**FISH RESEARCH PROJECT**
**OREGON**

# STEELHEAD ESCAPEMENT MONITORING IN THE UPPER GRANDE RONDE RIVER AND JOSEPH CREEK BASINS

## ANNUAL TECHNICAL REPORT

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Prepared By:

Shelley K. Tattam
Christopher D. Horn
James R. Ruzycki
Edwin R. Sedell
and
Kasey L. Bliesner

Oregon Department of Fish and Wildlife
203 Badgley Hall, EOU
One University Blvd.
La Grande, OR 97850

Funded By:

Bonneville Power Administration
905 NE 11th Ave
Portland, OR 97232

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# TABLE OF CONTENTS

## LIST OF FIGURES



## LIST OF TABLES

## EXECUTIVE SUMMARY

### Objectives

1. Estimate redd density and spawner escapement of summer steelhead in the Upper Grande Ronde River basin.
2. Estimate redd density and spawner escapement of summer steelhead in the Joseph Creek basin, a tributary to the Lower Grande Ronde River.
3. Estimate spawners:redd ratio above adult weir collection points.

### Accomplishments and findings

We conducted 166 surveys in the Upper Grande Ronde River (UGRR) basin and 78 surveys in the Joseph Creek basin from 24 February through 10 June 2015 to determine summer steelhead *Oncorhynchus mykiss* redd abundance and adult escapement for these two populations. We sampled 29 random, spatially-balanced sites throughout the UGRR basin encompassing 61.6 km (6.9%) of an estimated 892 km of available steelhead spawning habitat. In Joseph Creek, we surveyed 24 sites encompassing 48.3 km (12.6%) of the 384 km of available spawning habitat. During these surveys we observed 246 steelhead redds and 12 live steelhead in the UGRR basin and 286 redds and 47 live steelhead in the Joseph Creek basin. We observed three carcasses in UGRR basin and eight carcasses in the Joseph Creek basin basin.

On 18.7 km of Deer Creek, 49 redds, 39 live steelhead, and 49 carcasses were observed during five survey visits. A total of 58 wild-origin adult steelhead were passed above a permanent weir on Deer Creek, resulting in 1.37 fish:redd ratio for the 2015 spawning season. Using the fish:redd ratio extrapolated from Deer Creek surveys, adult steelhead escapement estimates for the UGRR and Joseph Creek basins were 4,837 (95% C.I.: 2,946–6,728) and 2,967 (95% C.I.: 1,976–3,958) respectively.

### Management recommendations

1. Using the current data of steelhead spawning distribution and geographic landscape variables, refine the sampling universe for the Upper Grande Ronde River and Joseph Creek populations to improve our knowledge of steelhead spawning distribution.
2. Estimate the biologically and statistically significant level of change in steelhead escapement for determining short- and long-term population changes.
3. Improve current methods for standardizing escapement estimates.
4. Manage the Upper Grande Ronde River and Joseph Creek populations exclusively for wild-origin steelhead and determine the extent and distribution of hatchery steelhead in the basin through observations of hatchery fish during the spawning season.

## ACKNOWLEDGMENTS

We would like to acknowledge the assistance and cooperation of the many private landowners throughout the area who allowed us access to their property. The cooperation of private landowners was essential in meeting our project objectives. Additionally, we thank the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) for providing data from weir collections on Catherine and Lookinglass creeks and the UGRR. The Nez Perce Tribe provided data from weir collections on Joseph Creek. Further, we would like to acknowledge our field crew members Shannon Skinner, Celeste Cole, Justin Zapata and Joe Whittle for their assistance as well as Jeff Yanke and Kyle Bratcher for their expertise and assistance.

## 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 basins support two of the four populations in the Grande Ronde Major Population Group (MPG). 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.

### Study area

The Grande Ronde River flows generally northeast 341 km from its origin in the Elkhorn Mountain range to join the Snake River at river kilometer (rkm) 271, about 32 rkm upstream of Asotin, WA and 793 rkm from the mouth of the Columbia River. The UGRR basin (Figure 1) includes the Grande Ronde River and its tributaries from the headwaters to the confluence with the Wallowa River (rkm 131). Major tributaries of the UGRR include Sheep Creek (rkm 312), Meadow Creek (rkm 290), Catherine Creek (rkm 225), and Lookingglass Creek (rkm 138). The UGRR drains approximately 4,200 km$^2$ and contains 1,475 km of streams (892 km of anadromous salmonid habitat). Elevations in the basin range from 705 m at the confluence of the Grande Ronde and Wallowa rivers to over 2,646 m in the headwater mountains. Stream physiography in headwater areas is similar to other western, inter-mountain systems, with forested uplands, perched meadows, and high to moderate stream gradients. However, the mid-portion of the UGRR flows through large historic wetland complex (approximately 56 x 24 km at its greatest extent), bounded by a geologic pinch point at the downstream end (Rinehart Gap). The main portion of this valley is extremely flat (stream gradient <0.1%), leading to increased stream sinuosity and decreased water velocity. Gradient increases after the UGRR passes downstream through Rinehart Gap (near the town of Elgin) and enters a canyon-dominated landscape. Land use in the headwaters is a mix of timberlands and cattle grazing, while the main valley is in irrigated crop production. Agricultural land use is relatively light downstream of Elgin.

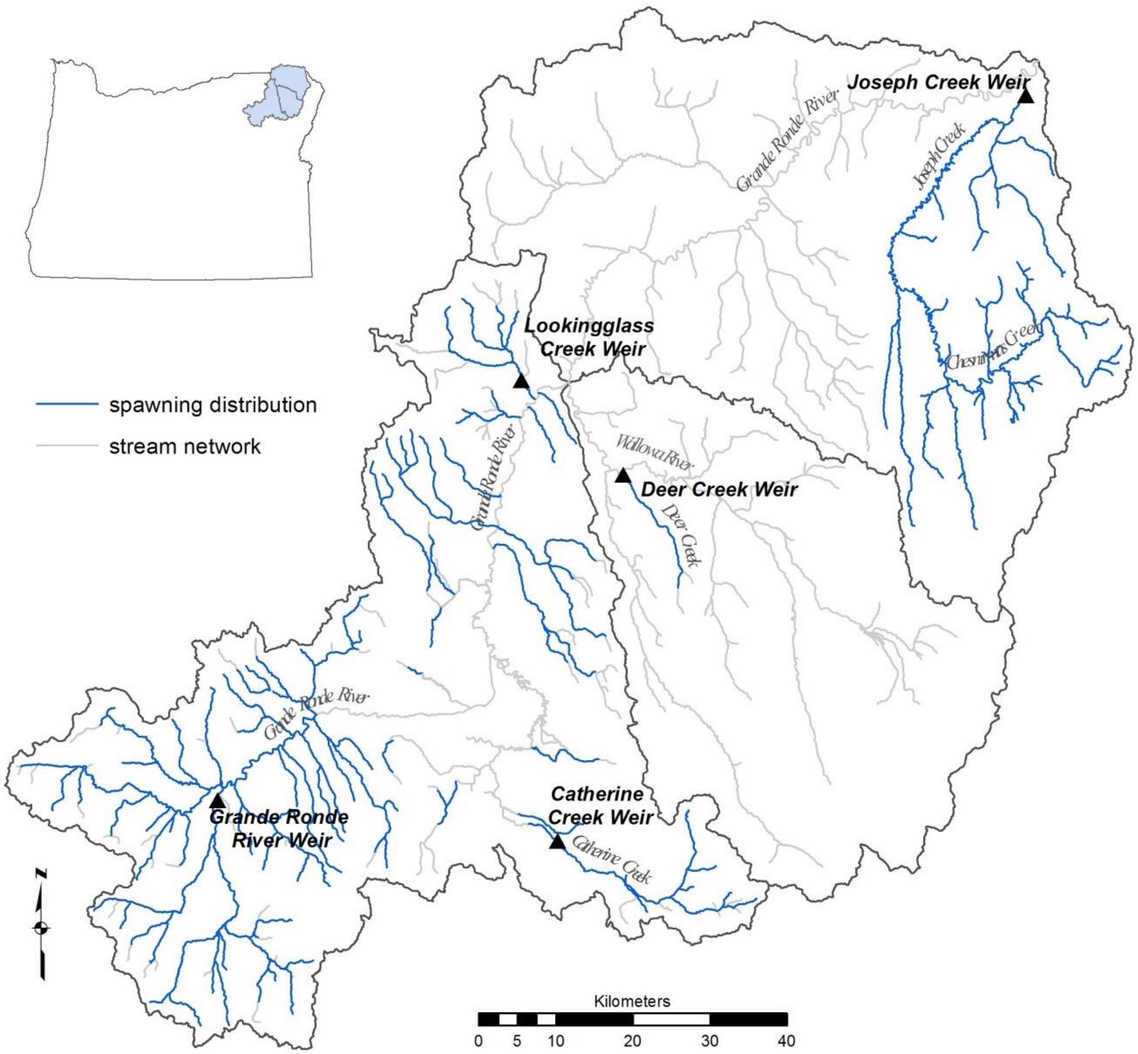


Figure 1. Sampling domains (blue) fall within the current spawning distribution of summer steelhead in Upper Grande Ronde River (UGRR) and Joseph Creek basins. Deer Creek and weir locations are also shown.

