/2016	No	Off
Deer3-0	Deer Creek	4/27/2016	Unk	Off
Deer3-0	Deer Creek	5/11/2016	Unk	On
Deer3-0	Deer Creek	5/11/2016	Unk	Off
Deer3-0	Deer Creek	5/23/2016	No	Off
Deer6-3	Deer Creek	4/27/2016	Unk	On
Deer6-3	Deer Creek	4/27/2016	No	On
Deer6-3	Deer Creek	4/27/2016	No	Off

Appendix Table B-17. Locations, dates, and characteristics of live steelhead observations in the Joseph Creek basin, 2016.

Site ID	Stream	Observation Date	Fin Clip	On/Off Redd
CBW05583-062978	Chesnimnus Creek	4/5/2016	Unk	Off
CBW05583-112130	Devils Run Creek	4/20/2016	Unk	Off
CBW05583-167426	Chesnimnus Creek	4/7/2016	Unk	Off
CBW05583-167426	Chesnimnus Creek	4/20/2016	Unk	On
CBW05583-167426	Chesnimnus Creek	4/20/2016	Unk	Off
CBW05583-169810	Chesnimnus Creek	4/6/2016	Unk	On
CBW05583-187906	Peavine Creek	3/14/2016	No	On
CBW05583-187906	Peavine Creek	3/23/2016	Unk	On
CBW05583-187906	Peavine Creek	3/23/2016	Unk	Off
CBW05583-187906	Peavine Creek	4/7/2016	No	Unknown
CBW05583-187906	Peavine Creek	4/7/2016	Unk	Unknown
CBW05583-187906	Peavine Creek	4/7/2016	Unk	Unknown
CBW05583-187906	Peavine Creek	4/7/2016	Unk	Unknown
CBW05583-227263	Davis Creek	3/31/2016	Unk	Off
CBW05583-408066	Summit Creek	4/14/2016	No	Off
CBW05583-408066	Summit Creek	4/14/2016	No	Off
CBW05583-408066	Summit Creek	4/14/2016	Unk	On
CBW05583-408066	Summit Creek	4/14/2016	Unk	Off

Appendix Table B-18. Locations, dates, and characteristics of dead steelhead observations in Joseph and Deer Creek basins, 2016.

Site ID	Population	Stream Name	Date Observed	Fish Sex	Fork Length (mm)	Origin
CBW05583-167426	Joseph	Chesnimnus Creek	4/20/2016	Female	680	Wild

Appendix Table B-19. Annual results of steelhead spawning ground surveys, 2008−2016. 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%
2015	29	892	30.8	246	61.6	1.37	4,837	±1,891	39.09%
2016	29	892	30.8	128	58.2	1.30	2,572	±1,024	39.81%
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%
2015	24	384	16	286	48.3	1.37	2,967 [c]	±991	33.40%
2016	26	384	14.8	177	52.7	1.30	1,663 [d]	±739	44.44%

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).
c. With 1.8% hatchery proportion the total natural spawners is 2,914 (95% CI ±938).
d. With 4.1% hatchery proportion the total natural spawners is 1,595 (95% CI ±709).

Appendix Table B-20. Origin of adult steelhead passed above Joseph Creek, UGRR, Catherine Creek, Lookingglass Creek and Deer Creek weirs in 2016.

	Natural Origin	Hatchery Origin	Proportion Hatchery (%)	Total Fish
Joseph Creek[a]	1,437	62	4.1%	1,499
UGRR[b]	25	0	0	25
Catherine Creek[b]	198	0	0	198
Lookingglass Creek[b]	254	3	1.2%	257
Deer Creek[c]	82	0	0	82

