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Upstream Migration Timing of Columbia Basin Chinook and Sockeye Salmon and Steelhead in 2021

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June 15, 2024

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Columbia River Inter-Tribal Fish Commission Technical Report for BPA Project 2008-518-00, Contract 73354

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ABSTRACT

Between April 20, and October 12, 2021, Chinook (*Oncorhynchus tshawytscha*) and Sockeye (*Oncorhynchus nerka*) salmon as well as steelhead (*Oncorhynchus mykiss*) were sampled at the Bonneville Dam Adult Fish Facility (AFF). Fish were measured for fork length, scales were collected for analysis of age, tissue samples collected for genetic analysis, and the fish were tagged with Passive Integrated Transponder (PIT) tags. These fish were tracked upstream as they passed through sites with PIT tag antennas, including fish ladders at dams, juvenile bypasses, hatcheries, and weirs, as well as in-stream antennas. Total numbers of fish tracked upstream were 1,273 spring Chinook, 999 summer Chinook, 1,205 fall Chinook, 640 steelhead, and 1,400 Sockeye Salmon.

Chinook Salmon median migration rates between mainstem dams ranged between 16.7 km/day for fall Chinook migrating between Priest Rapids and Wells dams and 56.7 km/day for fall Chinook migrating between John Day and McNary dams. An estimated 45.9% of spring Chinook sampled passed into the Snake Basin upstream of Ice Harbor Dam, while an estimated 63.6% of summer Chinook passed into the portion of the Columbia Basin upstream of Priest Rapids Dam. Among fall Chinook, the primary terminal area was between McNary Dam (passed by 55.0% of fall Chinook), with an estimated 10.0% passing Ice Harbor Dam had and 11.4% passing Priest Rapids Dam

Steelhead median migration rates between mainstem dams ranged from 24.1 km/day between Bonneville and John Day dams to 41.8 km/day between John Day and McNary dams. Among Steelhead classified as B-run (greater or equal to 78 cm fork length) that were last detected in terminal areas (tributaries between Bonneville and McNary Dam and above McNary Dam), 95.3% were detected in the Snake Basin. The percentage of steelhead classified as B-run at Bonneville Dam reached its highest level at 39.1% of the run in Statistical Week 39. The number of B-run steelhead peaked in Week 35 at 2,132 steelhead while the number of A-run (<78 cm) peaked in Week 36 at 7,734 fish. A total of 73 steelhead PIT tagged and tracked in 2021 were detected moving downstream (mostly in juvenile bypasses) after spawning, recovered or detected in kelt programs, or detected moving upstream in summer/fall 2022 and were designated as kelt.

For Sockeye the median migration rates between mainstem dams ranged between 29.7 (between Rock Island and Rocky Reach and John Day and McNary dams) and 48.8 (between The Dalles and John Day dams) km/day for adults tagged at Bonneville Dam. Escapement estimates for the entire Sockeye run derived from PIT tag detections at mainstem Columbia River dams differ from those estimated by visual counts by -26.0% to 15.4%.

The principal age components with percentage of run for spring Chinook were Age 1.2 (79.3%), Age 1.1 (17.2%), and 1.3 (3.5%), for summer Chinook Age 1.2 (40.6%), Age 1.3, (32.4%), and Age 1.1 (19.6%) and for fall Chinook Age 0.3 (55.0%), and 0.2 (21.9%). The steelhead run was 29.7% Age 1.1, 23.5% Age 1.2, and Age 2.1 16.0%. The Sockeye run was 57.4% Age 1.2, 27.3% Age 1.1 and 13.7% Age 1.3.

Stray rates were estimated using both Genetic Stock Identification (GSI]) and Parental Based Tagging (PBT) and site of last PIT tag detection. The stray rate was 14.4% for PBT-classified steelhead and 20.5% for GSI-classified steelhead. For Chinook, the stray rate was 12.0% for PBT-classified Chinook and 20.3% for GSI-classified Chinook. For Sockeye, the stray rate estimated by this project using GSI was 2.7% and 2.8% if PBT results are included.

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INTRODUCTION

Since 1985, the Columbia River Inter-Tribal Fish Commission (CRITFC) has been funded by the Pacific Salmon Commission (PSC) to sample Chinook (*Oncorhynchus tshawytscha*) and Sockeye (*Oncorhynchus nerka*) salmon at Bonneville Dam to determine age, length-at-age, and, in the case of Sockeye Salmon, stock composition (Fryer 2009). In 2004, CRITFC took over a similar long-running steelhead (*Oncorhynchus mykiss*) sampling program at Bonneville Dam from Oregon Department of Fish and Wildlife (Whiteaker and Fryer 2008). The development and maturation of two new technologies, Passive Integrated Transponder (PIT) tags and genetic stock identification (GSI), have provided an opportunity to greatly expand the information obtained from our stock monitoring program at Bonneville Dam. PIT tag antennas are now installed in fish ladders at most mainstem Columbia and Snake River dams, as well as at dams and weirs on many of the Columbia Basin tributaries. By PIT tagging fish sampled at Bonneville Dam, we can track tagged fish upstream providing valuable information on migration timing and survival rates. Data on the movement of PIT-tagged fish through Columbia Basin receivers is readily available to all managers and researchers on a near real-time basis through the PIT Tag Information System (PTAGIS) at www.ptagis.org. The information obtained by PIT tags can be further expanded by identifying the origin of the fish using GSI. Using these two technologies it becomes possible to determine migration timing, stray rates, and upstream survival on a stock-specific basis for Chinook and Sockeye salmon and steelhead.

The vast majority of PIT tagging in the Columbia Basin is conducted on juvenile salmonids captured at hatcheries, tributary smolt traps, or at dam juvenile bypasses. These tagging programs predominantly study downstream juvenile migration and survival through the hydrosystem, but rarely tag enough fish to assess survival of returning adults as they pass Bonneville Dam and migrate to the spawning grounds. There are also many salmon stocks in the Columbia Basin which are not PIT tagged, thus it is difficult to answer questions on upstream migration timing, straying, and survival for those stocks. Because our project randomly samples adult salmon and steelhead passing through the Bonneville Dam Adult Fish Facility (AFF) trap, this study tags salmonid stocks that have not previously been tagged and monitored.

METHODS

Sampling

Chinook and Sockeye salmon and steelhead were collected from April 20 through October 12, 2021, at the Bonneville Dam AFF, located adjacent to the Second Powerhouse at river km 234. This facility uses a weir with four pickets to divert fish ascending the Washington shore fish ladder into the AFF collection pool. An attraction flow is used to draw fish that enter the collection pool through a false weir where they then can be selected for sampling. Fish not selected, and fish that have recovered from sampling, migrate back to the Washington shore fish ladder above the pickets. An attempt was made to exclude minijacks (defined as Chinook spending no winters in saltwater) from the sample by not diverting Chinook Salmon into the sampling tank that were estimated to be less than 36 cm in length, and immediately releasing without sampling any fish diverted that turned out to be less than this threshold length. These small Chinook Salmon are excluded because sampling these fish would reduce our sample of larger Chinook as well as other species which are of more importance to managers. Also excluded from further analysis, other than reporting the site of final PIT tag detection, were any Chinook, Steelhead, and Sockeye Salmon that, based on scale analysis, did not spend a winter in saltwater.

Use of the AFF is restricted by protocols established by the Fish Passage Operation and Maintenance Coordination Team[1]. These protocols include restrictions on the number of salmonids that can simultaneously be in the anesthetic and recovery tanks and restrict picket lead operations at higher fish abundances. At temperatures above 21.1°C (70.0°F), sampling is restricted to four days per week from 0600-1030 hours, the number of salmonids allowed in the anesthetic tank is reduced, and picket lead operations are changed to divert fewer fish into the AFF. Above 22.2°C (72.0°F) sampling is halted until the daily average water temperature drops to 21.16°C (71.9°F). Picket lead deployment is also restricted when abundance of salmonids or shad is high with further restrictions when abundance occurs at high temperatures (Appendix A).

Salmon and steelhead selected for sampling were diverted into a tank where they were anesthetized, examined for tags, fin clips, wounds, and condition.

[1] The protocols can be found at https://pweb.crohms.org/tmt/documents/fpp/2021/final/FPP22_AppG_100820.pdf.

They were measured for fork length[2], and tissue and six scales (four scales for Sockeye) were collected for age analysis (Whiteaker and Fryer 2008, Kelsey et al. 2011). A small caudal clip for later genetic analysis was also collected (https://www.monitoringresources.org/Document/Method/Details/4087). Fish were scanned for PIT tags. If no tags were detected, standard techniques were used to inject PIT tags using a needle that penetrates the fish between the posterior tip of the pectoral fin and the anterior point of the pelvic girdle (CBFWA 1999). Tagged fish were then scanned for the PIT tag code, which was recorded if detected. If no tag was detected, no effort was made to re-tag the fish. Data on each PIT-tagged fish was uploaded to www.ptagis.org.

Columbia Basin Chinook Salmon are classified by Bonneville Dam passage date as being spring, summer, or fall run. Spring Chinook are most commonly considered as those Chinook passing Bonneville Dam between March 15 and May 31 annually (FPC 2021), although for management purposes June 15 is used as the end date of the spring Chinook migration (https://www.fws.gov/lsnakecomplan/Reports/USvOregon/FINAL.2018-%202027%20USvOR%20Management%20Agreement%20with%20Signature%20Feb%202018%20.pdf). This report will use the May 31 date, although some comparisons using the June 15 date will be provided. Chinook passing Bonneville Dam on or after June 1 will be classified as summer Chinook, while those passing between August 1 and November 15 will be classified as fall Chinook Salmon.

Upstream Detection

As tagged salmon and steelhead continued their migration they were detected by PIT tag receivers located in the adult fish ladders at major Columbia Basin mainstem dams (Bonneville, The Dalles, John Day, McNary, Priest Rapids, Rock Island, Rocky Reach, and Wells dams on the Columbia River; Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams on the Snake River) as well as in numerous tributaries and hatcheries in the Columbia Basin (Appendix C – Table C1 and Figure C1). PIT tag detection data from these sites is uploaded to www.ptagis.org, which is then accessible to users of the site.

[2] In 2021, lengths were recorded to the nearest 5 mm as opposed to previous years when they recorded in centimeters to the nearest 0.5 cm. Length data in this report will similarly be reported in mm rather than cm.