Joseph Creek is the most downstream tributary of the Grande Ronde River, entering approximately 7 km upstream of its mouth. Joseph Creek and its tributaries drain 1,420 $km^2$ originating on a plateau north of the upper Wallowa River valley, and flowing generally north into Washington (Wallace 2011). The Joseph Creek basin contains 536 km of streams, 384 km of which are estimated to be part of steelhead spawning distribution (Figure 1). Major tributaries include Crow and Chesnimnus creeks (which meet forming Joseph Creek at rkm 79), Swamp Creek (rkm 54), and Cottonwood Creek (rkm 7). Elevations in the basin are substantially lower than the UGRR basin, and range from 273 m at its confluence with the lower Grande Ronde

River to around 1,673 m in the headwater areas. Physiography within the drainage is a mixture of hills and valleys at the upstream end, and canyonlands in the downstream portion (Figure 1). Land use is primarily cattle grazing in the upper reaches, especially upstream of the origin of Joseph Creek. Some grazing occurs in the lower reaches and tributaries; however, most of lower Joseph Creek flows through federal (US Forest Service) and Nez Perce Tribal property. No significant municipalities exist in the Joseph Creek basin.

Deer Creek flows north from its origin in the Wallowa Mountains until reaching the Wallowa River at rkm 18. It is a narrow, elongated drainage, covering 79 $km^2$ with elevations ranging from 2,259 m to 787 m. Approximately 18.7 km of stream are considered anadromous fish spawning habitat, and all 18.7 km are surveyed annually. A concrete fish acclimation facility (Big Canyon), with a permanent weir, is located approximately 0.25 km from the mouth of Deer Creek. All wild-origin adult steelhead captured at Big Canyon were marked with an opercle punch and passed above the weir during their spawning migrations. The known number of adult steelhead allowed into the spawning areas enables us to determine the adult fish:redd ratio for extrapolation to the larger UGRR and Joseph Creek populations (Flesher et al. 2005; Gee et al. 2008; James Ruzycki, ODFW, unpublished data). Land use is almost entirely timberlands upstream of the permanent weir.

## METHODS

### Sampling domain and site selection

Steelhead were monitored using a probabilistic sampling approach that incorporates a sample-site selection procedure created for the Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP). The Generalized Random Tessellation Stratified (GRTS) design achieves a spatially balanced distribution of sites selected at random from the available spawning habitat to extrapolate an estimate of redd, and therefore, spawner abundance (Jacobs et al. 2009). This method follows the Oregon Plan for Salmon and Basins Monitoring Program approach (Stevens 2002).

This GRTS design was first implemented in the UGRR in 2008 and 2012 for Joseph Creek. Sample sites were limited to the current steelhead spawning distribution, which was defined by redd and fish counts from previous spawning ground surveys and barriers identified during habitat surveys for summer steelhead. This information is annually updated to include newly identified barriers as well as new reaches of spawning habitat. All reaches upstream of known barriers to anadromous fish passage were eliminated from the potential sampling area. Thirty sample sites were targeted in the UGRR for this year. Twenty-five sample sites were targeted in the Joseph Creek basin for this year.

Beginning in 2012, a new survey design implementing sites selected from the Columbia Habitat and Monitoring Program (CHaMP) was integrated into the legacy design that includes the following components for the UGRR:

- 10 sites repeated every year (annual)
- 10 sites repeated once every 3 years on a staggered basis
- 5 sites from UGRR CHaMP frame to be repeated once every 3 years.
- 5 sites new every year (once-only)

Under the new survey design, stream segments were stratified into three classifications (source, transport, and depositional) and sites were evenly distributed among those three strata (logistics allowing). Stream segments were classified using Geographical Information System (GIS) by several attributes including valley width, stream gradient and bankfull width (Tim Beechie, unpublished data). In stratifying the sampling universe, we attempted to identify and isolate areas of habitat differentially utilized for spawning, thereby increasing the precision of future adult escapement estimates.

There were no sites in the Joseph Creek basin integrated from CHaMP because the program is not implemented in that basin. Additionally, GRTS-selected sites were not stratified by stream classification. The initial GRTS draw (2012) was stratified similarly to UGRR, but resulted in significant site clustering in depositional stream reaches. We removed the stratification to promote wider distribution of sites within the basin. Therefore, sites were selected as follows:

- 10 sites repeated every year (annual)
- 15 sites repeated once every 3 years on a staggered basis

Incorporating a 1:100,000 digital stream network, GIS was used to insure an unbiased and spatially balanced selection of sample sites. The GIS site selection process generated geographic coordinates (i.e. latitude and longitude) for each candidate site (Table 1). A two-kilometer reach was established encompassing each candidate site. Topographic maps were produced showing the downstream and upstream ends of each survey reach along with the included GRTS sample point. In the field, crews used a handheld Global Positioning System (GPS) to locate the established survey reaches. Some candidate sites were not sampled due to denial of permission from private landowners or because sites were located upstream of previously unknown fish passage barriers. In such events, replacement sites were drawn from a pre-selected list of over-sample sites.

**Steelhead redd surveys**

Steelhead redd surveys were based on standard ODFW methods (Susac and Jacobs 1999; Jacobs et al. 2000; Jacobs et al. 2001) and were conducted from March through June, 2015. Individual sites were surveyed up to seven times to quantify the number of redds constructed at each site, with approximately two week intervals between successive surveys to account for the temporal variation in spawning activity. Generally, surveyors walked upstream from the bottom of each sample reach and counted all redds, live fish, and dead fish observed. In some cases the larger streams were surveyed in a downstream direction for safety.

New redds were flagged and locations were marked with a handheld GPS unit. During each visit, surveyors recorded the number of new redds as well as previously identified flagged redds. Redd visibility was rated 0 for newly discovered redds and ranged from 1 (clearly visible) to 5 (no longer visible) for previously observed redds. To reduce bias of surveyor observations, surveyors were rotated through sites and partners if logistics allowed.

Steelhead carcasses were examined to obtain population and life history information by recording fork length (mm), MEPS (middle of the eye to posterior scale) length (mm), sex, egg retention (females), and origin determined by presence (wild) or absence (hatchery) of an adipose fin. For all carcasses, surveyors also collected scale samples from the key scale area (Nicholas and Van Dyke 1982) for age determination. Additional details of the survey protocol can be downloaded from the PNAMP, Monitoring Methods website (https://www.monitoringmethods.org/Protocol/Details/757).

## Spawning timing

*Weir Counts*

Five weirs located on the UGRR, Joseph, and Deer creeks (Figure 1) were used to evaluate timing of steelhead entering the basins prior to spawning. The UGRR weirs, operated by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), are located on the mainstem Grande Ronde River (rkm 291), Catherine Creek (rkm 32), and Lookingglass Creek (rkm 3; Figure 1). The weir on Deer Creek, operated by ODFW, is located 0.25 rkm upstream of its confluence with the Wallowa River. Wild adult steelhead trapped at the Deer Creek weir were marked with an opercle punch and released upstream of the weir to spawn naturally. All wild and hatchery-origin adult steelhead were passed above the UGRR weirs to spawn naturally.

The Nez Perce Tribe (NPT) operates the weir on Joseph Creek just upstream of its confluence with the Grande Ronde River. All adult steelhead (wild- and hatchery-origin) were captured and passed above the weir unmarked to spawn naturally (John Robbins, NPT, unpublished data).

*Discharge and temperature*

We attempted to relate redd observations to discharge for the UGRR, Joseph and Deer creeks. We used discharge measurements taken by Oregon Water Resources Department (OWRD) on the mainstem Grande Ronde River (station ID 13318960) by Perry (rkm 263). Unfortunately the Joseph Creek gauge (station ID 35G060, Washington Department of Ecology) lost funding in late 2012, and is no longer operational.

## Estimating escapement

A locally weighted neighborhood variance estimator (Stevens and Olsen 2004), which incorporates the pair-wise dependency of all points and the spatially constrained nature of the design, was used to estimate a 95% confidence interval of the escapement estimate using SP Survey for R statistical software (R Development Core Team 2005). The statistical test was ran both with a single weighting value for the total spawning distribution and broken into a matrix of three strata by classification (source, transport, depositional) with weighting values depending on distance and number of surveys for each category (3).

Total escapement of adult steelhead ($E_s$) was determined by summing the product of the weight value (W), number of redds observed/km surveyed at each site (*i*), and fish:redd ratio determined from Deer Creek Surveys as:

$$E_s = \sum_{i=1}^{n} W_s \left(\frac{\text{Redds}}{\text{km}}\right)_i \left(\frac{\text{Fish}}{\text{Redd}}\right) \qquad (2)$$

Weight equals the distance of available spawning habitat in km (determined from GIS layer) divided by the number of sites surveyed as:

$$W = \left(\frac{km\ avail.}{no.sites}\right) \qquad (3)$$

The proportion of hatchery to wild-origin steelhead was calculated by dividing the total number of fin marked fish by all fish that could be observed for marks (live fish only). The number of hatchery fish straying to the basin was then estimated by multiplying this proportion of hatchery and wild-origin steelhead by our estimate of steelhead escapement.

