Technical Report 2018-1

EVALUATION OF THE MIGRATION BEHAVIORS OF RADIO-TAGGED ADULT SUMMER STEELHEAD IN THE UPPER COLUMBIA RIVER, 2015-2016 AND 2016-2017

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Acknowledgements

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Introduction

This report summarizes radio telemetry (RT) data collected from adult summer steelhead tagged at Priest Rapids Dam (Figure 1) in 2015 and 2016. Upper Columbia River summer steelhead are currently listed as threatened under the Endangered Species Act (ESA), a status reaffirmed in 2011 (NMFS, 2009). Low abundance of natural origin spawners and poor returning adult escapement were among the reasons for listing (Ford et al. 2011; Good et al. 2005). Surprisingly few telemetry studies have focused on adult steelhead in the Upper Columbia River, aside from those intended to identify main-stem dam passage and migration rates (English et al. 2006). Currently, escapement to tributaries is estimated for steelhead using a PIT tag based mark re-sight patch occupancy model, but model rates have not been validated. Similarly, survival in the Columbia River and tributaries prior to spawning is largely unknown. The goals of this study were to: 1) to validate tributary PIT array based escapement estimates using radio telemetry tags and methods, 2) estimate the proportion of hatchery and wild steelhead within each tributary population, 3) monitor the migration, distribution, and overwinter survival of both hatchery and natural-origin adult steelhead in tributary and main-stem Columbia River habitats, 4) identify overwinter holding habitats and behavior, and 5) monitor post-spawn and kelting movements and down-stream survival in the Upper Columbia River basin.

Methods

PIT and Radio-Tagging

Summer steelhead were collected and radio-tagged at the Off Ladder Adult Fish Trap (OLAFT) facility at Priest Rapids Dam from 6 -July through 10 -November 2015 and between 6 -July and 2 -November in 2016 by WDFW personnel. Sampling occurred three days per week during daylight hours (8:00 AM to 5:00 PM). Fish entered the OLAFT volitionally, where they were sorted from non-target species though a series of hydraulic diversions. Once positively identified, steelhead were immediately directed into a sampling tank. Radio-tagged fish were tagged in proportion to the run at a rate of 1 per every 6th fish in 2015 regardless of origin (i.e., both wild run and hatchery fish received tags). The steelhead return in 2016 was approximately 33% of historic ten year average Priest Rapids return escapement, and consequently the tag rate was increased from 1 per every 6th to as high as 1 per every 3rd fish to achieve the target sample size. Steelhead not previously PIT tagged were injected with a 12 mm PIT tag into the pelvic girdle (Gibbons and Andrews, 2004) and fish sex was determined using an ultrasound device (Martin et al. 1983). As sampling rates differed between both years of tagging we used a Kolmogorov-Smirnov (K-S) test to determine if there was a significant difference in the distribution of fish that were PIT tagged vs those that were radio-tagged and released at Priest Rapids Dam for each sampling year (Smirnov, 1939). Fish were anesthetized using tricaine-S methanosulfate (MS-222) at a concentration of 50 mg/L in a 100 gallon sampling tank (378 L). Once fish were sedated, measurements of length (cm), and visual markings (hatchery or wild) were recorded and handled fish were scanned for a PIT tag. Each steelhead received an intragastrically implanted 3-volt coded transmitter (model MCFT2-3A, Lotek Wireless, Newmarket, Ontario) that included a label with reward information ($50 US) with which anglers could report the location and date of tagged fish recaptures. The manufacturer reported radio

tag life was 52 weeks and tag size was 16 mm x 46 mm at 10 grams weight in air. The radio tags antenna was bent around the jaw allowing it to trail alongside the body. Known hatchery origin fish were determined by the presence of adipose or pelvic fin clips, floy tags, and/or coded wire tags. Unmarked adults were presumed to be of natural origin. Scales were taken for marine ageing estimates and to confirm the origin using scale pattern analysis (Bernard and Myers, 1996). Scales were taken above the lateral-line between the dorsal and adipose fins. Once tagged, all fish were released into an approximately 20m long holding tank adjacent to the fish ladder, where tagged fish could recover and volitionally return to the left bank fish ladder at Priest Rapids Dam and resume their upstream migration.

Fixed Telemetry Sites

A total of 28 fixed site receivers were installed and distributed throughout the Upper Columbia River basin between July-2015 to June-2017 with a maximum of 25 fixed sites operating at any given time throughout the entire season. Upper Columbia tributary fixed sites were deemed priority sites for meeting the objectives of this study and thus each tributary mouth was outfitted with two fixed site receivers to minimize the chances of missing detections should one receiver fail, and to attempt to infer movement direction of radio-tagged steelhead. The upper tributaries were also outfitted with one or two fixed sites (depending on tributary width) to allow estimation of detection efficiency of tributary mouth sites, by detecting fish missed initially at the lower fixed sites. Two fixed sites were located near Chief Joseph Hatchery, which is a commonly used overwintering area for steelhead returning to the Upper Columbia that overshoot tributaries prior to later entry. Receivers were downloaded a minimum of once per month, and heavily used sites were downloaded weekly or multiple times per week. Nearly all sites were outfitted with four element yagi antennas, with the exception of sites located at Rock Island (1-4RI), Wanapum (1WP), and Priest Rapids Dams (1-4PR) that were outfitted with six element antennas. Fixed sites located at Chief Joseph Hatchery were also outfitted with six element antennas (1CJ and 2CJ). Monitoring was limited to PIT tag arrays at Rocky Reach and Wells Dams, which both typically have high upstream PIT detection efficiencies. Not all sites were monitored continuously during both years of the study. The Twisp River sites (1TP, 2TP, and 3TP) were not installed until 14-March 2016, although mobile tracking was conducted prior to installation. Lower river main-stem dam fixed site receivers (at Priest Rapids and Wanapum Dams) were removed in March 2016 to augment the Twisp River detection sites and subsequently returned to the dams prior to July 2016. Fixed sites 4PR, 1CJ, and 1TP were removed prior to the 2016 tagging as these sites were deemed redundant after the 2015 tagging season.

Study Site Map

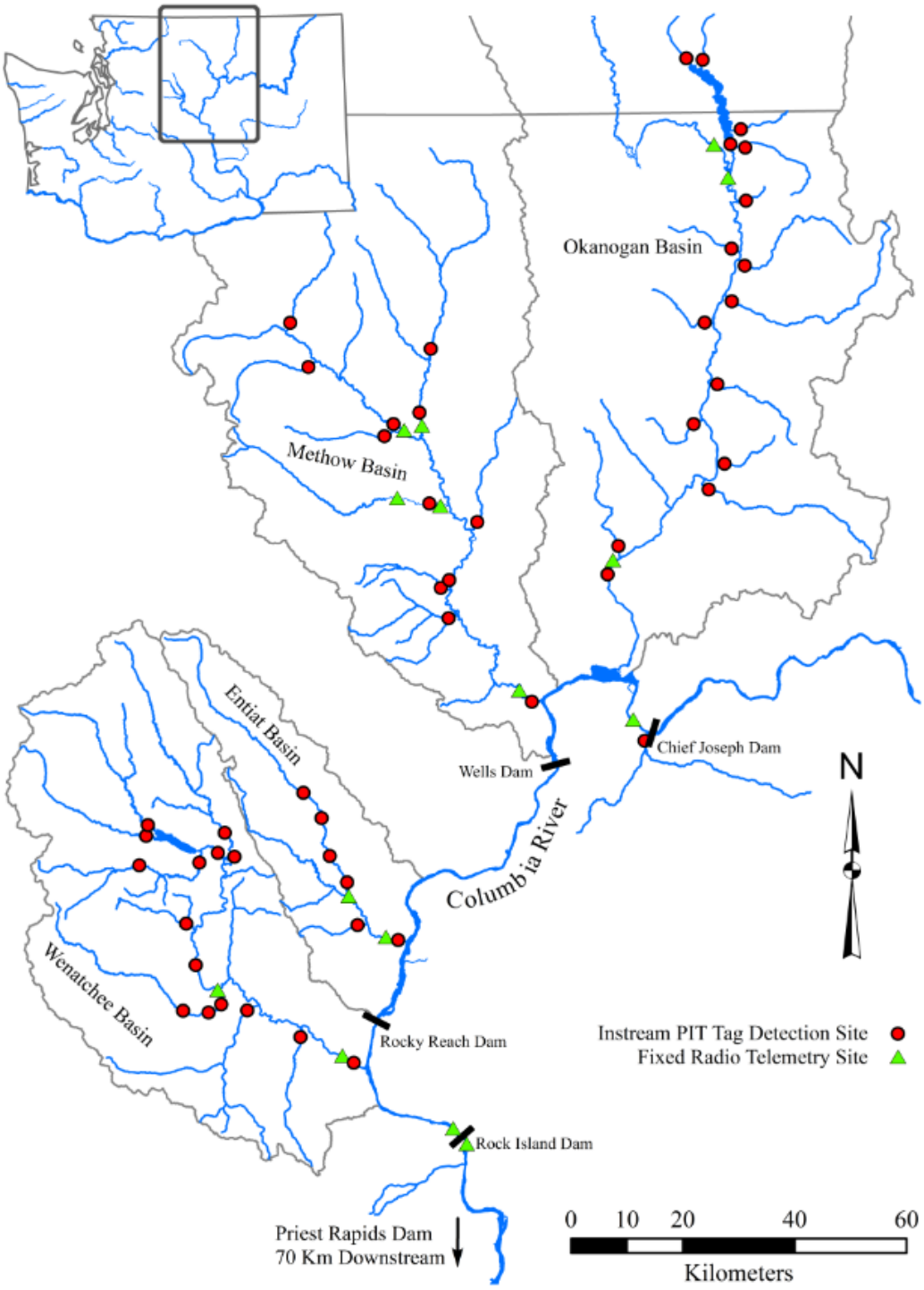

Figure 1. Location of dams (black rectangles), fixed site radio telemetry antennas (green triangles), and lower tributary PIT arrays (red dots) in the Upper Columbia River basin. The study area encompasses the waters between Priest Rapids Dam and Chief Joseph Dam and tributaries. All fixed site names and description locations are provided in Table 1.

Mobile Tracking

Mobile tracking augmented fixed site detections used to estimate detection efficiency and was used to evaluate overwinter survival and migration behavior in tributaries. Mobile monitoring took place via truck, raft, and jet boat from November-2015 through May-2016 for the 2015 return year (hereafter 'run year'), and from November-2016 through May-2017 for the 2016 run year. Over the course of the study, mobile tracking was conducted by University of Idaho, Colville Confederated Tribes, and Washington Department of Fish and Wildlife (Methow and Wenatchee offices) personnel. Mobile tracking by truck was the most commonly used method throughout the study with major river tributaries (i.e. Wenatchee) and smaller order tributaries surveyed at least once a month in the early season, and multiple times per month during spawning months (March-May 2016 and 2017). A total of 135 truck and raft based mobile tracking events occurred between 13-November 2015 and 20-May 2016 (2015 run year), and 81 truck and raft mobile tracking events occurred from 22-November to 30-May 2017 (2016 run year). Days spent mobile tracking tributaries were variable given differing tributary lengths and the proximity of the road to tributaries (relative ease of receiving detections). Each major Upper Columbia tributary was tracked a minimum of once per month starting January 2016 and was repeated again in January 2017. Boat tracking was exclusively used in monitoring the main-stem Columbia River between all dams from Priest Rapids Dam to Chief Joseph Dam (~875 river kilometers from the Columbia River Estuary), with a total of 24 boat tracking days occurring between 2-Febuary and 14-April 2016 (2015 run year), and 26 boat tracking days occurring between 26-January and 22-May 2017 (2016 run year). Each reach between main-stem dams was similarly tracked once per month starting in February 2016, one boat tracking day constituted approximately 6 hours of continuous tracking time. Tracking also took place downstream of Priest Rapids Dam to Ice Harbor Dam on the Snake River (rkm 538). Mobile tracking by raft was conducted primarily in tributaries where road access near the river was poor, or when a high degree of accuracy in determining fish location was necessary, and took place most commonly in Upper Wenatchee and Methow Rivers.

Data Analysis

After fish were tagged and released, a database was compiled that included detections from radio telemetry fixed sites, PIT tag detections, and mobile tracking records. PIT detection data was downloaded from the Pacific States Marine Fisheries Commission PIT Tag Information System database (PTAGIS) and used to supplement radio telemetry fish detection histories. All data sets included location and date relational data, from which we were able to create general migration histories for each fish. Telemetry records were compiled and used to score and quantify several behaviors and metrics as described below, and to classify individual steelhead fates. Key parameters included total fallback behavior below Priest Rapids, tributary entry, mortalities estimates, overwinter distribution and survival, survival to spawn, and kelting behaviors. In order to synthesis detection histories to address the specific objectives previously outlined, several smaller datasets were also generated (i.e. tributary PIT array detections for escapement estimate validation). Additional data used for analysis included 2015-16 Upper Columbia harvest creel estimates (WDFW, unpublished data) and return tag angler harvest locations.

Table 1. Listed fixed site radio telemetry receivers deployed in the Upper Columbia River basin in 2015, site abbreviation, river kilometer distances from the Columbia River mouth, site installation dates, total number of days in operation, and number of days per site with known outages are provided.

Fixed Antenna Site	Site code	RKM	Install Date	Days in Operation	Days With Outages
Priest Rapids Dam Tailrace	1PR	635.4	07/30/15	554	15
Priest Rapids Dam Forebay 1 (right bank)	2PR	639	07/16/15	560	28
Priest Rapids Dam Forebay 2 (left bank)	3PR	639.1	07/16/15	568	98
Priest Rapids Ladder Exit	4PR*	639.1	07/16/15	238	78
Wanapum Dam Tailrace	1WP	668.2	08/13/15	542	95
Rock Island Dam Tailrace	1RI	728.5	07/23/15	660	10
Rock Island Dam Forebay 1 (right)	2RI	730	07/24/15	659	57
Rock Island Dam Forebay 2 (center)	3RI	730	08/04/16	648	96
Rock Island Dam Forebay 3 (left)	4RI	730	08/17/15	635	27
Lower Wenatchee River Array 1	1LW	756.7	07/17/15	641	17
Lower Wenatchee River Array 2	2LW	756.7	07/17/15	641	21
Middle Wenatchee at Icicle Bridge	MWN	796.1	06/18/15	605	84
Lower Entiat River Array 1	1EN	780	06/15/15	667	12
Lower Entiat River Array 2	2EN	780	06/15/15	667	12
Entiat River Array at Ardenvoir	ENT	795.6	06/15/15	667	60
Lower Methow River Array 1	1ME	845.5	06/17/15	647	96
Lower Methow River Array 2	2ME	845.5	06/17/15	647	72
Upper Methow in Winthrop	MET	921.7	07/28/15	599	61
Chewuch in Winthrop	CHE	921.7	07/28/15	599	57
Lower Okanogan Array 1	1OK	883.3	07/27/15	623	93
Lower Okanogan Array 2	2OK	883.3	07/27/15	623	97
Below Ihot Island	IHI	977	06/17/15	667	26
Similkameen River	SIM	984.2	06/17/15	667	49
Chief Joe Hatchery	1CJ*	871	06/19/15	228	108
Chief Joe Hatchery	2CJ	871	06/19/15	629	116
Twisp River Smolt Trap	1TP*	911	03/14/16	89	5
Twisp River Weir (Downstream)	2TP	921.9	03/14/16	147	64
Twisp River Weir (Upstream)	3TP	922.1	03/14/16	99	32

*sites were active during 2015 run year only.

Upper Columbia Fallbacks

Radio-tagged steelhead fallbacks were determined by one or more detections at sites upstream of Priest Rapids Dam followed by detection at an out of basin PIT tag array downstream (e.g., Snake River), detection at the lower Priest Rapids Dam radio telemetry fixed site (1PR), mobile tracking detection below Priest Rapids Dam down to Ringold Hatchery, or if they were reported harvested or collected at hatcheries downstream of Priest Rapids Dam.

Tributary Entry Detections

Detection events at tributary fixed sites were split between tributary entries occurring during the fall upriver migration (detections pre 1-Jan) and those that occurred after overwintering (post 1-Jan). The total number of steelhead detected entering a tributary differed from the number of steelhead assigned as spawning in that tributary because: 1) fish detected in a tributary were sometimes later detected falling back out of the Upper Columbia River system, 2) fish were detected in a tributary, detected back downstream and then in an alternate tributary, and 3) fish were detected entering a tributary, then moved back downstream, overwintered in the main-stem Columbia and then returned to the original tributary in spring. All steelhead detected entering a tributary were used for estimation of fixes site detection efficiencies regardless of final spawning location to maximize sample size for detection efficiency calculations. Fish with multiple tributary detections served to bolster the number of total unique fish detections and hence were included in the detection efficiency calculation.

Tributary Fixed Site Detection Efficiencies

In order to estimate tributary escapement and detection efficiencies of lower tributary radio telemetry fixed site arrays, the total number of unique fish detections at each tributary were complied. Detections at in-stream PIT arrays, mobile tracking detections, and additional radio telemetry fixed sites located midway up tributaries were also quantified to determine the number of fish that entered a tributary undetected by radio telemetry fixed sites. Lower tributary radio telemetry fixed sites were installed at or near the mouth of tributaries and within ± 20m of lower tributary instream PIT tag arrays.

Detection efficiencies (DE) of lower tributary radio telemetry fixed site arrays (i) during upstream migration were calculated for the four major Upper Columbia River tributaries separately for fall and spring monitoring periods (DE_i). This was accomplished by taking the total number of fish detected by lower tributary radio telemetry fixed sites (LF_i) then dividing by the sum total number of fish known to have entered the tributary (TF_i) using detections at all upstream sites including, in-stream PIT arrays (PIT_i), mobile tracking detections (Mob_i), and additional upstream fixed site arrays (UF_i).

$$DE_i = \frac{LF_i}{TF_i} = \frac{LF_i}{PIT_i + Mob_i + UF_i}$$

Upper and lower bound 95% confidence interval limits were estimated as described in Newcombe (1998). Fish known to have shed radio transmitters, and fish that were reported harvested in a tributary below tributary fixed sites were censored from the analysis.

Comparison of Origin Composition by Tributary using PIT and Radio Tags

We calculated minimum estimates of tributary entry for radio tagged steelhead and estimated the total entry rates by adjusting for seasonal detection efficiency. The number of radio-tagged fish, grouped by season and origin, was divided by the respective seasonal tributary specific detection efficiency. The sum of the seasonal estimates (i.e. total of unique hatchery and wild steelhead) was used to estimate the proportion of hatchery and wild steelhead that entered each year. Chi-square tests (X^2) were used to test for significant differences in the proportion of hatchery and wild fish estimated

using PIT tag arrays and proportions generated using radio telemetry fixed sites after adjusting for detection efficiency (adjusted). Expected proportions escaping to lower tributary PIT array locations were provided by Washington Department of Fish and Wildlife (WDFW, unpublished data).

Fall Unknown Fates

Previous research conducted by Keefer et al. (2008a) determined 1-Jan to be a reasonable date to use as onset of the overwintering period for Lower Columbia and Snake River summer steelhead. We used the same date in tributary entry timing detections because the majority of fish had reached their overwintering locations by this date, where they were repeatedly detected "holding" in the same location throughout the wintering period and on into the spring spawning season. A subset of the tagged fish were last detected prior to 1-Jan and subsequently never detected further in either main-stem pools or tributaries anywhere within the system, or by any detection method (radio telemetry, PIT array or mobile tracking). These fish with unknown final fate were conservatively classified as fall mortalities, but we note this subset included the following fates: 1) harvested and unreported; 2) indirect harvest mortalities; 3) died as a result of handling or tagging; 4) fallen out of the Upper Columbia system and not detected further; 5) shed tags and were never detected further; and 6) suffered some form of natural mortality. The approach is conservative because it provides an upper limit on mortality/lowest limit on survival; we evaluate the potential magnitude of subcomponents of the unknown/mortality class and the effects on estimated rates in the Discussion. We also estimated seasonal survival by estimating mortality for several sources. For instance, we accounted for an indirect mortality category based on a 5% catch and release mortality rate (NMFS, 2003). Additionally, we classified a subset of fall mortalities into an unreported harvested and indirect harvest mortality categories based on creel survey harvest rates (available for 2015 tagged sample) and the proportion of radio tags returned by anglers. These fate scenarios were estimated with the aim of distinguishing between natural mortality ('Mortalities Prior to Wintering') and other forms of mortalities that occurred prior to 1-Jan. We assigned fall unknown fish to these categories as nearly all reported steelhead harvest occurred prior to 1-Jan 2016. Assignments of harvest locations of unreported fish (direct or indirect) were estimated using the overall harvest distribution provided by Washington Department of Fish and Wildlife creel data (WDFW, unpublished data). Steelhead classified as unknown/mortalities included steelhead that regurgitated radio tags as well as mortality, a concern in any radio tagging study. We examined telemetry records for evidence of shed tags and identified potential shed tags as those steelhead where: 1) fish were detected at PIT arrays but not radio-telemetry sites at more than one location and date; 2) fish were reported as collected at hatcheries without radio tags present, and/or 3) plausible PIT detections occurred after a radio tag was returned.