Almost all detection sites have multiple antennas, often laid out in parallel so that the antennas span a river or fishway in more than one location. We refer to each parallel antenna array as a "weir." Salmon can be detected more than once as they pass over or through each weir. Each detection will subsequently be referred to as a "weir detection." The combination of all detections at the multiple weirs at a given site, regardless of the time between those detections, will subsequently be referred to as a "site detection." For example, the configuration of PIT tag antennas at Rock Island Dam is shown in Figure 1. Salmon or steelhead can pass this dam using any of three fish ladders. Each ladder has two weirs

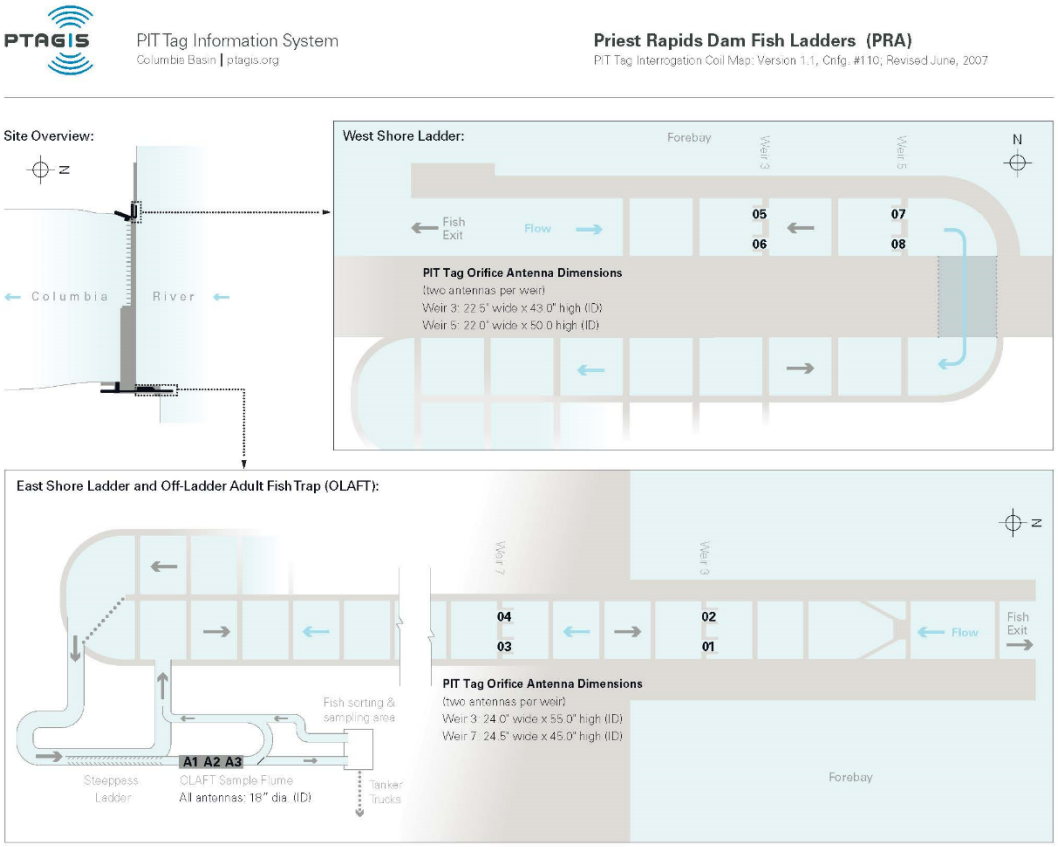


Figure 1. PIT tag detection configuration at Priest Rapids Dam showing two adjoining antennas at two weirs in each fish ladder (Figure from www.ptagis.org.)

(referred to as baffles 2 and 4 at each ladder) with PIT tag detection and two antennas in each weir (numbered as 01 to 0C in hexadecimal format). If a fish ascended the left ladder and generated two detections at Baffle 2 and three at Baffle 4 (the words "baffle" and "weir" are interchangeable), this is five weir detections, but only one site detection (Rock Island Dam).

Site Detection Percentage

All fish PIT tagged and released at the Bonneville Dam AFF exit into a fish

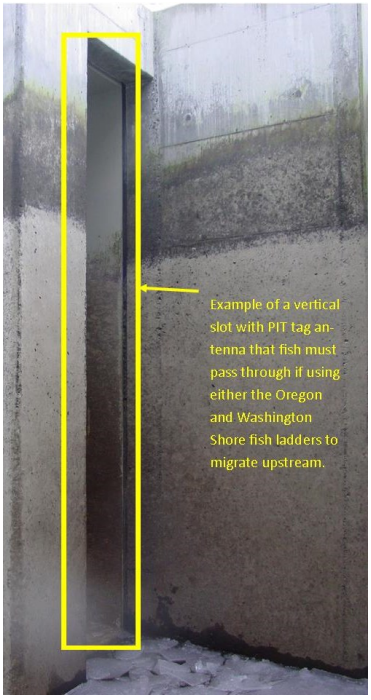
ladder with PIT tag antennas in both the upstream and downstream directions at site BO3. However, these antennas are at the underwater orifices with no monitoring of overflow weirs (Figure 2) which many salmonids, especially Sockeye Salmon use. Furthermore, it is possible for any salmon that moves downstream following tagging could pass upstream through the navigation locks at Bonneville Dam (Figure 3). There are other dams with navigation locks (The Dalles, John Day, McNary, Ice Harbor, Little Goose, Lower Monumental, and Lower Granite dams) where PIT-tagged salmon can pass undetected. The percentage of PIT-tagged fish missed at each dam with PIT tag detection arrays was calculated by looking at the fish detected upstream of the site in question and estimating the percentage not detected at that site. For example, the percentage missed at Rocky Reach Dam was calculated as:

$$P = \frac{R_m}{R_d}$$

where R_m was the number of fishes missed at Rocky Reach Dam but detected upstream of Rocky Reach Dam and R_d was the number of fish detected upstream of Rocky Reach Dam.

PIT tag detection antennas in fish ladders are always placed in at least two locations in relatively close proximity. PIT tag interrogation maps (available at www.ptagis.org) indicate that these antennas are placed at vertical slots, weirs, or pools. To simplify the nomenclature, these locations will all subsequently be referred to as weirs.

Bonneville Dam Vertical Slot Antenna



Bonneville Dam underwater antenna with unmonitored overflow weir

Figure 2. Pictures of the two types of PIT tag antennas at Bonneville Dam. The vertical slot antennas are at the upper end of both ladders, while the underwater antennas are in the lower parts of the ladders. Photos courtesy of Alan Brower of PTAGIS.

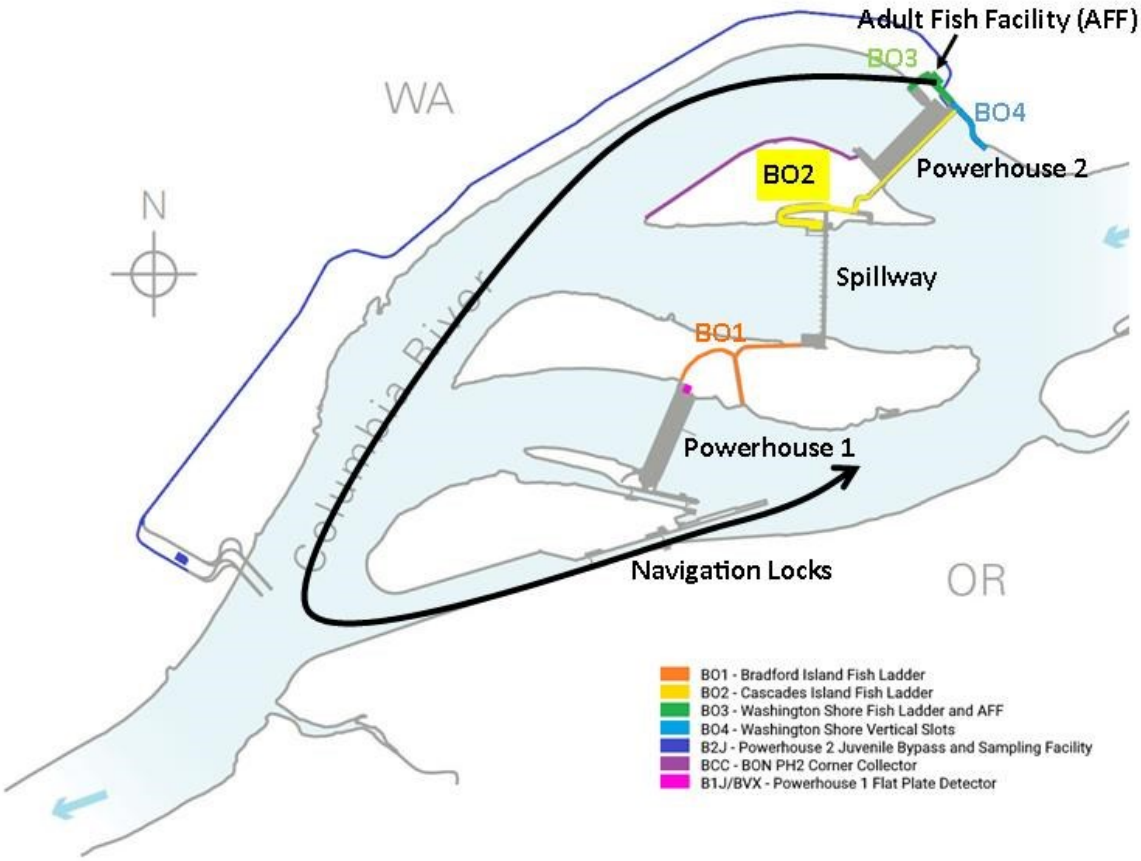


Figure 3. Site of Bonneville Dam PIT tag antennas and the most likely route for fish tagged at the Adult Fish Facility to pass upstream undetected (Figure from www.ptagis.org).

Age Analysis

Visual assessment of scale patterns was used to determine age composition through techniques developed for the Bonneville Stock Sampling project *(*Whiteaker and Fryer 2008, Kelsey et al. 2011*)*. The European method for fish age description (Koo 1962) was used where the number of winters a fish spent in freshwater (not including the winter of egg incubation) is described by an Arabic numeral followed by a period. The number following the period indicates the number of winters a fish spent in saltwater. Total age, therefore, is equal to one plus the sum of both numerals. If poor scale quality, particularly in the freshwater, prevents age determination in all scales collected from a particular fish, no age is assigned. The exception is steelhead, where if saltwater age can be reliably determined, the age is designated as r.y where “y” is the saltwater age and “r” stands for regenerated. Any salmonid (Chinook, steelhead, or Sockeye) judged by scale analysis to have spent no winters in saltwater were excluded from further analysis.

Other sources of age information are available in the form of age since release, from PIT tags from salmonids tagged as juveniles, as well as the total age of salmonids that could be identified using Parental Based Tagging (PBT). In 2021, the PBT age was available when Chinook and steelhead were being aged and that information was considered in estimating a scale age.

Escapement

Chinook and Sockeye salmon escapements at upstream detection sites were estimated as:

$$N = \sum_i \frac{B_i R_i}{T_i}$$

where N was the estimated escapement at a particular upstream site, *i* was the week at Bonneville Dam, B_i was the weekly count of fish passing Bonneville Dam in week *i*, T_i was the number of fish PIT tagged at Bonneville Dam in week *i,* and R_i was the number of PIT tag detections at the dam where escapement was being estimated of those fish tagged in week *i.* Estimated dam counts using PIT tag data were compared with dam counts made at fish ladder viewing windows or weir counts. No estimates were made for steelhead because many overwinter between dams on their upstream migration making it difficult to compare PIT tag estimates with dam counts.

Migration Rates and Passage Times

Run timing was estimated using the date and time of detection between sites. Migration rates were calculated between sites as the time between the last detection at the first site and the first detection at the upper site. The amount of time required to pass each dam was estimated as the difference between the first detection time at a dam and the last detection time at the same dam.