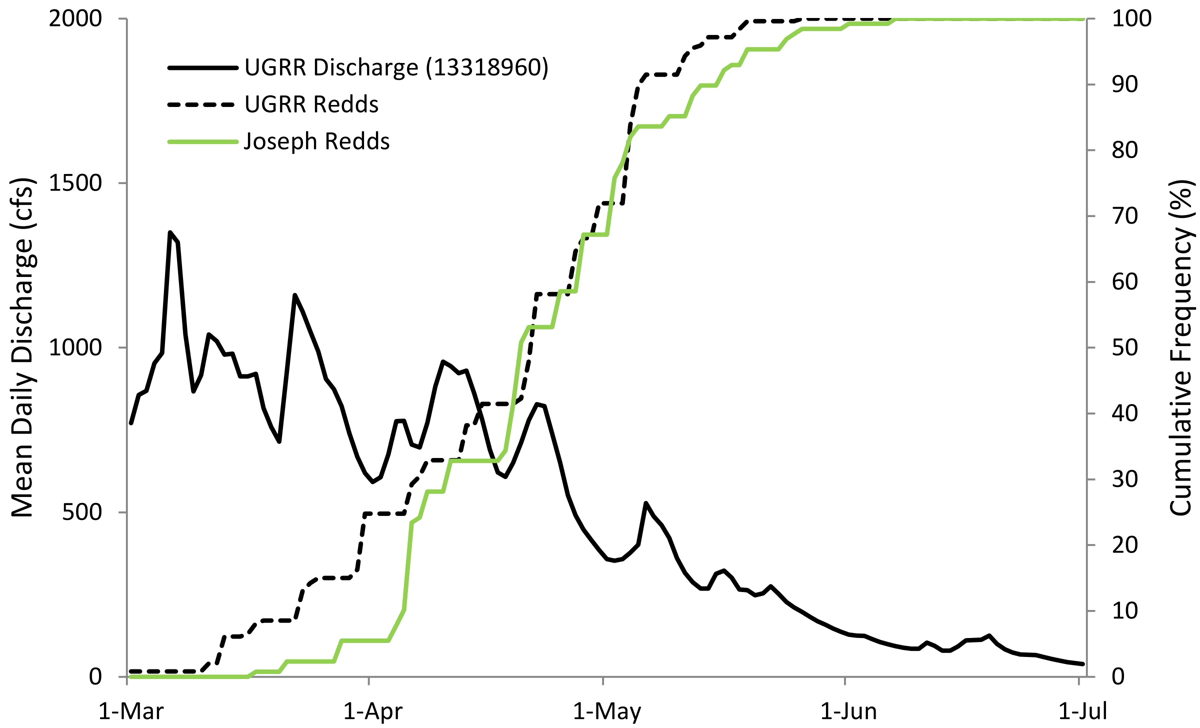
[a] Clark Watry, Nez Perce Tribe, Department of Fisheries Resources Management, unpublished data, personal communication
[b] Michael McLean, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fisheries Program, unpublished data, personal communication
[c] Michael 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, 2016.