Overwintering Locations, Mortalities, and Survival

The overwintering period began 1-Jan and overwintering locations (Columbia River or tributary) were determined based on the location where a tagged fish was detected with most frequency after 1-Jan but before the spawning period onset of 15-March. Geographic overwintering locations within the Columbia River were split between Upper Columbia River dam reservoirs and tributaries. Overwinter mortalities were determined by evaluating the detection history of tagged fish overwintering within the

main-stem Upper Columbia River and in tributaries. Fish detected consistently in the same location (<0.5 rkm from first winter detection location) beginning 1-Jan via mobile tracking and on through spawning months were considered to be mortalities. If tagged fish were detected: 1) having moved greater than 0.5 km from their overwintering location at any time after 1-Jan, 2) passing a dam, 3) at any PIT array (instream or at dams), or 4) at any radio telemetry fixed site, they were considered to have survived the overwintering period. Technically, overwintering mortalities could be considered "unknowns" as is the case for fall mortalities, given that the true fate of these fish could not be verified and mortality was assumed. Hence, mortality estimates may be overestimates as previously noted.

Spawning Locations

Spawning locations were assessed at the tributary level given that steelhead spawning has been documented in all four of the major Upper Columbia basin tributaries including the Entiat, Methow, Okanogan River, and Wenatchee Rivers. We defined the spawning onset date to be 15-March (2016 and 2017, respectively) as most fish had entered tributaries or were detected having made movements prior to this date. This date is consistent with the known onset of spawning for summer steelhead. Foster Creek located in Wells Pool near Chief Joseph Dam was the only minor tributary to the Columbia River that was not outfitted with a radio telemetry site, but was monitored exclusively by PIT array. Unmonitored potential spawning sites include the lower Chelan River, Chelan Hatchery outfall, Wells Dam tailrace outfall (Rocky Reach Pool), Eastbank Hatchery outfall (Rock Island Pool), and Crab Creek (Priest Pool). Spawning in the Columbia River is also possible but has never been rigorously documented. Very limited spawning is also possible in the small tributaries flowing into Wanapum Dam and Rock Island Dam reservoirs (Baldwin 2007).

Overwintering Survival and Survival to Spawn

Radio-tagged steelhead overwintering survival was estimated as 1- mortality given survival to the beginning of winter (1 -Jan). Overwintering survival was calculated independently for fish overwintering in Columbia River dam reservoirs and for those that overwintered in tributaries. Mortalities were determined using individual fish detection histories and should be considered worst case estimates, as determination of survival was entirely dependent on fish being detected by radio telemetry fixed sites, PIT tag arrays, and mobile tracking detections. Fish estimated to have spawned ('Tributary Survival to Spawn') were those with detection histories that indicated they had survived both the pre and post the 1 -Jan overwintering period and were detected overwintering in tributaries or were detected entering tributaries at some point after 1 -Jan ('Spring Tributary Entry Fish'). Steelhead classified as reported harvest and fallbacks below Priest Rapids Dam prior to 1-Jan were not included in survival rate estimates. Steelhead that overwintered in the Upper Columbia and fallbacks detected after 1 -Jan were included as overwinter survivors. Survivors detected moving post-wintering with unknown spawning locations were included in survival to spawn estimates given that many of these were detected in major tributaries and it is likely a subset of these fish entered tributaries undetected.

Kelting Rates

General migration detection histories were used to classify individual fish detected in tributaries as kelts if the adult fish was subsequently detected moving down river and ultimately detected arriving at the mouth of their returning tributary (by in-stream PIT array or fixed site) on or after 15 - March. March 15 was selected as an early kelting cut-off date based on similar work conducted in the Lower Columbia-Snake River basins (Keefer et al., 2008b). The minimum survival rate of kelts through the lower Columbia River was estimated from detections at Bonneville Dam. All kelts detected at Bonneville Dam were detected by the Bonneville corner collector (BCC), the juvenile bypass facility (B2J), or by the estuary towed array (TWX). Steelhead kelt detection efficiency at Bonneville Dam will not be available until next year when kelts return to spawn.

Results

PIT and Radio-Tagging

A total of 400 and 407 adult summer steelhead were radio-tagged at the Priest Rapids Dam OLAFT facility in 2015 and 2016, respectively. The sampling periods ranged from 6-July 2015 and 10-November in 2015 and 6-July 2016 through 2-November 2016. A total of 13,766 and 5,927 fish were counted at Priest Rapids Dam during the sample periods (2015 and 2016, respectively); tagged fish constituted 2.91% of the run passing during the sample period in 2015, and 6.87% in 2016 (http://www.cbr.washington.edu/dart/query/adult_daily). Total annual Ladder counts provided by Grant County PUD were 14,316 and 6,498 for steelhead at Priest Rapids Dam in 2015 and 2016, respectively. The distribution of radio-tagged fish and total steelhead passage over Priest Rapids Dam by date of release is given in Figures 2 (2015 run) and 3 (2016 run). Mean number of fish sampled per day across both years was 5 with a median of 2, minimum of 1, and a maximum of 47 tagged per day. Of the total fish tagged in 2015, 264 were of hatchery origin and 136 were of wild origin, comprising 66% and 34% of total fish tagged, respectively. A total of 321 hatchery and 86 wild fish were tagged in 2016, comprising 79% and 21% of the total tagged fish, respectively. Results of the Kolmogrov-Smirnov (K-S) Test indicated no significant difference in the distribution timing of fish tagged by PIT and Radio telemetry tags in either year of sampling. A total of 23 radio-tagged fish met the criteria indicating they had shed radio telemetry tags anytime over the course of this study, 7 from the 2015 and 16 from the 2016 tagged steelhead years. Sex differences, rearing origin counts, and proportions are given (Table 2).

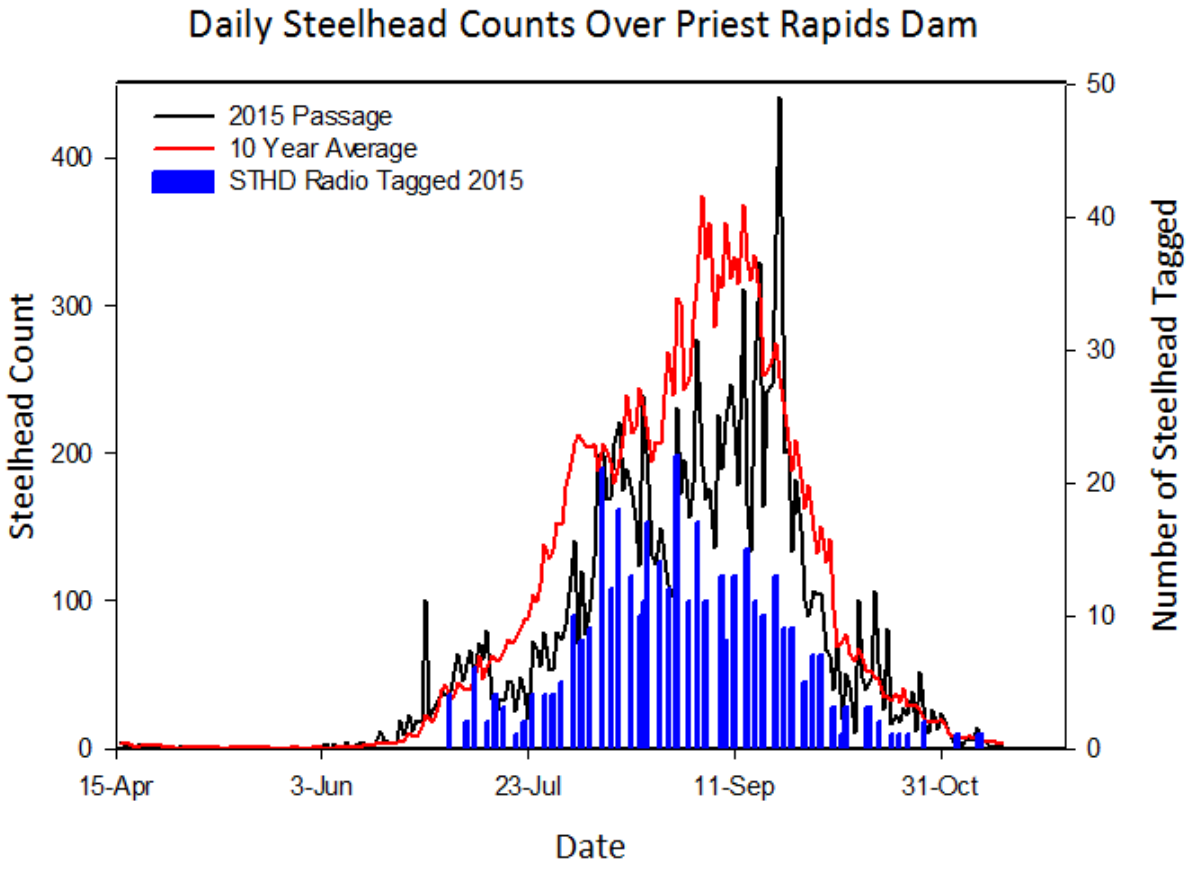

Figure 2. Summer steelhead count passage over Priest Rapids Dam in 2015 and average annual passage for the previous ten years are given by count date. Daily counts of summer steelhead radio-tagged from 6-July through 10-November 2015 are also indicated (blue bars) and radio-tagged fish counts are represented along the right y-axis.

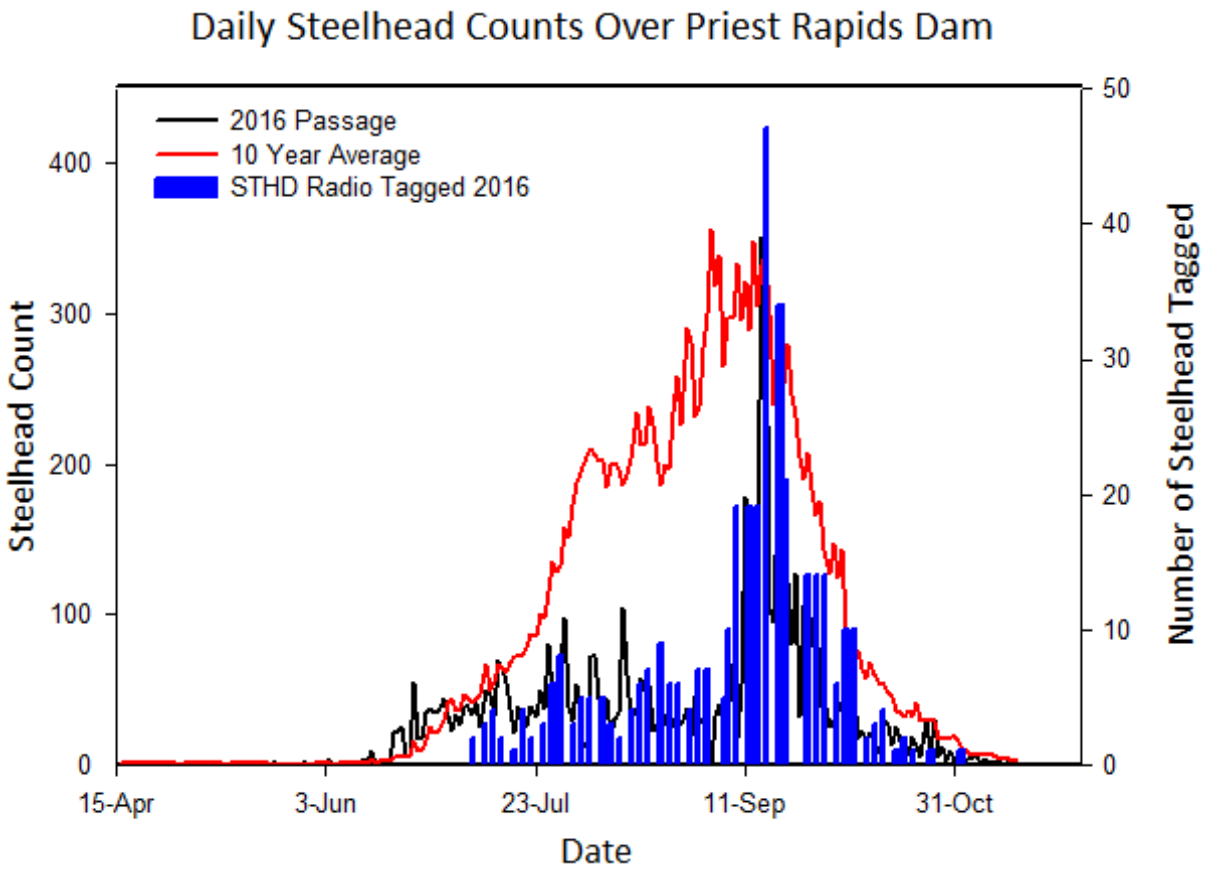

Figure 3. Summer steelhead count passage over Priest Rapids Dam in 2016 and average annual passage for the previous ten years are given by count date. Daily counts of summer steelhead radio-tagged from 6-July through 2-November 2016 are also indicated (blue bars) and radio-tagged fish counts are represented along the right y-axis.

Table 2. Origin and estimated sex frequencies of adult summer steelhead radio-tagged at Priest Rapids Dam 2015 (*n* = 400) and 2016 (*n* = 407). Proportions of males and females by origin are provided.

Sex	Number of Steelhead			Proportion	
	Hatchery	Wild	Total	Hatchery	Wild
		2015			
Male	103	54	157	0.656	0.344
Female	161	82	243	0.663	0.337
Total	264	136	400	0.660	0.340
		2016			
Male	75	30	105	0.714	0.286
Female	246	56	302	0.815	0.185
Total	321	86	407	0.789	0.211
		Total			
Male	178	84	262	0.679	0.321
Female	407	138	545	0.747	0.253
Grand Total	585	222	807	0.725	0.275

Upper Columbia River Radio-Tagged Steelhead Fallbacks

A total of 71 fish (18% tagged in 2015) and 94 fish (23% tagged in 2016) at Priest Rapids Dam were detected falling back below Priest Rapids Dam at some time prior to spawning season in both years of the study (Table 3). Combined for both years of this study, fallbacks represent (20%) of the total tagged fish released at Priest Rapids Dam (*n*=807). A majority of fallbacks were detected or reported in the Snake River basin and tributaries in both 2015 (61%) and 2016 (62%) run years. An additional 28 fish (39%) in 2015 and 36 fish (38%) in 2016 were detected or reported in the Middle Columbia River, tributaries, or at hatcheries below Priest Rapids Dam.

Tributary Return Timing

A total of 241 and 240 tagged fish (2016 and 2017, respectively) were detected entering Upper Columbia tributaries prior to and after 1-Jan, exhibiting a bimodal entry timing distribution. All tributaries other than the Entiat had a majority of fish entering prior to 1-January. Of the 241 total tributary returning tagged fish, 177 entered tributaries prior to 1-Jan 2016 (73%) while 64 (27%) entered tributaries after 1-Jan 2016. Of the 246 tributary returning tagged fish 180 (73%) were detected entering tributaries prior to 1-Jan 2017, while 66 (27%) were detected entering after the same date.

Percentages of seasonal tributary entry by natal origin were nearly identical to the total seasonal percentages (approx. 73% hatchery and 74% wild entered pre 1-Jan 2016). Tributary entry timing by origin was slightly more variable the second year (2017) with 74% and 70% (hatchery and wild, respectively) detected entering tributaries prior to 1-Jan 2017. A small percentage (~5%) of tagged fish were detected entering an Upper Columbia tributary other than their final return tributary detection.

Table 3. Radio-tagged summer steelhead tributary fallback detection locations. Locations are split between fallbacks returning to the Snake River and tributaries, Middle Columbia River tributary and other fallback locations. Counts of fallback fish rearing origins (H and W) and totals (T) are provided.

Region	River/Other	H	W	T	H	W	T	All
		2015 Run Fallbacks			2016 Run Fallbacks			
Middle Columbia								
	John Day River	0	2	2	1	0	1	3
	Umatilla River	0	2	2	0	0	0	2
	Walla Walla River	0	0	0	1	1	2	2
	Yakima River	0	12	12	2	6	8	20
	Columbia River - Hanford Reach	8	3	11	11	3	14	25
	Columbia River - McNary Dam	0	0	0	1	0	1	1
	Columbia River - Priest Hatchery	0	0	0	1	0	1	1
	Columbia River - Ringold Hatchery	1	0	1	9	0	9	10
	Total	9	19	28	26	10	36	64
Snake River								
	Asotin Creek	0	1	1	0	0	0	1
	Joseph Creek	0	1	1	1	0	1	2
	Salmon River	4	2	6	3	0	3	9
	Grande Ronde River	4	0	4	0	0	0	4
	Tucannon River	1	1	2	3	0	3	5
	Snake River	20	9	29	44	7	51	80
	Total	29	14	43	51	7	58	101
Grand Total		38	33	71	77	17	94	165

We assigned these fish to a population based on their final tributary entry. Foster Creek was monitored exclusively by PIT tag array, 4 and 6 radio-tagged fish (2016 and 2017, respectively) were detected entering this tributary after 1-Jan in both years. Total counts and proportions of return tributary detections before and after 1-Jan 2016 were similar regardless of fish origin. Further breakdown of returning tributary detected fish counts, proportions and origins are provided (Table 4).

Table 4. The number and proportion (in parenthesis) of steelhead detected entering a tributary pre and post 1-Jan, 2016 (upper) 2017 (lower).

Tributary	Entry Before 1-Jan 2016						Entry After 1-Jan 2016						Grand Total
	Hatchery		Wild		Total		Hatchery		Wild		Total		
Entiat	1	(0.25)	6	(0.43)	7	(0.39)	3	(0.75)	8	(0.57)	11	(0.61)	18
Methow	65	(0.84)	23	(0.85)	88	(0.85)	12	(0.16)	4	(0.15)	16	(0.15)	104
Okanogan	25	(0.63)	9	(0.64)	34	(0.63)	15	(0.38)	5	(0.36)	20	(0.37)	54
Wenatchee	22	(0.73)	26	(0.84)	48	(0.79)	8	(0.27)	5	(0.16)	13	(0.21)	61
Foster Ck.	0	(0.00)	0	(0.00)	0	(0.00)	4	(1.00)	0	(0.00)	4	(1.00)	4
Total	113	(0.73)	64	(0.74)	177	(0.73)	42	(0.27)	22	(0.26)	64	(0.27)	241

Tributary	Entry Before 1-Jan 2017						Entry After 1-Jan 2017						Grand Total
	Hatchery		Wild		Total		Hatchery		Wild		Total		
Entiat	1	(0.20)	3	(0.20)	4	(0.20)	4	(0.80)	12	(0.80)	16	(0.80)	20
Methow	93	(0.79)	22	(0.85)	115	(0.80)	24	(0.21)	4	(0.15)	28	(0.20)	143
Okanogan	37	(0.82)	5	(0.83)	42	(0.82)	8	(0.18)	1	(0.17)	9	(0.18)	51
Wenatchee	7	(0.54)	12	(0.92)	19	(0.73)	6	(0.46)	1	(0.08)	7	(0.27)	26
Foster Ck.	0	(0.00)	0	(0.00)	0	(0.00)	6	(1.00)	0	(0.00)	6	(1.00)	6
Total	138	(0.74)	42	(0.70)	180	(0.75)	48	(0.26)	18	(0.30)	66	(0.27)	246
Sum Total	251	(0.74)	106	(0.73)	357	(0.74)	90	(0.26)	40	(0.27)	130	(0.27)	487

Tags Returned

In total, 70 (17% of the 2015 tagged sample) and 47 (11.5% of 2016 tagged sample) radio tags were returned in both years of this study. The majority of fates assigned to steelhead with returned tags in 2015 were the result of harvest (81%) while steelhead fates assigned with returned tags in 2016 were most commonly the result of collection at hatcheries (74%). Radio tags were returned by anglers, hatchery staff, various departmental employees, and private citizens (Table 5).

Table 5. Number of returned tags by origin and the proportion of tags assigned to various harvest related fate categories.

Fate of Tagged Fish	Hatchery	Wild	Total	Hatchery	Wild	Total
	Returned 2016			*Returned 2017*		
Reported Harvested	56	1	57	6	0	6
Caught and released	1	4	5	3	0	3
Found on river bank	0	1	0	3	0	3
Collected at hatcheries	6	1	7	32	3	35
Total	63	7	70	44	3	47

Fish Harvest and Collection Locations in 2015-2016

A total of 64 radio tags were returned by anglers or collected at hatcheries or weirs during the 2015 run season, not including 4 fish caught and released and 1 tag found on the bank of the Methow River, as well as 1 additional tag pulled from a fish in the Umatilla River that was released. The majority of tagged fish harvested in Upper Columbia tributaries were harvested from the Methow River, where 20 hatchery fish and 1 wild fish were reported harvested by anglers. A total of 15 hatchery fish were harvested above Priest Rapids Dam in the Columbia River dam reservoirs. Eighteen tags were returned indicating fish were harvested or collected in waters below Priest Rapids Dam, or inferred from the detection history of the fish (this was the case for six hatchery origin fish). Of these, 3 fish were collected for broodstock (one at Ringold Hatchery, two on the Grande Ronde River) with one additional hatchery fish collected at Wallowa Hatchery. Further breakdown of fish harvest locations above and below Priest Rapids Dam in 2016 are provided in (Table 6).