Upstream Age and Length-at-Age Composition Estimates

The age composition at upstream locations was calculated as:

$$T_j = \sum_k A_{j,k} * W_k$$

where T_j was the estimate for age group *j* at a particular location, $A_{j,k}$ was the percentage of fish for age group *j* in week *k* at Bonneville Dam (such that $\sum_j A_{j,k} = 1$) and W_k was the percentage of the run that passed Bonneville Dam in week *k.*

Fallback

Three methods were used to determine fallback, which is defined as a fish that ascends a fish ladder into the reservoir above the dam, then "falls back" to the downstream side of the dam either over the spillway, or through the navigation locks, juvenile bypass systems, or turbines. Migrating downstream through the fish ladders is not considered a fallback. The first method was if an adult salmon or steelhead was detected in the juvenile bypass system. However, on the Columbia River, only Bonneville, John Day, McNary, and Rocky Reach dams have juvenile bypass system PIT detection capability while all four dams in the Snake River have juvenile detection. Furthermore, there is no detection at any dam for fish falling back over the spillway or through the navigation locks or turbines. Therefore, a second method of estimating fallback was to look at each dam for fish detected at an "upper" weir followed by detection at a "lower" weir separated by more than two hours. At McNary and Bonneville dams, the upper detection weir is at the fish counting windows (which are believed to detect all passing PIT-tagged fish), while the PIT tag detectors near the entrance to the fish ladder are the lower weirs. At Priest Rapids, Rock Island, Rocky Reach, and Wells dams, there are only two weirs with PIT tag detection in each fish ladder, so these were designated as the upper and lower detection weirs, even if they are not at the top or bottom of the ladders. At McNary and Bonneville dams, detection histories of fish detected at multiple ladders were also reviewed (MC1 and MC2 for McNary and BO1 and BO4 for Bonneville) (see http://www.ptagis.org for maps of sites). Finally, a third method of estimating fallback was ascertained by fish that passed an upstream PIT tag detector at a given dam but then were next observed at a site downstream of the dam in question. These methodologies will underestimate fallback as they do not include fish that fall back over a dam and are not subsequently detected.

Adult steelhead downstream movements on or after March 31, 2021, were not considered fallbacks; rather, they were considered kelts on their way downstream. Some steelhead move out of the system before April 1st, and with more detection sites added at dams and in-stream arrays placed in tributaries in the last few years, it has been easier to determine more kelts between March 1st and April 1st. Consideration of these fish as kelts versus assigning them as fallbacks is now part of the analysis process.

Night Passage

Fish counting at Columbia Basin dams is not consistent between dams. Salmonids passing Corps of Engineers-operated dams (Bonneville, The Dalles,

John Day, McNary, Ice Harbor, Lower Monumental, Little Goose and Lower Granite) are counted live by observers stationed at fish ladder viewing windows 50 minutes per hour (with the counts then expanded by 20% to account for the missing 10 minutes) from 0400 to 2000 PST with most supplemented with video counts of passage between 2000 and 0400 from June through September (https://www.fpc.org/111_sharedfiles/adult_metadatav3.php), which is the span of months that salmonids are tagged by this study. Salmonids passing Priest Rapids, Rock Island, Rocky Reach, and Wells dams are all counted 24 hours per day from recorded video. Tributary dam passage is estimated using 24-hour recorded video and/or counts at adult fish traps.

Night passage rates (where night is defined as 2000 to 0400 PST) were calculated based on the last time fish were detected in a fish ladder for all dams passed. This last time detected at a ladder was used as an approximation for passage time at the counting window, as the uppermost weir is closest to the fish counting window at nearly all ladders. (For maps of site configuration for mainstem dams see http://www.ptagis.org.)

Steelhead B-Run Analyses

For management purposes, Columbia Basin steelhead are commonly referred to as being either A- or B-run. B-run steelhead are defined as greater than or equal to 78 cm in length, while A-run steelhead are under 78 cm (Busby et al. 1996). B-run steelhead are generally older, spending three winters in saltwater compared to one or two winters for A-run steelhead, and generally pass Bonneville Dam after August 25, while A-run steelhead generally pass earlier (Busby et al. 1996). Upstream, run timing separation is not observed and the groups are separated based on size and age (Busby et al. 1996). B-run steelhead are thought to only be produced in the Clearwater, Middle Fork and South Fork Salmon rivers (Busby et al. 1996).

Analyses of B-run steelhead consisted of comparing the timing of the A- and B-runs at Bonneville Dam with the established August 25 criteria, comparing the length group of sampled steelhead with where they were last detected, and looking at the destination of B-run-sized steelhead by statistical week sampled at Bonneville Dam.

Steelhead Kelt Analyses

Steelhead differ from other salmonids studied in this project as they are

capable of spawning multiple times. After spawning in late winter or early spring, some steelhead will migrate downstream to the ocean to feed; these fish are known as kelt. The fish that survive return in a subsequent spawning season. We considered all steelhead detected moving downstream (mostly in juvenile bypasses) on or after March 31, the year after tagging, to be kelt and tabulated where they were last detected. We also carefully considered fish moving between March 1st and April 1st through juvenile bypasses and the Bonneville Corner Collector as kelts, especially when tag detections indicate they have visited upper reaches of tributaries in late winter early spring.

Straying

Since 2017, stray rates have been estimated by comparing PIT tag movements of steelhead and Chinook with GSI/PBT results. A matrix of final-PIT-fate categories (neutral, on-target, putative stray, and putative overshoot) was created where “neutral” fates indicate movements through the mainstem river corridor on route to their expected destination (basin-of-origin, population-of-origin, or hatchery-of-origin). “On-target” fates indicate fish that were last detected at their expected destination. “Putative stray” indicates fish that were last detected in tributaries or the mainstem that were outside of a normal route to their expected destination. “Putative overshoot” indicates when a fish may have gone into an area adjacent to its expected destination. Common examples of “putative overshoot” are Umatilla River Chinook last detected at McNary Dam and Priest Rapids Hatchery Chinook last detected at Priest Rapids Dam. The stray rate for a given stock was estimated as the number of “putative stray” fish divided by the sum of the “on-target” and “putative stray” fish for that stock. This is the template that we will build upon in future years.

RESULTS-CHINOOK

Sample Size

A total of 1,276 spring Chinook, 1,001 summer Chinook, and 1,225 fall Chinook Salmon were sampled between April 20 and October 12, 2021[3] (Tables 1-3). A total of 1,256 spring Chinook, 989 summer Chinook, and 1,222 fall Chinook Salmon were PIT tagged (Tables 1-3). After adding previously tagged fish (which were sampled and therefore identified for the tracking study and included in our sample), subtracting fish that were not detected after release (due to shed tags, mortalities, malfunctioning tags, or PIT-tagged Chinook missing PIT tag antennas), and excluding 1 summer Chinook and 6 fall Chinook classified as minijacks, the numbers of Chinook tracked upstream and used in analysis consisted of 1,273 spring Chinook, 999 summer Chinook, and 1,205 fall Chinook Salmon (Table 1-3). One summer Chinook (3DD.003D829CB2) was sampled twice on June 4 (week 27); while a spring Chinook (3DD.003D82A141) was sampled on May 25, 2021, with the next subsequent detection on May 28, 2021. In both cases the second sampling event was excluded from further analysis to simplify analysis as well as the likelihood that the tagging event contributed to the downstream movement after tagging.

[3] An addition 150 Tule Chinook (identified by their dark coloration) were sampled between August 20 and October 24 for a genetics study and are not included in the results but will be briefly summarized in the discussion.

Table 1. Number of sampled and PIT-tagged spring Chinook Salmon at Bonneville Dam that were then tracked, by date and statistical week, in 2021.

Sample Dates	Week	Percentage of Run	Number Sampled	Number Tagged	Previously Tagged	Previously tagged by CRITFC	Mortalities	Not Detected After Release	Not Detected at or upstream of Bonneville ladder exits	Total Tracked	Days Sampling Restrictions in Effect		
											Reduced Sampling-Temperature	Reduced Sampling-Shad or Salmonid Abundance	No Sampling, Temperatures
No sampling	<17	1.4											
4/20-4/23	17	3.6	113	111	2	0	0	0	1	113	0	0	0
4/27-4/30	18	20.9	184	181	3	0	0	0	0	184	0	0	0
5/3-5/7	19	20.8	317	314	3	0	0	0	0	317	0	0	0
5/10-5/14	20	26.4	320	316	4	0	0	2	0	318	0	0	0
5/17-5/21	21	13.5	195	189	5	0	0	0	0	194	0	0	0
5/24-5/28	22	10.2	147	145	2	1	0	0	1	147	0	0	0
No sampling	23	3.1											
Total		**100.0**	**1276**	**1256**	**19**	**1**	**0**	**2**	**2**	**1273**	**0**	**0**	**0**

Table 2. Number of sampled and PIT-tagged summer Chinook Salmon at Bonneville Dam that were then tracked, by date and statistical week, in 2021.

Sample Dates	Week	Percentage of Run	Number Sampled	Number Tagged	Previously Tagged	Previously tagged by CRITFC	Mortalities	Not Detected After Release	Not Detected at or upstream of Bonneville ladder exits	Total Tracked	Days Sampling Restrictions in Effect		
											Reduced Sampling-Temperature	Reduced Sampling-Shad or Salmonid Abundance	No Sampling, Temperatures
6/1-6/4	23	7.8	189	188	1	0	0	0	0	189	0	0	0
6/7-6/11	24	12.6	221	220	1	0	1	0	0	220	0	1	0
6/14-6/18	25	18.4	240	237	3	0	0	0	0	240	0	5	0
6/21-6/25	26	19.8	160	156	4	0	0	0	0	160	0	5	0
6/28-7/2	27	14.4	51	50	1	0	0	0	0	51	0	5	0
7/6-7/9	28	11.9	54	54	0	0	0	0	0	54	4	0	1
7/12-7/15	29	7.2	36	36	0	0	0	0	0	36	4	0	1
7/19-7/22	30	4.8	35	33	2	0	0	1	1	34	4	0	1
7/26	31	3.1	15	15	0	0	0	0	0	15	1	0	4
Total		**100.0**	**1001**	**989**	**12**	**0**	**1**	**1**	**1**	**999**	**13**	**16**	**7**

Table 3. Number of sampled and PIT-tagged fall Chinook Salmon at Bonneville Dam that were then tracked, by date and statistical week in 2021.

Sample Dates	Week	Percentage of Run	Number Sampled	Number Tagged	Previously Tagged	Previously tagged by CRITFC	Mortalities	Not Detected After Release	Not Detected at or upstream of Bonneville ladder exits	Total Tracked	Days Sampling Restrictions in Effect		
											Reduced Sampling-Temperature	Reduced Sampling-Shad or Salmonid Abundance	No Sampling, Temperatures
Trap Closed	32	0.7											5
8/10	33	0.9	6	6	0	0	0	0	2	4	1	0	4
8/20	34	1.9	5	5	0	0	0	0	0	5	1	0	4
8/24	35	17.9	157	156	0	0	0	1	0	155	1	3	0
8/30,31,9/1-3	36	25.4	211	209	1	0	1	1	1	207	0	5	0
9/7-9/10	37	19.9	191	191	2	0	1	2	0	190	0	4	0
9/13-9/17	38	14.4	293	293	0	0	2	2	2	287	0	5	0
9/20-9/23	39	8.8	166	166	0	0	0	3	0	163	0	4	0
9/27-30,10/1	40	4.7	112	112	0	0	0	0	1	111	0	3	0
10/5-10/7	41	2.6	82	82	0	0	0	1	0	81	0	0	0
10/11	42	1.3	2	2	0	0	0	0	0	2	0	0	0
No sampling	>42	1.5											
Total		**100.0**	**1225**	**1222**	**3**	**0**	**4**	**10**	**6**	**1205**	**3**	**24**	**13**

Distribution of Sample

The weekly distribution of spring Chinook sampled at Bonneville Dam was similar to the distribution of the run passing Bonneville Dam throughout the spring Chinook migration (Figure 4). The percentage of the summer Chinook sample was reduced relative to the percentage passing Bonneville Dam in weeks 26 due to sampling restrictions which continued through fall Chinook sampling in Week 37 (Figures 5 and 6). Sample sizes in weeks 24-28, and 35-40 were sampled primarily under protocols b), c), and d) which required leaving pickets up for some or all of the time sampling occurred due to high abundance and/or water temperatures above 21.1C. This likely reduced our sample size and may have biased our sample as fish could selectively choose to enter the trap. Details on picket lead protocols can be found in Appendix B.