Table 1. Steelhead spawning ground survey characteristics, location and stream classification for sites in the UGRR basin, 2015.

| Site ID | Stream | Panel | Stream Classification | Survey Distance (km) | Upstream Latitude | Upstream Longitude | Downstream Latitude | Downstream Longitude |
|---|---|---|---|---|---|---|---|---|
| CBW05583-095642 | McCoy Creek | Panel 2 | Transport | 2.25 | 45.33986 | -118.549122 | 45.35167 | -118.567439 |
| dsgn4-000001 | North Fork Catherine Creek | Panel 2 | Depositional | 2.30 | 45.11974 | -117.647623 | 45.13171 | -117.628805 |
| dsgn4-000168 | North Fork Catherine Creek | Panel 2 | Depositional | 1.78 | 45.15209 | -117.617520 | 45.16747 | -117.605616 |
| dsgn4-000205 | Grande Ronde River | Panel 2 | Depositional | 2.25 | 45.32210 | -118.259900 | 45.31181 | -118.277140 |
| ORW03446-006894 | Dry Creek | Panel 2 | Transport | 2.25 | 45.56483 | -118.076598 | 45.57764 | -118.093546 |
| ORW03446-007768 | Dry Creek | Random | Source | 2.25 | 45.63670 | -118.116580 | 45.62136 | -118.112210 |
| ORW03446-010990 | Little Phillips Creek | Random | Source | 1.99 | 45.62780 | -118.015500 | 45.64500 | -118.020200 |
| ORW03446-016600 | Graves Creek | Random | Source | 1.50 | 45.27843 | -118.181980 | 45.28575 | -118.189080 |
| ORW03446-018904 | Spring Creek | Annual | Transport | 2.39 | 45.34725 | -118.307330 | 45.33805 | -118.286129 |
| ORW03446-049208 | Camp Creek | Panel 2 | Source | 2.34 | 45.38646 | -117.758490 | 45.39038 | -117.737670 |
| ORW03446-059352 | Clark Creek | Annual | Depositional | 1.84 | 45.50022 | -117.819943 | 45.51500 | -117.828889 |
| ORW03446-065720 | Spring Creek | Panel 2 | Transport | 2.37 | 45.35793 | -118.324996 | 45.36594 | -118.345920 |
| ORW03446-077704 | Burnt Corral Creek | Panel 2 | Source | 2.22 | 45.22095 | -118.476224 | 45.20598 | -118.491617 |
| ORW03446-079752 | Grande Ronde River | Annual | Depositional | 1.99 | 45.17927 | -118.389368 | 45.19335 | -118.395185 |
| ORW03446-101102 | Phillips Creek | Annual | Depositional | 2.30 | 45.56971 | -117.993709 | 45.56694 | -117.973246 |
| ORW03446-101560 | Meadow Creek | Annual Replacement | Transport | 1.97 | 45.29236 | -118.612176 | 45.28316 | -118.602238 |
| ORW03446-108270 | Little Phillips Creek | Panel 2 | Transport | 1.94 | 45.59398 | -118.007900 | 45.61066 | -118.016300 |
| ORW03446-111960 | Pelican Creek | Panel 2 | Transport | 2.19 | 45.39508 | -118.293712 | 45.40877 | -118.309351 |
| ORW03446-118408 | West Chicken Creek | Annual | Source | 1.95 | 45.02682 | -118.403583 | 45.04449 | -118.403882 |
| ORW03446-118856 | Marley Creek | Random | Source | 1.87 | 45.18785 | -118.446230 | 45.20443 | -118.439770 |
| 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 |
| ORW03446-130030 | Clark Creek | Panel 2 | Depositional | 2.26 | 45.54977 | -117.891010 | 45.54264 | -117.871564 |
| ORW03446-147928 | Five Points Creek | Annual | Depositional | 2.36 | 45.41072 | -118.201787 | 45.40341 | -118.222762 |
| ORW03446-149464 | Middle Fork Clark Creek | Panel 2 | Source | 2.13 | 45.50890 | -117.806050 | 45.49634 | -117.789890 |
| ORW03446-155196 | Clear Creek | Random | Source | 1.92 | 45.02863 | -118.326700 | 45.02850 | -118.326700 |
| ORW03446-159368 | Chicken Creek | Panel 2 | Transport | 1.87 | 45.04709 | -118.392366 | 45.04710 | -118.392420 |
| ORW03446-170478 | Little Lookingglass Creek | Panel 2 | Depositional | 2.10 | 45.75443 | -117.878045 | 45.76761 | -117.887897 |
| ORW03446-177134 | East Phillips Creek | Annual | Source | 2.20 | 45.63454 | -118.055699 | 45.62304 | -118.072221 |

Table 2. Steelhead spawning ground survey characteristics, location and stream classification for sites in the Joseph Creek basin, 2015.

| 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 |
| CBW05583-012802 | Cottonwood Creek | Panel 1 | Source | 1.97 | 45.89784 | -116.996640 | 45.91148 | -117.00802 |
| CBW05583-043522 | Broady Creek | Panel 1 | Source | 1.70 | 45.94215 | -117.101000 | 45.94788 | -117.08126 |
| CBW05583-045183 | Elk Creek | Panel 1 | Transport | 1.95 | 45.67850 | -117.171720 | 45.69487 | -117.18499 |
| CBW05583-051026 | Unnamed trib to Alder | Annual | Source | 1.69 | 45.69084 | -117.011250 | 45.70425 | -117.02264 |
| CBW05583-087554 | Cottonwood Creek | Panel 1 | Source | 1.10 | 45.85616 | -116.978200 | 45.86228 | -116.97984 |
| CBW05583-112130 | Devils Run Creek | Annual | Source | 2.02 | 45.78225 | -116.969200 | 45.78081 | -116.98547 |
| CBW05583-116562 | Alder Creek | Panel 1 | Transport | 2.23 | 45.70334 | -117.025960 | 45.70532 | -117.05077 |
| CBW05583-128514 | Chesnimnus Creek | Panel 1 | Transport | 1.95 | 45.71588 | -116.934840 | 45.72763 | -116.95046 |
| CBW05583-141826 | Basin Creek | Annual | Source | 2.12 | 45.91900 | -117.059000 | 45.93269 | -117.05829 |
| 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 |
| CBW05583-237503 | Swamp Creek | Panel 1 | Depositional | 2.08 | 45.80855 | -117.229320 | 45.82245 | -117.23183 |
| CBW05583-258175 | Chesnimnus Creek | Panel 1 | Depositional | 2.07 | 45.70521 | -117.136170 | 45.71422 | -117.15567 |
| CBW05583-301570 | Cottonwood Creek | Annual | Source | 1.88 | 45.93356 | -117.052350 | 45.94326 | -117.05991 |
| CBW05583-318978 | Chesnimnus Creek | Panel 1 | Depositional | 2.21 | 45.73194 | -117.050870 | 45.72186 | -117.06529 |
| CBW05583-354818 | West Fork Broady Creek | Panel 1 | Source | 2.02 | 45.86955 | -117.095730 | 45.87912 | -117.08801 |
| CBW05583-389247 | Chesnimnus Creek | Annual | Depositional | 1.94 | 45.69840 | -117.121006 | 45.70513 | -117.13607 |
| CBW05583-394754 | Devils Run Creek | Panel 1 | Source | 2.02 | 45.77077 | -116.911930 | 45.77286 | -116.93246 |
| CBW05583-487551 | Crow Creek | Panel 1 | Source | 2.04 | 45.67705 | -117.139950 | 45.69023 | -117.15037 |
| CBW05583-493394 | Salmon Creek | Annual | Transport | 1.92 | 45.70401 | -117.049560 | 45.71857 | -117.05021 |
| CBW05583-509778 | Pine Creek | Panel 1 | Transport | 2.05 | 45.67738 | -117.029690 | 45.68976 | -117.03870 |
| CBW05583-515586 | Chesnimnus Creek | Annual | Depositional | 2.40 | 45.73674 | -117.033240 | 45.73187 | -117.05089 |
| CBW05583-527874 | Devils Run Creek | Panel 1 | Transport | 2.33 | 45.07765 | -116.927380 | 45.77810 | -116.94788 |

## RESULTS

### Sampling domain and site selection

We surveyed 29 sites in the UGRR (Figure 2) encompassing 61.6 km of an estimated 892 km (6.9 %) available steelhead spawning habitat (Table 1). One site was not surveyed due to persistent high discharge and accessibility. This site was not included in our calculations. Stream classification for the 29 surveyed sites was distributed evenly (11 sites in source classification, 8 in transport, and 10 in depositional). Four sites were located above the Grande Ronde River weir, two above the Catherine Creek weir, and one above the Lookingglass Creek weir.

Twenty-four sites were surveyed in Joseph Creek and tributaries (Figure 3), encompassing 48.3 km of an estimated 384 km (12.6 %) available spawning habitat (Table 2), all of which were above the weir. One site was not surveyed due landowner access issues later in the season. Stream classification for the 24 sites was random with 10 sites surveyed in source classification, eight in transport, and six in depositional.

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.

### Steelhead redd surveys

We conducted 166 surveys in the UGRR basin in 2015, with a mean interval of 14.7 days between surveys. A total of 246 steelhead redds were observed at 20 of the 29 sites (Table 3). Redds were not evenly distributed among stream classifications: 19 (7%) were found in source areas, 127 (52%) in transport, and 100 (41%) in depositional reaches. A total of 12, live adult steelhead were observed in the UGRR (Table 5). Of these fish none had an observable adipose fin clip, nine were of wild origin, and three were of unknown origin. Two male and one female carcass were observed at three sites during our surveys in the UGGR basin.