Table 6. Locations of fish reported harvested by anglers or collected at hatcheries in 2016. Breakdown of tags returned is split between those harvested/collected above and below Priest Rapids Dam, and between main-stem and tributary locations. All totals provided are based on information reported by anglers, and hatchery or tribal staff, or were inferred by PIT tag detection histories (below Priest Rapids).

Location	Harvested			Broodstock or Found		
	Hatchery	Wild	Total	Hatchery	Wild	Total
Upstream of Priest Rapids Dam						
Methow	20	1	21	1	1	2
Okanogan	6	0	6	0	0	0
Entiat	1	0	1	0	0	0
Wenatchee	0	0	0	0	0	0
Columbia River	15	0	15	1	0	1
Total	42	1	43	2	1	3
Downstream of Priest Rapids Dam						
Columbia River	6	0	6	1	0	1
Snake River Basin	8	0	8	3	0	3
Total	14	0	14	4	0	4
Grand Total	56	1	57	6	1	7

Unreported Harvest of Radio-Tagged Fish 2015

Of the estimated 7,907 adipose-clipped hatchery steelhead available for harvest in 2015-2016 fishing season, 1588 were reported harvested indicating a 20.1% harvest rate (WDFW, unpublished data). Of 233 radio-tagged adipose clipped hatchery origin fish, 42 were reported harvested indicating a ~18.1% radio-tagged fish harvest rate. Assuming radio-tagged steelhead were reported harvested at the same

rate as non-tagged fish, the ratio of these harvest rates (0.181/0.201) indicates a reporting rate of 0.90. When the reporting rates are divided by the number of radio-tagged fish reported (42/0.90 = 47), an additional 5 hatchery origin fish were likely harvested and went unreported. The 5 hatchery origin fish represent 2% of the available non-fallback, non-harvested radio-tagged sample. These fish were assigned a fate of unreported harvest as they were last detected in high use harvest locations (Table 7) and where fall mortalities were last detected (i.e. Wells Pool and Methow River).

An additional two hatchery origin radio-tagged fish were detected in private residences and are likely examples of unreported harvest and represent the only tags with last known detections repeatedly detected out of water. As only 44% of the anglers that reported harvesting radio-tagged steelhead reside in the Upper Columbia basin (based on addresses submitted by anglers) it is logical that not all unreported radio tags would be detected during surveys.

Adjusting for Indirect Angler Mortality of Radio-Tagged Fish 2015-2016

Indirect angler mortality estimates were derived from the estimated number of fish caught and released and multiplying by a 5% assumed mortality rate (Steele, 2016). Creel data collected in 2015 (WDFW, unpublished data), of the estimated fishing effort in the Upper Columbia and the 4,560 wild fish present in 2015 resulted in an estimated hooking mortality rate of 0.013. This rate multiplied by the 136 wild radio-tagged fish for that year indicates that a minimum estimate of 2 fish likely died as a result of indirect angler catch and release. Mortality locations were assigned from last known fish detection locations of radio-tagged fish initially assigned as fall mortalities (Table 7).

Table 7. Location assignments of radio-tagged steelhead categorized as unreported harvest or indirect mortality upstream of Priest Rapids Dam.

Location	Unreported Harvest			Indirect Angler Mortality		
	Hatchery	Wild	Total	Hatchery	Wild	Total
			Columbia River Reach			
Priest	0	0	0	0	0	0
Wanapum	0	0	0	0	0	0
Rock Island	1	0	1	0	0	0
Rocky Reach	0	0	0	0	1	1
Wells	1	0	1	0	1	1
Total	2	0	2	0	2	2
			Tributary			
Entiat	0	0	0	0	0	0
Methow	2	0	2	0	0	0
Okanogan	1	0	1	0	0	0
Wenatchee	0	0	0	0	0	0
Total	3	0	3	0	0	0
Grand Total	5	0	5	0	2	2

Fish Harvest and Collection Locations in 2016-2017

A total of 41 radio tags were returned by anglers or collected at hatcheries or weirs during the 2016 run season, not including 1 fish caught and released in Hanford Reach below Priest Rapids, and 3 tags found on the bank (1 in the Methow, 2 on the bank of Rocky Reach reservoir), as well as 2 additional tags pulled from fish carcasses on the bank of the Methow River. The 2016 Upper Columbia River steelhead fishery was suspended given low adult escapement to the basin for that year. With the exception of 1 fish harvested in the Upper Columba River (tribal harvest) the 5 remaining reported harvested fish were harvested at locations below Priest Rapids Dam (1 in Hanford Reach, 4 in Snake River and tributaries). Further breakdown of fish harvest locations above and below Priest Rapids Dam in 2017 are provided (Table 8).

Table 8. Locations of fish reported harvested by anglers or collected at hatcheries in 2017. Breakdown of tags returned is split between those harvested/collected above and below Priest Rapids Dam, and between main-stem and tributary locations. All totals provided are based on information reported by anglers, and hatchery or tribal staff, or were inferred by PIT tag detection histories (below Priest Rapids).

Location	Harvested			Broodstock or Found		
	Hatchery	Wild	Total	Hatchery	Wild	Total
Upstream of Priest Rapids Dam						
Methow	0	0	0	22	3	25
Okanogan	0	0	0	0	0	0
Entiat	0	0	0	0	0	0
Wenatchee	0	0	0	0	0	0
Columbia River	1	0	1	9	0	9
Total	1	0	1	31	3	34
Downstream of Priest Rapids Dam						
Columbia River	1	0	1	1	0	1
Snake River Basin	4	0	4	0	0	0
Total	5	0	5	1	0	1
Grand Total	6	0	6	32	3	35

Mortalities Prior to Wintering Period

A total of 37 radio-tagged fish (in both years) last detected prior to 1-Jan were classified as fall mortalities and constitute 9.2% and 9.1% of the total tagged samples for 2015 and 2016, respectively. Hatchery fish were more commonly detected as mortalities during both years and constituted 86% and 72% of the total assigned fall mortalities (2015 and 2016, respectively). The majority of fall mortality assigned fish last detections took place in main-stem reservoirs (75% and 81% for 2015 and 2016, respectively) while tributary fall mortalities were most commonly last detected in the Methow River

(68% of total tributary assigned fall mortalities). Counts of tagged fish last detection locations prior to 1-Jan are provided (Table 9). Fish last detected in Priest Rapids Reservoir closest to Priest Rapids Dam may provide an estimate of short term tagging related mortality.

Table 9. Counts of tagged fish, by origin, last detected prior to 1-Jan in the Upper Columbia River and tributaries across both tagging years.

Location	Hatchery	Wild	Total	Hatchery	Wild	Total	All
	Columbia River Reach 2015			*Columbia River Reach 2016*			
Priest	6	3	9	7	2	9	18
Wanapum	2	1	3	1	0	1	4
Rock Island	5	0	5	5	2	7	12
Rocky Reach	0	0	0	2	0	2	2
Wells	10	1	11	7	4	11	22
Total	23	5	28	22	8	30	58
	Tributary 2015			*Tributary 2016*			
Entiat	0	0	0	0	0	0	0
Methow	9	0	9	1	1	2	11
Okanogan	0	0	0	1	0	1	1
Wenatchee	0	0	0	3	1	4	4
Total	9	0	9	5	2	7	16
Grand Total	32	5	37	27	10	37	74

Overwintering Distribution

A total of 548 radio-tagged steelhead were detected overwintering in the Upper Columbia in both years of the study representing 68% of the total tagged sample (*n* = 807). A total of 248 and 300 fish (2016 and 2017, respectively) overwintered in the Upper Columbia River and represented 62% and 73% of each year's radio-tagged sample (*n* = 400 in 2016, and *n* = 407 in 2017, respectively). A greater proportion of fish overwintered in the Columbia River than tributaries (133 and 163) representing ~54% of the total overwintering fish during each consecutive year. Wells Dam reservoir had the highest count (76 and 92) and percent (31%) of total overwintering fish across all monitored locations during both years. Methow River overwintering fish represented 17% and 26% of the total tributary overwintering fish (2016 and 2017, respectively) and represented the majority of the total tributary overwintering fish in 2017, but not 2016. Conversely, Wenatchee River overwintering fish represented 18% of total fish in 2016, but only 5% in 2017. No fish were consistently observed as overwintering in the Entiat River in either year, although some were detected entering prior to 1-Jan. Hatchery origin fish made up the majority of overwintering fish in every location with the exceptions of the Wenatchee River (both years) and Rocky Reach reservoir (2016). Total counts and proportions of overwintering fish by location, rearing origin, and year are provided (Table 10).

Table 10. Counts of radio-tagged fish by overwintering distribution within Upper Columbia basin pools and tributaries in 2016. Total counts by overwintering location and proportions of fish by rearing origin (H and W, hatchery and wild respectively) and totals (T) by location are given.

Location	2016			*Proportion 2016*			2017			*Proportion 2017*			All
	H	W	T	H	W	T	H	W	T	H	W	T	
						Columbia River Reach							
Priest	9	6	15	0.60	0.40	0.06	8	3	11	0.73	0.27	0.04	26
Wanapum	5	3	8	0.63	0.38	0.03	10	0	10	1.00	0.00	0.03	18
Rock Island	3	5	8	0.38	0.63	0.03	4	7	11	0.36	0.64	0.04	19
Rocky Reach	13	13	26	0.50	0.50	0.10	24	15	39	0.62	0.38	0.13	65
Wells	53	23	76	0.70	0.30	0.31	81	11	92	0.88	0.12	0.31	168
Total	83	50	133	0.62	0.38	0.54	127	36	163	0.78	0.22	0.54	296
						Tributary							
Entiat	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0
Methow	26	16	42	0.62	0.38	0.17	64	13	77	0.83	0.17	0.26	119
Okanogan	19	9	28	0.68	0.32	0.11	39	5	44	0.89	0.11	0.15	72
Wenatchee	20	25	45	0.44	0.56	0.18	4	12	16	0.25	0.75	0.05	61
Total	65	50	115	0.57	0.44	0.46	107	30	137	0.78	0.22	0.46	252
Grand Total	148	100	248	0.60	0.40	1.00	234	66	300	0.78	0.22	1.00	548

Apparent Overwintering Mortalities

A combined total of 92 overwintering fish (16.8% of the total 548 combined overwintering fish) did not make movements considered to be significant (<0.5 rkm) at any time after the overwintering onset, or went undetected at PIT arrays as previously specified. A total of 49 and 43 overwintering mortalities were assigned, constituting 19.7% and 14.3% of the overwintering fish between both years (2016 and 2017, respectively). Hatchery origin fish made up the majority of overwintering mortalities (80% and 84%) in both years (2016 and 2017, respectively). Wells Dam reservoir had the highest proportion of mortalities of any one location (0.29 and 0.30) across both years of the study (2016 and 2017, respectively). Total counts of distinct fish overwintering mortalities by last known location and proportions by rearing origin are provided (Table 11).

Table 11. Overwintering tagged fish mortalities by last detection location post 1-January. Counts, proportions, and total mortalities by rearing origin (H and W, indicate hatchery and wild respectively) and the proportion of total (T) mortalities are given.

Location	Overwinter 2016			Proportion			Overwinter 2017			Proportion			All
	H	W	T	H	W	T	H	W	T	H	W	T	
Columbia River Reach													
Priest	3	3	6	0.50	0.50	0.12	1	0	1	1.00	0.00	0.02	7
Wanapum	4	0	4	1.00	0.00	0.08	8	0	8	1.00	0.00	0.19	12
Rock Island	1	2	3	0.33	0.67	0.06	3	1	4	0.75	0.25	0.09	7
Rocky Reach	6	1	7	0.86	0.14	0.14	3	1	4	0.75	0.25	0.09	11
Wells	12	2	14	0.86	0.14	0.29	13	0	13	1.00	0.00	0.30	27
Total	26	8	34	0.77	0.24	0.69	28	2	30	0.93	0.07	0.70	64
Tributary													
Entiat	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0
Methow	5	0	5	1.00	0.00	0.10	4	1	5	0.80	0.20	0.12	10
Okanogan	4	1	5	0.80	0.20	0.10	3	1	4	0.75	0.25	0.09	9
Wenatchee	4	1	5	0.80	0.20	0.10	1	3	4	0.25	0.75	0.09	9
Total	13	2	15	0.87	0.13	0.31	8	5	13	0.62	0.38	0.30	28
Grand Total	39	10	49	0.80	0.20	1.00	36	7	43	0.84	0.16	1.00	92

Overwintering Survival Estimates

Fish detected having moved any time after 1-Jan 2016 were categorized as having survived the overwintering period. Of those detected at PIT tag arrays, a total of 199 and 257 (2016 and 2017, respectively) fish of the Upper Columbia overwintering group (*n=548* total for both years) were detected having moved, and were categorized as having survived the overwintering period (80% and 86% for 2016 and 2017, respectively). Of the 133 and 163 total tagged fish that overwintered in the Columbia River, 99 and 133 (2016 and 2017, respectively) were detected moving at some point after 1-Jan (74% and 82% for 2016 and 2017, respectively). Among tributary overwintering fish, 100 and 124 were detected moving after the winter period (87% and 90% survived) for 2016 and 2017 tagged sample years respectively.

Hatchery origin fish exhibited lower overwintering survival (73% and 85%) versus wild fish (90% and 89%) throughout the Upper Columbia basin and between years (2016 and 2017, respectively). Hatchery fish overwintering in dam reservoirs had lower survival rates (69% and 78%) versus wild fish (84% and 94%) across both years (2016 and 2017, respectively). Tributary overwintering survival of hatchery fish was lower than wild fish in 2016 (80% and 96%) but not in 2017 (92% and 83% hatchery and wild, respectively). Total counts and proportions of fish having survived overwintering by location and rearing origin in 2016 (*Appendix A*) and 2017 (*Appendix B*) are provided.

Spring Tributary Entry Fish

Radio-tagged steelhead overwintering in the Columbia River and subsequently detected moving prior to spawning exhibited three primary behaviors: 1) detected entering a tributary, 2) detected falling back out of the Upper Columbia River basin, or 3) detected moving within the Columbia River but were never detected entering a tributary. A total of 69 and 52 (2016 and 2017, respectively) Columbia River overwintering radio-tagged steelhead were detected entering tributaries after the overwintering period. This number differs slightly from the previously reported tributary entry detections as it includes the addition of mobile tracking detections added to unique fish detection histories, and mobile tracking occurred exclusively during winter and spring months (Jan-May 2016 and 2017).

An additional 30 and 79 (2016 and 2017, respectively) fish were detected making movements after the wintering period (i.e., Other Detected Survivors; Table 12) but were not detected entering Upper Columbia River tributaries. Of this subset, 9 and 25 (2016 and 2017, respectively) fish fell back after the overwintering onset date and where detected by PIT arrays or reported at locations below Priest Rapids Dam (*Below Priest*). Additionally, 4 and 8 fish were detected entering Foster Creek in Wells Dam reservoir (2016 and 2017, respectively), this site was monitored exclusively by PIT tag array and mobile tracking. Eight additional fish were detected entering Beebee Springs Hatchery outflow channel in 2017, this site was monitored exclusively by mobile tracking.

Adjusting observed frequencies for non-detection using detection probabilities generated for tributary radio telemetry fixed sites described below, 9 and 3 (2016 and 2017, respectively) survivors with unknown tributary assignments were estimated to have entered tributaries (i.e., Estimated; Table 12). The remaining 8 and 35 (2016 and 2017, respectively) surviving fish were never detected entering an Upper Columbia tributary by any method but were detected moving after overwintering. Counts of post wintering tributary entry fish, fish estimated to have entered tributaries, and other detected post wintering behaviors separated by rearing origins with corresponding totals are provided (Table 12).

Tributary Survival to Spawn

A total of 167 and 144 (2016 and 2017, respectively) fish were detected in tributaries having survived overwintering or having entered tributaries from the Columbia River after 1-Jan. Total counts per tributary differ slightly from overwintering survival estimates given that 5 and 6 (2016 and 2017, respectively) fish overwintered in a tributary other than their ultimate return tributary (see *Appendices A and B*). Six of these fish overwintered in the Methow River and then 3 fell back to the Wenatchee River (2 in 2016 and 1 in 2017, respectively), 2 to the Okanogan River (1 each year), and one fish to the Entiat (2017). Five steelhead overwintered in the Okanogan River and fell back to the Methow River (2 in 2016 and 3 in 2017).

The overall probability of survival to spawn of steelhead that were not harvested, collected for broodstock, surplused, or fell back over Priest Rapids Dam prior to 1-Jan was 0.72 for the Upper Columbia basin radio-tagged steelhead across both years of this study (Table 13). Hatchery origin fish survival probability was lower (0.60 and 0.73, for 2016 and 2017, respectively) than wild origin fish (0.86

and 0.77, for 2016 and 2017, respectively). Fish collected for broodstock or surplused in the Methow River (2 in 2016, and 25 in 2017 respectively) were not included as putative spawners.

Table 12. The number and origin of radio-tagged fish that were detected entering tributaries after 1-Jan 2016 and 2017. Estimated numbers of fish were based on spring 2016 and 2017 tributary detection probabilities. Fish detected in Foster Creek, Beebee Springs, fallbacks after overwintering, and unknown return tributary fish are included.

Location	2016 Survivors			2017 Survivors			All
	Hatchery	Wild	Total	Hatchery	Wild	Total	
			Detected				
Entiat	3	14	17	3	15	18	*35*
Methow	15	9	24	16	4	20	*44*
Okanogan	10	6	16	4	0	4	*20*
Wenatchee	8	4	12	6	4	10	*22*
Total	36	33	69	29	23	52	*121*
			Estimated				
Entiat	0	1	1	0	1	1	*2*
Methow	1	0	1	1	0	1	*2*
Okanogan	4	2	6	0	0	0	*6*
Wenatchee	1	0	1	1	0	1	*2*
Total	6	3	9	2	1	3	*12*
			Other Detected Survivors				
Foster Creek	3	1	4	8	0	8	*12*
Beebee Springs	0	0	0	8	0	8	*8*
Unknown	8	0	8	31	4	35	*43*
Below Priest	4	5	9	18	7	25	*34*
Total	15	6	21	65	11	76	*97*
Grand Total	57	42	99	96	35	131	*230*

Table 13. Final counts of Upper Columbia radio-tagged steelhead survivors to tributaries, total survivors, and total mortalities (fall and overwintering). Survival probabilities are extrapolated using total survivors and total combined mortalities.

Location	2016 Spawners			2017 Spawners			All
	Hatchery	Wild	Total	Hatchery	Wild	Total	
			Tributary Putative Spawners				
Entiat	3	14	17	4	15	19	36
Methow	36	25	61	53	13	66	125
Okanogan	25	14	39	32	4	36	75
Wenatchee	24	28	52	10	13	23	75
Total	87	80	167	99	45	144	311
			Additional Survivors				
Columbia River	21	9	30	67	12	79	109
Grand Total Survivors	108	89	197	166	57	223	420
			Mortalities				
Fall Mortalities	32	5	37	27	10	37	74
Overwintering Mortalities	39	10	49	36	7	43	92
Grand Total Mortalities	71	15	86	63	17	80	166
Survival Probability	0.603	0.856	0.696	0.725	0.770	0.736	0.716

Tributary Fixed Site Detection Efficiencies

Radio telemetry fixed site detection probabilities were greater than 85% for nearly all tributaries with the exception of the Okanogan River in the spring and fall of 2016. The mean detection efficiency for all tributaries over the course of this study was 0.89 and 0.91 (2016 and 2017, respectively). The Entiat River lower radio telemetry fixed site array detection efficiency was 1.0 in fall when all fish that entered were detected and 0.933 in spring. This site had the smallest sample size (n = 21, in both years), resulting in the largest confidence intervals. The Methow River had the largest sample size and the least variable detection efficiency between seasons and across both years. The Okanogan River lower RT fixed site displayed the highest temporal variation in detection probability decreasing from 0.86 to 0.70 in 2016 (fall and spring, respectively) then increasing from 0.71 to 0.95 in 2017 (fall and spring, respectively). The primary factors decreasing detection efficiency were radio telemetry fixed site power outages, damaged or windblown antennas, and spring flooding events. Detection efficiency estimates for all tributaries, across season, and years, and counts of unique fish detections for lower tributary fixed site arrays (Lower) and all other upper tributary detection sites (Upstream) are provided (Table 14).

Table 14. Counts of distinct fish detections for Upper Columbia tributaries using radio telemetry fixed sites (Lower), and counts of total known tributary entry unique detections are provided (Upstream).