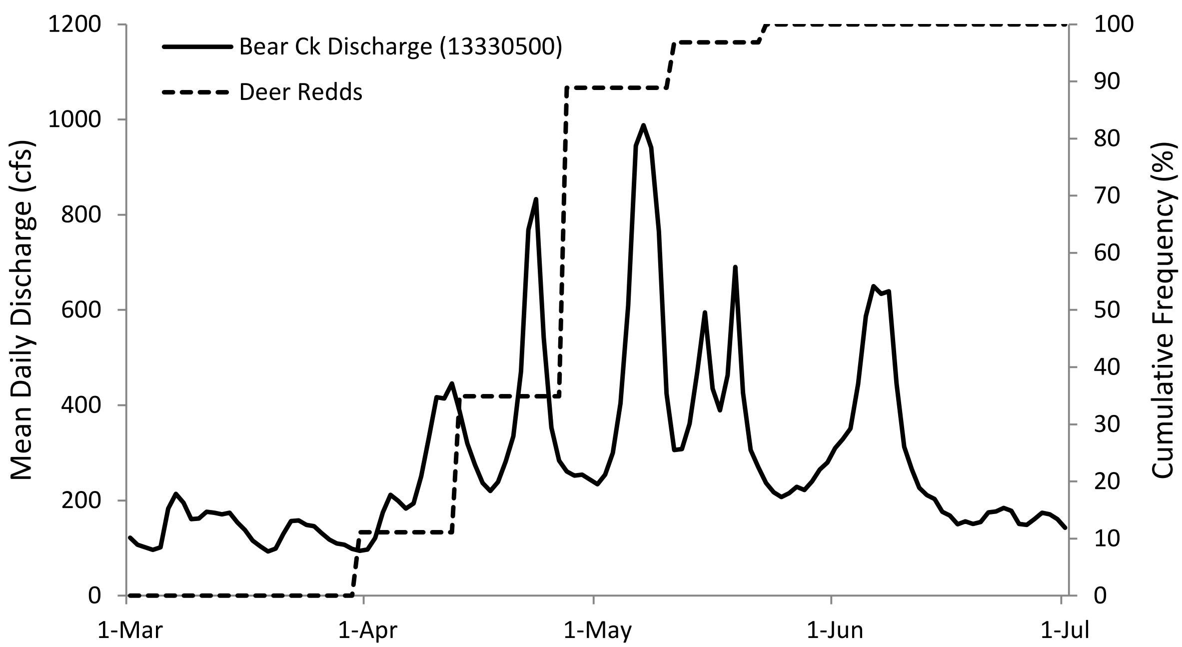
Stream Classification	No. of sites	Spawning habitat (km)	Weight value	Distance surveyed (km)	Total redds observed	Redds per km	Spawner escapement	Lower 95% CI	Upper 95% CI
Source	10	453	41.18	20.12	38	1.9	1,186	16	2,356
Transport	8	243	30.33	15.56	44	2.8	841	481	1,201
Depositional	11	197	19.70	22.55	46	2.0	530	178	884
Total	**29**	**892**	**91.21**	**58.23**	**128**	**4.1**	**2,558**	**1,284**	**5,513**

Appendix Table B-22. Survey characteristics and spawning survey results, grouped by stream classification type for Joseph Creek basin, 2016.

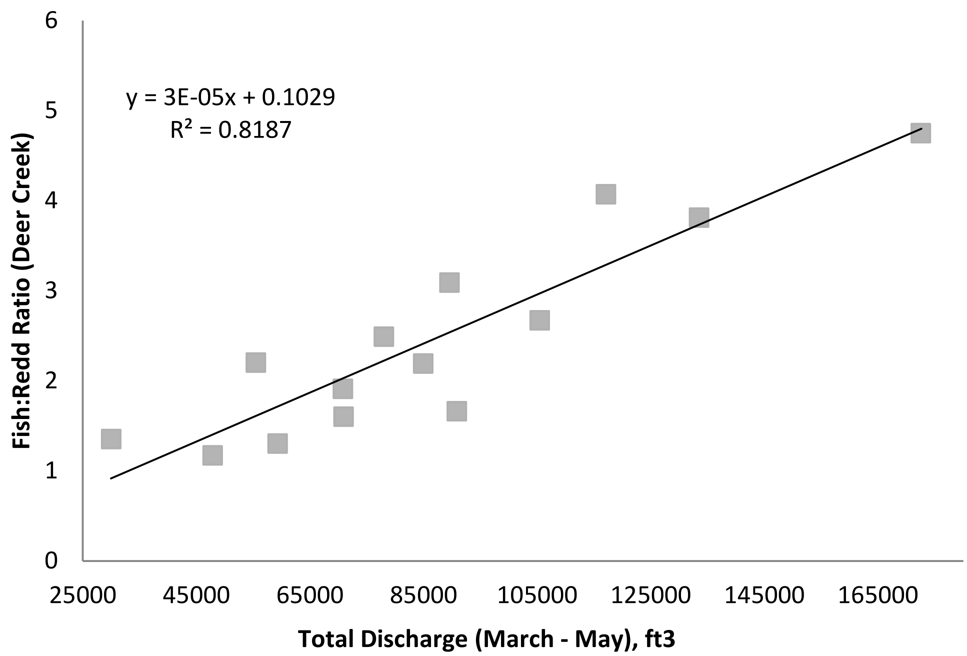
Stream Classification	No. of sites	Spawning habitat (km)	Weight value	Distance surveyed (km)	Total redds observed	Redds per km	Spawner escapement	Lower 95%CI	Upper 95% CI
Source	11	159	14.45	21.73	82	3.7	783	219	1,346
Transport	8	115	14.38	16.05	61	3.8	565	147	983
Depositional	7	111	15.86	14.96	34	2.3	304	78	529
Total	**26**	**384**	**44.69**	**52.74**	**177**	**9.8**	**1,651**	**914**	**2,389**