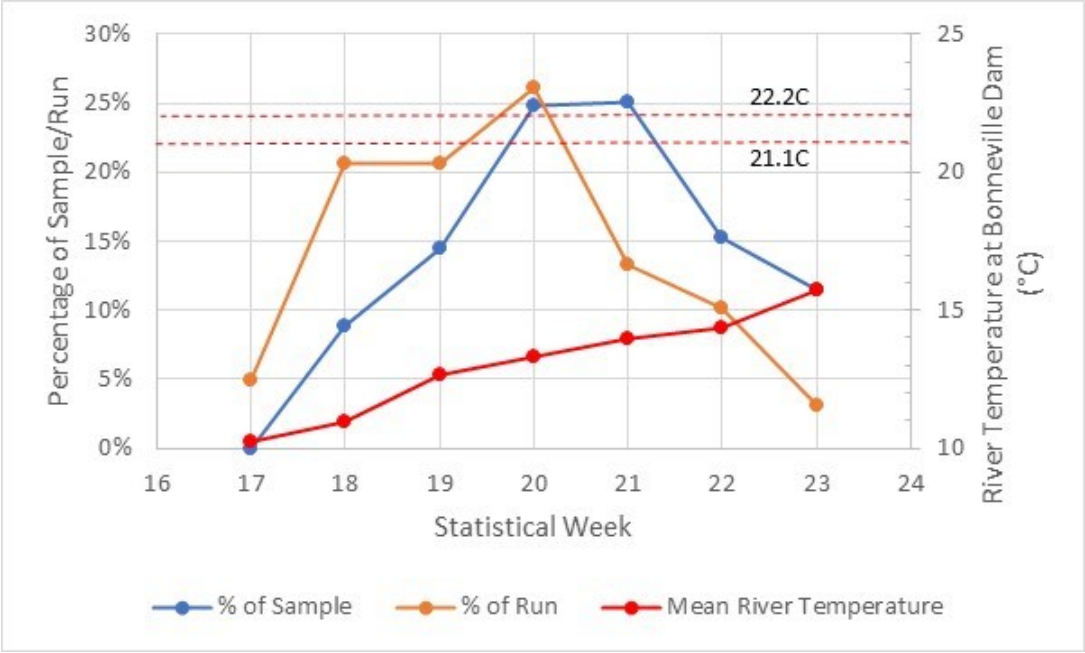


Figure 4. The weekly spring Chinook sample and run as a percentage of the total sample and run size at Bonneville Dam in 2021.

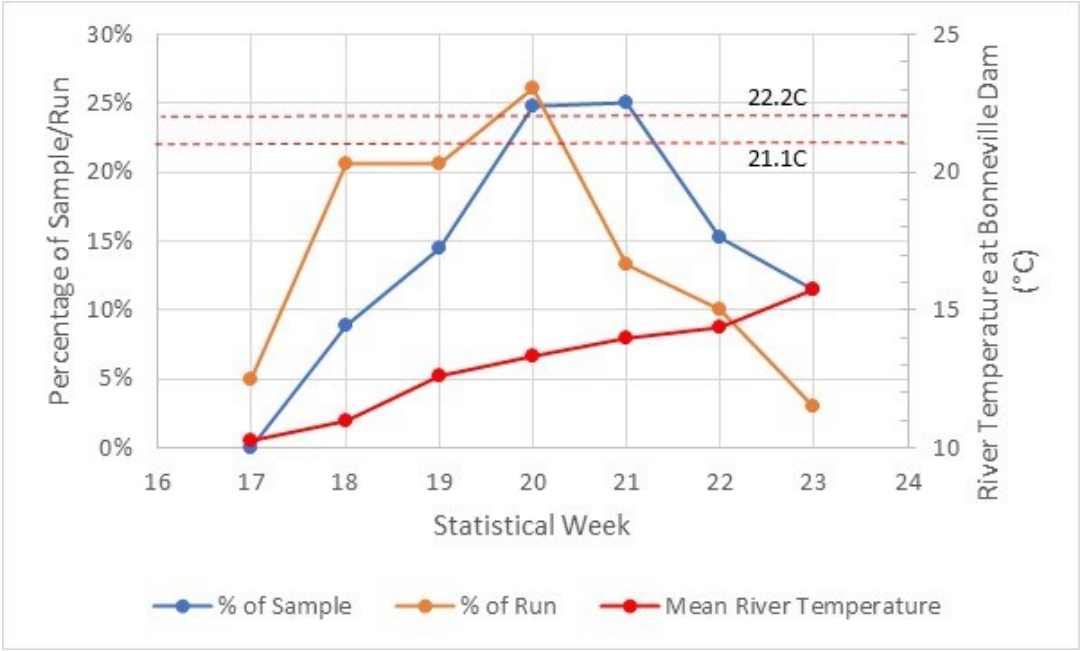


Figure 5. The weekly summer Chinook sample and run as a percentage of the total sample and run size at Bonneville Dam in 2021. AFF regulations require reduced sampling at 21.1°C with sampling halted at 22.2°C.

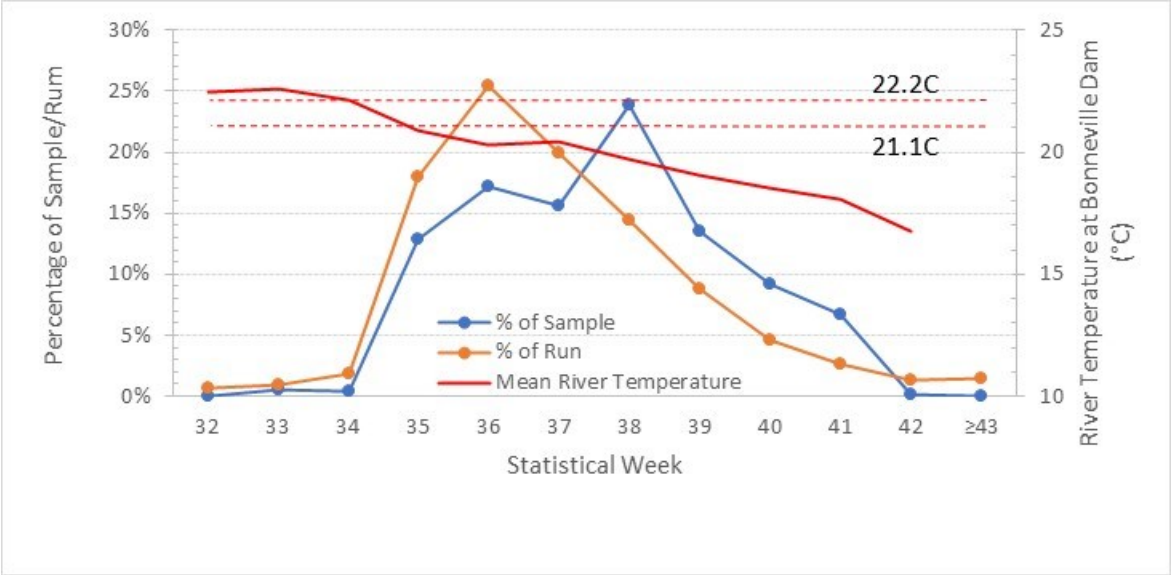


Figure 6. The weekly fall Chinook sample and run as a percentage of the total sample and run size at Bonneville Dam in 2021. AFF regulations require reduced sampling at 21.1°C with sampling halted at 22.2°C.

Detection Numbers

The tracking of 1273 spring Chinook generated 107,067 weir detections, which were grouped into 1,461 site detections at 118 sites. The 999 summer Chinook generated 82,496 weir detections grouped into 8,702 site detections at 54 sites, and the 1205 fall Chinook generated 47,645 weir detections grouped into 9,016 site detections at 52 sites[4]. Maps and table of sites found in the Appendix C (Table C1 and Figures C1, C2-C15) show the sites and the categorical ranges of detection numbers at the sites throughout the Columbia Basin. Note that the number of Chinook tracked in each run is determined by the migration timing at Bonneville, with the spring Chinook run ending May 31st, the summer Chinook running from June 1 through July 31st, and the fall Chinook run starting August 1st (FPC 2021) with minijacks and Tules (Table C1 and Figures C1, C16, and C17) excluded from analysis.

Mainstem Dam Recoveries, Mortality, and Escapement Estimates

Chinook bound for the Snake River predominated among the spring Chinook (Table 4, Figure 7). Summer Chinook were predominantly last detected upstream in terminal areas upstream of Priest Rapids Dam and fall Chinook in

[4] Also tracked were 135 Tules which generated 2761 detections at 13 sites and 7 minijacks which generated 180 detections at 17 sites.

spawning areas between McNary and Ice Harbor/Priest Rapids dams (Table 4, Figures 8-9). The early run (weeks 18-19) was primarily last detected downstream of McNary Dam, transitioning to a run bound for the Snake River, peaking in Week 20 (Figure 10). Beginning in early June, summer Chinook bound for above Priest Rapids dam predominated with the percentage decreasing in late July when sampling was halted. Chinook last detected downstream of McNary dam comprised the majority of the run though Statistical Week 39.

Table 4. Percentage of spring, summer, and fall Chinook Salmon tracked from Bonneville Dam detected at Columbia and Snake River dams in 2021.