Location	Lower	Upstream	Estimated Efficiency	Lower	Upstream	Estimated Efficiency	Lower	Upstream	Estimated Efficiency
		Fall 2015			*Spring 2016*			*Total*	
Entiat	6	6	1.000	14	15	0.933	20	21	0.952
Methow	64	68	0.941	23	24	0.958	87	92	0.946
Okanogan	18	21	0.857	16	23	0.696	34	44	0.773
Wenatchee	40	47	0.851	9	10	0.900	49	57	0.860
Total	128	142	0.912	62	72	0.872	190	214	0.883
		Fall 2016			*Spring 2017*			*Total*	
Entiat	4	4	1.000	16	17	0.941	20	21	0.952
Methow	74	77	0.961	39	41	0.951	113	118	0.958
Okanogan	24	34	0.706	18	19	0.947	42	53	0.792
Wenatchee	23	26	0.885	10	11	0.909	33	37	0.892
Total	125	141	0.888	83	88	0.937	208	229	0.899
Grand Total	253	283	0.900	145	160	0.905	398	443	0.891

Tributary Entry Detections and Predicted Tributary Escapements

We estimated the number of adult steelhead reaching tributaries each season and year by adjusting the observed frequencies for undetected entry using estimated detection efficiencies. The number of estimated steelhead entering each tributary undetected averaged 3 (range: 0-14) because detection efficiencies were generally high (Table 15). A total of 26 and 21 radio-tagged fish (2016 and 2017, respectively) were estimated to have entered tributaries undetected over the two years of this study. The Okanogan River had the highest number of predicted non detected fish tributary entries given that its detection probability was the most variable between seasons and years monitored. Conversely, the Entiat River had only 2 fish estimated to have entered the tributary undetected, one each year. Total counts of observed numbers of tributary detected radio-tagged fish by origin, tributary detection probability estimates, estimated counts of non-detected fish, and totals are provided (Table 15). Detection probability upper and lower confidence intervals (95%) are also provided.

Table 15. Observed numbers of fish detected entering tributaries at lower tributary fixed site radio telemetry arrays (*lower*) and all upstream sites (RT, PIT, mobile tracking) across seasons and between years. Detection probability estimates and upper and lower confidence intervals (95%) are given. Predicted numbers of non-detected (ND) and the total number of tributary entry fish are also provided.

Location	Year	Season	Observed			Detection Probability			Predicted	
			H	W	T	Estimate	Upper 95% CI	Lower 95% CI	ND	Total
Entiat	2015	Fall	0	0	0	1.000	1.000	0.541	0	0
	2016	Spring	3	14	17	0.933	0.998	0.681	1	18
	2016	Fall	0	0	0	1.000	1.000	0.398	0	0
	2017	Spring	3	15	18	0.941	0.999	0.713	1	19
Methow	2015	Fall	26	16	42	0.941	0.984	0.856	3	45
	2016	Spring	15	9	24	0.958	0.999	0.789	1	25
	2016	Fall	37	9	46	0.961	0.992	0.890	2	48
	2017	Spring	16	4	20	0.951	0.994	0.835	1	21
Okanogan	2015	Fall	19	9	28	0.857	0.970	0.637	5	33
	2016	Spring	10	6	16	0.696	0.868	0.471	7	23
	2016	Fall	28	4	32	0.706	0.849	0.525	14	46
	2017	Spring	4	0	4	0.947	0.999	0.740	0	4
Wenatchee	2015	Fall	20	25	45	0.851	0.938	0.717	8	53
	2016	Spring	8	4	12	0.900	0.997	0.555	1	13
	2016	Fall	4	9	13	0.885	0.976	0.698	2	15
	2017	Spring	6	4	10	0.909	0.998	0.587	1	11

Tributary Return Fish Origin Composition

The expected hatchery and wild steelhead proportions based on the PIT based patch occupancy model were similar to the observed proportions detected using radio telemetry and methods. Chi-square test results indicated that there was no significant difference in tributary origin compositions for any of the major tributaries steelhead populations. This finding was consistent across both years of this study (Table 16).

Table 16. Proportions of hatchery and wild steelhead detected entering major tributaries after adjusting radio telemetry frequencies for detection efficiency. Chi-square test statistics and P-Values (0.05) are provided.

Tributary Population	PIT Tag Arrays		Radio Telemetry (adjusted)			
	H	W	H	W	X^2	*P*-Value
2016						
Entiat	0.093	0.907	0.167	0.833	1.098	0.295
Methow	0.637	0.363	0.629	0.371	0.022	0.881
Okanogan	0.750	0.250	0.643	0.357	3.429	0.064
Wenatchee	0.481	0.519	0.500	0.500	0.103	0.749
2017						
Entiat	0.289	0.711	0.158	0.842	1.599	0.206
Methow	0.714	0.286	0.812	0.188	3.189	0.074
Okanogan	0.885	0.115	0.880	0.120	0.008	0.930
Wenatchee	0.520	0.480	0.462	0.538	0.247	0.556

Kelting Rate and Bonneville Dam Detections

A total of 174 fish were classified as kelts (92 in 2016 and 82 in 2017), which provides an estimate of the number of steelhead surviving to post-spawn kelt status from the total detected putative spawners (55.1% and 56.9% in 2016 and 2017, respectively; total spawners: 167 in 2016 and 144 in 2017). This included two kelts collected for reconditioning at Rock Island Dam by Yakama Nation Fisheries staff in spring 2016. These data suggest a combined Upper Columbia kelting rate of 56% of the fish detected overwintering, entering a tributary, and surviving to spawn (*n=311*). Of these, 63 and 65 were female indicating a 68% and 80% female kelt majority for 2016 and 2017 kelts, respectively.

Survival to Bonneville was low, with only 16 tagged steelhead (12 females, 4 males) detected at Bonneville Dam in 2016. Only 1 male kelt was detected at Bonneville Dam in 2017. The kelt migration survival (16/92 = 0.17) in 2016 and (1/82 = 0.01) in 2017 are minimum values given that kelt detection efficiency at Bonneville Dam is currently unavailable. An additional three tagged fish were detected at or below Bonneville Dam in 2016 with unknown return tributaries (not shown in Table 17, but part of the 'other detected survivors' spawning group in Table 12). Presuming these adults spawned upstream of Priest Rapids Dam produces a slightly higher survival rate through the kelt migration (19/92 = 0.21) for that year. An additional five tagged fish detected below Priest Rapids Dam were later detected at Bonneville, and are not included in Table 17. These fish were part of the 'Fallbacks Below Priest Rapids' group, three were detected in the Yakima River (2 in 2016 and 1 in 2017) and two were detected below Priest Rapids and part of the 'Kelt Lower Columbia Tributary' group provided in Table 19 (see next sections 'Final Fates Of 2015 and 2016 Priest Rapids Radio Tagged Steelhead'). Approximately 9.6% and 1.0% of the total Upper Columbia 'Tributary Survival to Spawn' (2016 and 2017, respectively) were

detected at or below the Bonneville Power facility. Rearing origins, sexes and counts of fish for both tag years included as part of the total Kelt rate are provided (Table 17 and 18). We note the reported proportions are unadjusted for the female sex-bias in tagging rate and likely overestimate true overall survival to kelting assuming females exhibited higher survival to kelting than males (Keefer et al. 2017).

Table 17. Number of downstream migrating kelts detected and proportions calculated from return tributary surviving radio-tagged fish detections, and the total 2015 tagged sample. Counts of fish are divided between those assigned as part of the kelting rate group (upper table) and those that were detected at or below Bonneville Dam (lower table). Counts of tagged fish sex (F and M, female and male, respectively) separated between rearing origins and totals (T) and proportions are provided.

Tributary	Hatchery			Wild			Total	Proportion Tributary Survivors *n*=167		
	F	M	All	F	M	All		F	M	All
Downstream Detected Kelts										
Entiat	0	0	0	6	5	11	11	0.036	0.030	0.066
Methow	6	4	10	9	2	11	21	0.090	0.036	0.126
Okanogan	9	4	13	7	1	8	21	0.096	0.030	0.126
Wenatchee	12	6	18	14	7	21	39	0.156	0.078	0.234
Total	27	14	41	36	15	51	92	0.377	0.174	0.551
Kelts Detected at Bonneville										
Entiat	0	0	0	3	1	4	4	0.018	0.006	0.024
Methow	0	0	0	2	0	2	2	0.012	0.000	0.012
Okanogan	2	0	2	0	0	0	2	0.012	0.000	0.012
Wenatchee	1	1	2	4	2	6	8	0.030	0.018	0.048
Total	3	1	4	9	3	12	16	0.072	0.024	0.096

Table 18. Number of downstream migrating kelts detected and proportions calculated from return tributary surviving radio-tagged fish detections, and the total 2016 tagged sample. Counts of fish are divided between those assigned as part of the kelting rate group (upper table) and those that were detected at or below Bonneville Dam (lower table). Counts of tagged fish sex (F and M, female and male, respectively) separated between rearing origins and totals (T) and proportions are provided.

Tributary	Hatchery			Wild			Total	Proportion Tributary Survivors *n*=144		
	F	M	All	F	M	All		F	M	All
Downstream Detected Kelts										
Entiat	0	3	3	6	7	13	16	0.042	0.069	0.111
Methow	27	0	27	6	1	7	34	0.229	0.007	0.236
Okanogan	15	1	16	2	0	2	18	0.118	0.007	0.125
Wenatchee	3	4	7	6	1	7	14	0.063	0.035	0.097
Total	45	8	53	20	9	29	82	0.451	0.118	0.569
Kelts Detected at Bonneville										
Entiat	0	0	0	0	1	1	1	0.000	0.007	0.007
Methow	0	0	0	0	0	0	0	0.000	0.000	0.000
Okanogan	0	0	0	0	0	0	0	0.000	0.000	0.000
Wenatchee	0	0	0	0	0	0	0	0.000	0.000	0.000
Total	0	0	0	0	1	1	1	0.000	0.007	0.007

Final Fates of 2015 Priest Rapids Tagged Steelhead

All fish radio-tagged and released at Priest Rapids Dam in 2015 were assigned a final fate given their individual detected migration histories. A total of 329 fish had detection histories or last detections (presumed mortalities) that suggested they remained above Priest Rapids Dam and within the Upper Columbia basin. Fifty-five of these were harvested, collected at hatcheries, or estimated harvested in the Upper Columbia main-stem or tributaries. A total of 171 fish were detected in tributaries (including Foster Creek) with 16 ultimately detected kelting to Bonneville Dam. The previously reported survival to spawn estimate of 169 tagged fish included two fish collected late in the spawning season (May 5th) for hatchery broodstock (not included below but part of the 'Reported Harvested/Collected in Upper Columbia Tributaries' group) and did not include the four Foster Creek detected fish (included below 'Survivors to Spawn'). A total of 71 radio-tagged steelhead (18%) were detected having fallen back below Priest Rapids Dam throughout the study in 2015 and 2016. These fish had fates split between those harvested or collected (*n=18*), those that were detected in tributaries downstream of Priest Rapids (*n=49*), and 4 fish ultimately detected at Bonneville Dam as kelts.

Among fish with unknown fates, 103 had detection histories that were more speculative as to what final fate may have taken place. A total of 86 fish were presumed mortalities between those with detection histories suggesting mortality pre and post 1-Jan 2016 overwintering onset. Further breakdown of final

fate possibilities were provided previously (see 'Mortalities Prior to Wintering' Table 9 and 'Apparent Overwintering Mortalities' Table 11). The remaining 17 fish include 14 with detection histories suggesting they survived the pre and post wintering period, these fish were never detected in Upper Columbia tributaries and may represent an estimate of fish that spawned in unmonitored spawning areas or entered tributaries undetected. Of these, three were later detected at Bonneville Dam as kelts, but their spawning tributary could not be determined. Further breakdown of final fates is given (Table 19). Fates, tag codes, overwintering locations, last PIT and last radio telemetry detections of 2015 tagged fish are provided (*Appendix C*).

Final Fates of 2016 Priest Rapids Tagged Steelhead

A total of 313 fish had detection histories or last detections (presumed mortalities) that suggested they remained above Priest Rapids Dam and within the Upper Columbia basin after being tagged in 2016. Thirty-five of these were harvested or collected at hatcheries in the Upper Columbia main-stem or tributaries. A total of 163 fish were detected in tributaries (including Foster Creek and Beebee Springs hatchery outflow) with 1 ultimately detected kelting to Bonneville Dam. This total also includes 3 fish estimated to have entered tributaries during the spring spawning season ('Spring Tributary Entry Fish'). The previously reported survival to spawn estimate of 144 tagged fish did not include fish collected for broodstock or surplus at hatcheries in the Upper Columbia basin. A total of 94 radio-tagged steelhead (23%) were detected having fallen back below Priest Rapids Dam throughout the study in 2016 and 2017. These fish had fates split between those harvested or collected (*n=6*), those that were detected in tributaries or at dams downstream of Priest Rapids (*n=87*), and 1 fish ultimately detected at Bonneville Dam as a kelt.

Of the Upper Columbia River remaining tagged fish, 115 had detection histories that were more speculative as to what final fate may have taken place. A total of 80 fish were presumed mortalities between those with detection histories suggesting mortality pre and post 1-Jan 2017 overwintering onset. Further breakdown of final fate possibilities were provided previously (see 'Mortalities Prior to Wintering' Table 9 and 'Apparent Overwintering Mortalities' Table 11). The remaining 35 fish have detection histories suggesting they survived the pre and post wintering period but were never detected in Upper Columbia tributaries and may represent an estimate of fish that spawned in unmonitored spawning areas or entered tributaries undetected. Further breakdown of final fates are given (Table 20). Fates, tag codes, overwintering locations, last PIT and last radio telemetry detections of 2016 tagged fish are provided (*Appendix D*).

Table 19. Final fates of the 2015 Priest Rapids Dam radio-tagged summer steelhead sample. Fates are split between fish that were detected falling back below Priest Rapids, fish detected remaining above Priest Rapids, and fish whose ultimate fates were more difficult to determine given fewer detections and suspected mortalities. Total counts of fish by rearing origin and proportions are provided.

Radio-Tagged Steelhead Fate	Number of Fish			Proportion		
	H	W	Total	H	W	Total
Last Detected Below Priest Rapids Dam						
Harvested/Collected	18	0	18	1.000	0.000	0.045
Detected in Snake or Lower Columbia	20	29	49	0.408	0.592	0.123
Kelt Lower Columbia Tributary	0	4	4	0.000	1.000	0.010
Total	38	33	71	0.535	0.465	0.178
Last Detected Above Priest Rapids Dam						
Reported Harvested/Collected in Columbia River	16	0	16	1.000	0.000	0.040
Reported Harvested/Collected in Tributary	28	2	30	0.933	0.067	0.075
Estimated Indirect Hooking Mortalities	0	2	2	0.000	1.000	0.005
Estimated Unreported Harvest	7	0	7	1.000	0.000	0.018
Total Upper Columbia Harvest Fates	51	4	55	0.927	0.073	0.138
Fates of Tributary Survivors to Spawn						
Survivors to Spawn*	49	30	79	0.620	0.380	0.198
Kelts	37	39	76	0.487	0.513	0.190
Kelts (Detected at Bonneville)	4	12	16	0.250	0.750	0.040
Total Tributary Survivors to Spawn	90	81	171	0.526	0.474	0.428
Upper Columbia Tagged Fish Presumed Mortalities						
Presumed Fall Mortalities	32	5	37	0.865	0.135	0.093
Presumed Overwinter Mortalities	39	10	49	0.796	0.204	0.123
Total Presumed Mortalities	71	15	86	0.826	0.174	0.215
Overwinter Survivors Not Detected in Tributaries						
Columbia River	12	2	14	0.857	0.143	0.035
Kelted Survivors (Detected at Bonneville)	2	1	3	0.667	0.333	0.008
Total Survivors	14	3	17	0.824	0.176	0.043
Total Upper Columbia Tagged Fish Fates	226	103	329	0.687	0.313	0.823
Grand Total Radio Tagged Fish	264	136	400	0.660	0.340	1.000

*****Includes fish detected in Foster Creek.

Table 20. Final fates of the 2016 Priest Rapids Dam radio-tagged summer steelhead sample. Fates are split between fish that were detected falling back below Priest Rapids, fish detected remaining above Priest Rapids, and fish whose ultimate fates were more difficult to determine given fewer detections and suspected mortalities. Total counts of fish by rearing origin and proportions are provided.

Radio-Tagged Steelhead Fate	Number of Fish			Proportion		
	H	W	Total	H	W	Total
Last Detected Below Priest Rapids Dam						
Harvested/Collected	6	0	6	1.000	0.000	0.015
Detected in Snake or Lower Columbia	71	16	87	0.816	0.184	0.214
Kelt Lower Columbia Tributary	0	1	1	0.000	1.000	0.002
Total	77	17	94	0.819	0.181	0.231
Last Detected Above Priest Rapids Dam						
Reported Harvested/Collected in Columbia River	10	0	10	1.000	0.000	0.025
Reported Harvested/Collected in Tributary	22	3	25	0.880	0.120	0.061
Estimated Indirect Hooking Mortalities	0	0	0	0.000	0.000	0.000
Estimated Unreported Harvest	0	0	0	0.000	0.000	0.000
Total Upper Columbia Harvest Fates	32	3	35	0.914	0.086	0.086
Fates of Tributary Survivors to Spawn						
Survivors to Spawn*	64	16	80	0.800	0.200	0.197
Kelts	53	29	82	0.646	0.354	0.201
Kelts (Detected at Bonneville)	0	1	1	0.000	1.000	0.002
Total Tributary Survivors to Spawn	117	46	163	0.718	0.282	0.400
Upper Columbia Tagged Fish Presumed Mortalities						
Presumed Fall Mortalities	27	10	37	0.730	0.270	0.091
Presumed Overwinter Mortalities	36	7	43	0.837	0.163	0.106
Total Presumed Mortalities	63	17	80	0.788	0.213	0.197
Overwinter Survivors Not Detected in Tributaries						
Columbia River	32	3	35	0.914	0.086	0.086
Kelted Survivors (Detected at Bonneville)	0	0	0	0.000	0.000	0.000
Total Survivors	32	3	35	0.914	0.086	0.086
Total Upper Columbia Fates	244	69	313	0.780	0.220	0.769
Total Tagged Fish	321	86	407	0.789	0.211	1.000

*Includes Fish detected in Foster Creek, Beebee Springs, and estimated tributary entry fish.

Discussion

Independent validation of the PIT tag based patch occupancy model tributary escapement estimates was a primary objective of the radio telemetry study. The proportion of hatchery and wild steelhead entering a tributary detected by radio telemetry arrays was not significantly different than the proportion of hatchery and wild fish generated using a patch occupancy model (WDFW, unpublished data) suggesting these estimates of proportion are unbiased. Validation of the PIT tag patch occupancy model was a final step prior to the formal adoption of this method for estimating steelhead tributary-specific abundance.

Estimated detection efficiency of radio telemetry fixed sites differed between sites, seasons, and years. The Okanogan River lower fixed site tributary radio telemetry array had the most variability across all sites do in part to frequent power outages (Fall 2016) and heavy flooding that occurred in spring of 2016. In contrast, the Entiat River had the highest seasonal detection efficiencies, including two seasons where all fish entering the tributary were detected (Fall of 2015 and 2016, respectively). Detection efficiency at tributaries is likely affected in part by the morphology, water depth, and geographic characteristics of the tributary location at which the fixed site was located, as well as equipment outages. Differences in river gradient, channelization, and annual flow regime dynamics may explain to some degree detection efficiency variability between tributaries and seasons.

A total of 23 radio-tagged fish met one or more of the criteria indicating they had likely shed tags across the two study years. The 2.9% shed tag rate is similar to that observed in steelhead tagged in the Snake and Lower Columbia Rivers (~4.0%; Keefer et al. 2004).

Overwintering Distribution and Survival

The overwintering distribution and survival of tagged steelhead differed among years, in part, because there was no sport fishing season for hatchery fish tagged in 2016 (Year 2). Hence, proportionately more hatchery fish were detected overwintering and surviving to spawn compared to 2015. The lack of harvested fish may also account for the slightly higher fallback rate and count in the 2nd year (2016) in that 25 fish fell back below Priest Rapids Dam after overwintering, that otherwise would have been available for harvest had the fishery taken place.

A substantial proportion (82/296; 28%) of main-stem overwintering fish had entered tributaries before main-stem overwintering. This behavior was most commonly observed in fish detected entering the Entiat River, and may be attributed to the fact that much of the Entiat River has been observed freezing (including the lower river) and may not provide desirable overwintering habitat. Although temperature monitoring was not a primary objective of this research it may serve as an alternative reasoning in explaining why the majority of fish overwintered in main-stem dam reservoirs vs tributaries where temperatures were likely less variable, possibly providing a more stable habitat and a reduced risk of predation. The majority of research focusing on Steelhead migration survival in relation to temperature has focused on upper temperature threshold limits and determining thermal refugia in relation to high use harvest areas (Keefer et al. 2009; Richter and Kolmes 2005). Identifying the possibility of a lower temperature regime preference requires further research.

Greater numbers of overwintering mortalities were detected in Upper Columbia Dam reservoirs vs tributaries in both years of this study. This finding contrasts with the pattern observed for overwintering survival in steelhead in the Snake River reservoirs (Keefer et al. 2008a), where higher proportions of fish survived that overwintered in the hydrosytem vs tributaries. Although, the Upper Columbia River Basin and Snake River Basins are similar geographically and (i.e. dams and tributaries), fishing efforts in the Snake River were primarily highest in tributaries prior to wintering (Keefer et al. 2008a). Harvest in the Upper Columbia in 2015-2016 was split approximately 60% and 40% (in tributaries and reservoirs, respectively), with the majority of tributary harvest occurring in the lower Methow River (WDFW, unpublished creel data), and the relatively higher rate of fishing mortality in the Columbia River compared to the Snake River reservoirs may account for some of the contrast in mortality pattern between systems. However, the overwintering distribution and mortalities in the main-stem Columbia were similar in a year with (2015) and without (2016) an active winter fishery, suggesting harvest-related mortalities was not the sole cause of overwintering mortality. Other potential factors contributing to overwinter mortality in the main-stem include, predation, mortality associated with fallback at dams, or depleted energy reserves resulting from the lengthy upriver return migration from the Columbia River estuary.