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 2016.



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 2016.



Appendix Figure B-23 Relationship between total discharge in UGRR (Perry Station) and the fish:redd ratio derived from Deer Creek surveys, 2008−2016.

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 2016.

Site ID	Stream	Easting	Northing	Mean BF Width(m)	Site Length(m)	Sample Method	Agency
CBW05583-013882	Peet Creek	373285	5013217	2.9	115.5	Efish	ODFW
CBW05583-020282	Meadow Creek	383425	5011663	11.1	246.1	Snorkel	ODFW
CBW05583-031546	Grande Ronde River	390577	5007700	23.0	356.6	Snorkel	CRITFC
CBW05583-036266	Catherine Creek	446793	4996103	16.9	267.8	Snorkel	CRITFC
CBW05583-062890	Milk Creek	444482	4997207	3.9	128.4	Efish	ODFW
CBW05583-071770	Grande Ronde River	397254	5017514	25.8	510.4	Snorkel	CRITFC
CBW05583-095642	McCoy Creek	377391	5023153	8.1	162.7	Efish	ODFW
CBW05583-099818	Grande Ronde River	398345	4989413	7.0	169.5	Snorkel	CRITFC
CBW05583-109658	Grande Ronde River	403782	5021686	30.5	594.4	Snorkel	CRITFC
CBW05583-135615	Gordon Creek	424812	5052328	5.3	133.0	Snorkel	ODFW
CBW05583-142490	Clark Creek	435852	5039113	11.2	163.3	Snorkel	ODFW
CBW05583-147626	Catherine Creek	436692	5002436	20.8	509.4	Snorkel	ODFW
CBW05583-204202	S. Fk. Catherine Creek	450427	4995581	8.0	205.7	Snorkel	CRITFC
CBW05583-228666	Sheep Creek	384622	4988279	5.8	127.7	Snorkel	CRITFC
CBW05583-240730	Rock Creek	403951	5021630	7.8	117.5	Snorkel	ODFW
CBW05583-252730	Meadow Creek	389676	5012418	15.9	405.9	Snorkel	ODFW
CBW05583-253354	N. Fk. Catherine Creek	451111	4999024	10.0	277.4	Snorkel	CRITFC
CBW05583-269738	S. Fk. Catherine Creek	449891	4996019	9.5	204.8	Snorkel	ODFW
CBW05583-278698	Catherine Creek	435193	5003955	16.1	329.2	Snorkel	CRITFC
CBW05583-294202	W. Chicken Creek					N/A	CRITFC
CBW05583-311466	Catherine Creek	439051	5000516	12.5	284.2	Snorkel	CRITFC
CBW05583-325034	Catherine Creek	444445	4997628	16.9	408.0	Snorkel	CRITFC
CBW05583-370490	Grande Ronde River	391983	5000498	15.9	353.3	Snorkel	CRITFC
CBW05583-405674	Catherine Creek	434102	5005124	16.5	329.5	Snorkel	CRITFC
CBW05583-449962	M. Fork Catherine Creek	452007	4999942	8.0	121.8	Snorkel	CRITFC
CBW05583-468458	Grande Ronde River	395099	4992655	10.6	225.8	Snorkel	CRITFC
CBW05583-480666	Waucup Creek	372811	5016477	3.6	124.0	Snorkel	ODFW
CBW05583-491690	Catherine Creek	437180	5002020	20.1	507.6	Snorkel	CRITFC
CBW05583-502586	Fly Creek	388785	5003379	9.4	207.7	Snorkel	CRITFC
CBW05583-515498	N. Fk. Catherine Creek	452375	5001652	9.1	201.0	Snorkel	CRITFC
CBW05583-527786	Catherine Creek	445893	4996417.5	15.7	271.9	Snorkel	ODFW
dsgn4-000001	N. Fk. Catherine Creek	449392.5	4996710	12.3	255.2	Snorkel	ODFW
dsgn4-000006	W. Chicken Creek	389627	4990426	3.0	122.2	Efish	ODFW
dsgn4-000009	Grande Ronde River	397788.5	4989994.5	7.2	167.5	Snorkel	CRITFC
dsgn4-000010	Catherine Creek	444030.5	4998165.5	18.1	306.4	Snorkel	CRITFC
dsgn4-000092	Spring Creek	400310.9	5020246.2	6.6	130.0	Snorkel	ODFW
dsgn4-000094	Fly Creek	385814.2	4997841.7	7.0	161.8	Snorkel	ODFW
dsgn4-000161	S. Fk. Catherine Creek	455539	4994700.5	7.2	203.3	Snorkel	ODFW
dsgn4-000168	N. Fk. Catherine Creek	451484	5000077.5	11.0	214.3	Snorkel	ODFW
dsgn4-000202	Grande Ronde River	390902	5010922.5	15.2	444.6	Snorkel	CRITFC
dsgn4-000205	Grande Ronde River	400044	5018986	30.0	621.7	Snorkel	ODFW