A total of 78 surveys were completed in the Joseph Creek basin, with a mean interval of 20.3 days between surveys. We found 286 steelhead redds at 17 of the 24 sites (Table 4). More redds were found in the depositional stream classification (n=185, 75%), than source or transport reaches (n=57 (10%) and 44 (15%) respectively). Forty-seven live adult steelhead were observed at eight sites (Table 6), while eight dead, adult steelhead were found at five sites (Table 7). No adipose-clipped hatchery fish were observed during our Joseph Creek surveys.

On 18.7 km of Deer Creek, 49 redds, 39 live steelhead, and 49 carcasses were observed during five survey visits (Table 7).

### Spawning timing

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 24 February in the UGRR, March 10 Joseph Creek basins (Figure 4) and 09 April in Deer Creek (Figure 5). The last redds were observed on 10 June in the UGRR, 19 May in Joseph Creek and 26 May in Deer Creek. By 21 April 48% of the total redds in the UGRR basin were observed. By 07 April 59% of the total redds in the Joseph Creek basin were observed. By the third survey on 23April, 73% of the total redds were observed on Deer Creek. Onset of redd building was similar among basins as well as peak redd observations (Figure 4). The onset of redd building occurred weeks earlier than in previous years (Fitzgerald et al. 2013, Banks et al. 2014). In past years, UGRR redds were first observed during the descending limb of the hydrographs in early May to late June. However, this year flows in the UGRR was relatively flat and the descending limb didn't occur until late May when almost 100% of the redds were built (Figure 4). Surveys on Deer Creek coincided with low discharge periods (Figure 5).

*Weir Counts*

The Catherine Creek, Lookingglass Creek, and the Grande Ronde River weirs were operable 2 March, 1 March, and 2 March, respectively. During the spring of 2015, 290 wild and 15 hatchery adult steelhead were passed at the Lookingglass Creek weir, 293 wild adult steelhead at the Catherine Creek weir, and 30 wild adult steelhead at the Grande Ronde River weir (Table 8). The first adult steelhead were passed on 4 March at the Lookingglass Creek, 13 March at Catherine Creek, and 9 March on Grande Ronde River. The last steelhead were passed on 7 June at the Grande Ronde River and 10 June at Lookingglass Creek and 22 May in Catherine Creek (Mike McLean, CTUIR, unpublished data). The Catherine Creek, Lookingglass, and the Grande Ronde River weirs were removed 29 July, 18 September, and 07 June, respectively.

Adult steelhead were captured at the weir operated by Nez Perce Tribe (NPT) near the mouth of Joseph Creek and all fish (wild- and hatchery-origin) were passed above the weir to spawn naturally (Table 8, John Robbins, NPT, unpublished data 2015).

At the Deer Creek weir, 66 adult wild-origin steelhead were passed upstream to spawn naturally (Table 8).

**Estimating escapement**

A fish:redd ratio of 1.37 (66/49) was generated using the number of fish passed above the weir at Deer Creek and the number of redds observed there in 2015. We recovered 16 hatchery males and 3 hatchery females that fell back to the weir. We included these adults in our total spawner estimate.

Using this ratio and a single weight value for all stream classifications (30.8), 4,837 adult steelhead (95% C.I.: 2,946–6,728) escaped into the UGRR basin and naturally spawned (Table 9; Figure 6). No adipose-clipped hatchery fish were observed during surveys on the UGRR. Using this same method with a weight value of 16, 2,967 adult steelhead (95% C.I.: 1,976–3,958) escaped into the Joseph Creek basin (Table 9; Figure 6). Three adipose-clipped hatchery fish (1 carcass; 2 live fish) were observed during surveys on Joseph Creek.

Using the weight values for each strata, source (50.1), transport (27.0), and depositional (19.7), we estimated that **4,228 (95% CI, 2,944–5,513)** adult steelhead for the UGRR population (Table 10). For Joseph Creek estimates changed by only one fish: using the weight values for each strata, source (15.9), transport (14.3), and depositional (15.8), we estimated that **3,201 (95% CI, 2,431–3,972)** adult steelhead returned to spawn (Table 11).

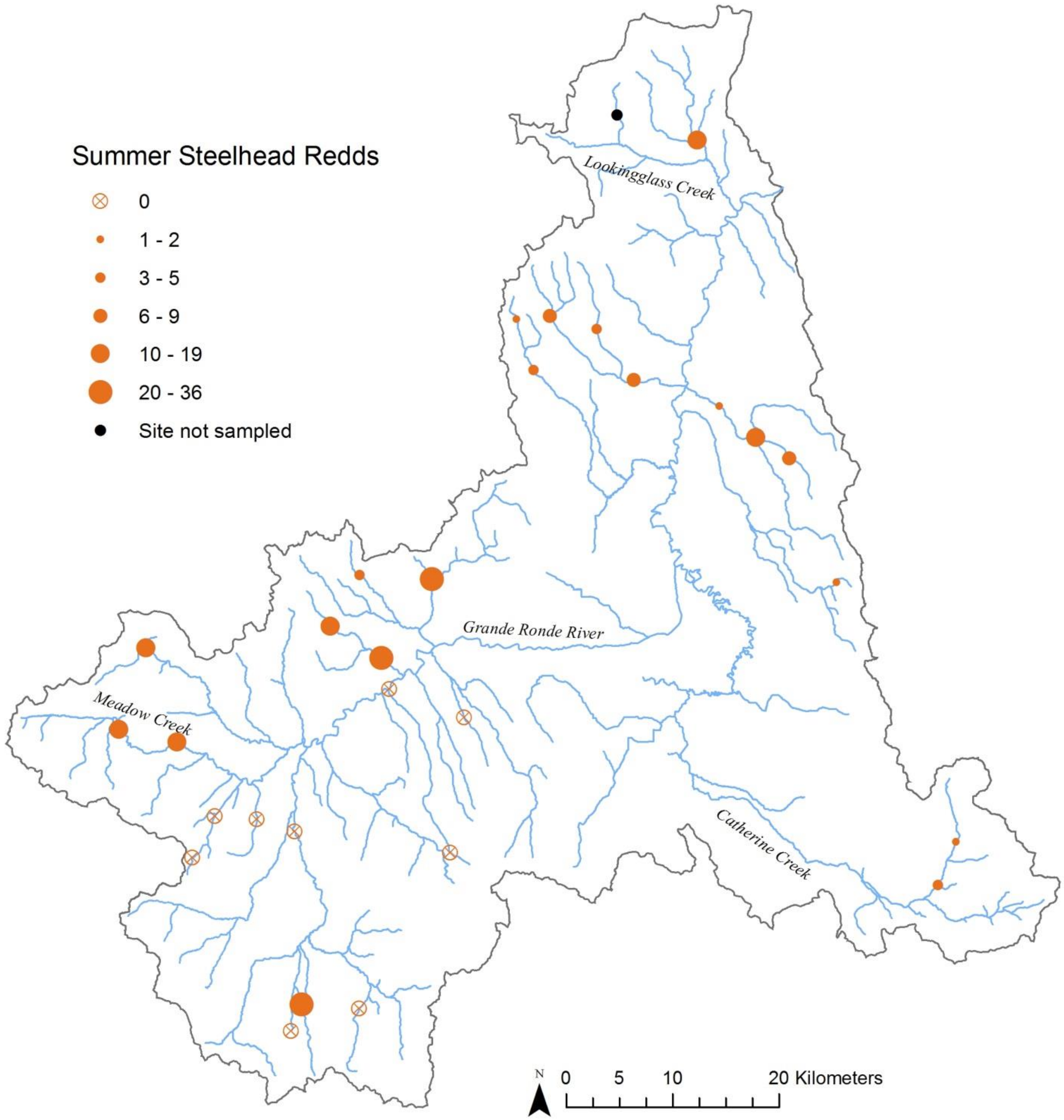


Figure 2. Map of the Upper Grande Ronde River basin displaying count of redds observed at each site in 2015. The two sites not surveyed were due to continual high flows and dangerous wading conditions.