Survivors detected moving post wintering with unknown spawning locations were included in survival estimates given that many of these were detected briefly (~1 day) in major tributaries and it is likely a subset of these fish entered tributaries undetected. It is equally likely that some of these fish spawned in as yet unmonitored tributaries (i.e. Crab Creek, Chelan Falls, etc.) or may have spawned on the banks of reservoirs or near hatcheries. Baldwin et al. (2007) conducted steelhead spawning ground surveys on numerous small order tributaries between Priest Rapids and Rocky Reach Dam reservoirs and found spawning steelhead present.

More broadly, we considered the influence of uncertainty in fate classifications on estimating survival rates by comparing survival estimates under the following three scenarios; 1) survival excluding (censoring) unknown tributary spawners, 2) survival including unknown tributary spawners as spawners, and 3) survival including unknown tributary spawners as presumed mortalities. By excluding unknown tributary steelhead (i.e. scenario 1) total mean steelhead survival probability for both years was 0.69 and 0.70 (2016 and 2017, respectively). By including unknown tributary fish as survivors or conversely as mortalities (scenarios 2 and 3) the total mean probability of survival for each year is 0.70 and 0.80 (assuming survival), and 0.67 and 0.68 (assuming mortality) for 2016 and 2017, respectively. Our survival estimates reported previously, that included detection efficiency adjusted assigned tributary steelhead, were ~0.70 and ~0.74, falling within the ranges highlighted of the 2nd and 3rd scenarios. Thus, survival estimates fell within a relatively narrow range across a broad array of assumptions concerning uncertainty in fate classification, and the true survival rate was very likely at or above 0.7 in both years.

Kelting Rate and Bonneville Dam Detections

Post spawning kelting rates to the mainstem Upper Columbia were similar for both monitored years of the study (55% and 57% for 2016 and 2017 out migrating years). Fish were assigned as kelts if they were detected leaving their presumed spawning tributary or if they were detected by any radio telemetry

fixed sites located at Rock Island or Priest Rapids Dams. Proportionately more detected kelts were female than male for every tributary population during both years of monitoring, a finding consistent with other research regarding sex ratios in kelts (Marston et al. 2012).

Estimated downstream migration success to Bonneville was lower in 2017 than 2016 where a single fish leaving Upper Columbia tributaries was detected at Bonneville, versus 16 being detected in 2016. Given that radio telemetry monitoring ended at Priest Rapids Dam, further downstream passage of tagged fish was possible at PIT tag arrays in juvenile bypass systems and by the Bonneville Corner Collector and estuary towed arrays. Seasonally high spring flows occurred in Spring of 2017 and it is likely that downstream passage detection efficiency at Bonneville Dam was reduced in that year, and a large number of kelts may have passed via unmonitored spillways rather than PIT array monitored routs.

Proportionately more fish assigned as kelts were of hatchery origin in 2017 while 2016 kelting origin composition had a wild majority. The higher proportion of wild-origin kelts in 2016, a year with a winter fishery, is consistent with previous observations of reduced kelt outmigration success in hatchery reared fish and for older (salt age 2) fish (Keefer and Caudill 2014; Keefer at al. 2017) in the Snake and Lower Columbia River basins, where reduced hatchery kelt survival was largely attributed to the fact that hatchery fish are prone to harvest and broodstock collection. As the 2016 Upper Columbia River tagged sample was comprised of proportionality more hatchery and salt age 2 fish than the previous 2015 tagged sample, this may account in some degree to the limited number of kelts detected at Bonneville in 2017, though inter-annual differences in main-stem detection efficiency likely contributed to numbers detected at Bonneville and downstream.

Considering the great distance associated with migrating to and kelting from the Upper Columbia basin, it is not surprising that so few fish survive to post spawning kelting status. While iteroparity rates in interior summer steelhead were likely always low, other research focusing on the Snake and lower Columbia River (English et al. 2006; Keefer et al. 2008b) highlights the need for benign downstream winter passage routes. Steelhead returning to the Methow and Okanogan Rivers will have ascended a total of 9 Dams before descending the same number on their return back to the ocean. Such routes would also reduce mortality affects associated with overshoot and fallback during homing.

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Appendices

Appendix A. Counts, rearing origins and locations of tagged fish having survived the overwintering period in 2016. The proportion of fish having survived the overwintering period at each location, based on the total number of overwintering fish at each location. Values in the parenthesis represent the number of fish present at the onset of overwintering.

Location	Number of Fish			Proportion Survived		
	Hatchery	Wild	Total	Hatchery	Wild	Total
			Columbia River Reach			
Priest	6 (9)	3 (6)	9 (15)	0.667	0.500	0.600
Wanapum	1 (5)	3 (3)	4 (8)	0.200	1.000	0.500
Rock Island	2 (3)	3 (5)	5 (8)	0.667	0.600	0.625
Rocky Reach	7 (13)	12 (13)	19 (26)	0.538	0.923	0.731
Wells	41 (53)	21 (23)	62 (76)	0.774	0.913	0.816
Total	57 (83)	42 (50)	99 (133)	0.689	0.840	0.744
			Tributary			
Entiat	0 (0)	0 (0)	0 (0)	0.000	0.000	0.000
Methow	21 (26)	16 (16)	37 (42)	0.808	1.000	0.881
Okanogan	15 (19)	8 (9)	23 (28)	0.789	0.889	0.821
Wenatchee	16 (20)	24 (25)	40 (45)	0.800	0.960	0.889
Total	52 (65)	48 (50)	100 (115)	0.800	0.960	0.870
Grand Total	109 (148)	90 (100)	199 (248)	0.736	0.900	0.802

Appendix B. Counts, rearing origins and locations of tagged fish having survived the overwintering period in 2017. The proportion of fish having survived the overwintering period at each location, based on the total number of overwintering fish at each location. Values in the parenthesis represent the number of fish present at the onset of overwintering.

Location	Number of Fish			Proportion Survived		
	Hatchery	Wild	Total	Hatchery	Wild	Total
			Columbia River Reach			
Priest	7 (8)	3 (3)	10 (11)	0.875	1.000	0.909
Wanapum	2 (10)	0 (0)	2 (10)	0.200	0.000	0.200
Rock Island	1 (4)	6 (7)	7 (11)	0.250	0.857	0.636
Rocky Reach	21 (24)	14 (15)	35 (39)	0.875	0.933	0.897
Wells	68 (81)	11 (11)	79 (92)	0.840	1.000	0.859
Total	99 (127)	34 (36)	133 (163)	0.780	0.944	0.816
			Tributary			
Entiat	0 (0)	0 (0)	0 (0)	0.000	0.000	0.000
Methow	60 (64)	12 (13)	72 (77)	0.938	0.923	0.935
Okanogan	36 (39)	4 (5)	40 (44)	0.923	0.800	0.909
Wenatchee	3 (4)	9 (12)	13 (16)	0.750	0.750	0.765
Total	99 (107)	25 (30)	124 (137)	0.925	0.833	0.905
Grand Total	198 (234)	59 (66)	257 (300)	0.846	0.894	0.857

Appendix C. Channel and codes, origins, last PIT and last radio telemetry detections of steelhead tagged in 2015 at Priest Rapids Dam. Final fates and overwintering locations are also provided.

Ch-Code	Origin	PIT ID	Last PIT	Last RT	Fate	Winter Loc
1-46	H	3DD.0077530E3E	WEA	Methow	Harvested Methow	NA
1-47	H	3DD.00775533EE	WEA	Wells Pool	OW Mortality	Wells Pool
1-48	W	3DD.00775572F8	BCC	Wenatchee	Kelt Wenatchee	RI Pool
1-49	W	3DD.00775308BD	PRO	3PR	Umatilla River	Below PRD
1-50	W	3DD.007752AA96	BCC	PRD	Kelt Yakima	Below PRD
1-51	H	3DD.0077552DFF	WEA	2CJ	Fall Mortality	Wells Pool
1-52	H	384.3B23B179FD	LMR	Methow	Harvested Methow	NA
1-53	H	3DD.0077554CB3	RRJ	2RI	Kelt Wenatchee	Methow
1-54	H	3DD.007755157C	WELLD2	Okanogan	Harvested Okanogan	NA
1-55	W	3DD.007752D442	CHW	1RI	Kelt Wenatchee	Wenatchee
1-56	H	3DD.007754F7F8	LMR	Methow	Harvested Methow	NA
1-57	W	3DD.007754F56C	UWE	2RI	Kelt Wenatchee	Wenatchee
1-58	H	3DD.007755244B	WEA	1ME	OW Mortality	Methow
1-59	W	3D9.1C2D76E336	RRJ	Wan Pool	Kelt Entiat	RR Pool
1-60	W	3DD.00775274F5	SAT	3PR	Yakima River	PRD Pool
1-61	H	3DD.007755093E	RIA	Wan Pool	OW Mortality	Wan Pool
1-62	W	3DD.00775269C3	RRJ	1RI	Kelt Methow	Methow
1-63	H	3DD.0077551320	BCC	Wan Pool	Kelt Unknown Trib	PRD Pool
1-64	W	3DD.007752F63C	PRA	2PR	Fall Mortality	PRD Pool
1-65	W	3DD.0077534FF5	ACB	2PR	Asotin CK	Snake
1-66	W	3DD.0077550581	PRA	Umatilla	Yakima River	Below PRD
1-67	W	3DD.0077550AC1	PRO	4RI	Yakima River	Wells Pool
1-68	H	3DD.0077528A18	SA0	1RI	Kelt Okanogan	Wells Pool
1-69	H	3DD.007753230A	WEA	RR Pool	OW Mortality	RR Pool
1-70	W	3DD.0077527B76	TWR	Methow	Last Det Methow	Methow
1-71	W	3DD.007752F1EF	WEA	RI Pool	OW Mortality	RR Pool
1-72	H	3DD.007753950E	PRA	Below PRD	Harvested Hanford	NA
1-73	W	3DD.0077553B4F	MRC	Methow	Broodstock Winthrop	Methow
1-74	W	3DD.007753764C	WFC	2CJ	Last Det Methow	Methow
1-75	H	3DD.007752703D	WEA	Wells Pool	Harvested Wells Pool	NA
1-76	H	3DD.0077556682	GRA	2PR	Snake River	Snake
1-77	W	3DD.007754EF81	BCC	1RI	Kelt Wenatchee	Wenatchee
1-78	H	3DD.00775559E0	CHJO	Wells Pool	Harvested Wells Pool	NA
1-79	W	3DD.007754DC1B	GRA	2PR	Snake River	Snake
1-80	H	3DD.007755247A	WEA	1CJ	Harvested Wells Pool	NA
1-81	H	3DD.00775378A5	METH	MET	Last Det Methow	Wells Pool
1-82	H	3DD.0077532F3A	OKL	Okanogan	Residence Unrep Harvest	Okanogan
1-83	H	3DD.00775260E2	GRA	Snake	Harvested Snake	NA
1-84	H	3DD.0077912986	WEA	2EN	Last Det Entiat	Wells Pool

1-85	H	3DD.0077912925	TUF	1RI	Kelt Wenatchee	Wenatchee
1-86	H	3DD.007753516A	LMR	1ME	OW Mortality	Methow
1-87	W	3DD.0077533513	B2J	Wan Pool	Kelt Unknown Trib	Wan Pool
1-88	W	3DD.007753762B	RRJ	1RI	Kelt Methow	Wells Pool
1-89	H	3DD.0077536284	TWX	1RI	Kelt Wenatchee	Wenatchee
1-90	H	3DD.0077927F95	WEA	Methow	Harvested Methow	NA
1-91	W	3DD.007752A4AE	ACM	Snake	Harvested Snake	NA
1-92	W	3DD.00775383D5	OMK	1OK	Last Det Okanogan	RR Pool
1-93	H	3DD.007752D279	RRJ	1RI	Kelt Wenatchee	Wells Pool
1-94	H	3DD.007752C6FA	WEA	2CJ	Last Det Methow	RR Pool
1-95	H	3DD.0077928BA0	MSH	Methow	Last Det Methow	Methow
1-96	W	3DD.0077525B5F	CRW	1ME	Last Det Methow	Methow
1-97	H	3DD.0077533EB1	LMR	2RI	Fall Mortality	RI Pool
1-98	H	3DD.0077526935	PRA	3PR	Fall Mortality	PRD Pool
1-99	H	3DD.0077526E7F	CHJO	2CJ	Fall Mortality	Wells Pool
1-100	H	3DD.007791D372	MSH	MET	Last Det Methow	Methow
1-101	W	3DD.007752E99C	ICM	Wenatchee	OW Mortality	Wenatchee
1-102	H	3DD.0077526882	LLC	Okanogan	Last Det Okanogan	Okanogan
1-103	W	3DD.0077536ED0	RRF	3RI	UNK Return Trib	RR Pool
1-104	H	3DD.007753166D	BPC	IHI	Last Det Okanogan	Okanogan
1-105	H	3DD.007792A48E	SCP	Methow	Last Det Methow	Wells Pool
1-106	H	3DD.007752D466	UWE	Wenatchee	Last Det Wenatchee	Wenatchee
1-107	H	3DD.0077535B82	UWE	1RI	Kelt Wenatchee	Wenatchee
1-108	W	3DD.0077535F62	CHJO	2CJ	Fall Mortality	Wells Pool
1-109	W	3DD.007753697C	LMR	Methow	Last Det Methow	Methow
1-110	H	3D9.1C2DE53D0D	WELLD1	2CJ	Fall Mortality	Wells Pool
1-111	W	3DD.0077530756	BCC	1RI	Kelt Wenatchee	Wenatchee
1-112	H	3DD.00775383BE	WEA	1RI	Harvested Methow	Wan Pool
1-113	H	3DD.007752E747	LMR	Methow	Harvested Methow	NA
1-114	W	3DD.0077929924	WAN	1RI	Kelt Wenatchee	Wenatchee
1-115	H	3DD.007791C788	MRC	Methow	Broodstock Winthrop	Wells Pool
1-116	W	3DD.0077555659	LMR	RR Pool	UNK Return Trib	Wells Pool
1-117	H	3DD.007752E9C1	LMA	PRD	Snake River	Snake
1-118	H	3DD.0077535026	LMR	Methow	OW Mortality	Methow
1-119	W	3DD.0077525F48	PRA	Priest Pool	OW Mortality	PRD Pool
1-120	W	3DD.0077530585	TWR	1RI	Kelt Methow	Methow
1-121	W	3DD.007755157D	PRO	2PR	Yakima River	Below PRD
1-122	H	3DD.007754E5A4	ICH	2PR	Harvested Snake	NA
1-123	H	3DD.0077535DC3	PRA	2PR	Fall Mortality	PRD Pool
1-124	W	3DD.007752A509	MCJ	3PR	Priest Fallback	Below PRD
1-125	W	3DD.007752711C	BCC	1RI	Kelt Wenatchee	Wenatchee
1-126	H	3DD.007791253B	WEA	RR Pool	OW Mortality	RR Pool
1-127	H	3DD.0077915D2B	GRA	3PR	Snake River	Snake

1-128	H	3DD.00779114ED	WALH	3PR	Wallowa RIver	Below PRD
1-129	H	3DD.007792B409	TUM	1RI	Kelt Wenatchee	RI Pool
1-130	W	3DD.007791CCA1	LWE	Wenatchee	Last Det Wenatchee	RI Pool
1-133	W	3DD.007791BDC7	WEA	Okanogan	OW Mortality	Okanogan
1-137	W	3DD.0077925473	LLC	2CJ	Last Det Okanogan	Wells Pool
1-138	H	3DD.0077920A68	RRJ	1RI	Kelt Okanogan	Okanogan
1-141	H	3DD.0077911C37	WEA	Wells Pool	OW Mortality	Wells Pool
1-142	H	3DD.0077920C43	BPC	1OK	Kelt Okanogan	Wells Pool
1-145	H	3DD.0077913CA8	TWISPW	2ME	Last Det Methow	Methow
1-146	W	3DD.00779297DD	SAT	1WP	Yakima River	Below PRD
1-149	H	3DD.003BB88CB1	LLC	1OK	Kelt Okanogan	Wells Pool
1-150	H	3DD.007791A106	WEA	RR Pool	OW Mortality	RR Pool
1-153	H	3DD.007791A5D7	TNK	2RI	Last Det Okanogan	Okanogan
1-154	H	3DD.0077921305	MRT	Methow	Harvested Methow	NA
1-155	W	3DD.007792B2CA	CRU	Methow	Last Det Methow	Methow
1-157	H	3DD.0077920867	BPC	1OK	Kelt Okanogan	Wells Pool
1-158	W	3DD.0077919A81	TWX	3PR	Kelt Yakima	Yakima
1-159	H	3DD.007791ACBE	BCC	1RI	Kelt Unknown Trib	Wells Pool
1-160	H	3DD.007752D4F4	RRJ	1RI	Kelt Wenatchee	RR Pool
1-161	W	3DD.00779153BD	WEA	Methow	Last Det Methow	Wells Pool
1-162	H	3DD.007791FAF7	OMK	1OK	Kelt Okanogan	Okanogan
1-163	H	3DD.007753763E	WEA	CJD	Harvested Wells Pool	NA
1-164	H	3DD.007791A0AC	SA1	Okanogan	Last Det Okanogan	Wells Pool
1-165	H	3DD.0077916A05	LMR	2ME	Harvested Methow	NA
1-166	H	3DD.0077917727	FST	2CJ	Last Det Foster Creek	Wells Pool
1-167	H	3DD.0077926D70	OMK	1OK	Kelt Okanogan	Okanogan
1-168	H	3DD.0077929BDE	MRC	1RI	Kelt Methow	Wells Pool
1-169	H	3DD.00779252B2	GRA	3PR	Snake River	Snake
1-170	H	3DD.007790EFE2	RIA	1RI	Kelt Wenatchee	RI Pool
1-171	H	3DD.00779158DF	WEA	Wells Pool	OW Mortality	Wells Pool
1-172	W	3DD.0077906D09	BCC	1RI	Kelt Entiat	Wells Pool
1-173	W	3DD.0077531808	CHW	MWN	Kelt Wenatchee	Wenatchee
1-174	H	3DD.007791CC4D	WEA	Methow	OW Mortality	Methow
1-175	H	3DD.003BAC7B28	OBF	Okanogan	Last Det Okanogan	Wells Pool
1-176	H	3DD.007792116A	WEA	2CJ	Fall Mortality	Wells Pool
1-177	H	3DD.007752E085	WFC	1RI	Kelt Methow	Methow
1-178	H	3DD.00779094C4	RIA	Below PRD	Priest Fallback	Below PRD
1-179	H	3DD.0077913739	CHJO	Methow	Harvested Methow	NA
1-180	H	3DD.0077911B99	LMR	2ME	Fall Mortality	Methow
1-181	W	3DD.0077527AA8	ENL	1RI	Kelt Wenatchee	Methow
1-182	H	3DD.00779058F4	OKL	Okanogan	Last Det Okanogan	Wells Pool
1-183	H	3DD.007792483B	PRA	Priest Pool	OW Mortality	Wan Pool
1-184	H	3DD.0077923C2F	WEA	1CJ	Fall Mortality	Wells Pool