Site ID	Stream	Easting	Northing	Mean BF Width(m)	Site Length(m)	Sample Method	Agency
dsgn4-000213	Meadow Creek	390705.5	5013202.5	30.0	354.8	Snorkel	ODFW
dsgn4-000245	Grande Ronde River	392876	5013713.5	23.6	612.3	Snorkel	CRITFC
dsgn4-000277	Grande Ronde River	392551	4998767	16.3	366.4	Snorkel	CRITFC
ORW03446-025816	W. Fork Ladd Creek	419661	5011643	2.1	118.5	Efish	ODFW
ORW03446-071176	Milk Creek	443653	4998112	4.5	124.1	Snorkel	CRITFC
ORW03446-084462	Lookingglass Creek	432426	5065706	20.0	355.9	Snorkel	ODFW
ORW03446-101102	Phillips Creek	423712	5046362	9.7	200.1	Snorkel	ODFW
ORW03446-118408	W. Chicken Creek	389456	4987955	4.2	127.2	Efish	ODFW
ORW03446-130904	L. Whiskey Creek					N/A	ODFW
ORW03446-131128	Clark Creek	440647	5031111	5.4	128.1	Snorkel	ODFW
ORW03446-139144	Meadow Creek	385223	5010734	12.4	251.2	Snorkel	ODFW
ORW03446-157422	Phillips Creek					N/A	ODFW

Appendix Table B-24. Raw counts of steelhead and Chinook by size class for CHaMP sites snorkeled and electrofished (denoted with *) in 2016.