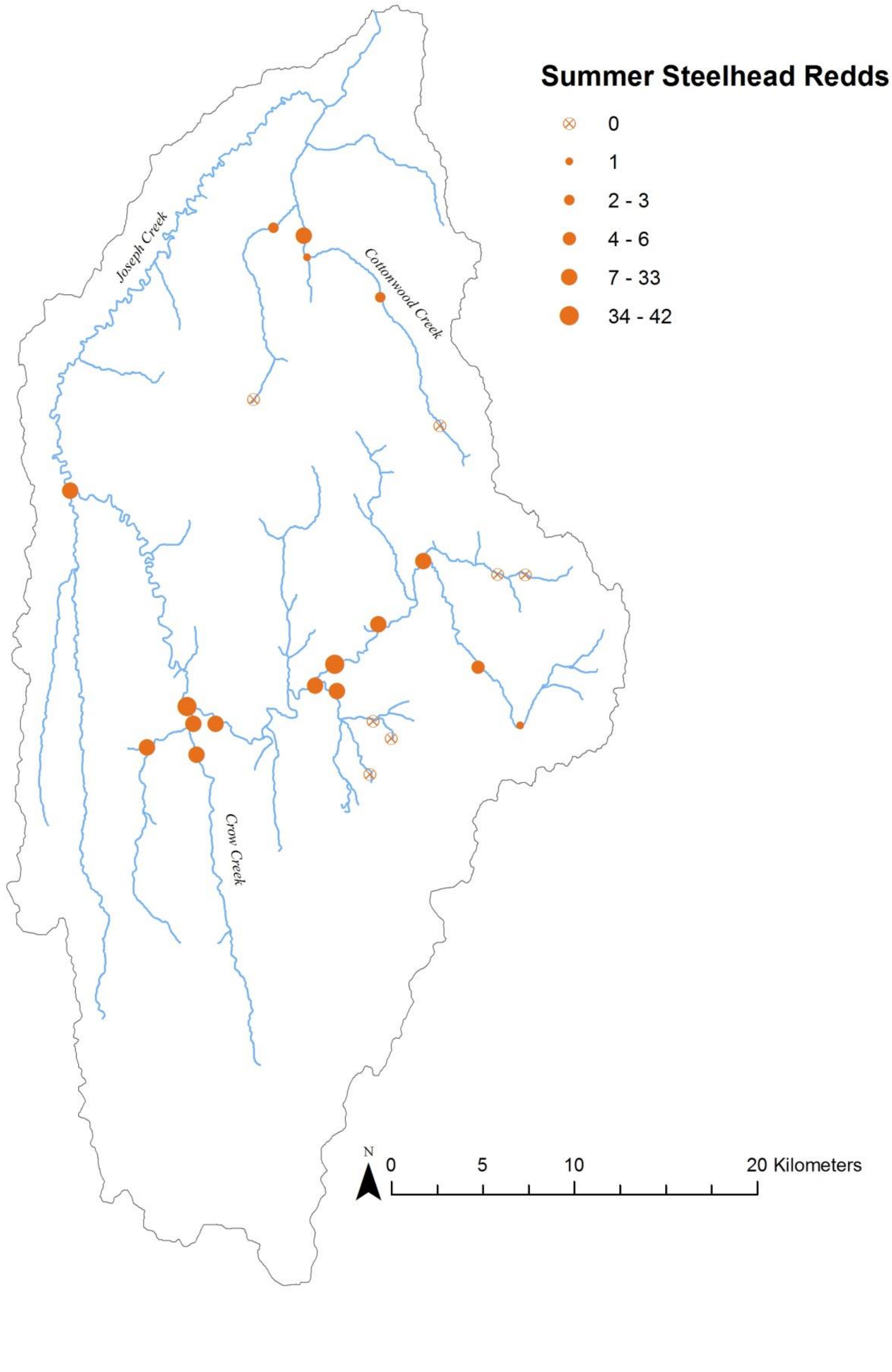


Figure 3. Map of the Joseph Creek basin showing count of redds observed at each site in 2015.

Table 3. Completion dates and general results for redd surveys in the Upper Grande Ronde River basin and Deer Creek, 2015.

| 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 | 8th Survey |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 000001 | North Fork Catherine Creek | 12.7 | 5 | 3/24/2015 | 4/7/2015 | 4/20/2015 | 4/30/2015 | 5/11/2015 | 5/28/2015 | 6/8/2015 | |
| 000168 | North Fork Catherine Creek | 12.7 | 1 | 3/24/2015 | 4/7/2015 | 4/20/2015 | 4/30/2015 | 5/11/2015 | 5/28/2015 | 6/8/2015 | |
| 000205 | Grande Ronde River | 14.3 | 0 | 3/16/2015 | 4/1/2015 | 4/14/2015 | 4/28/2015 | 5/12/2015 | | | |
| 006894 | Dry Creek | 15.0 | 4 | 2/25/2015 | 3/18/2015 | 3/30/2015 | 4/13/2015 | 4/27/2015 | 5/11/2015 | | |
| 007768 | Dry Creek | 13.5 | 2 | 3/18/2015 | 3/30/2015 | 4/13/2015 | 4/27/2015 | 5/11/2015 | | | |
| 016600 | Graves Creek | 14.5 | 0 | 3/16/2015 | 4/1/2015 | 4/14/2015 | | | | | |
| [a]018904 | Spring Creek | 13.3 | 29 | 2/24/2015 | 3/13/2015 | 3/31/2015 | 4/8/2015 | 4/13/2015 | 4/28/2015 | 5/12/2015 | 5/27/2015 |
| 041944 | Jordan Creek | 14.0 | 0 | 4/7/2015 | 4/20/2015 | 5/5/2015 | | | | | |
| 049208 | Camp Creek | 16.0 | 1 | 4/16/2015 | 4/28/2015 | 5/19/2015 | 6/3/2015 | | | | |
| 059352 | Clark Creek | 16.5 | 18 | 2/24/2015 | 3/11/2015 | 3/24/2015 | 4/6/2015 | 4/20/2015 | 5/5/2015 | 6/3/2015 | |
| 065720 | Spring Creek | 14.2 | 19 | 3/16/2015 | 3/31/2015 | 4/13/2015 | 4/28/2015 | 5/12/2015 | 5/27/2015 | 6/9/2015 | |
| 077704 | Burnt Corral Creek | 14.0 | 0 | 3/17/2015 | 3/30/2015 | 4/15/2015 | 4/27/2015 | 5/12/2015 | | | |
| 079752 | Grande Ronde River | 14.3 | 0 | 3/16/2015 | 4/1/2015 | 4/14/2015 | 4/28/2015 | 5/12/2015 | 5/27/2015 | 6/10/2015 | |
| 095642 | McCoy Creek | 13.2 | 16 | 3/23/2015 | 4/6/2015 | 4/22/2015 | 5/5/2015 | 5/18/2015 | 5/27/2015 | 6/10/2015 | |
| 101102 | Phillips Creek | 13.5 | 6 | 3/25/2015 | 4/8/2015 | 4/21/2015 | 5/5/2015 | 5/18/2015 | | | |
| 101560 | Meadow Creek | 15.6 | 18 | 3/23/2015 | 4/6/2015 | 4/22/2015 | 5/4/2015 | 5/18/2015 | 6/9/2015 | | |
| 108270 | Little Phillips Creek | 14.2 | 4 | 3/25/2015 | 4/8/2015 | 4/21/2015 | 5/6/2015 | 5/18/2015 | 6/4/2015 | | |
| 111960 | Pelican Creek | 16.2 | 3 | 3/19/2015 | 3/31/2015 | 4/13/2015 | 5/4/2015 | 5/18/2015 | 6/8/2015 | | |
| 118408 | West Chicken Creek | 17.8 | 0 | 3/23/2015 | 4/7/2015 | 4/21/2015 | 5/19/2015 | 6/2/2015 | | | |
| 118856 | Marley Creek | 14.5 | 0 | 3/17/2015 | 3/30/2015 | 4/15/2015 | | | | | |
| 120904 | Burnt Corral Creek | 14.5 | 0 | 3/30/2015 | 4/15/2015 | 4/27/2015 | 5/12/2015 | 5/27/2015 | | | |
| 125832 | Meadow Creek | 14.0 | 17 | 3/23/2015 | 4/6/2015 | 4/22/2015 | 5/6/2015 | 5/18/2015 | | | |
| 130030 | Clark Creek | 14.0 | 1 | 2/25/2015 | 3/11/2015 | 3/24/2015 | 4/6/2015 | 4/23/2015 | 5/5/2015 | 5/20/2015 | 6/3/2015 |
| 147928 | Five Points Creek | 14.2 | 36 | 3/17/2015 | 3/31/2015 | 4/15/2015 | 4/30/2015 | 5/14/2015 | 5/28/2015 | 6/10/2015 | |
| 149464 | Middle Fork Clark Creek | 15.4 | 7 | 3/24/2015 | 4/6/2015 | 4/20/2015 | 5/5/2015 | 5/20/2015 | 6/9/2015 | | |
| 155196 | Clear Creek | 18.7 | 0 | 4/7/2015 | 4/21/2015 | 5/19/2015 | 6/2/2015 | | | | |
| 159368 | Chicken Creek | 17.8 | 34 | 3/23/2015 | 4/7/2015 | 4/21/2015 | 5/19/2015 | 6/2/2015 | | | |
| 170478 | Little Lookingglass Creek | 13.7 | 16 | 3/18/2015 | 3/30/2015 | 4/13/2015 | 4/27/2015 | 5/10/2015 | 5/26/2015 | 6/8/2015 | |
| 177134 | East Phillips Creek | 15.5 | 9 | 4/8/2015 | 4/21/2015 | 5/4/2015 | 5/18/2015 | 6/9/2015 | | | |

[a] The ninth survey was completed on 6/10/2015.