1-185	H	3DD.0077920C3E	RRF	2PR	Harvested Hanford	NA
1-186	H	3DD.00778F4B9F	WEA	Wells Pool	OW Mortality	Wells Pool
1-187	H	3DD.0077929B95	PRD	Methow	Last Det Methow	Wells Pool
1-188	H	3DD.007792746F	WEA	1RI	UNK Return Trib	Wells Pool
1-189	W	3DD.00779271D7	SA0	Priest Pool	Last Det Okanogan	Okanogan
1-190	H	3DD.0077921CB2	UWE	Wenatchee	Last Det Wenatchee	Wenatchee
1-191	H	3DD.0077911CDF	RRF	Wells Pool	UNK Return Trib	Wells Pool
1-192	W	3DD.007792130B	PEU	Wenatchee	Last Det Wenatchee	RI Pool
1-193	H	3DD.00779212FB	GRA	3PR	Broodstock Wallowa	Snake
1-194	H	3DD.003BAC81C5	OMK	1OK	Last Det Okanogan	Methow
1-195	H	3DD.0077924B45	WEA	2EN	Last Det Entiat	Wells Pool
2-46	W	3DD.007754589F	RRJ	Methow	Kelt Methow	RR Pool
2-47	H	3DD.0077552056	SCP	Methow	Last Det Methow	Methow
2-48	H	3DD.007753513E	SCP	MET	Last Det Methow	Wells Pool
2-49	H	3DD.00775383CD	LMR	Methow	Harvested Methow	NA
2-50	W	3DD.00775263FF	GRA	3PR	Snake River	Snake
2-51	W	3DD.007755CE9D	LMR	1RI	Kelt Methow	Methow
2-52	H	3DD.007754F4E2	WEA	2ME	Fall Mortality	Methow
2-53	H	3DD.00775303CA	RRJ	1RI	Kelt Wenatchee	RR Pool
2-54	W	3DD.0077528908	PRA	1RI	Fall Mortality	Wan Pool
2-55	H	3DD.007752C5C3	WEA	Wells Pool	Harvested Wells Pool	NA
2-56	H	3DD.007753392D	MRC	Methow	Last Det Methow	Methow
2-57	H	3DD.00773D3F69	JDJ	1RI	Kelt Wenatchee	Wenatchee
2-58	W	3DD.0077531D4D	WHS	IHI	Last Det Okanogan	Okanogan
2-59	W	3DD.0077529BCD	ENA	2EN	Kelt Entiat	RR Pool
2-60	H	3DD.007752DCB1	LMR	Okanogan	Harvested Okanogan	NA
2-61	H	3DD.007791A805	WEA	1ME	Fall Mortality	Methow
2-62	H	3DD.007752C6BD	SCP	Wells Pool	Last Det Methow	Wells Pool
2-63	W	3DD.007752743D	UWE	Wenatchee	Last Det Wenatchee	Wenatchee
2-64	H	3DD.0077525B9E	METH	Methow	Last Det Methow	Wells Pool
2-65	H	3DD.007752FD5E	LWE	1RI	Kelt Wenatchee	Wenatchee
2-66	H	3DD.007753803E	WEA	RR Pool	Harvested Wells Pool	NA
2-67	H	3DD.007752B25C	LMR	Methow	Harvested Methow	NA
2-68	H	3DD.00775541C4	LLC	1OK	Last Det Okanogan	Wells Pool
2-69	W	3DD.0077550A95	LBC	1RI	Kelt Methow	Methow
2-70	W	3DD.007752763B	PES	1RI	Kelt Wenatchee	Wenatchee
2-71	H	3DD.00775305DE	DRY	Wenatchee	OW Mortality	Wenatchee
2-72	H	3DD.00775368A2	PRA	Okanogan	Harvested Okanogan	NA
2-74	W	3DD.0077556C96	WEA	2CJ	Indirect Angler Mortality	Wells Pool
2-75	W	3DD.00775552CE	MAD	ENT	Last Det Entiat	RR Pool
2-76	H	3DD.0077525BAD	GRA	Snake	Harvested Snake	NA
2-77	W	3DD.0077554A3B	BCC	Wenatchee	Kelt Wenatchee	Wells Pool
2-78	H	3DD.0077553E7F	PRA	1WP	Fall Mortality	Wan Pool

2-79	W	3DD.0077553DDE	RIA	1LW	Kelt Wenatchee	Wenatchee
2-80	W	3DD.0077554EC7	ENL	2RI	Kelt Entiat	RR Pool
2-81	W	3DD.0077554E16	JDM	2PR	John Day River	Below PRD
2-82	W	3DD.007752E6F0	LLC	1OK	Kelt Okanogan	Okanogan
2-83	W	3DD.007754F9CA	NAU	RI	Kept for Reconditioning	Wenatchee
2-84	W	3DD.0077555B59	RIA	Wan Pool	OW Mortality	RI Pool
2-85	H	3DD.007752B8E2	USE	2PR	Salmon River	Below PRD
2-86	W	3DD.007754A2AC	BCC	3PR	Kelt Unknown Trib	Below PRD
2-87	W	3DD.0077556933	BCC	1RI	Kelt Methow	Methow
2-88	W	3DD.0077546CD5	WEA	Wells Pool	OW Mortality	Wells Pool
2-89	H	3DD.007752B3BC	GOJ	Snake	Harvested Snake	NA
2-90	W	3DD.007754E557	LTR	Priest Pool	Tucannon River	PRD Pool
2-91	H	3DD.007755458D	ICH	2PR	Snake River	Snake
2-92	H	3DD.007792B300	RSH	Priest Pool	Priest Fallback	PRD Pool
2-94	H	3DD.0077925673	WEA	1ME	Fall Mortality	Methow
2-95	H	3DD.007791BE2A	WEA	RR Pool	UNK Return Trib	Wells Pool
2-96	H	3DD.007791F1D8	WEA	RR Pool	UNK Return Trib	RR Pool
2-97	H	3DD.007792245D	RRJ	1RI	UNK Return Trib	Wells Pool
2-99	H	3DD.007790C239	CHM	2LW	Last Det Wenatchee	Wells Pool
2-100	H	3DD.0077911FB6	MRC	MET	Last Det Methow	Wells Pool
2-103	H	3DD.007791BE1E	ICH	Snake	Harvested Snake	NA
2-104	H	3DD.0077911C3A	PRA	3PR	Fall Mortality	PRD Pool
2-107	H	3DD.007790CD30	GOA	2PR	Harvested Snake	NA
2-108	W	3DD.00779142AB	PRD	3PR	OW Mortality	PRD Pool
2-111	W	3DD.007791FC35	PRD	2PR	Fall Mortality	PRD Pool
2-112	H	3DD.00779101EE	PRA	Priest Pool	OW Mortality	PRD Pool
2-115	H	3DD.00778F44D6	WEA	1CJ	Fall Mortality	Wells Pool
2-116	H	3DD.0077919A8A	CHW	Wenatchee	Last Det Wenatchee	Wenatchee
2-119	H	3DD.0077917B95	GRA	1WP	Snake River	Snake
2-120	H	3DD.0077912ABA	MRC	1RI	Kelt Methow	Methow
2-121	H	3DD.007791C2ED	RRF	2RI	Fall Mortality	RI Pool
2-122	W	3DD.007791C10E	TMF	2PR	Umatilla River	Below PRD
2-123	H	3DD.0077912ACE	ANT	Okanogan	Kelt Okanogan	Wells Pool
2-124	W	3DD.0077911B9D	PES	Wenatchee	Last Det Wenatchee	Wenatchee
2-125	H	3DD.007791C537	WEA	2CJ	Fall Mortality	Wells Pool
2-126	H	3DD.0077919D34	RRJ	1RI	Kelt Wenatchee	Wells Pool
2-127	H	3DD.007791A601	GRA	3PR	Snake River	PRD Pool
2-128	W	3DD.007791FA24	BCC	Entiat	Kelt Entiat	Wells Pool
2-129	H	3DD.007791C066	OMK	1OK	Kelt Okanogan	Okanogan
2-130	H	3DD.0077924B59	WEA	1ME	Unreported Harvest	Methow
2-131	H	3DD.00779221FA	GRA	3PR	Snake River	PRD Pool
2-132	H	3DD.0077923A12	WEA	Wells Pool	Harvested Wells Pool	NA
2-133	H	3DD.00779280DC	PRA	2PR	Fall Mortality	PRD Pool

2-134	H	3DD.0077917B45	CHJO	Wells Pool	OW Mortality	Wells Pool
2-135	W	3DD.0077927FCF	GRA	2PR	Snake River	Snake
2-136	H	3DD.00779207A5	CHJO	Okanogan	OW Mortality	Okanogan
2-137	H	384.36F2B34EB9	LMR	1ME	Fall Mortality	Methow
2-138	H	3DD.0077917A02	OKL	Okanogan	Harvested Okanogan	NA
2-139	W	3DD.007792565A	ENA	Wan Pool	Kelt Entiat	RR Pool
2-140	H	3D9.1C2DEE8F06	SCP	Wan Pool	Kelt Methow	Methow
2-141	H	3DD.00775340AC	WEA	RR Pool	OW Mortality	RR Pool
2-142	H	3DD.0077916D45	WEA	Wells Pool	Harvested Wells Pool	NA
2-143	H	3DD.0077914DC9	WELLD1	1RI	Kelt Wenatchee	Wenatchee
2-144	H	3DD.00779264A9	WEA	Wenatchee	OW Mortality	Wenatchee
2-145	H	3DD.0077927243	LMR	Methow	Harvested Methow	NA
2-146	H	3DD.0077928D8E	WEA	1CJ	Fall Mortality	Wells Pool
2-147	H	3DD.00779153FD	LMR	Methow	OW Mortality	Methow
2-148	H	3DD.0077926E77	WEA	Wells Pool	OW Mortality	Wells Pool
2-149	W	3DD.0077920699	ICL	1RI	Kelt Wenatchee	Wenatchee
2-150	H	3DD.0077924563	WEA	Okanogan	Harvested Okanogan	NA
2-151	W	3DD.007791ED0A	SA1	1RI	Kelt Okanogan	Okanogan
2-152	H	3DD.0077929728	ENM	ENT	Last Det Entiat	Wells Pool
2-153	W	3DD.0077538ACB	RRJ	1RI	Kelt Okanogan	Wells Pool
2-154	H	3DD.007752C6B1	LLC	1OK	Last Det Okanogan	Okanogan
2-155	W	3DD.007790F85D	TWISPW	2TP	Last Det Methow	Wells Pool
2-156	W	3DD.007791E29A	RRJ	RR Pool	Kelt Okanogan	Wells Pool
2-157	H	3DD.007752DAB7	TWISPW	Wells Pool	Kelt Methow	Wells Pool
2-158	W	3DD.0077537405	JOC	2PR	Joseph CK	Snake
2-159	H	3DD.0077525E7F	PRA	2RI	Harvested Hanford	NA
2-160	W	3DD.0077925585	TUM	1LW	Kelt Wenatchee	Wenatchee
2-161	H	3DD.0077532104	BCC	1RI	Kelt Okanogan	Okanogan
2-162	H	3DD.003BAA5659	OMK	1RI	Kelt Okanogan	Okanogan
2-163	H	3DD.0077531098	WEA	1ME	Fall Mortality	Methow
2-164	H	3DD.0077536056	WEA	Wells Pool	OW Mortality	Wells Pool
2-165	H	3DD.0077536120	WEA	Wan Pool	Kelt Methow	Methow
2-166	H	3DD.007752A3E8	OKL	Okanogan	OW Mortality	Okanogan
2-167	H	3DD.00775327A7	UWE	1RI	Kelt Wenatchee	Wenatchee
2-168	H	3DD.0077537898	WEA	Wells Pool	OW Mortality	Wells Pool
2-169	H	3DD.0077533C7E	LLC	1OK	Last Det Okanogan	Okanogan
2-170	H	3DD.0077535DF6	LMR	Methow	Harvested Methow	NA
2-171	H	3DD.007752F27C	CHJO	Methow	Surplused Chief Joseph	NA
2-172	H	3DD.007792BB35	RRJ	1RI	Kelt Methow	Methow
2-173	H	3DD.0077527E92	LMR	1ME	Fall Mortality	Methow
2-174	H	3DD.0077535CB3	SA1	1RI	Kelt Okanogan	Okanogan
2-175	H	3DD.007752F027	CRW	Methow	Last Det Methow	Methow
2-176	H	3DD.00775305E2	GRA	2PR	Snake River	Snake

2-177	H	3DD.0077536992	WEA	RR Pool	UNK Return Trib	RR Pool
2-178	W	3DD.0077535D06	RIA	2RI	Kelt Wenatchee	Wenatchee
2-179	H	3DD.00775377E1	WELLD1	RR Pool	OW Mortality	RR Pool
2-180	H	3DD.003BC4438F	WEA	2OK	Unreported Harvest	Okanogan
2-181	H	3DD.00775269EE	UWE	1RI	Kelt Wenatchee	Wenatchee
2-182	W	3DD.00775283D3	BCC	2PR	Kelt Unknown Trib	Below PRD
2-183	W	3DD.0077530B50	RRF	RI Pool	OW Mortality	RI Pool
2-184	H	3DD.0077537048	WEA	Wan Pool	OW Mortality	Wan Pool
2-185	H	3DD.0077928B69	LMR	Methow	Last Det Methow	Methow
2-186	H	3DD.0077926491	18N	MET	Last Det Methow	Methow
2-187	H	3DD.0077914046	METH	Methow	Last Det Methow	Methow
2-188	H	3DD.0077912B46	WEA	RR Pool	Last Det Methow	Wells Pool
2-189	H	3DD.0077918C63	MWF	MET	Last Det Methow	Wells Pool
2-190	W	3DD.007792A77B	CRU	Methow	Last Det Methow	Wells Pool
2-191	H	3DD.007791535F	LMR	Methow	Harvested Methow	NA
2-192	H	3DD.003BC491D0	METH	1ME	Kelt Methow	Methow
2-193	H	3DD.00779104B6	OKL	Okanogan	Harvested Okanogan	NA
2-194	W	3DD.007792A826	ROZ	3PR	Yakima River	Yakima
2-195	H	3DD.00779248DC	GRA	3PR	Harvested Snake	NA
3-50	H	3DD.00779261D1	WEA	Wells Pool	OW Mortality	Wells Pool
3-51	W	3DD.0077919E79	BCC	1RI	Kelt Entiat	Wan Pool
3-54	H	3DD.0077927FBA	RRF	2RI	Fall Mortality	RI Pool
3-58	H	3DD.007792482D	BCC	1RI	Kelt Okanogan	Wells Pool
3-62	H	3DD.007792884B	PRA	1WP	Harvested Hanford	NA
3-66	W	3DD.007791926C	GRA	2PR	Snake River	Snake
3-70	W	3DD.007791609D	GRA	2PR	Snake River	Snake
3-71	H	3D9.1C2DF1A977	RRJ	2CJ	UNK Return Trib	Wells Pool
3-74	H	3DD.0077924713	USE	3PR	Salmon River	Snake
3-75	W	3DD.007791DE25	MWF	Methow	Last Det Methow	Wells Pool
3-76	W	3DD.0077921B94	PRA	Wells Pool	OW Mortality	Wells Pool
3-77	H	3DD.007791BE1D	WALH	3PR	Surplused Wallowa	Snake
3-78	H	3DD.0077926F8B	WEA	CJD	Harvested Wells Pool	NA
3-79	H	3DD.007791A0BC	WEA	1RI	Fall Mortality	Wan Pool
3-80	H	3DD.0077916D72	WEA	Okanogan	Harvested Wells Pool	NA
3-81	W	3DD.0077923476	BCC	1RI	Kelt Entiat	RR Pool
3-82	W	3DD.0077912AE8	ROZ	2PR	Yakima River	Snake
3-83	W	3DD.0077926E1E	FST	2CJ	Last Det Foster Creek	Wells Pool
3-84	W	3DD.0077929941	PRA	Priest Pool	OW Mortality	PRD Pool
3-85	H	3DD.0077924739	WEA	2RI	Fall Mortality	RI Pool
3-86	H	3DD.007792B2AE	RIA	MWN	Last Det Wenatchee	Wenatchee
3-87	W	3DD.007791B051	TWR	Methow	Last Det Methow	Methow
3-88	H	3DD.007791A0E1	SCP	Methow	Last Det Methow	Methow
3-89	H	3DD.0077928268	RRF	Wan Pool	OW Mortality	Wan Pool

3-90	H	3DD.0077917B25	PRA	Priest Pool	OW Mortality	PRD Pool
3-91	W	3DD.0077921E11	USE	1WP	Salmon River	Snake
3-92	W	3DD.007791BE39	TWR	Methow	Last Det Methow	Wells Pool
3-93	W	3DD.00779136B6	MAD	RR Pool	Last Det Entiat	Wells Pool
3-94	H	3DD.007792167A	WEA	2CJ	UNK Return Trib	RR Pool
3-95	W	3DD.007791251E	GRA	Priest Pool	Snake River	Wan Pool
3-96	H	3DD.00779254E5	PRA	Wenatchee	OW Mortality	Wenatchee
3-98	W	3DD.0077920F3A	TWX	1RI	Kelt Wenatchee	Wenatchee
3-99	W	3DD.00778F35F4	PRD	2PR	Fall Mortality	Wells Pool
3-100	W	3DD.0077910F65	CRW	1CJ	Last Det Methow	Okanogan
3-101	H	3DD.007790F92F	USE	2PR	Salmon River	Snake
3-102	W	3DD.007792A7AD	RRJ	1RI	Kelt Methow	Wells Pool
3-103	H	3DD.007790D811	WEA	Wells Pool	OW Mortality	Wells Pool
3-104	H	3DD.00779232B4	GRA	2PR	Harvested Snake	NA
3-105	W	3DD.0077919841	ENA	Entiat	Last Det Entiat	RR Pool
3-106	H	3DD.007790EDF0	WEA	2CJ	Fall Mortality	Wells Pool
3-107	W	3DD.0077926F95	BCC	1RI	Kelt Methow	Methow
3-108	H	3DD.0077920672	CHM	1RI	Kelt Wenatchee	Wells Pool
3-109	W	3DD.00778F9C48	RRJ	1RI	Kelt Methow	Methow
3-110	H	3DD.007791DC38	GRA	3PR	Snake River	Snake
3-111	H	3DD.00779202B6	PRD	Priest Pool	Fall Mortality	PRD Pool
3-112	H	3DD.00779298FB	LMR	1ME	Fall Mortality	Methow
3-113	H	3DD.0077929D8D	WEA	Okanogan	OW Mortality	Okanogan
3-114	W	3DD.0077907D5A	TUM	Wenatchee	Last Det Wenatchee	Wenatchee
3-115	H	3DD.007790BEA5	WEA	Okanogan	OW Mortality	Okanogan
3-116	H	3DD.0077921CB3	CHJO	Wells Pool	Harvested Wells Pool	NA
3-117	H	3DD.00779212D3	PRD	Below PRD	Harvested Hanford	NA
3-118	W	3DD.0077921480	ENA	1EN	Kelt Entiat	RR Pool
3-119	H	3DD.00779152EB	WEA	RR Pool	UNK Return Trib	RR Pool
3-120	H	3DD.007791EA06	WEA	Okanogan	Residence Unrep Harvest	Okanogan
3-121	H	384.3B23A3A9AF	GRA	2PR	Snake River	Snake
3-122	W	3DD.00778F9293	RRF	1LW	Indirect Angler Mortality	RR Pool
3-123	H	3DD.007792071C	NMC	Okanogan	Last Det Okanogan	Okanogan
3-124	H	3DD.007792C475	LMR	RI Pool	OW Mortality	RI Pool
3-125	W	3DD.007791CF7A	CHU	Wenatchee	Last Det Wenatchee	Wenatchee
3-126	H	3DD.007791BA3F	WEA	Wells Pool	OW Mortality	Wells Pool
3-129	W	3DD.007791DF1D	OMK	1OK	Kelt Okanogan	Okanogan
3-130	H	3DD.007752DC91	UWE	2RI	Kelt Wenatchee	Wenatchee
3-131	H	3DD.0077528FCA	RRF	3PR	UNK Return Trib	PRD Pool
3-132	H	3DD.0077530C19	LMR	Methow	Harvested Methow	NA
3-133	W	3DD.007791C28E	CRW	1RI	Kelt Methow	Methow
3-134	H	3DD.0077532674	CHJO	RR Pool	OW Mortality	RR Pool
3-135	W	3DD.007752753F	RIA	1RI	Kelt Wenatchee	Wenatchee

3-136	W	3DD.00775261A0	MCJ	1LW	Kelt Wenatchee	Wenatchee
3-137	W	3DD.007791B75F	TWR	1ME	Last Det Methow	Wells Pool
3-138	H	3DD.007752AA88	LMR	2ME	Harvested Methow	NA
3-139	H	3DD.0077531393	WEA	Wells Pool	Harvested Wells Pool	NA
3-140	H	3DD.00775303CE	SCP	Methow	Last Det Methow	Methow
3-141	H	3DD.0077530ED0	USI	1RI	Salmon River	Snake
3-142	W	3DD.0077530A55	RRJ	1RI	Kelt Okanogan	Wells Pool
3-143	W	3DD.0077533D8E	UWE	Wenatchee	Last Det Wenatchee	Wenatchee
3-144	H	3DD.0077525F87	18N	1TP	Last Det Methow	Okanogan
3-145	W	3D9.1C2DEC94F8	ENS	1RI	Kelt Entiat	Wells Pool
3-146	H	3DD.007752E752	CHM	Wenatchee	Last Det Wenatchee	Wenatchee
3-147	W	3DD.007752A612	LMR	1ME	Harvested Methow	NA
3-148	W	3DD.0077536CF5	PEU	Wenatchee	Last Det Wenatchee	Wenatchee
3-149	H	3DD.0077535DDD	WEA	Entiat	Harvested Entiat	NA
3-150	H	3DD.00775297DC	TWR	1RI	Kelt Methow	Wells Pool
3-151	H	384.36F2B35B8D	SCP	Methow	Last Det Methow	Methow
3-152	H	3DD.007752AA1A	BCC	1RI	Kelt Wenatchee	Wenatchee
3-153	H	3DD.0077528A52	WEA	2CJ	Fall Mortality	Wells Pool
3-154	W	3DD.007753404C	PES	2RI	Kelt Wenatchee	Wenatchee
3-155	H	3DD.0077538591	OKL	2OK	Last Det Okanogan	Okanogan
3-156	H	3DD.0077536A1E	PRA	Ring Hatch	Broodstock Ringold	Below PRD
3-157	W	3DD.00775350E9	ENS	1RI	Kelt Entiat	RR Pool
3-158	W	3DD.003B9EF0E1	OMK	Okanogan	Last Det Okanogan	Okanogan
3-159	H	3DD.00775528EC	WEA	Methow	Harvested Methow	NA
3-160	W	3DD.007752F2BD	SAT	2PR	Yakima River	Yakima
3-161	H	3DD.007752F2B2	WEA	Wells Pool	OW Mortality	Wells Pool
3-162	W	3DD.007753348B	GRA	2PR	Snake River	Snake
3-163	W	3DD.007754BE04	CHANDL	2PR	Yakima River	Yakima
3-164	H	3DD.0077527C14	RRJ	1RI	Last Det Methow	Wells Pool
3-165	H	3DD.007753238F	LMR	Methow	Harvested Methow	NA
3-166	W	3DD.00775505ED	LMA	2PR	Snake River	Snake
3-167	H	3DD.007755469A	UWE	Wenatchee	Last Det Wenatchee	Wenatchee
3-168	H	3DD.0077528968	WEA	CJD	Harvested Wells Pool	NA
3-169	H	3DD.0077535DF0	FST	2CJ	Last Det Foster Creek	Wells Pool
3-170	W	3DD.0077551470	OKL	1OK	Kelt Okanogan	Wells Pool
3-171	W	3DD.007753763A	TOP	2PR	Yakima River	PRD Pool
3-172	H	3DD.0077536A18	WEA	1RI	Harvested Wells Pool	NA
3-173	H	3DD.00775390B7	PRA	Wan Pool	UNK Return Trib	Wan Pool
3-174	H	3DD.007752F067	WEA	1ME	Unreported Harvest	Methow
3-175	H	3DD.0077551D7D	LMR	Methow	Harvested Methow	NA
3-176	W	3DD.0077532F8B	USE	2PR	Salmon River	Snake
3-177	H	3DD.0077538DB6	WEA	2CJ	Harvested Wells Pool	NA
3-178	H	3DD.0077550987	LMA	3PR	Snake River	Snake