			O. mykiss/Steelhead Counts					Chinook Size Counts				Bull Trout Counts			
		Est. Fork Length (mm)→	<80	80-130	130-200	>200	Total	<100	>100	Adult	Juv. Tot.	<80	80-130	130-200	>200
Site ID	Waterbody	Date													
CBW05583-013882*	Peet Creek	7/25	11	11	7	0	29	0	0	0	0	0	0	0	0
CBW05583-062890*	Milk Creek	7/28	118	8	8	0	134	20	0	0	20	0	0	0	0
CBW05583-095642*	McCoy Creek	7/25	411	0	0	0	411	0	0	0	0	0	0	0	0
dsgn4-000006*	W. Chicken Creek	7/26	34	20	6	0	60	0	0	0	0	0	0	0	0
ORW03446-118408*	W. Chicken Creek	7/26	7	29	3	0	39	0	0	0	0	0	0	0	0
ORW03446-025816*	W. Fk. Ladd Creek	7/28	0	0	0	0	0	0	0	0	0	0	0	0	0
CBW05583-020282	Meadow Creek	7/27	19	4	1	0	24	0	0	0	0	0	0	0	0
CBW05583-031546	Grande Ronde River	8/7	0	27	12	7	46	306	3	4	309	0	0	0	0
CBW05583-036266	Catherine Creek	8/5	44	12	8	0	64	80	1	0	81	0	0	0	0
CBW05583-071770	Grande Ronde River	8/7	0	5	5	0	10	0	0	0	0	0	0	0	0
CBW05583-099818	Grande Ronde River	8/3	13	9	5	0	27	200	0	1	200	0	0	1	0
CBW05583-109658	Grande Ronde River	8/9	0	1	4	1	6	0	0	0	0	0	0	0	0
CBW05583-135615	Gordon Creek	7/26	139	27	3	0	169	0	0	0	0	0	0	0	0
CBW05583-142490	Clark Creek	7/25	157	49	19	1	226	0	0	0	0	0	0	0	0
CBW05583-147626	Catherine Creek	9/20	38	7	0	0	45	357	2	1	359	0	0	0	0
CBW05583-204202	S. Fk. Catherine Creek	8/4	1	37	17	1	56	17	0	0	17	0	0	0	0
CBW05583-228666	Sheep Creek	8/4	31	31	14	0	76	2	0	0	2	0	0	0	0
CBW05583-240730	Rock Creek	7/26	2	0	0	0	2	0	0	0	0	0	0	0	0
CBW05583-252730	Meadow Creek	7/28	0	0	1	0	1	0	0	0	0	0	0	0	0
CBW05583-253354	N. Fk. Catherine Creek	8/5	26	36	39	7	108	10	0	0	10	0	0	1	3
CBW05583-269738	S. Fk. Catherine Creek	8/4	1	1	3	1	6	1	0	0	1	0	0	0	0
CBW05583-278698	Catherine Creek	8/22	23	7	4	0	34	78	2	1	80	0	0	0	0
CBW05583-311466	Catherine Creek	8/8	6	2	1	0	9	5	0	2	5	0	0	0	0
CBW05583-325034	Catherine Creek	8/5	84	7	0	0	91	118	0	9	118	0	0	0	0
CBW05583-370490	Grande Ronde River	8/6	9	30	25	1	65	192	2	0	194	0	0	0	0
CBW05583-405674	Catherine Creek	8/9	5	10	4	0	19	66	2	0	68	0	0	0	0
CBW05583-449962	M. Fk. Catherine Creek	8/3	0	2	2	2	6	0	0	0	0	0	1	1	0
CBW05583-468458	Grande Ronde River	8/3	11	38	14	0	63	225	1	2	226	0	2	0	0
CBW05583-480666	Waucup Creek	7/25	17	14	3	0	34	0	0	0	0	0	0	0	0
CBW05583-491690	Catherine Creek	8/8	5	1	0	0	6	133	0	0	133	0	0	0	0