Table 4. Completion dates and general results for surveys in the Joseph Creek basin, 2015.

| Site ID | Stream | Mean No. days between surveys | Redd Count | 1st Survey | 2nd Survey | 3rd Survey | 4th Survey |
|---|---|---|---|---|---|---|---|
| 002175 | Crow Creek | 21.0 | 12 | 3/11/2015 | 4/1/2015 | 4/22/2015 | |
| 012802 | Cottonwood Ceek | 21.0 | 2 | 3/10/2015 | 3/13/2015 | 4/21/2015 | 5/12/2015 |
| 043522 | Broady Creek | 21.0 | 2 | 3/9/2015 | 3/30/2015 | 4/20/2015 | 5/11/2015 |
| 045183 | Elk Creek | 21.0 | 19 | 3/11/2015 | 4/1/2015 | 4/22/2015 | 5/13/2015 |
| 051026 | Unnamed | 21.0 | 0 | 3/17/2015 | 4/8/2015 | 4/28/2015 | |
| 087554 | Cottonwood Creek | 0 | 0 | 3/25/2015 | | | |
| 112130 | Devils Run Creek | 20.0 | 21 | 3/19/2015 | 4/6/2015 | 4/29/2015 | 5/18/2015 |
| 116562 | Alder Creek | 21.3 | 0 | 3/17/2015 | 4/8/2015 | 4/27/2015 | 5/20/2015 |
| 128514 | Chesnimnus Creek | 17.3 | 5 | 3/23/2015 | 4/14/2015 | 4/27/2015 | 5/14/2015 |
| 141826 | Basin Creek | 20.7 | 1 | 3/10/2015 | 3/30/2015 | 4/20/2015 | 5/11/2015 |
| 167426 | Chesnimnus Creek | 18.3 | 33 | 3/19/2015 | 4/15/2015 | 4/27/2015 | 5/13/2015 |
| 169810 | Chesnimnus Creek | 17.3 | 1 | 3/23/2015 | 4/14/2015 | 4/27/2015 | 5/14/2015 |
| 237503 | Swamp Creek | 0 | 18 | 5/5/2015 | | | |
| 258175 | Chesnimnus Creek | 21.3 | 42 | 3/16/2015 | 4/6/2015 | 4/29/2015 | 5/19/2015 |
| 301570 | Cottonwood Creek | 21.0 | 22 | 3/10/2015 | 3/31/2015 | 4/21/2015 | 5/12/2015 |
| 318978 | Chesnimnus Creek | 22.7 | 29 | 3/12/2015 | 4/2/2015 | 4/27/2015 | 5/19/2015 |
| 354818 | West Fork Brady Creek | 0 | 0 | 5/6/2015 | | | |
| 389247 | Chesnimnus Creek | 22.7 | 21 | 3/12/2015 | 4/7/2015 | 4/29/2015 | 5/19/2015 |
| 394754 | Devils Run Creek | 18.3 | 0 | 3/24/2015 | 4/13/2015 | 4/29/2015 | 5/18/2015 |
| 487551 | Crow Creek | 21.0 | 9 | 3/11/2015 | 4/1/2015 | 4/22/2015 | |
| 493394 | Salmon Creek | 21.3 | 7 | 3/17/2015 | 4/8/2015 | 4/27/2015 | 5/20/2015 |
| 509778 | Pine Creek | 20.0 | 0 | 3/18/2015 | 4/8/2015 | 4/27/2015 | |
| 515586 | Chesnimnus Creek | 19.3 | 42 | 3/16/2015 | 4/7/2015 | 4/27/2015 | 5/13/2015 |
| 527874 | Devils Run Creek | 18.3 | 0 | 3/24/2015 | 4/13/2015 | 4/29/2015 | 5/18/2015 |

Table 5. Locations, dates, and characteristics of live steelhead observations in the UGRR and Deer Creek basins, 2015.

| Site ID | Stream | Observation Date | Fin Clip | On/Off Redd |
|---|---|---|---|---|
| 18904 | Spring Creek | 3/13/2015 | No | On |
| 147928 | Five Points Creek | 3/31/2015 | No | On |
| 177134 | East Phillips Creek | 4/8/2015 | Unknown | Off |
| Deer3-0 | Deer Creek | 4/9/2015 | Unknown | Off |
| Deer3-0 | Deer Creek | 4/9/2015 | Unknown | Off |
| Deer3-0 | Deer Creek | 4/9/2015 | Unknown | Off |
| Deer3-0 | Deer Creek | 4/9/2015 | No | Off |
| Deer3-0 | Deer Creek | 4/9/2015 | Unknown | Off |
| Deer3-0 | Deer Creek | 4/9/2015 | Yes | NR |
| Deer3-0 | Deer Creek | 4/9/2015 | Yes | On |
| Deer3-0 | Deer Creek | 4/9/2015 | No | On |
| Deer3-0 | Deer Creek | 4/9/2015 | Unknown | Off |
| Deer6-3 | Deer Creek | 4/9/2015 | Unknown | On |
| Deer6-3 | Deer Creek | 4/9/2015 | Unknown | On |
| Deer6-3 | Deer Creek | 4/9/2015 | No | Off |
| Deer6-3 | Deer Creek | 4/9/2015 | Unknown | Off |
| Deer6-3 | Deer Creek | 4/9/2015 | No | On |
| Deer6-3 | Deer Creek | 4/9/2015 | Unknown | On |
| 65720 | Spring Creek | 4/13/2015 | No | Off |
| 65720 | Spring Creek | 4/13/2015 | No | Off |
| 108270 | Little Phillips Creek | 4/21/2015 | No | Off |
| 108270 | Little Phillips Creek | 4/21/2015 | Unknown | Off |
| 101560 | Meadow Creek | 4/22/2015 | Unknown | On |
| Deer8-6 | Deer Creek | 4/23/2015 | Yes | Off |
| Deer8-6 | Deer Creek | 4/23/2015 | No | Off |
| Deer8-6 | Deer Creek | 4/23/2015 | Unknown | Off |
| 18904 | Spring Creek | 4/27/2015 | No | On |
| 147928 | Five Points Creek | 4/30/2015 | No | Off |
| 159368 | Chicken Creek | 5/4/2015 | No | Off |
| 177134 | East Phillips Creek | 5/4/2015 | No | On |
| Deer3-0 | Deer Creek | 5/7/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/7/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/7/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/7/2015 | Yes | Off |
| Deer3-0 | Deer Creek | 5/7/2015 | Yes | Off |
| Deer3-0 | Deer Creek | 5/7/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/7/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | Yes | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | Yes | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | Yes | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |
| Deer3-0 | Deer Creek | 5/21/2015 | No | Off |

Table 6. Locations, dates, and characteristics of live steelhead observations in the Joseph Creek basin, 2015.

| SiteIDShort | StreamName | Observation Date | Fin Clip | On/Off Redd |
|---|---|---|---|---|
| 002175 | Crow Creek | 4/1/2015 | No | Off |
| 002175 | Crow Creek | 4/1/2015 | Unknown | Off |
| 012802 | Cottonwood Creek | 4/21/2015 | No | Off |
| 012802 | Cottonwood Creek | 3/31/2015 | Unknown | Off |
| 012802 | Cottonwood Creek | 3/31/2015 | Unknown | Off |
| 012802 | Cottonwood Creek | 3/31/2015 | Unknown | Off |
| 012802 | Cottonwood Creek | 3/31/2015 | Unknown | Off |
| 012802 | Cottonwood Creek | 3/31/2015 | Yes | On |
| 012802 | Cottonwood Creek | 3/31/2015 | No | On |
| 043522 | Broady Creek | 3/30/2015 | No | Off |
| 043522 | Broady Creek | 3/30/2015 | No | On |
| 043522 | Broady Creek | 3/30/2015 | No | On |
| 045183 | Elk Creek | 4/22/2015 | Unknown | On |
| 045183 | Elk Creek | 4/1/2015 | Unknown | On |
| 045183 | Elk Creek | 4/1/2015 | No | Off |
| 045183 | Elk Creek | 4/1/2015 | No | Off |
| 045183 | Elk Creek | 4/1/2015 | No | On |
| 045183 | Elk Creek | 4/1/2015 | No | On |
| 045183 | Elk Creek | 4/1/2015 | Unknown | On |
| 112130 | Devils Run Creek | 4/29/2015 | No | Off |
| 112130 | Devils Run Creek | 4/29/2015 | No | Off |
| 112130 | Devils Run Creek | 4/6/2015 | No | Off |
| 258175 | Chesnimnus Creek | 4/29/2015 | No | Off |
| 258175 | Chesnimnus Creek | 3/16/2015 | Unknown | Off |
| 258175 | Chesnimnus Creek | 3/16/2015 | Unknown | Off |
| 258175 | Chesnimnus Creek | 3/16/2015 | Unknown | On |
| 258175 | Chesnimnus Creek | 3/16/2015 | Unknown | On |
| 258175 | Chesnimnus Creek | 4/6/2015 | Unknown | Off |
| 258175 | Chesnimnus Creek | 4/6/2015 | No | Off |
| 258175 | Chesnimnus Creek | 4/6/2015 | No | On |
| 301570 | Cottonwood Creek | 3/31/2015 | No | On |
| 301570 | Cottonwood Creek | 3/31/2015 | Unknown | Off |
| 301570 | Cottonwood Creek | 3/31/2015 | Unknown | Off |
| 318978 | Chesnimnus Creek | 4/28/2015 | Unknown | Off |
| 318978 | Chesnimnus Creek | 4/2/2015 | Unknown | Off |
| 318978 | Chesnimnus Creek | 4/2/2015 | Unknown | On |
| 318978 | Chesnimnus Creek | 4/2/2015 | No | On |
| 318978 | Chesnimnus Creek | 4/2/2015 | Unknown | On |
| 389247 | Chesnimnus Creek | 4/29/2015 | No | Off |
| 389247 | Chesnimnus Creek | 5/19/2015 | Yes | On |
| 389247 | Chesnimnus Creek | 5/19/2015 | Yes | On |
| 515586 | Chesnimnus Creek | 4/27/2015 | No | Off |
| 515586 | Chesnimnus Creek | 4/27/2015 | No | Off |
| 515586 | Chesnimnus Creek | 4/7/2015 | No | Off |
| 515586 | Chesnimnus Creek | 4/7/2015 | No | Off |
| 515586 | Chesnimnus Creek | 4/7/2015 | No | On |
| 515586 | Chesnimnus Creek | 4/7/2015 | Unknown | On |