	Spring Chinook		Summer Chinook		Fall Chinook	
Dam	Mean	SE	Mean	SE	Mean	SE
The Dalles	80.8%	1.1%	87.7%	1.3%	74.9%	1.3%
John Day	71.5%	1.2%	81.3%	1.5%	60.8%	1.4%
McNary	67.9%	1.3%	78.7%	1.6%	55.0%	1.5%
Priest Rapids	15.9%	1.0%	63.6%	1.8%	11.6%	0.9%
Rock Island	15.9%	1.0%	61.5%	1.8%	4.1%	0.6%
Rocky Reach	6.2%	0.7%	54.3%	1.9%	3.5%	0.6%
Wells	5.5%	0.6%	40.2%	1.9%	1.2%	0.3%
Ice Harbor	45.9%	1.2%	12.5%	1.6%	10.0%	1.0%
Lower Monumental	45.4%	1.3%	12.3%	1.3%	9.7%	0.9%
Little Goose	44.6%	1.4%	12.2%	1.2%	9.6%	0.9%
Lower Granite	44.0%	1.4%	11.8%	1.0%	8.8%	0.8%

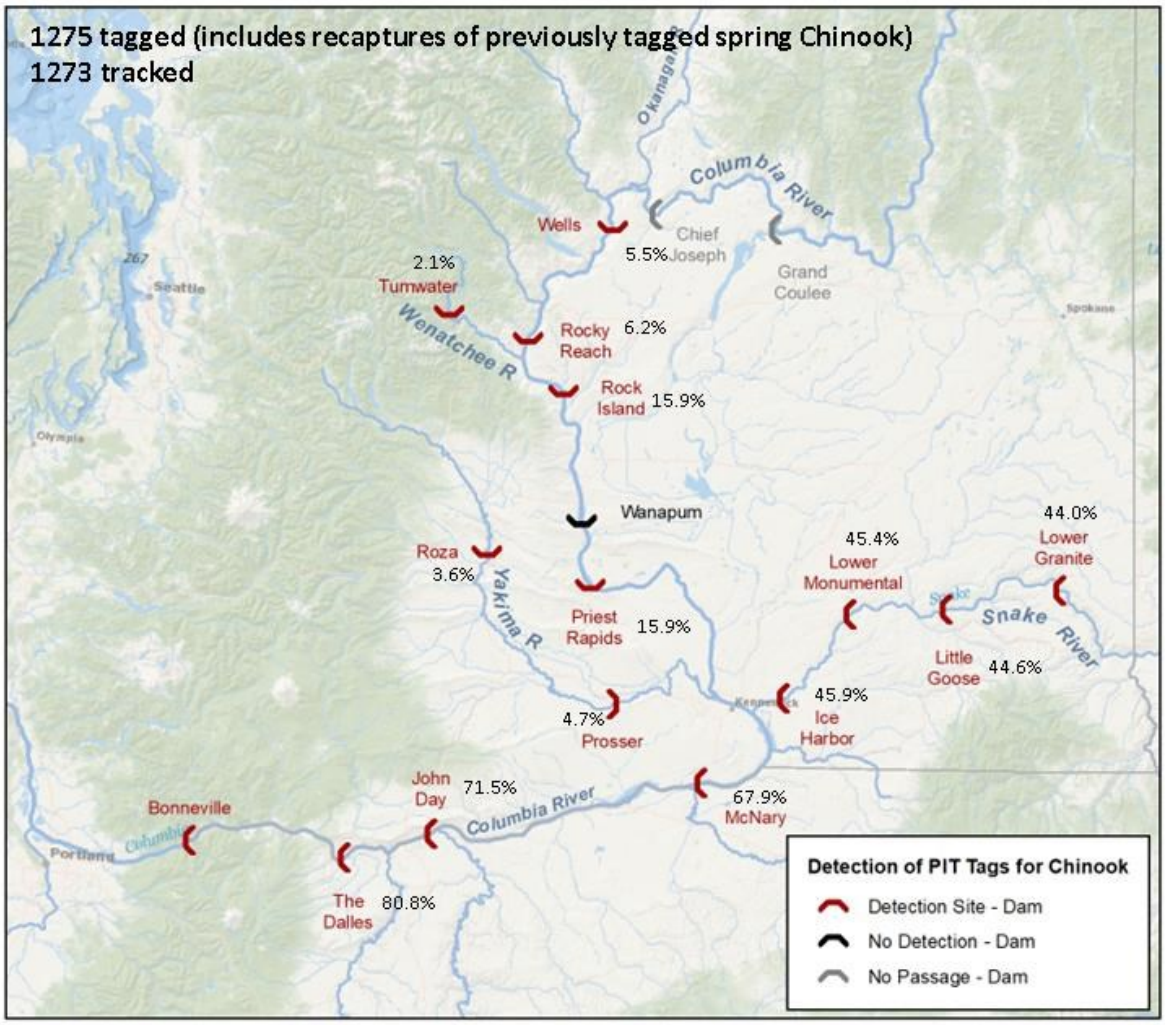


Figure 7. Map of the Columbia River Basin from Bonneville to Wells and Lower Granite dams showing the number of spring Chinook Salmon PIT tagged at Bonneville Dam, and the percentage of the run estimated to pass upstream dams in 2021.

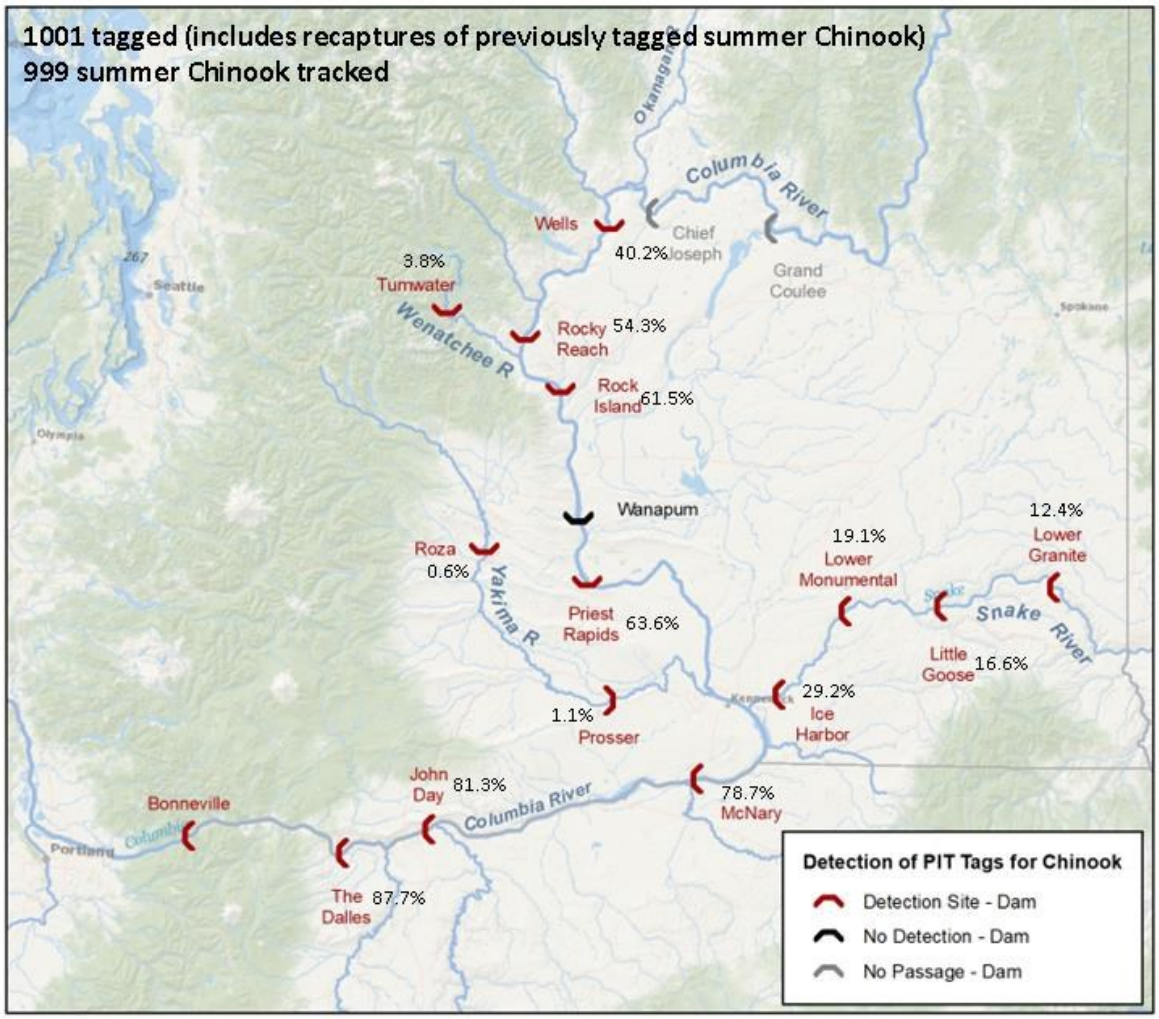


Figure 8. Map of the Columbia River Basin from Bonneville to Wells and Lower Granite dams showing the number of summer Chinook Salmon PIT tagged at Bonneville Dam, and the percentage of the run estimated to pass upstream dams in 2021.

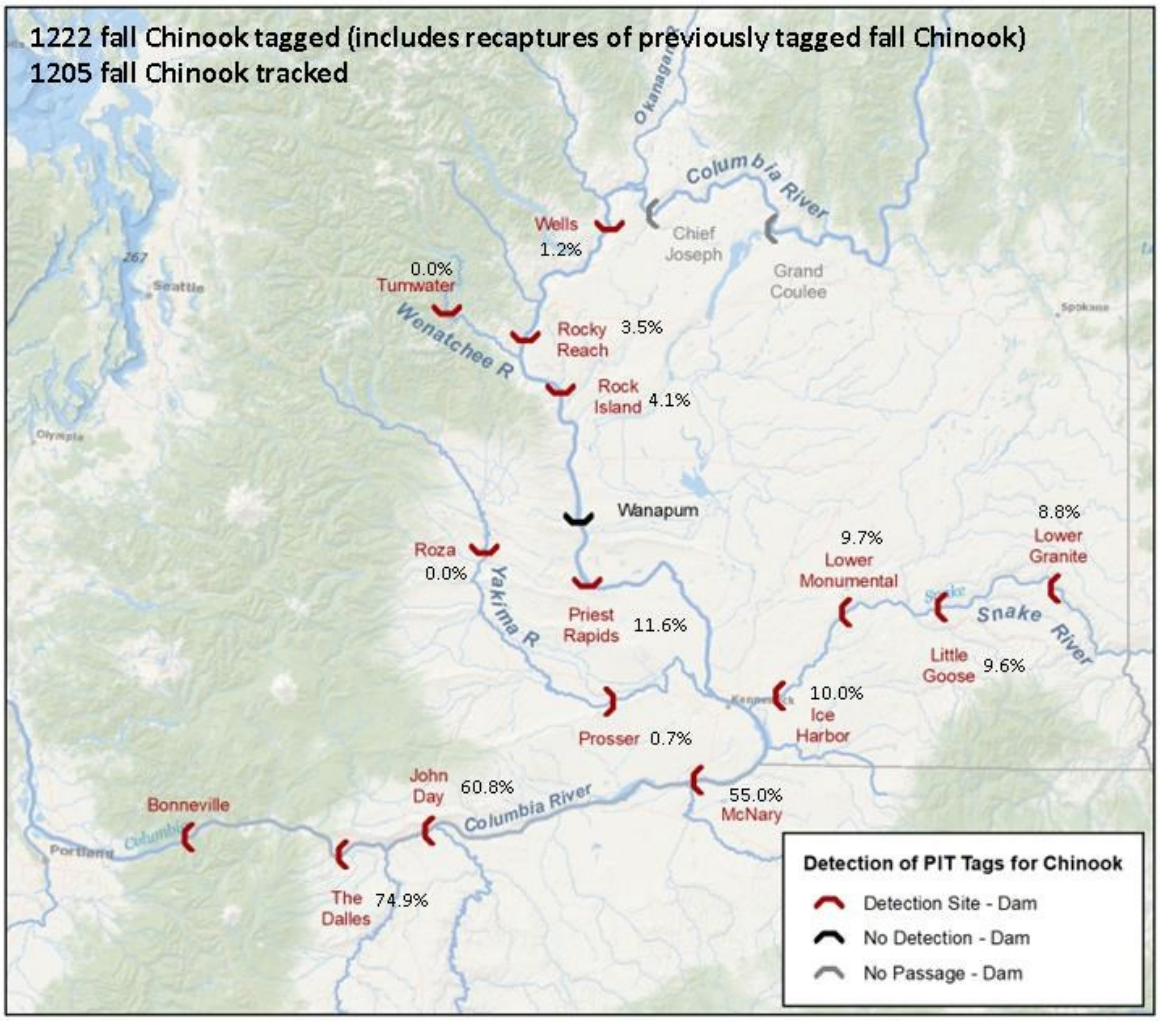


Figure 9. Map of the Columbia River Basin from Bonneville to Wells and Lower Granite dams showing the number of fall Chinook Salmon PIT tagged at Bonneville Dam, and the percentage of the run estimated to pass upstream dams in 2021.