			O. mykiss/Steelhead Counts					Chinook Size Counts				Bull Trout Counts			
		Est. Fork Length (mm)→	<80	80-130	130-200	>200	Total	<100	>100	Adult	Juv. Tot.	<80	80-130	130-200	>200
Site ID	Waterbody	Date													
CBW05583-502586	Fly Creek	8/4	85	30	14	1	130	14	0	0	14	0	0	0	0
CBW05583-515498	N. Fk. Catherine Creek	8/3	1	4	3	1	9	0	0	0	0	0	6	8	1
CBW05583-527786	Catherine Creek	7/27	113	59	20	0	192	289	0	0	289	0	0	0	0
dsgn4-000001	N. Fk. Catherine Creek	8/1	8	0	0	0	8	38	0	3	38	0	0	0	2
dsgn4-000009	Grande Ronde River	8/3	15	16	1	0	32	230	1	1	231	0	0	0	1
dsgn4-000010	Catherine Creek	8/8	10	3	2	0	15	275	0	2	275	0	0	0	0
dsgn4-000092	Spring Creek	7/26	63	7	0	0	70	0	0	0	0	0	0	0	0
dsgn4-000094	Fly Creek	7/26	146	105	21	2	274	0	0	0	0	0	0	0	0
dsgn4-000161	S. Fk. Catherine Creek	8/4	0	14	8	4	26	0	0	0	0	0	0	3	0
dsgn4-000168	N. Fk. Catherine Creek	8/1	11	45	20	7	83	0	0	0	0	0	4	5	4
dsgn4-000202	Grande Ronde River	8/6	1	4	0	0	5	8	0	0	8	0	0	0	0
dsgn4-000205	Grande Ronde River	7/26	1	2	1	0	4	2	0	0	2	0	0	0	0
dsgn4-000213	Meadow Creek	7/28	91	123	14	1	229	0	0	0	0	0	0	0	0
dsgn4-000245	Grande Ronde River	8/7	4	18	6	0	28	17	0	0	17	0	0	0	0
dsgn4-000277	Grande Ronde River	8/6	8	37	26	0	71	269	4	0	273	0	0	0	0
ORW03446-071176	Milk Creek	8/4	6	2	0	0	8	13	0	0	13	0	0	0	0
ORW03446-084462	Lookingglass Creek	7/28	155	318	120	7	600	411	3	4	414	0	0	4	0
ORW03446-101102	Phillips Creek	7/25	45	12	4	0	61	0	0	0	0	0	0	0	0
ORW03446-131128	Clark Creek	7/25	15	2	6	0	23	0	0	0	0	0	0	0	0
ORW03446-139144	Meadow Creek	7/27	14	15	5	0	34	7	0	0	7	0	0	0	0