Table 7. Locations, dates, and characteristics of dead steelhead observations in UGR, Joseph and Deer Creek basins, 2015.

| Site ID | Population | Stream Name | Date Observed | Fish Sex | Fork Length (mm) | Origin |
|---|---|---|---|---|---|---|
| 18904 | UGR | Spring Creek | 3/31/2015 | Male | 854 | Wild |
| 45183 | Joseph | Elk Creek | 4/22/2015 | Female | 675 | Unknown |
| 45183 | Joseph | Elk Creek | 4/22/2015 | Female | 690 | Wild |
| 45183 | Joseph | Elk Creek | 4/1/2015 | Female | 695 | Wild |
| 112130 | Joseph | Devils Run Creek | 4/29/2015 | Female | 690 | Wild |
| 112130 | Joseph | Devils Run Creek | 4/29/2015 | Female | 685 | Wild |
| 258175 | Joseph | Chesnimnus Creek | 4/29/2015 | Male | 601 | Wild |
| 389247 | Joseph | Chesnimnus Creek | 4/29/2015 | Female | 520 | Hatchery |
| 515586 | Joseph | Chesnimnus Creek | 4/7/2015 | Female | 665 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/7/2015 | Male | 730 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/7/2015 | Female | 675 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/7/2015 | Male | 760 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/7/2015 | Male | 690 | Wild |
| Deer3-0 | Deer | Deer Creek | 4/23/2015 | Female | 725 | Wild |
| Deer3-0 | Deer | Deer Creek | 4/23/2015 | Female | 725 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/26/2015 | Male | 741 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Unknown | - | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 575 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 680 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 774 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 740 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 530 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 520 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 620 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 510 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 708 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 601 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 630 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 521 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 549 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 710 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 660 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 570 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 720 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 520 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 522 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 672 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 660 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 598 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 636 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 510 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 530 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 580 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 580 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 500 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 480 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 622 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 676 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 730 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 554 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 560 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 674 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 660 | Wild |

| Site ID | Population | Stream Name | Date Observed | Fish Sex | Fork Length (mm) | Origin |
|---|---|---|---|---|---|---|
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 594 | Wild |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 535 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 562 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Male | 527 | Hatchery |
| Deer3-0 | Deer | Deer Creek | 5/21/2015 | Female | 573 | Wild |
| 130030 | UGR | Clark Creek | 4/23/2015 | Female | 72 | Wild |
| 147928 | UGR | Five Points Creek | 4/30/2015 | Male | 78 | Wild |

Table 8. Origin of fish passed above Joseph Creek, UGRR, Catherine Creek, Lookingglass Creek and Deer Creek weirs in 2015.

| | Natural Origin | Hatchery Origin | Proportion Hatchery (%) | Total Fish |
|---|---|---|---|---|
| Joseph Creek* | 2,917 | 53 | 1.8% | 2,970 |
| UGRR** | 30 | 0 | 0 | 30 |
| Catherine Creek** | 293 | 0 | 0 | 293 |
| Lookingglass Creek** | 290 | 15 | 4.9% | 305 |
| Deer Creek*** | 58 | 8 | 12.1% | 66 |

*John Robbins, Nez Perce Tribe, Department of Fisheries Resources Management, unpublished data, personal communication

**Michael McLean, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fisheries Program, unpublished data, personal communication

***Michael Flesher, Oregon Department of Fish & Wildlife, La Grande Fish Research, unpublished data, personal communication

Table 9. Annual results of steelhead spawning ground surveys, 2008−2015. 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% |
| **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% |

*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.*

Table 10. Survey characteristics and results, grouped by stream classification type for the UGRR basin, 2015.

| 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 | 453 | 41.18 | 22.98 | 19 | 0.8 | 490 | 84 | 896 |
| Transport | 8 | 243 | 30.38 | 17.23 | 127 | 7.4 | 2,489 | 1,573 | 3,405 |
| Depositional | 10 | 197 | 19.70 | 21.35 | 100 | 4.7 | 1,249 | 446 | 2,053 |
| **Total** | **29** | **892** | **91.27** | **61.56** | **246** | **12.9** | **4,228** | **2,944** | **5,513** |

Table 11. Survey characteristics and results, grouped by stream classification type for the Joseph Creek basin, 2015.

| Stream Classification | No. of sites | Spawning habitat (km) | Weight value | Distance surveyed (km) | Total redds observed | Redds per km | Spawner escapement | Lower 95%CI | Upper 95% CI |
|---|---|---|---|---|---|---|---|---|---|
| Source | 10 | 159 | 15.9 | 18.55 | 57 | 3.1 | 636 | 80 | 1,191 |
| Transport | 8 | 115 | 14.4 | 16.58 | 44 | 2.7 | 438 | 177 | 699 |
| Depositional | 6 | 111 | 18.5 | 13.13 | 185 | 14.1 | 2,127 | 1,661 | 2,593 |
| **Total** | **24** | **384** | **48.8** | **48.26** | **286** | **19.9** | **3,201** | **2,431** | **3,972** |

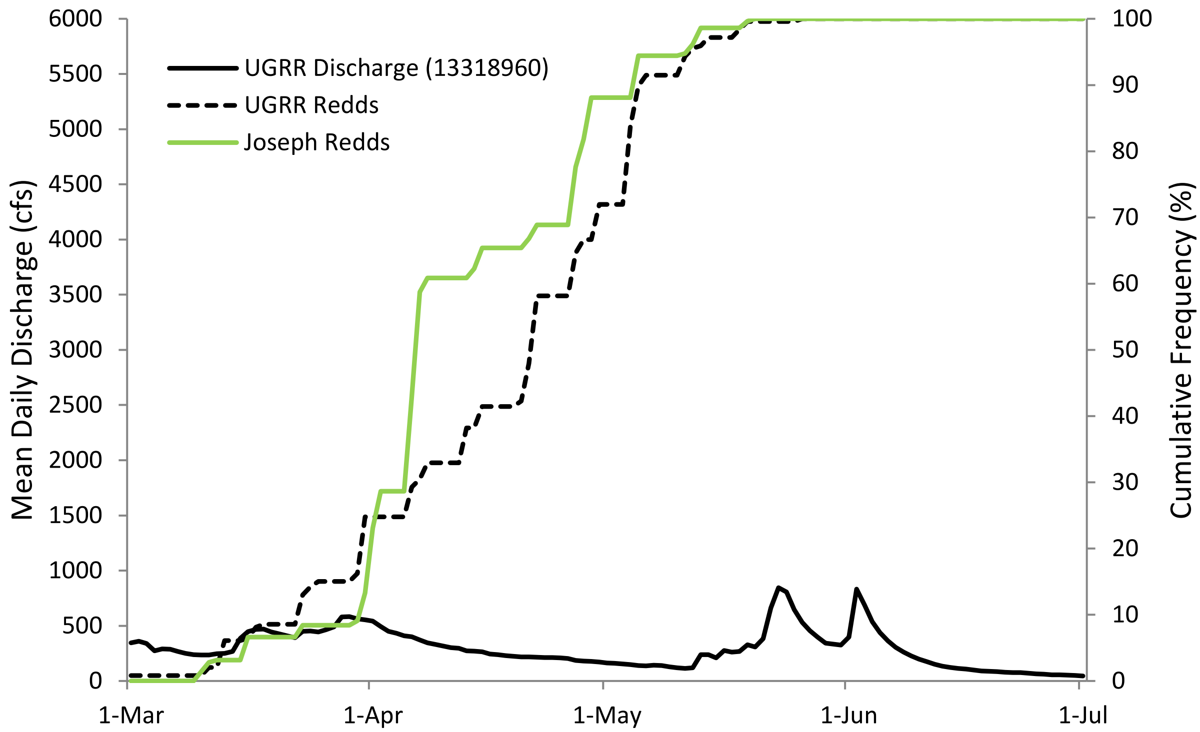


Figure 4. Cumulative frequency of observed redds and mean daily discharge during the spawning period for the UGRR basin (OWRD station #13318960) in 2015.