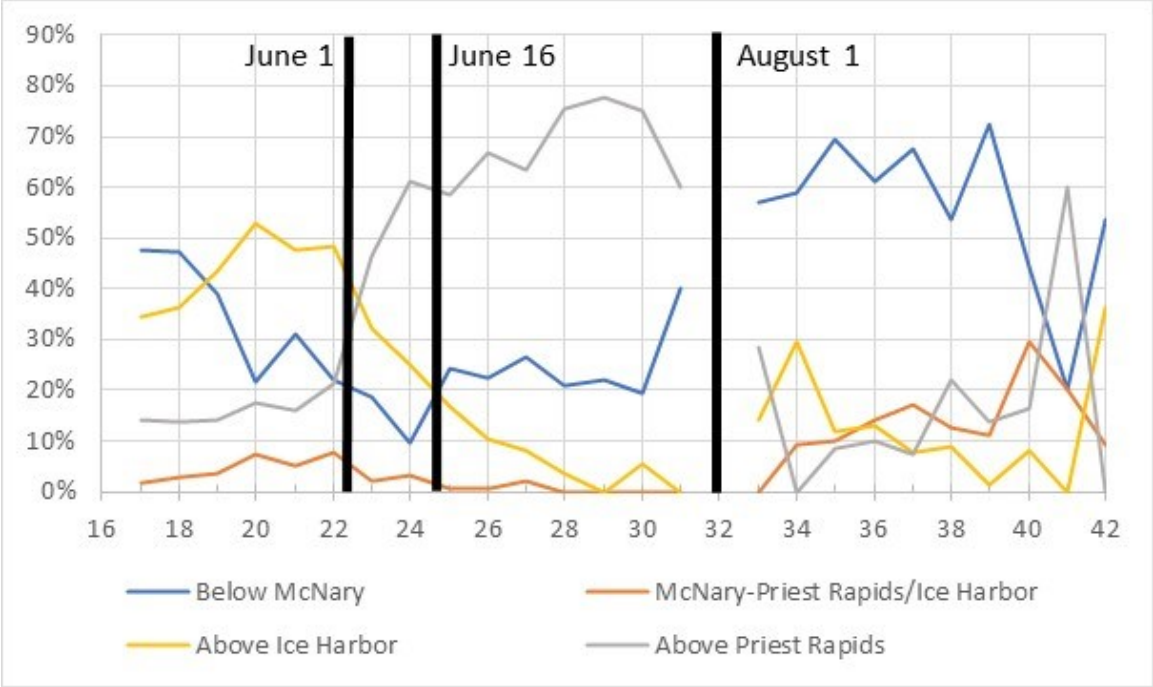


Figure 10. Distribution of final detection areas of the Columbia Basin by statistical week for Chinook Salmon PIT tagged at Bonneville Dam in 2021. Dates used to differentiate spring, summer, and fall Chinook are shown; both June 1 and June 16 are used to differentiate spring and summer Chinook.

The mean percentage of PIT-tagged Chinook Salmon passing mainstem Columbia and Snake River dams without detection, was 0.2% for spring Chinook, 0.3% for summer Chinook and 0.1% for fall Chinook (Table 5). Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams all have navigation locks where it is possible that PIT-tagged fish could pass upstream undetected. The highest rates of missed detections were fall Chinook at Rock Island Dam at 2.1% (though this comprised only 1 fall Chinook out of 47 passing) and summer Chinook at John Day at 1.4%.

The mean deviation between total Chinook escapement estimates based on PIT tags and those estimated by visual counts was 0.5%; -7.6% for spring Chinook, 6.1% for summer Chinook, and 1.3% for fall Chinook (Table 6). However, total differences between visual and PIT tag estimates at individual dams varied by up to 20.5% for Chinook at Lower Granite Dam. For spring Chinook, all PIT tag escapement estimates were less than visual counts, while for summer Chinook, except for at The Dalles Dam, the opposite was true. A possible explanation would be that Chinook tagged at Bonneville Dam as spring Chinook pass upstream dams as summer Chinook. This was the case at Priest Rapids, Rock Island, and Rocky Reach dams; however, this was more than offset by summer Chinook

passing upstream as spring Chinook at Wells Dam and the Snake River dams. (Table 7).

Table 5. Percentage of Chinook Salmon detected upstream that missed detection at mainstem dams in 2021.

Dam	% Spring	% Summer	% Fall
Bonneville	0.0	0.0	0.0
The Dalles	0.0	0.1	0.1
John Day	0.2	1.4	0.1
McNary	0.4	0.8	0.3
Priest Rapids	0.0	0.0	0.0
Rock Island	0.0	0.0	2.1
Rocky Reach	0.0	0.0	0.0
Wells	0.0	0.0	0.0
Ice Harbor	0.9	0.6	0.0
Lower Monumental	0.4	0.0	0.0
Little Goose	0.0	0.0	0.0
Lower Granite	0.0	0.0	0.0
Mean (weighted by sample size)	**0.2%**	**0.3%**	**0.1%**

Table 6. Spring, summer, fall, and total Chinook Salmon escapement at Columbia Basin mainstem dams upstream of Bonneville Dam in 2021. Estimates are from both PIT tag recoveries and dam counts (FPC 2021

Site	Spring Chinook Salmon			Summer Chinook Salmon		
	Viewing Window Count	PIT Tag Estimate	Percent Difference	Viewing Window Count	PIT Tag Estimate	Percent Difference
The Dalles	70215	63492	-9.6	78065	77602	-0.6
John Day	61416	56134	-8.6	66109	71900	8.8
McNary	56886	53318	-6.3	61734	69634	12.8
Priest Rapids	14552	12514	-14.0	51613	56206	8.9
Rock Island	13801	12514	-9.3	54415	54423	0.0
Rocky Reach	5456	4832	-11.4	47871	48031	0.3
Wells	6886	4326	-37.2	30229	35581	17.7
Ice Harbor	36831	36060	-2.1	9725	11033	13.4
L. Monumental	38460	35689	-7.2	9742	10897	11.9
Little Goose	35814	35001	-2.3	10474	10751	2.6
Lower Granite	36898	34559	-6.3	10353	10399	0.4
Mean (weighted)			**-7.6%**			**6.1%**

	Fall Chinook Salmon			Total Chinook Salmon		
The Dalles	278398	299218	7.5	426678	440312	3.2
John Day	198444	247026	24.5	325969	375060	15.1
McNary	202831	223018	10.0	321451	345970	7.6
Priest Rapids	53914	45866	-14.9	120079	114584	-4.6
Rock Island	17281	14081	-18.5	85497	81018	-5.2
Rocky Reach	15814	12082	-23.6	69141	64945	-6.1
Wells	5313	4822	-9.2	42428	44728	5.4
Ice Harbor	44849	29419	-34.4	91405	76511	-16.3
L. Monumental	43775	28595	-34.7	91977	75181	-18.3
Little Goose	43491	27808	-36.1	89779	73559	-18.1
Lower Granite	41416	25561	-38.3	88667	70519	-20.5
Mean (weighted)			**1.3%**			**0.5%**

Table 7. Percentage of Chinook sampled at Bonneville Dam as one race (as determined by run timing) that passed upstream dams as another race (as determined by run timing at each dam) in 2021.

Last Date Spring Run	First Date Fall Run	Race at Bonneville Race at Dam Listed Below	Spring % Summer	Summer % Spring	Summer % Fall	Fall % Summer
June 3	August 4	The Dalles	0.3	0.3	0.0	0.0
June 5	August 6	John Day	1.0	2.7	0.2	0.0
June 8	August 9	McNary	1.6	4.1	0.3	0.0
June 13	August 14	Priest Rapids	9.4	0.3	0.5	0.0
June 17	August 18	Rock Island	10.3	0.9	0.5	0.0
June 19	August 20	Rocky Reach	21.1	0.2	0.8	0.0
June 28	August 29	Wells	5.9	14.0	1.4	6.3
June 11	August 12	Ice Harbor	0.9	22.5	0.0	0.0
June 13	August 14	L. Monumental	0.9	24.3	0.0	0.0
June 15	August 16	Little Goose	2.8	21.1	0.0	0.0
June 17	August 18	Lower Granite	3.0	21.9	0.0	0.0

As in past years, dam escapement estimates from PIT tags for three tributary dams (Tumwater Dam on the Wenatchee River and Prosser and Roza dams on the Yakima River), were compared with estimates from visual counts (Table 8). The deviations of the PIT tag escapement estimate from visual counts at these dams were generally lower than that in past years, possibly due to larger samples sizes. Chinook that ultimately passed these three dams primarily passed Bonneville Dam in the spring and, to a lesser extent, in the fall (Figure 11).

Table 8. Chinook Salmon escapement, as estimated using PIT tag detections, to Tumwater, Prosser, and Roza dams in 2021.

Location and River	Number of Tag Detections	Escapement Estimate from Visual Counts	Estimated Escapement Using PIT Tags		Percent Difference
			Mean	SE	
Tumwater Dam, Wenatchee River	76	4051	4997	639	9.2
Prosser Dam, Yakima River	82	5366	4658	1058	-11.9
Roza Dam, Yakima River	56	3282	3375	436	2.8

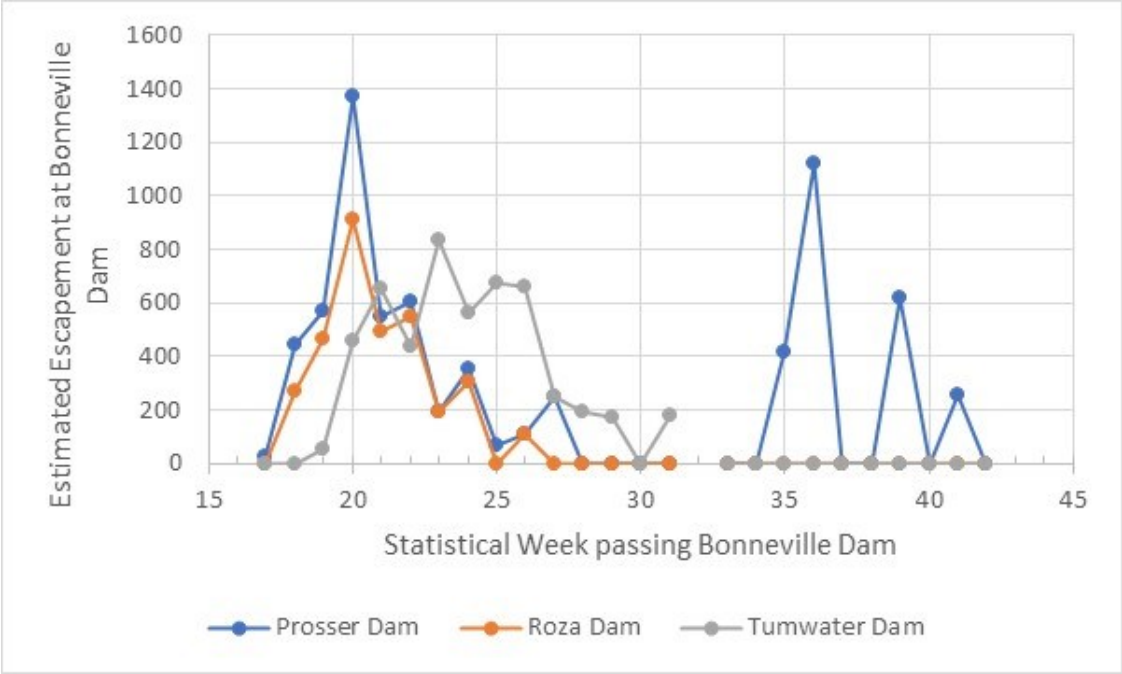


Figure 11. Percentage of Chinook Salmon by statistical week tagged at Bonneville Dam in 2021 destined for the Tumwater Dam (Wenatchee River), Prosser Dam (Yakima River) and Roza Dam (Yakima River) based on upstream PIT tag detections.