3-179	H	3DD.007753044C	LTR	3PR	Tucannon River	PRD Pool
3-180	H	3DD.00775342A0	FST	2CJ	Last Det Foster Creek	Wells Pool
3-181	H	3DD.0077525BD1	SCP	1RI	Kelt Methow	Methow
3-182	H	3DD.007752B80D	GRA	3PR	Broodstock Wallowa	Snake
3-183	W	3DD.0077556406	JDM	2PR	John Day River	Below PRD
3-184	H	3DD.00775569A2	RRF	2RI	Fall Mortality	RI Pool
3-185	H	3DD.0077537B4C	WEA	2CJ	Unreported Harvest	Wells Pool
3-186	H	3DD.0077534A51	RRF	Below PRD	Harvested Hanford	NA
3-187	H	3DD.0077920C27	WEA	2ME	Fall Mortality	Methow
3-188	H	3DD.00779208C2	RIA	2RI	Unreported Harvest	RI Pool
3-189	H	3DD.007791A9E9	WEA	Priest Pool	OW Mortality	PRD Pool
3-190	W	3DD.0077526855	ANT	1OK	Kelt Okanogan	Okanogan
3-191	H	3DD.007791A34B	WEA	Methow	Last Det Methow	Wells Pool
3-192	H	3DD.0077912A8C	PRD	PRD	Fall Mortality	PRD Pool
3-193	H	3DD.007791C74C	RIA	Wenatchee	OW Mortality	Wenatchee
3-194	W	3DD.00775289AA	UWE	RI	Kept for Reconditioning	Wenatchee
3-195	H	3DD.00775289F2	LMR	Methow	Harvested Methow	NA

Appendix D. Channel and codes, origins, last PIT and last radio telemetry detections of steelhead tagged in 2016 at Priest Rapids Dam. Final fates and overwintering locations are also provided.

Ch-Code	Origin	PIT ID	Last PIT	Last RT	Fate	Winter Loc
4-63	H	3DD.0077A0D740	RSH	Below PRD	Broodstock Ringold	PRD Pool
4-64	H	3DD.0077A056F5	GRA	1PR	Snake River	Snake
4-65	H	3DD.007791F5CA	MRC	Methow	Broodstock Methow	Wells Pool
4-66	H	3DD.007792605F	GRA	1PR	Snake River	Snake
4-67	H	3DD.007791A9AB	WEA	RR Pool	Beebee Springs	Wells Pool
4-68	W	3DD.00779264B0	UWE	MWN	Overwinter Mortality	Wenatchee
4-69	H	3DD.0077A05F0A	RRJ	2RI	UNK Return Trib	RR Pool
4-70	W	3DD.0077A10C3A	RRJ	RR Pool	Kelt Entiat	RR Pool
4-71	H	3DD.0077912971	SA1	1RI	Okanogan Kelt	Okanogan
4-72	H	3DD.007792B322	GRA	1PR	Snake River	Snake
4-73	H	3DD.0077918C08	WEA	Wells Pool	Harvested Wells Pool	NA
4-74	H	3DD.00779101E4	WEA	2CJ	Overwinter Mortality	Wells Pool
4-75	H	3DD.0077928DA8	WEA	1RI	UNK Return Trib	Wells Pool
4-76	H	3DD.0077913FC9	WEA	Wells Pool	Overwinter Mortality	Wells Pool
4-77	H	3DD.0077923D07	LMR	RR Pool	UNK Return Trib	Wells Pool
4-78	H	3DD.0077A0AD14	PRH	1PR	Broodstock Priest	Wan Pool
4-79	H	3DD.0077A0BB9F	RIA	Priest Pool	Overwinter Mortality	PRD Pool
4-80	W	3DD.007791ACD5	TUF	Wenatchee	Overwinter Mortality	Wenatchee
4-81	H	384.3B23A49466	WEA	1PR	Hanford Reach	Wells Pool
4-82	W	3DD.007792118F	LMR	1ME	Broodstock Winthrop	Methow
4-83	H	3DD.007791E278	TWR	Methow	Last Det Methow	Methow
4-84	W	3DD.00779128F0	RRJ	1RI	UNK Return Trib	RR Pool
4-85	H	3DD.007790633E	PRA	3PR	Fall Mortality	NA
4-86	H	3DD.0077922D08	LMA	1PR	Snake River	Wells Pool
4-87	H	3DD.0077917C39	GRA	1PR	Snake River	Snake
4-88	H	3DD.00779245BB	PRA	1RI	Fall Mortality	NA
4-89	W	384.3B23AC7298	CRU	1ME	Last Det Methow	Methow
4-90	H	3DD.007791615A	SCP	Methow	Last Det Methow	Methow
4-91	H	3DD.0077929A33	MRW	Methow	Last Det Methow	Methow
4-92	H	3DD.007790A454	RRJ	2PR	Okanogan Kelt	Okanogan
4-93	H	3DD.007790FE3D	MRC	Methow	Surplused Winthrop	Methow
4-94	H	3DD.0077928C44	RSH	1PR	Hanford Reach	Below PRD
4-95	H	3DD.0077923417	TUF	2RI	Fall Mortality	NA
4-96	H	3DD.00779296C7	GRA	1PR	Snake River	Snake
4-97	H	3DD.0077928AD9	WEA	Methow	Overwinter Mortality	Methow
4-98	H	3DD.007790A196	PRA	3PR	Fall Mortality	NA
4-99	H	3DD.007791CBF5	WEA	1RI	Beebee Springs	Wells Pool
4-100	H	3DD.007791C81B	RIA	Wan Pool	Overwinter Mortality	Wan Pool
4-101	W	3DD.0077927239	GRA	1PR	Snake River	Snake

4-102	H	3DD.00779230E8	MRC	1ME	Methow Kelt	Wells Pool
4-103	W	3D9.1C2DE9FE13	MAD	3PR	Kelt Entiat	RR Pool
4-104	W	3DD.00778F6929	WEA	2CJ	Fall Mortality	NA
4-105	H	3DD.00778F84A2	RSH	1PR	Hanford Reach	Below PRD
4-106	H	3DD.007791FD32	RRF	RR Pool	UNK Return Trib	RR Pool
4-107	H	3DD.0077921307	RRJ	1RI	Beebee Springs	Wells Pool
4-108	H	3DD.0077921BBC	LMR	Wells Pool	Surplused Wells	Methow
4-109	H	3DD.00779184C5	MRC	Methow	Surplused Winthrop	Methow
4-111	H	3DD.007790D6DA	LMR	RR Pool	Overwinter Mortality	RR Pool
4-112	H	3DD.007791AA5A	OKL	1OK	Fall Mortality	NA
4-113	H	3DD.0077921168	RRJ	RR Pool	UNK Return Trib	RR Pool
4-114	W	3DD.0077928919	LMR	1ME	Methow Kelt	Wells Pool
4-115	H	3DD.007791DE4F	RSH	3PR	Hanford Reach	PRD Pool
4-116	H	3DD.0077912756	TWR	Methow	Surplused Twisp	Okanogan
4-117	H	3DD.007790C2B2	WEA	Wells Pool	Surplused Wells	Wells Pool
4-118	H	3DD.007791FB95	RSH	Below PRD	Hanford Reach	Below PRD
4-119	H	3DD.0077921723	WEA	2PR	UNK Return Trib	Wells Pool
4-120	H	3DD.0077928AE2	ICH	1PR	Snake River	Snake
4-121	H	3DD.0077A0012A	MRC	Methow	Surplused Methow	Methow
4-123	H	3DD.0077926E18	GRA	1PR	Snake River	RR Pool
4-124	H	3DD.0077A07C51	LMR	1PR	Methow Kelt	Methow
4-125	H	3DD.0077A0840D	MC2	2PR	McNary Pool	PRD Pool
4-127	H	3DD.0077923C76	MSH	Methow	Surplused Methow	Wells Pool
4-128	H	3DD.00779FDCCC	PRA	3PR	Fall Mortality	NA
4-129	H	3DD.0077A07C4C	JOH	Okanogan	Last Det Okanogan	Wells Pool
4-130	W	3DD.0077A0E18E	GOA	1PR	Snake River	Snake
4-131	H	3DD.007791F8AF	WEA	Wells Pool	Overwinter Mortality	Wells Pool
4-132	H	3DD.00778F304A	LMR	RR Pool	Methow Kelt	Methow
4-135	H	3DD.0077910EFE	WEA	Methow	Last Det Methow	Methow
4-136	H	3DD.0077A0A248	WEA	Wan Pool	Overwinter Mortality	Wan Pool
4-137	H	3DD.0077A0C7D8	LMR	2PR	UNK Return Trib	Wells Pool
4-142	W	3DD.0077A0081B	WEA	2RI	Fall Mortality	NA
4-144	W	3DD.0077A02D47	RRF	2PR	UNK Return Trib	RR Pool
4-147	W	3DD.0077921CF3	PRA	1WP	Fall Mortality	NA
4-148	H	3DD.007792708C	WEA	RR Pool	UNK Return Trib	RR Pool
4-149	H	3DD.0077921247	WEA	1RI	Beebee Springs	RR Pool
4-150	W	3DD.007790ED15	RRJ	1PR	Kelt Entiat	Wells Pool
4-151	H	3DD.007790C1D3	WEA	2CJ	UNK Return Trib	Wells Pool
4-152	W	3DD.007791DFCC	SA1	1PR	Okanogan Kelt	Okanogan
4-153	H	3DD.0077915272	CRW	1RI	Methow Kelt	Methow
4-154	H	3DD.0077919B6D	WEA	3PR	Fall Mortality	NA
4-155	H	3DD.0077915CDD	SA0	2PR	Okanogan Kelt	Okanogan
4-156	H	3DD.003BABDD67	JOH	Priest Dam	Last Det Okanogan	Okanogan

4-157	H	3DD.0077911B53	RRJ	3PR	Methow Kelt	Methow
4-158	H	3DD.0077911225	GRA	1PR	Snake River	Snake
4-159	H	3DD.0077918F3E	TUF	Wenatchee	Fall Mortality	NA
4-160	H	3DD.007791AC21	WEA	Entiat	Last Det Entiat	Wells Pool
4-161	H	3DD.007791E34B	RSH	1PR	Hanford Reach	Below PRD
4-162	H	3DD.007791C4C9	RIA	Wan Pool	Overwinter Mortality	Wan Pool
4-163	W	3DD.007791C80C	TWR	1PR	Methow Kelt	Methow
4-164	H	3DD.007791AA91	MRC	Methow	Surplused Methow	Methow
4-165	H	3DD.0077919E3F	RRJ	1PR	Methow Kelt	Methow
4-166	H	3DD.007791FBAB	RRJ	1RI	Foster	Wells Pool
4-167	H	3DD.00779223BA	WEA	Okanogan	Overwinter Mortality	Okanogan
4-168	H	3DD.00779192FF	ICH	1PR	Snake River	Snake
4-169	H	3DD.007792A768	WEA	1ME	Fall Mortality	NA
4-170	H	3DD.0077913726	MSH	1RI	Methow Kelt	Methow
4-171	H	3DD.007791B6F3	WEA	Wells Pool	Overwinter Mortality	RR Pool
4-172	W	3DD.0077927ED8	LMR	Methow	Last Det Methow	Methow
4-173	H	3DD.0077910914	RRJ	Wan Pool	UNK Return Trib	RR Pool
4-174	H	3DD.003BAA5915	ANT	2PR	Okanogan Kelt	Okanogan
4-175	H	3DD.0077912724	NAL	1PR	Kelt Wenatchee	Wenatchee
4-176	H	3DD.00779105CE	PRA	1WP	Fall Mortality	NA
4-177	H	3DD.007791B64C	ICH	1PR	Snake River	Snake
4-178	W	3DD.0077910DFB	BCC	1PR	Kelt Yakima	Below PRD
4-179	H	3DD.00779219EB	WEA	RI Pool	Overwinter Mortality	RI Pool
4-180	H	3DD.0077920EFD	TON	1RI	Okanogan Kelt	Okanogan
4-181	H	3DD.007792A681	WEA	Below PRD	Hanford Reach	Below PRD
4-182	W	3DD.007791FCCA	PES	Priest Dam	Last Det Wenatchee	Wenatchee
4-183	H	3DD.007791608C	GOA	1PR	Snake River	Snake
4-184	H	3DD.007791749C	WEA	2CJ	Methow Kelt	Methow
4-185	W	3DD.0077922172	PES	1WP	Kelt Wenatchee	Wenatchee
4-186	H	3DD.0077923ABA	TUF	Wenatchee	Fall Mortality	NA
4-187	H	3DD.00778F8020	TUF	Wenatchee	Fall Mortality	NA
4-188	H	3DD.0077920C2B	OKL	Okanogan	Last Det Okanogan	Okanogan
4-189	W	3DD.007791527C	RIA	RI Pool	Overwinter Mortality	RI Pool
4-190	H	3DD.0077910D5B	SCP	Methow	Last Det Methow	Methow
4-191	H	3DD.0077924489	PRA	1WP	Fall Mortality	NA
4-192	H	3DD.0077928D8C	RRJ	RI Pool	UNK Return Trib	Wells Pool
4-193	H	3DD.003BAAF7DC	RRJ	4RI	Okanogan Kelt	Okanogan
4-194	H	3DD.007791E0ED	MSH	Methow	Surplused Methow	Methow
4-195	H	3DD.007792497A	PRA	1PR	Hanford Reach	Below PRD
4-196	H	3DD.00779129C6	WEA	Priest Dam	Overwinter Mortality	Methow
4-197	W	3DD.0077913B02	PRD	Below PRD	Hanford Reach	Below PRD
4-198	H	3DD.007792494C	SA0	Okanogan	Okanogan Kelt	Okanogan
4-199	W	3DD.007791914E	TUF	Wenatchee	Fall Mortality	NA

4-200	H	3DD.003BC487D9	TWR	Methow	Last Det Methow	Methow
4-201	H	3DD.0077911B79	WEA	1WP	UNK Return Trib	Wells Pool
4-202	H	3DD.007791AC19	LMR	Wells Pool	Overwinter Mortality	Wells Pool
4-203	W	3DD.0077906D23	UWE	Wenatchee	Last Det Wenatchee	Wenatchee
4-204	H	3DD.007790F0C6	18N	Methow	Last Det Methow	Methow
4-206	W	3DD.007790F130	GRA	1PR	Snake River	Snake
4-207	H	3DD.0077926385	RRJ	RI Pool	Kelt Entiat	Methow
4-208	W	3DD.00779192EC	ENA	Entiat	Last Det Entiat	RR Pool
4-209	W	3DD.007791CE5A	CHU	1PR	Kelt Wenatchee	Wenatchee
4-210	H	3DD.007791F8BD	WEA	Wells Pool	Overwinter Mortality	Wells Pool
4-211	H	3DD.0077924826	RIA	Wan Pool	Overwinter Mortality	Wan Pool
4-212	H	3DD.0077926FED	WEA	RR Pool	Fall Mortality	NA
5-63	H	3DD.0077A0FED0	RRJ	RI Pool	UNK Return Trib	Wells Pool
5-64	H	3DD.0077A0ABF1	MCJ	Priest Dam	Methow Kelt	Wells Pool
5-65	H	3DD.0077A11F32	RRJ	Wells Pool	Methow Kelt	Methow
5-66	H	3DD.0077A04978	MRC	1ME	Methow Kelt	Wells Pool
5-68	W	3DD.007791344D	ENL	RR Pool	Kelt Entiat	RR Pool
5-69	H	3DD.0077A0F07A	GRA	1PR	Snake River	Snake
5-70	H	3DD.0077A00759	RSH	1PR	Harvested Little Salmon R.	Below PRD
5-71	H	3DD.0077927DB7	GRA	1PR	Snake River	Snake
5-72	H	3DD.0077918E61	RRF	RI Pool	Overwinter Mortality	RI Pool
5-73	H	3DD.007790D1AE	WEA	Wells Pool	Overwinter Mortality	Wells Pool
5-74	H	3DD.0077A0E22B	PRA	Wan Pool	Overwinter Mortality	Wan Pool
5-75	H	3DD.0077A0EDB4	FST	Foster	Foster	Wells Pool
5-76	H	3DD.003BC489BB	LMR	Methow	Last Det Methow	Methow
5-77	H	3DD.00779FAB9F	GRA	1PR	Snake River	Snake
5-78	H	3DD.0077A09805	WEA	1ME	Overwinter Mortality	Methow
5-79	H	3DD.0077927017	GRA	1PR	Snake River	Snake
5-86	H	3DD.0077A070FF	WEA	IHI	Last Det Okanogan	Okanogan
5-91	H	3DD.0077922171	USE	1PR	Snake River	Snake
5-92	H	3DD.007791321E	WEA	2CJ	Foster	Wells Pool
5-93	H	3DD.007791189D	TUF	1PR	Kelt Wenatchee	Wenatchee
5-94	W	3DD.007791615F	RRJ	1RI	Kelt Entiat	RR Pool
5-95	H	3DD.0077918F62	RRJ	1PR	Methow Kelt	Wells Pool
5-96	H	3DD.007791EF32	RSH	3PR	Harvested Hanford Reach	PRD Pool
5-97	H	3DD.0077910011	TWR	2TP	Surplused Twisp	Methow
5-98	W	3DD.007791AD23	MRC	Methow	Broodstock Winthrop	Methow
5-99	H	3DD.0077917824	MRC	1ME	Last Det Methow	Okanogan
5-100	H	384.3B23A52E7B	MRC	Methow	Surplused Winthrop	Methow
5-101	H	3DD.0077927D51	LWE	Wenatchee	Last Det Wenatchee	RR Pool
5-102	H	3DD.00779174C8	TON	2PR	Okanogan Kelt	Okanogan
5-103	H	3DD.007791E9B7	WEA	Wells Pool	Beebee Springs	RR Pool
5-104	H	3DD.007791D250	WEA	RR Pool	Foster	Wells Pool