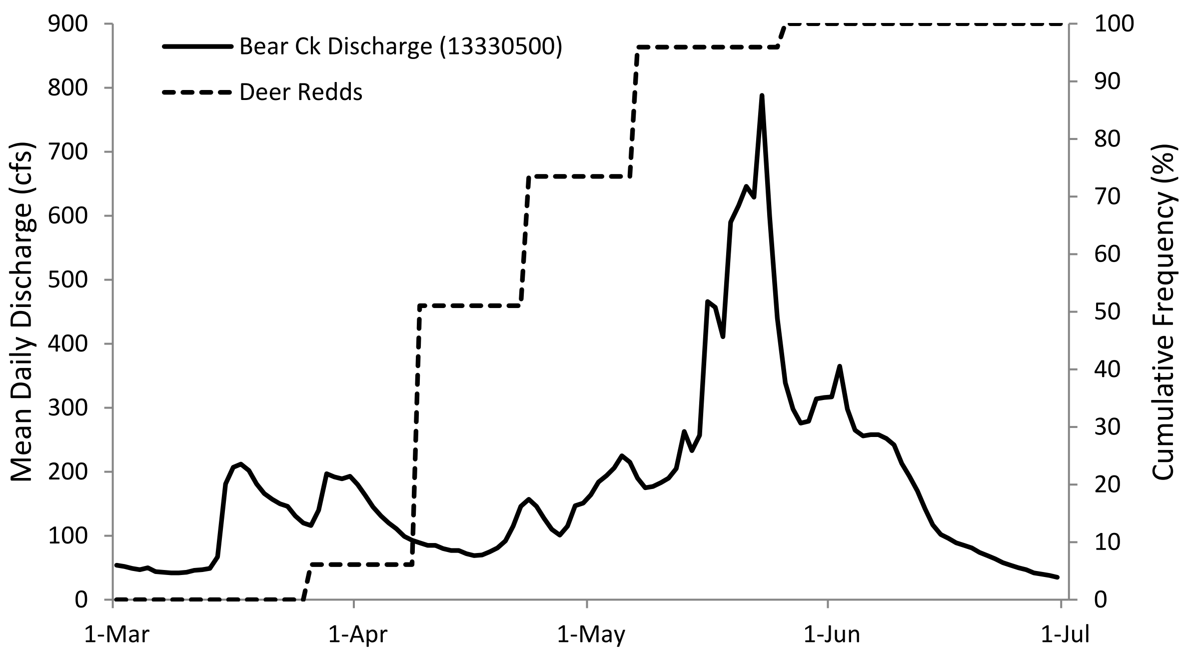


Figure 5. Cumulative frequency of observed redds during the spawning period for Deer Creek and discharge from neighboring Bear Creek (OWRD station #13330500) in 2015.

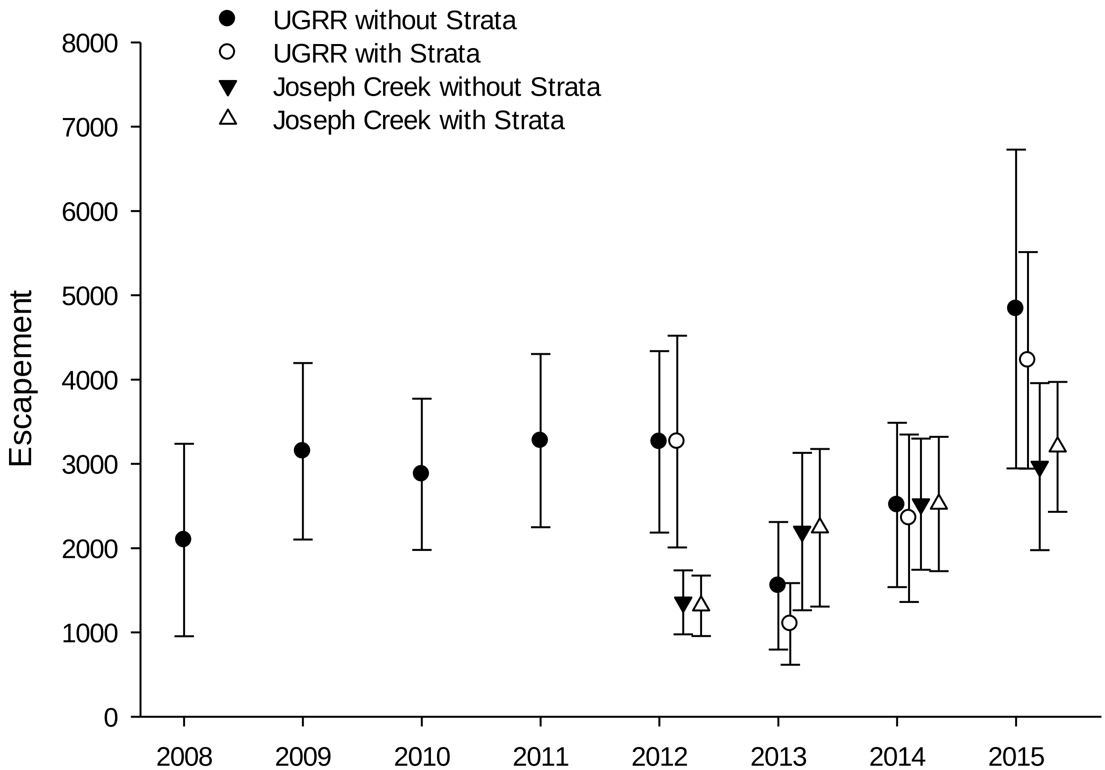


Figure 6. Escapement estimates with 95% confidence intervals for steelhead in the Upper Grande Ronde River basin using a single weight value, 2008−2015 and using strata weights for the three classifications of stream type for UGRR and Joseph Creek, 2012−2015.

## DISCUSSION

### Steelhead redd surveys

Water clarity during surveys was good 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. However, they were much lower than in previous years and we had early and consistent access throughout the spawning season. Our protocol indicates that surveys should be conducted at two week intervals and we achieved this in the UGRR.

The efficiency of our surveys on larger tributaries (i.e. Lookingglass and Catherine creeks) was better this year than in previous. We observed 16 redds in Little Lookingglass Creek this year and in most years we usually observed zero redds due to our inability to cross or even walk in the channel for significant stretches because of high water flows.

The fish:redd ratio from Deer Creek correlated strongly with the total water volume from UGRR (Figure 7). 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.

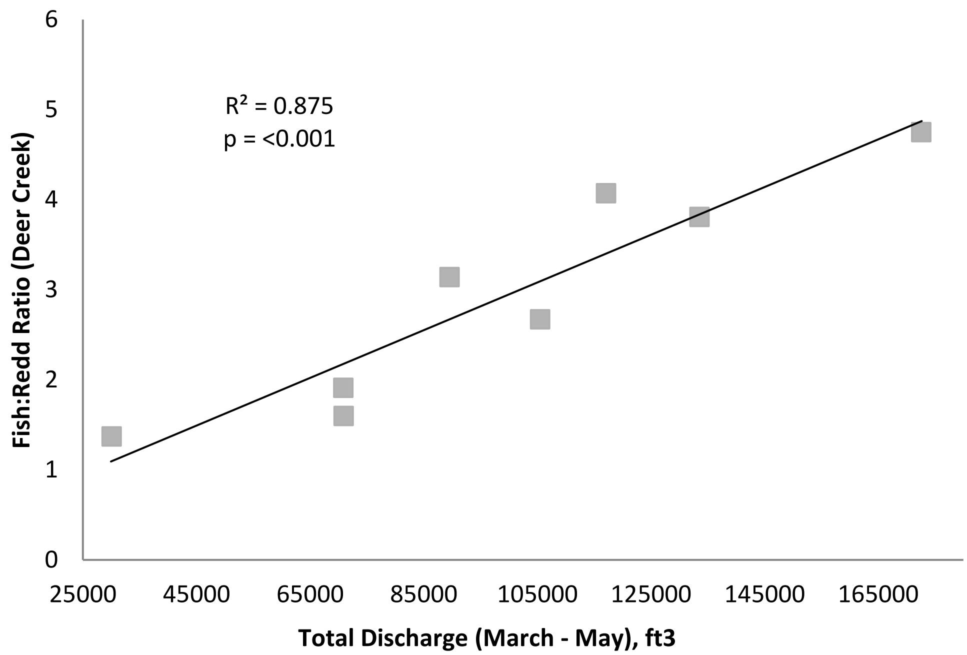


Figure 7. Relationship between total discharge in UGRR (Perry Station) and the fish:redd ratio derived from Deer Creek surveys, 2008−2015.

### Spawning timing

Redds were observed earlier in the year than had been in previous years. In past years most redds were first observed during descending limbs of the hydrograph. However, this year the hydrograph didn't display its typical pulse in early spring and the flow remained consistently low the spawning season. Nevertheless, 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. Our observations of redds usually occur during these descending periods; however, 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 (Figure 5). 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 March) between redd building in UGRR and Joseph Creek (Figure 4). 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. However, the lag period was in early April those years. 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.

**Estimating escapement**

Population-scale escapement estimates had relatively poor precision for both Joseph Creek and UGRR (95% CI ~39% of the estimate).  This is similar to better than last year's precision estimate of ~38% of estimate.  Confidence intervals have consistently been 30–35% of the UGRR escapement estimate since 2009 (Table 9). 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 2015 we observed zero redds at 31% of our UGRR basin sites, and 29% 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 fourth year of attempting to correlate redd locations with stream classifications. Redd observations were highest in transport reaches for UGRR and highest in depositional reaches for Joseph basins.  This distribution is similar to Joseph Creek observations in 2012 - 2014, but far different for UGRR streams (Dobos et. al 2012, Fitzgerald et. al 2013, Banks et al. 2014).  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.

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