Migration Rates and Passage Time

Chinook migration rates between mainstem dams in Table 9 in 2021 ranged between 16.7 km/day for fall Chinook between Priest Rapids and Wells dams and 56.7 km/day for fall Chinook between John Day and McNary dams (Table 9) when comparing all three races of Chinook.

Among the mainstem and tributary dams in Table 10, Chinook Salmon had the greatest median dam passage time (as determined by minutes between first detection time and last detection time at a dam) at Tumwater dam for spring Chinook and Lower Granite Dam for summer Chinook and fall Chinook. At Bonneville, Lower Granite, McNary, Rock Island, Rocky Reach, and Wells dams, there is a greater distance between the furthest downstream and furthest upstream PIT tag detection antennas than at other dams; conversely, the distance between the PIT tag detection antennas at most other dams are placed at adjacent or nearby weirs. Passage times at Lower Granite, Bonneville, Priest Rapids, Tumwater, and Wells dams may also be inflated by trapping operations that take place at fish ladders at those dams.

Table 9. Chinook Salmon migration rates between Columbia Basin dams estimated using PIT tag data in 2021.

		Median Migration Rate (km/day)		
Between Mainstem Dams	Distance (km)	Spring Chinook	Summer Chinook	Fall Chinook
Bonneville-The Dalles	74	41.2	40.0	36.6
The Dalles-John Day	39	35.0	34.0	38.1
John Day-McNary	123	54.9	48.8	56.7
McNary-Priest Rapids	169	31.5	35.5	26.5
Priest Rapids-Rock Island	124	37.4	41.0	25.3
Rock Island-Rocky Reach	33	29.0	28.9	27.6
Rocky Reach-Wells	67	22.3	28.2	25.9
Bonneville-John Day	113	38.4	37.5	36.3
Bonneville-McNary	236	42.2	40.5	40.6
Bonneville-Priest Rapids	405	36.7	36.7	32.6
Bonneville-Wells	596	31.6	31.2	22.9
Bonneville-Ice Harbor	304	44.4	44.1	43.5
Bonneville-Lower Granite	461	39.8	38.1	38.1
Priest Rapids-Wells	191	26.1	27.0	16.7
McNary-Ice Harbor	68	45.0	39.5	42.0
Ice Harbor-Lower Granite	157	36.2	30.5	32.1
To and Between Tributary Sites				
Rock Island - Tumwater	68	2.8	4.3	NA
McNary - Prosser	145	23.5	12.3	6.8
Prosser - Roza	130	12.0	16.0	NA

Table 10. Median passage time in minutes by run, from the time of first detection to time of last detection at a dam and the percentage of Chinook taking more than 12 hours between first and last detection in 2021.

	Median Passage Time (minutes)			Percentage of run with more than 12 hours between first and last detection at a dam		
Dam	Spring Chinook	Summer Chinook	Fall Chinook	Spring Chinook	Summer Chinook	Fall Chinook
Bonneville	78.6	85.4	72.3	6.5	5.9	3.3
The Dalles	0.1	0.1	0.1	1.3	0.6	1.2
John Day	0.2	0.1	0.1	1.8	1.5	2.0
McNary	94.4	89.6	74.9	3.0	2.0	2.9
Priest Rapids	4.0	8.4	1.5	5.7	5.1	3.4
Rock Island	61.2	46.2	91.5	1.0	1.8	8.3
Rocky Reach	14.2	8.2	10.7	6.4	3.1	16.0
Wells	146.1	119.8	97.3	2.6	4.0	2.2
Ice Harbor	3.1	2.3	1.4	17.9	7.8	13.3
Lower Monumental	0.8	0.4	0.2	2.8	2.8	2.3
Little Goose	0.1	0.1	0.0	4.2	10.2	6.9
Lower Granite	149.9	163.5	139.2	2.3	5.7	3.1
Prosser	0.1	0.1	0.2	1.8	0.0	0.0
Roza	2.3	0.8	NA	37.8	9.1	NA
Tumwater	250.7	43.4	NA	25.9	31.9	NA

Bonneville Dam Chinook Salmon Age Composition

Age 1.2 was the dominant age group for spring Chinook in all weeks and overall comprised 79.3% of the run with Age 1.1 comprising 17.2% of the run and Age 1.3, 3.5% (Table 11, Figure 12). Females were 94.3% Age 1.2 and 5.1% Age

1.3, while males were 65.4% Age 1.2 and 32.9% Age 1.1 and 1.7% Age 1.1. These differences were all statistically significant at α=0.05.

Table 11. Weekly and total age composition of spring Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2021.

Week	% of Run	Number Ageable	% Female		Brood Year and % Age Class 2018 1.1	2017 1.2	2016 1.3
17	5.0	78	56.9		0.0	98.7	1.3
18	20.9	136	56.6		2.2	95.6	2.2
19	20.8	259	52.9		6.2	91.9	1.9
20	26.4	273	46.2		26.0	71.8	2.2
21	13.5	175	46.1		28.6	67.4	4.0
22	13.3	128	32.9		35.2	53.9	10.9
Composite	**95.6%**	**1049**	**48.8**		**17.2%**	**79.3%**	**3.5%**
SE			**1.4**		**1.1**	**1.2**	**0.6**
		% Female	**Mean**		**0.6%**	**94.3%**	**5.1%**
			SE		**0.4**	**1.0**	**1.0**
		% Male	**Mean**		**32.9%**	**65.4%**	**1.7%**
			SE		**1.8**	**1.9**	**0.6**
T-Statistic for test of differences					**17.4**	**13.7**	**3.0**
p-value					**<0.01**	**<0.01**	**<0.01**

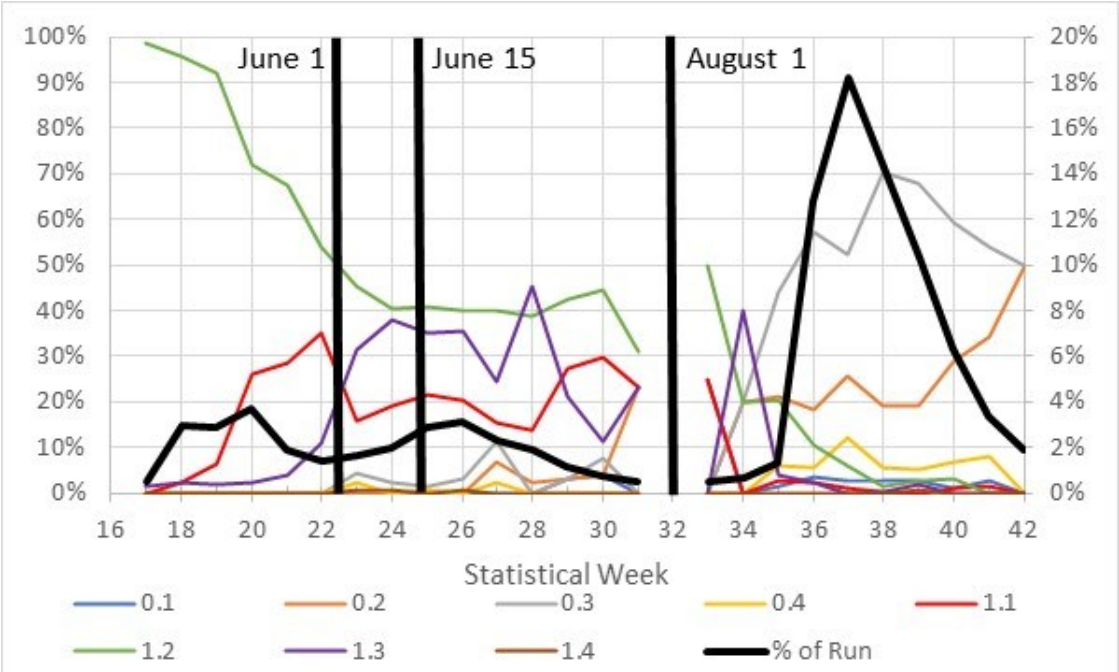


Figure 12. Weekly age composition of Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2021 with weekly percentage of run. Dates used to differentiate spring, summer, and fall Chinook are shown; both June 1 and June 16 are used to differentiate spring and summer Chinook.

The predominant age class for summer Chinook was also 1.2, comprising an estimated 40.6% of the population (Tables 12, Figure 12) followed by Age 1.3 at 32.4% and Age 1.1 at 19.6%. The dominant age class for female summer Chinook was Age 1.3 at 50.3% followed by Age 1.2 at 43.2%. The predominant age for male summer Chinook was Age 1.2 at 40.6%, followed by Age 1.1 at 31.3% and Age 1.3 at 20.0%. The differences in age composition were significant at α=0.05 for Age 0.2, 1.1, and 1.3.

The predominant age class for fall Chinook was 0.3 at 55.0% of the run (Table 13, Figure 12) followed by Age 0.2 at 21.9%, and Age 1.2 at 9.1%. Females were primarily Age 0.3 (65.1%) with lesser percentages of 0.2 (12.1%) and 0.4 (10.1%) fish. Among Males, Age 0.3 also predominated (42.9%) with 30.2% Age 0.2 and 9.2% Age 1.2. The differences in age classes between the sexes were significant at α=0.05 for Ages 0.1, 0.2, 0.3, 0.4, 1.1, 1.2, and 1.4.

The percentage of yearling freshwater (Age 1.x) Chinook was at or near 100% through Week 23, then began to decline through the rest of the year, with the percentage of subyearling freshwater Chinook (0.x) showing the opposite trend (Figure 13). The first week that Age 0.x Chinook predominated was Week 35 at 72.8% of the run.

Table 12. Weekly and total age composition of summer Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2021. Composite age composition estimates are weighted by the percentage of the run passing Bonneville Dam in each week.