5-105	W	3DD.007792A3AB	SA0	Okanogan	Last Det Okanogan	Okanogan
5-106	H	3DD.0077921D1D	LMR	Methow	Last Det Methow	Methow
5-107	H	3DD.00779213FB	WEA	2PR	UNK Return Trib	Wells Pool
5-108	H	3DD.00778F7699	RRJ	1ME	UNK Return Trib	Wells Pool
5-109	W	3DD.007791857D	MRC	Methow	Last Det Methow	Wells Pool
5-110	H	3DD.00779106F3	WEA	RR Pool	UNK Return Trib	RR Pool
5-111	H	3DD.007791A77B	OKL	IHI	Last Det Okanogan	Okanogan
5-112	H	3DD.007791DF8E	GRA	1PR	Snake River	Snake
5-113	H	3DD.007792892A	RIA	1PR	Hanford Reach	Below PRD
5-114	H	3DD.00779121A0	WEA	RI Pool	Overwinter Mortality	Wells Pool
5-115	H	3DD.0077A1178D	OMK	RR Pool	Okanogan Kelt	Okanogan
5-119	H	3DD.0077927F7A	PRA	1WP	Fall Mortality	NA
5-120	H	3DD.0077907D44	WEA	RR Pool	Surplused Wells	RR Pool
5-121	H	3DD.007791E774	GRA	1PR	Snake River	Snake
5-122	H	3DD.007790CB5C	GRA	1PR	Harvested Snake R.	NA
5-123	H	3DD.0077924922	RSH	1PR	Hanford Reach	Below PRD
5-124	H	3DD.0077A0AD12	WEA	2CJ	UNK Return Trib	Wells Pool
5-125	H	3DD.00779F8FA3	RRF	RR Pool	Beebee Springs	RR Pool
5-126	W	3DD.007792522D	MCL	1RI	Kelt Wenatchee	RI Pool
5-127	H	3DD.0077927CB1	RRJ	1PR	Okanogan Kelt	Okanogan
5-128	H	3DD.007791F99D	RRJ	1WP	UNK Return Trib	Wells Pool
5-129	W	NONE	*NA*	1PR	Kelt Entiat	RR Pool
5-130	H	3DD.007792079B	LTP	1ME	Methow Kelt	Methow
5-131	H	3DD.0077927146	GRA	1PR	Snake River	Snake
5-132	H	3DD.007791FAF5	GRA	1PR	Snake River	PRD Pool
5-133	H	3DD.003BABE2EB	ANT	3PR	Okanogan Kelt	Okanogan
5-134	H	3DD.0077920C2F	WEA	IHI	Last Det Okanogan	Wells Pool
5-135	H	3DD.00778F2CFF	WEA	Wells Pool	UNK Return Trib	Wells Pool
5-136	H	3DD.0077929A28	GRA	2PR	Snake River	Okanogan
5-137	H	3DD.00779212D7	MRC	Methow	Broodstock Methow	Methow
5-138	H	3DD.0077923A20	OKL	RR Pool	Beebee Springs	Okanogan
5-139	H	3DD.007790F49C	MWF	Methow	Last Det Methow	Methow
5-140	H	3DD.0077914364	WEA	RR Pool	Overwinter Mortality	Wells Pool
5-141	H	3DD.0077910DF1	RRF	Wells Pool	Beebee Springs	RR Pool
5-142	H	3DD.0077914407	SCP	Methow	Last Det Methow	Methow
5-143	H	3DD.007792891C	GRA	1PR	Snake River	Snake
5-144	H	3DD.0077923F2F	WEA	Wells Pool	Surplused Wells	Methow
5-145	H	3DD.00779079A3	USE	Priest Dam	Salmon River	Below PRD
5-146	W	3DD.007792A7B0	SAT	1PR	Yakima River	Below PRD
5-147	H	3DD.0077911D4C	GRA	1PR	Harvested Snake R.	NA
5-148	H	3DD.0077928CE9	LMR	Wan Pool	UNK Return Trib	Wells Pool
5-149	H	3DD.0077910E3A	GRA	1PR	Snake River	Snake
5-150	H	3DD.007791B652	GRA	1PR	Snake River	PRD Pool

5-151	H	3DD.007792BE5E	ICH	1PR	Snake River	Snake
5-152	H	3DD.007791A35C	MSH	2ME	Last Det Methow	Methow
5-153	H	3DD.0077928B54	LMR	RR Pool	Last Det Methow	Wells Pool
5-154	H	3DD.0077912B02	MRC	Methow	Last Det Methow	Wells Pool
5-156	W	3DD.0077922BD1	WEA	2CJ	Fall Mortality	NA
5-157	W	3DD.0077928CDC	LMR	Methow	Broodstock Winthrop	Methow
5-158	H	3DD.007791FCFD	PRA	1PR	Hanford Reach	Below PRD
5-159	H	3DD.0077921C90	MRW	1PR	Methow Kelt	Methow
5-160	H	3DD.00778F7244	SC2	1PR	Harvested Clearwater R.	NA
5-161	H	3DD.0077921583	GRA	1PR	Snake River	RR Pool
5-162	H	3DD.007791EAF4	WEA	Wenatchee	Last Det Wenatchee	Wells Pool
5-163	H	3DD.007792144B	LMR	Methow	Last Det Methow	Methow
5-164	H	3DD.0077923BD4	BVC	Methow	Last Det Methow	Okanogan
5-165	H	3DD.00779208BE	WEA	RI Pool	Overwinter Mortality	RI Pool
5-166	H	3DD.0077924977	BPC	Okanogan	Last Det Okanogan	Wells Pool
5-167	W	3DD.00779117E8	WEA	Methow	Last Det Methow	Wells Pool
5-168	H	3DD.007792B40B	GRA	1PR	Snake River	Snake
5-169	H	3DD.007792C4E6	RRJ	Wan Pool	Foster	Methow
5-170	H	3DD.00778F404A	PRA	1RI	Fall Mortality	NA
5-171	H	3DD.00779140BF	RRJ	2PR	Methow Kelt	Wells Pool
5-172	W	3DD.0077910DF7	GLC	1RI	Methow Kelt	Methow
5-173	H	3DD.00779174B6	MRC	1PR	Methow Kelt	Wells Pool
5-174	H	3DD.0077928FC9	GOA	1PR	Snake River	Wells Pool
5-175	H	3DD.0077924B27	BPC	Okanogan	Last Det Okanogan	Okanogan
5-176	W	3DD.007791EEB1	TUF	2PR	Kelt Wenatchee	Wenatchee
5-177	H	3DD.0077911446	GRA	1WP	Snake River	Snake
5-178	W	3DD.0077923EFA	ENF	1EN	Kelt Entiat	RR Pool
5-179	H	3DD.007792BEE8	GRA	1PR	Snake River	Snake
5-180	H	3DD.0077910B6A	WEA	Priest Pool	Overwinter Mortality	Wan Pool
5-181	W	3DD.007790F78D	WEA	2ME	Fall Mortality	NA
5-182	H	3DD.0077928B1C	RSH	Below PRD	Hanford Reach	Below PRD
5-183	W	3DD.00775DB3C3	PEU	1WP	Last Det Wenatchee	RI Pool
5-184	H	3DD.0077921BC2	RRJ	RR Pool	UNK Return Trib	Wells Pool
5-185	H	3DD.0077922D57	MRC	2TP	Surplused Twisp	Methow
5-186	W	3DD.00778F5A2D	PRV	1PR	Walla Walla River	Below PRD
5-187	W	3DD.00779124D6	RRJ	2PR	Methow Kelt	Methow
5-188	H	3DD.007791A933	MRC	Methow	Overwinter Mortality	Methow
5-189	H	3DD.00779253ED	RIA	3RI	Fall Mortality	NA
5-190	W	3DD.007792156E	RCT	1PR	Kelt Entiat	RR Pool
5-191	W	3DD.00779164B9	LWE	2RI	Fall Mortality	NA
5-192	H	3DD.007792BAC9	ICL	2RI	Kelt Wenatchee	Wells Pool
5-193	W	3DD.0077927CB2	UWE	2PR	Kelt Wenatchee	Wenatchee
5-194	W	3DD.0077916D3E	BCC	1EN	Kelt Entiat	Wells Pool

5-195	H	3DD.0077927DDC	LMR	Okanogan	Last Det Okanogan	Okanogan
5-196	H	3DD.0077913172	WEA	2CJ	Fall Mortality	NA
5-197	W	3DD.00779131F2	PRO	1PR	Yakima River	RI Pool
5-198	H	3DD.0077912F96	RRJ	Wells Pool	UNK Return Trib	Wells Pool
5-199	W	3DD.00779261B4	PRO	1PR	Yakima River	RI Pool
5-200	H	3DD.00778F70A9	PRA	1PR	Hanford Reach	Below PRD
5-201	H	3DD.007791933E	RRJ	2PR	Okanogan Kelt	Methow
5-202	W	3DD.0077916306	LMR	Methow	Overwinter Mortality	Methow
5-203	H	3DD.007791C59B	OKL	Okanogan	Last Det Okanogan	Wells Pool
5-204	H	3DD.007792AA87	WEA	Wells Pool	Surplused Wells	RR Pool
5-205	H	3DD.007792485E	RIA	Wan Pool	Overwinter Mortality	Wan Pool
5-206	H	3DD.007792974A	SA0	Okanogan	Last Det Okanogan	Okanogan
5-207	H	3DD.007792073D	BPC	Wan Pool	Okanogan Kelt	Okanogan
5-208	H	3DD.007792C4FB	MSH	Methow	Surplused Methow	Methow
5-209	H	3DD.003BC48400	WEA	Wells Pool	Overwinter Mortality	Wells Pool
5-210	W	3DD.00774244B1	WHS	1PR	Okanogan Kelt	Okanogan
5-211	H	3DD.007792C504	LWE	1PR	Kelt Wenatchee	Methow
5-212	H	3DD.0077926FBE	WEA	Wells Pool	Surplused Wells	Wells Pool
6-71	W	3DD.0077A0AAE4	GRA	1PR	Snake River	Snake
6-72	H	3DD.0077912947	GRA	1PR	Snake River	Snake
6-73	H	3DD.00779F9CB9	OKL	Wan Pool	UNK Return Trib	Okanogan
6-74	H	3DD.0077916D38	MRC	Methow	Surplused Winthrop	Methow
6-75	H	3DD.0077A07249	MRC	Methow	Last Det Methow	Wells Pool
6-76	H	3DD.0077A0571F	LWE	Wan Pool	Kelt Wenatchee	Wells Pool
6-77	W	3DD.0077A08137	ENL	Priest Dam	Kelt Entiat	RR Pool
6-78	W	3DD.0077A0BA22	WEA	RR Pool	Overwinter Mortality	RR Pool
6-79	H	3DD.007791B02F	MSH	Methow	Broodstock Winthrop	Methow
6-81	H	3DD.0077923C0D	CRW	RR Pool	Methow Kelt	Wells Pool
6-82	W	3DD.0077A03550	WEA	2RI	Fall Mortality	NA
6-83	H	3DD.00779FDC9D	RRJ	Wan Pool	UNK Return Trib	RR Pool
6-84	W	3DD.0077A04865	RRJ	1RI	Methow Kelt	Wells Pool
6-85	H	3DD.0077A116E7	PRO	1PR	Yakima River	Wells Pool
6-86	H	3DD.0077A049C6	RRJ	1PR	Methow Kelt	Wells Pool
6-87	H	3DD.0077A10A48	RIA	Wan Pool	UNK Return Trib	Wan Pool
6-88	H	3DD.0077A03A4A	TON	IHI	Last Det Okanogan	Okanogan
6-89	H	3DD.0077A0EFB0	OKL	Methow	Surplused Methow	Okanogan
6-90	H	3DD.007791FA95	MRC	Methow	Last Det Methow	Methow
6-91	H	3DD.00779261A4	GRA	1PR	Snake River	Snake
6-92	H	3DD.0077926FD3	TWR	RR Pool	Methow Kelt	Methow
6-93	H	3DD.0077922D37	PRV	1PR	Walla Walla River	Below PRD
6-94	W	3DD.007792173A	WEA	2CJ	Fall Mortality	NA
6-95	H	3DD.003BA0D499	WEA	Wells Pool	Surplused Wells	Wells Pool
6-96	H	3DD.0077918F78	WEA	Wells Pool	Fall Mortality	NA

6-97	H	3DD.007791D35F	JOH	Okanogan	Last Det Okanogan	Okanogan
6-98	H	3DD.00779112B9	USE	1PR	Salmon River	Below PRD
6-99	H	3DD.0077929A0F	MRC	Methow	Surplused Winthrop	Methow
6-100	H	3DD.0077928DB6	TUF	Wenatchee	Overwinter Mortality	Wenatchee
6-101	H	3DD.007792248A	WEA	Okanogan	Foster	Okanogan
6-102	H	3DD.0077911BDC	WEA	RR Pool	UNK Return Trib	Wells Pool
6-103	H	3DD.00779129C1	MRC	Methow	Last Det Methow	Wells Pool
6-104	W	3DD.007792BC9B	WEA	Wenatchee	Last Det Wenatchee	Wells Pool
6-105	H	3DD.007791532E	SA0	Okanogan	Last Det Okanogan	Okanogan
6-106	H	3DD.0077927CDD	RRF	4RI	Fall Mortality	NA
6-107	H	3DD.0077908B78	RRJ	1PR	Methow Kelt	Methow
6-108	H	3DD.0077907B72	PRA	4RI	Fall Mortality	NA
6-109	W	3DD.0077921758	RRJ	Okanogan	Last Det Okanogan	Okanogan
6-110	H	3DD.007792171C	JDJ	1PR	John Day Pool	Below PRD
6-111	H	3DD.003BC49868	WEA	2CJ	Fall Mortality	NA
6-112	H	3DD.0077923FFF	RRF	1RI	UNK Return Trib	RR Pool
6-113	W	3DD.007792B183	CRW	Methow	Last Det Methow	Methow
6-114	H	3DD.007792498E	RRJ	1PR	Methow Kelt	Methow
6-115	W	3DD.007791E08C	OKL	Okanogan	Overwinter Mortality	Okanogan
6-116	H	3DD.007791EF69	WEA	Wan Pool	Overwinter Mortality	Wan Pool
6-117	H	3DD.00778F8136	SCP	Methow	Last Det Methow	Wells Pool
6-118	W	3DD.007791EAEA	MRC	Methow	Last Det Methow	Methow
6-119	H	3DD.0077A0FD58	OKL	1RI	Okanogan Kelt	Okanogan
6-121	H	3DD.007791A015	MRC	Methow	Last Det Methow	Wells Pool
6-122	H	3DD.007791AA90	WEA	1PR	Foster	Wells Pool
6-123	H	3DD.0077917909	RRJ	1PR	Methow Kelt	Okanogan
6-124	H	3DD.007791DC73	GRA	1PR	Snake River	Snake
6-125	W	3DD.0077925205	WEA	Wells Pool	UNK Return Trib	RR Pool
6-126	H	3DD.0077A06CC2	MRC	Methow	Surplused Methow	Methow
6-128	W	3DD.0077927351	GRA	2PR	Snake River	PRD Pool
6-129	H	3DD.0077912A9E	RIA	2RI	Fall Mortality	NA
6-130	H	3DD.0077922318	RRJ	1PR	Hanford Reach	RR Pool
6-131	H	3DD.007790C27B	RSH	1PR	Hanford Reach	Methow
6-132	H	3DD.00779152C0	TWR	Methow	Last Det Methow	Methow
6-133	H	3DD.0077923A03	WEA	RR Pool	UNK Return Trib	Wells Pool
6-136	H	3DD.0077924728	RRJ	2PR	Methow Kelt	Methow
6-137	H	3DD.003BA52C85	OMK	Okanogan	Last Det Okanogan	Okanogan
6-138	H	3DD.007791B3D6	LTR	Priest Dam	Tucannon River	Wells Pool
6-139	W	3DD.007792330E	GRA	1PR	Snake River	Snake
6-140	W	3DD.0077911AF2	MAD	1PR	Kelt Entiat	Wells Pool
6-143	W	3DD.0077A09F8E	WEA	3PR	Fall Mortality	NA
6-144	H	3DD.00779280EC	GRA	1PR	Snake River	Snake
6-145	H	3DD.00779118B2	PRA	1PR	Hanford Reach	Below PRD

6-146	H	3DD.007791445D	GRA	1PR	Snake River	Snake
6-147	H	3DD.0077916DBC	WEA	1RI	UNK Return Trib	RR Pool
6-148	H	3DD.00779253C3	WEA	2CJ	Fall Mortality	NA
6-149	H	3DD.00779232DF	WEA	1RI	UNK Return Trib	RR Pool
6-150	H	3DD.0077916120	WEA	1RI	Kelt Entiat	Wells Pool
6-151	H	3DD.007792AA8C	MRC	RR Pool	Methow Kelt	Methow
6-152	W	3DD.00779152D2	WEA	2PR	UNK Return Trib	RR Pool
6-153	H	384.3B239A9E6D	MRC	Methow	Broodstock Winthrop	Methow
6-154	H	3DD.007792A87F	PRD	Foster	Foster	Wells Pool
6-155	H	3DD.0077912A3E	WEA	1RI	Overwinter Mortality	Wells Pool
6-156	W	3DD.007791E04B	CRW	1ME	Methow Kelt	Methow
6-157	H	3DD.0077913604	RIA	Wenatchee	Last Det Wenatchee	RI Pool
6-158	W	3DD.0077923D60	RRJ	4RI	Methow Kelt	Methow
6-159	H	3DD.007791B4F2	MRC	Methow	Surplused Winthrop	Methow
6-160	H	3DD.0077910207	MRC	Methow	Surplused Methow	Methow
6-161	H	3DD.0077929ACC	WEA	1PR	Okanogan Kelt	Okanogan
6-162	H	3DD.003BD6DED7	WEA	RR Pool	UNK Return Trib	Wells Pool
6-163	H	3DD.007791377F	LTR	1PR	Tucannon River	Below PRD
6-164	W	3DD.007791F7F9	RIA	1PR	Hanford Reach	RI Pool
6-165	W	3DD.0077842E1A	MAD	2PR	Kelt Entiat	Wells Pool
6-166	H	3DD.007791B748	WEA	Wells Pool	Overwinter Mortality	Wells Pool
6-167	H	3DD.00779211D5	WEA	4RI	Fall Mortality	NA
6-168	H	3DD.0077916165	GRA	1PR	Snake River	Snake
6-169	H	3DD.007791A644	WEA	Wells Pool	Overwinter Mortality	Wells Pool
6-170	H	3DD.0077912ACB	GRA	1PR	Snake River	Snake
6-171	H	3DD.007791D9FC	RRJ	RI Pool	Kelt Entiat	Wells Pool
6-172	H	3DD.007791E76A	USE	1PR	Salmon River	PRD Pool
6-173	H	3DD.00779263B2	OKL	Okanogan	Last Det Okanogan	Okanogan
6-174	H	3DD.0077904DB6	MWF	Methow	Last Det Methow	Methow
6-175	H	3DD.0077915D28	JOC	1PR	Joseph Ck.	Below PRD
6-176	H	3DD.0077928B2D	WEA	RR Pool	UNK Return Trib	Wells Pool
6-177	H	3DD.0077914769	WEA	Wells Pool	Overwinter Mortality	Wells Pool
6-178	W	3DD.007791FD07	TUF	Wenatchee	Overwinter Mortality	Wenatchee
6-179	W	3DD.0077927AEF	RIA	1PR	Hanford Reach	Wells Pool
6-180	W	3DD.0077923EDA	PRO	1PR	Yakima River	Below PRD
6-181	W	3DD.007792C388	UWE	1PR	Kelt Wenatchee	Wenatchee
6-182	H	3DD.0077913B45	MRC	Methow	Last Det Methow	Methow
6-183	H	3DD.007791C5D6	NAU	1PR	Kelt Wenatchee	Wenatchee
6-184	H	3DD.00779165E1	WEA	Okanogan	Overwinter Mortality	Okanogan
6-185	W	3DD.0077918CC6	ENA	1PR	Kelt Entiat	Wells Pool
6-186	H	3DD.007791EF31	LTR	1PR	Tucannon River	Below PRD
6-187	H	3DD.007791A90F	ICL	2LW	Kelt Wenatchee	RR Pool
6-188	H	3DD.007792BC8B	LMR	1RI	Methow Kelt	Methow

6-189	H	3DD.0077919676	MWF	RR Pool	Methow Kelt	Methow
6-190	H	3DD.00779079E8	LMR	Wells Pool	Surplused Wells	Methow
6-191	W	3DD.007792B43D	PRO	1PR	Yakima River	PRD Pool
6-192	W	3DD.00779153FE	BVP	Wenatchee	Last Det Wenatchee	Wenatchee
6-193	H	3DD.0077924B42	RRJ	1PR	Okanogan Kelt	Okanogan
6-194	H	3DD.0077911756	GRA	1PR	Snake River	Snake
6-195	H	3DD.007784559B	WEA	2CJ	Fall Mortality	NA
6-196	W	3DD.0077928B24	MAD	1RI	Kelt Entiat	RR Pool
6-197	W	3DD.007791EB7E	ICL	1WP	Kelt Wenatchee	RI Pool
6-198	H	3DD.0077929A00	WEA	Wells Pool	Surplused Wells	Wells Pool
6-199	H	3DD.0077927F7B	WEA	1OK	Overwinter Mortality	Okanogan
6-200	H	3DD.007790FB3C	GRA	1PR	Snake River	Snake
6-201	H	3DD.0077918F36	MRC	Methow	Last Det Methow	Wells Pool
6-202	H	3DD.0077919AD1	SAT	1PR	Yakima River	Below PRD
6-203	H	3DD.0077927E93	WEA	4RI	Fall Mortality	NA
6-204	H	3DD.007791E736	MRC	Methow	Surplused Winthrop	Methow
6-205	H	3DD.0077928B38	RRJ	1ME	UNK Return Trib	Wells Pool
6-206	H	3DD.00779248F5	RRJ	Priest Pool	Methow Kelt	Wells Pool
6-207	H	3DD.0077921E85	RRF	RI Pool	Overwinter Mortality	RR Pool
6-208	W	3DD.0077920A0E	GRA	1PR	Snake River	PRD Pool
6-209	W	3DD.007791EF10	NAL	Wenatchee	Last Det Wenatchee	Wenatchee
6-210	H	3DD.003BC44086	WEA	RR Pool	UNK Return Trib	Wells Pool
6-211	H	3DD.007791CC3E	PRA	Below PRD	Hanford Reach	Below PRD
6-212	H	3DD.007792A85E	RSH	Below PRD	Hanford Reach	Below PRD