Appendix Table B-25. Fish species/taxa observed during snorkel surveys, 2016. 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	7/25	OM		
CBW05583-020282	Meadow Creek	7/27	SD	NP, LD, CT, RS	OM
CBW05583-031546	Grande Ronde River	8/7		SU, RS, NP, CH	MW, SD, OM, LD
CBW05583-036266	Catherine Creek	8/5		CH, OM	MW, CT
CBW05583-062890	Milk Creek	7/28	OM		
CBW05583-071770	Grande Ronde River	8/7		NP, SD, LD, RS	OM, SU
CBW05583-095642	McCoy Creek	7/25	OM		
CBW05583-099818	Grande Ronde River	8/3	CH	OM	BT
CBW05583-109658	Grande Ronde River	8/9	RS	NP	OM, SU, SD
CBW05583-135615	Gordon Creek	7/26	OM		
CBW05583-142490	Clark Creek	7/25	DC	OM	CT
CBW05583-147626	Catherine Creek	9/20	CH	OM,	CT, LD, MWF
CBW05583-204202	S. Fk. Catherine Creek	8/4	OM	CH	
CBW05583-228666	Sheep Creek	8/4	OM		LD, CH, CT
CBW05583-240730	Rock Creek	7/26	DC	SU	OM
CBW05583-252730	Meadow Creek	7/28	NP	SD, RS, SU	LD, OM, CM
CBW05583-253354	N. Fk. Catherine Creek	8/5	OM	CH	BT
CBW05583-269738	S. Fk. Catherine Creek	8/4	OM	CH	
CBW05583-278698	Catherine Creek	8/22	CH	OM, MW	CT, SU
CBW05583-311466	Catherine Creek	8/8	MW	OM	CH
CBW05583-325034	Catherine Creek	8/5		CH, OM	CT., MW
CBW05583-370490	Grande Ronde River	8/6		CH, LD, SD, SU, NP, OM	MW, RS, CT
CBW05583-405674	Catherine Creek	8/9	CH	OM	MW
CBW05583-449962	M. Fk. Catherine Creek	8/3	OM	BT	
CBW05583-468458	Grande Ronde River	8/3	CH	OM	LD, MW, CT, NP
CBW05583-480666	Waucup Creek	7/25	SD	OM, RS	LD, CT
CBW05583-491690	Catherine Creek	8/8	CH	MW	LD
CBW05583-502586	Fly Creek	8/4	OM	CH	SU, CT, LP
CBW05583-515498	N. Fk. Catherine Creek	8/3	BT	OM	
CBW05583-527786	Catherine Creek	7/27	CH	OM	CT, LD, MW
dsgn4-000001	N. Fk. Catherine Creek	8/1	CH	OM	MW, BT
dsgn4-000006	W. Chicken Creek	7/26	OM		
dsgn4-000009	Grande Ronde River	8/3	CH	OM	CT, BT
dsgn4-000010	Catherine Creek	8/8	CH	OM	MW

dsgn4-000092	Spring Creek	7/26	OM		CT
dsgn4-000094	Fly Creek	7/26	OM	DC, SU	NP
dsgn4-000161	S. Fk. Catherine Creek	8/4	OM	BT	
dsgn4-000168	N. Fk. Catherine Creek	8/1	OM	BT	
dsgn4-000202	Grande Ronde River	8/6		RS, NP, SU	CH, OM, SD
dsgn4-000205	Grande Ronde River	7/26	RS	SD, NP	SU, CH, OM, CT, SMB
dsgn4-000213	Meadow Creek	7/28	NP	SD, LD, RS,CM, SU, OM	CN
dsgn4-000245	Grande Ronde River	8/7	NP	SK, RS, NP, SU	LD, CH, CT
dsgn4-000277	Grande Ronde River	8/6		OM, CH, LD, NP, SU	MW, SD
Mock2012-000109	Five Points Creek	9/7	OM		
ORW03446-025816	W. Fk. Ladd Creek	7/28	No Fish		
ORW03446-071176	Milk Creek	8/4	CH	OM	
ORW03446-084462	Lookingglass Creek	7/28	OM	CH	BT, CT
ORW03446-101102	Phillips Creek	7/25	OM		
ORW03446-118408	W. Chicken Creek	7/26	OM		
ORW03446-131128	Clark Creek	7/25	OM		
ORW03446-139144	Meadow Creek		SD	NP, RS, LD	SU, OM, CHS

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

Appendix Table B-26. Capture statistics for electrofished sites, 2016.

Site ID	Stream	Date	Species	Count	CPUE (fish/hr)	Mean FL (mm)	StDev FL (mm)
CBW05583-013882	Peet Creek	7/25	OM	29	61.8	92.6	40.6
CBW05583-062890	Milk Creek	7/28	OM	134	125.2	63.7	34.5
CBW05583-062890	Milk Creek	7/28	CH	20	18.7	69.9	4.9
CBW05583-095642	McCoy Creek	7/25	OM	411	517.5	47.6	8.8
dsgn4-000006	W. Chicken Creek	7/26	OM	60	85.8	79.4	37.1
ORW03446-025816	W. Fk. Ladd Creek	7/28	No Fish	0	0		
ORW03446-118408	W. Chicken Creek	7/26	OM	39	79.3	98.7	22.6

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