Week	% of Run	Number Ageable	% Female	Brood Year and % Age Class							
				2019	2018		2017		2016		2015
				0.1	0.2	1.1	0.3	1.2	0.4	1.3	1.4
23	7.8	165	38.8	0.0	0.0	15.8	4.2	45.5	2.4	31.5	0.6
24	12.6	184	39.5	0.0	0.0	19.0	2.2	40.2	0.0	38.0	0.5
25	18.4	205	41.4	0.0	0.5	21.5	1.5	41.0	0.5	35.1	0.0
26	19.8	127	41.8	0.0	0.0	20.5	3.1	40.2	0.0	35.4	0.8
27	14.4	45	44.7	0.0	6.7	15.6	11.1	40.0	2.2	24.4	0.0
28	11.9	44	40.4	0.0	2.3	13.6	0.0	38.6	0.0	45.5	0.0
29	7.2	33	39.4	3.0	3.0	27.3	3.0	42.4	0.0	21.2	0.0
30	4.8	27	28.6	3.7	3.7	29.6	7.4	44.4	0.0	11.1	0.0
31	3.1	13	33.3	0.0	23.1	23.1	0.0	30.8	0.0	23.1	0.0
Composite	**100.0%**	**843**	**40.4**	**0.4%**	**2.4%**	**19.6%**	**3.7%**	**40.6%**	**0.6%**	**32.4%**	**0.3%**
SE			**1.5**	**0.3**	**0.8**	**1.6**	**0.8**	**2.0**	**0.3**	**1.9**	**0.2**
		% Female	**Mean**	**0.0%**	**0.8%**	**0.0%**	**4.2%**	**43.2%**	**1.2%**	**50.3%**	**0.3%**
			SE	**0.0**	**0.0**	**0.7**	**3.3**	**1.5**	**3.2**	**1.0**	**0.2**
		% Male	**Mean**	**0.7%**	**3.7%**	**31.3%**	**3.2%**	**40.6%**	**0.2%**	**20.0%**	**0.3%**
			SE	**0.5**	**2.5**	**1.2**	**2.6**	**1.0**	**2.1**	**0.2**	**0.3**
T-Statistic for test of differences				**1.4**	**2.0**	**12.8**	**0.5**	**0.6**	**1.0**	**7.9**	**0.1**
p-value				**0.08**	**0.02**	**0.00**	**0.30**	**0.27**	**0.16**	**0.00**	**0.47**

Table 13. Weekly and total age composition of fall Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2021. Composite age composition estimates are weighted by the percentage of the run passing Bonneville Dam in each.

				Brood Year and % Age Class							
		Number	%	2019	2018		2017		2016		2015
Week	Weight	Ageable	Females	0.1	0.2	1.1	0.3	1.2	0.4	1.3	1.4
32-34	3.5	9	80.0	11.1	11.1	11.1	11.1	33.3	0.0	22.2	0.0
35	17.9	147	45.0	1.4	21.1	2.7	44.2	20.4	6.1	4.1	0.0
36	25.4	164	43.8	3.7	18.3	2.4	57.3	10.4	5.5	2.4	0.0
37	19.9	180	49.8	2.8	25.6	1.1	52.2	6.1	12.2	0.0	0.0
38	14.4	265	50.0	2.6	19.2	0.4	70.2	1.5	5.7	0.4	0.0
39	8.8	153	52.0	2.6	19.0	0.0	68.0	2.6	5.2	2.0	0.7
40	4.7	101	54.3	1.0	28.7	1.0	59.4	3.0	6.9	0.0	0.0
41-42	5.3	78	45.8	2.6	34.6	1.3	53.8	0.0	7.7	0.0	0.0
Composite	**100.0%**	**1097**	**49.7**	**2.9%**	**21.9%**	**1.8%**	**55.0%**	**9.1%**	**6.8%**	**2.3%**	**0.1%**
SE			**1.5**	**0.6**	**1.4**	**0.6**	**1.6**	**1.1**	**0.8**	**0.7**	**0.1**
		% Female	**Mean**	**0.0%**	**12.1%**	**0.6%**	**65.1%**	**8.8%**	**10.1%**	**3.1%**	**0.1%**
			SE	**0.0**	**1.7**	**0.4**	**2.2**	**1.7**	**1.3**	**1.3**	**0.1**
		% Male	**Mean**	**5.3%**	**30.2%**	**2.6%**	**42.9%**	**9.2%**	**3.1%**	**1.2%**	**5.4%**
			SE	**1.2**	**2.1**	**0.9**	**2.3**	**1.5**	**0.8**	**0.8**	**1.0**
T-Statistic for test of differences				**4.5**	**6.7**	**1.9**	**7.0**	**0.2**	**4.7**	**1.3**	**5.5**
p-value				**<0.01**	**<0.01**	**0.03**	**<0.01**	**0.44**	**<0.01**	**0.10**	**<0.01**

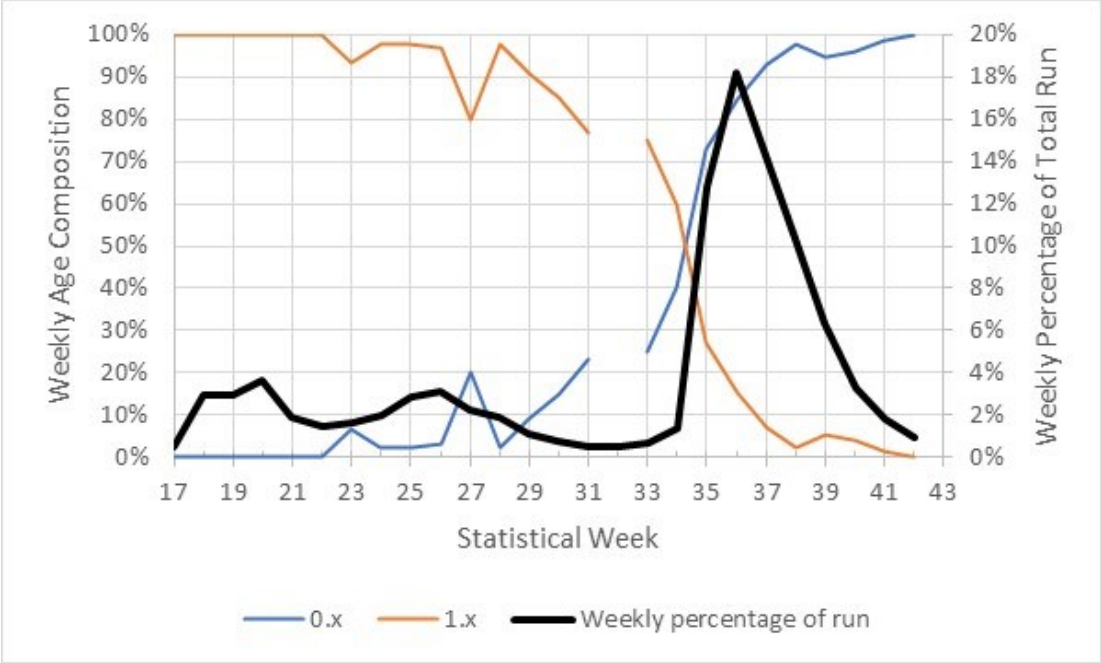


Figure 13. Weekly age composition of Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2021 with weekly percentage of run.

Upstream Age and Length-at-Age Composition

Age 1.2 was the dominant age class for spring Chinook at all dams (Table 14, Figure 14). Among summer Chinook, age 1.2 was the most abundant age component at all dams except for Priest Rapids, Rock Island and Rocky Reach where 1.3 was most abundant (Table 14, Figure 15). Among fall Chinook age 0.3 was the most abundant age component at all dams except for the Snake River dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams) where Age 0.2 was most abundant (Table 14, Figure 16). Length-at-age composition estimates at mainstem dam sites are summarized in Tables 15-17.

Table 14. Unweighted age composition estimates of spring, summer, and fall Chinook Salmon at mainstem Columbia Basin dams as estimated using upstream PIT tag detections for Chinook sampled at Bonneville Dam and aged using scale pattern analysis in 2021[5].

		Brood Year and % Age Class							
Run and Site	Ageable	2019	2018		2017		2016		2015
Spring	**N**	**0.1**	**0.2**	**1.1**	**0.3**	**1.2**	**0.4**	**1.3**	**1.4**
Bonneville	1050	0.0	0.0	17.6	0.0	79.0	0.0	3.3	0.0
The Dalles	899	0.0	0.0	19.1	0.0	78.0	0.0	2.9	0.0
John Day	793	0.0	0.0	20.8	0.0	76.0	0.0	3.2	0.0
McNary	751	0.0	0.0	21.0	0.0	75.6	0.0	3.3	0.0
Priest Rapids	166	0.0	0.0	17.5	0.0	74.1	0.0	8.4	0.0
Rock Island	166	0.0	0.0	17.5	0.0	74.1	0.0	8.4	0.0
Rocky Reach	69	0.0	0.0	23.2	0.0	62.3	0.0	14.5	0.0
Wells	62	0.0	0.0	24.2	0.0	61.3	0.0	14.5	0.0
Ice Harbor	527	0.0	0.0	21.3	0.0	76.9	0.0	1.9	0.0
Low. Mon.	522	0.0	0.0	21.3	0.0	77.0	0.0	1.7	0.0
Little Goose	512	0.0	0.0	21.1	0.0	77.1	0.0	1.8	0.0
Lower Granite	508	0.0	0.0	21.1	0.0	77.2	0.0	1.8	0.0
Summer	**N**	**0.1**	**0.2**	**1.1**	**0.3**	**1.2**	**0.4**	**1.3**	**2.2**
Bonneville	841	0.2	1.2	19.4	3.1	41.5	0.7	33.5	0.4
The Dalles	754	0.3	1.2	20.2	3.1	41.1	0.8	33.0	0.4
John Day	702	0.3	1.3	19.9	3.3	41.2	0.7	32.9	0.4
McNary	681	0.3	1.3	19.7	3.4	41.3	0.7	32.9	0.4
Priest Rapids	496	0.4	1.6	10.3	4.6	38.7	1.0	42.7	0.6
Rock Island	484	0.2	1.4	10.3	4.8	38.8	1.0	42.8	0.6
Rocky Reach	415	0.2	1.0	9.4	4.8	39.0	1.0	44.1	0.5
Wells	307	0.0	1.3	7.5	6.2	42.7	1.3	40.4	0.7
Ice Harbor	164	0.0	0.0	45.7	0.0	50.0	0.0	4.3	0.0
Low. Mon.	162	0.0	0.0	45.1	0.0	50.6	0.0	4.3	0.0
Little Goose	161	0.0	0.0	44.7	0.0	50.9	0.0	4.3	0.0
Lower Granite	155	0.0	0.0	45.8	0.0	50.3	0.0	3.9	0.0
Fall	**N**	**0.1**	**0.2**	**1.1**	**0.3**	**1.2**	**0.4**	**1.3**	**2.2**
Bonneville	1099	2.5	22.6	1.3	58.8	6.6	6.8	1.5	0.1
The Dalles	834	2.2	22.9	1.6	58.3	7.2	6.5	1.4	0.0
John Day	668	2.2	22.0	1.2	60.8	7.2	5.2	1.3	0.0
McNary	613	2.3	22.5	1.3	60.4	7.5	4.7	1.3	0.0
Priest Rapids	138	2.9	19.6	0.0	67.4	6.5	2.9	0.7	0.0
Rock Island	50	2.0	22.0	0.0	62.0	10.0	4.0	0.0	0.0
Rocky Reach	44	2.3	25.0	0.0	59.1	11.4	2.3	0.0	0.0
Wells	15	0.0	13.3	0.0	66.7	20.0	0.0	0.0	0.0
Ice Harbor	113	3.5	41.6	6.2	39.8	7.1	0.0	1.8	0.0
Low. Mon.	111	3.6	42.3	6.3	39.6	6.3	0.0	1.8	0.0
Little Goose	110	3.6	41.8	6.4	40.0	6.4	0.0	1.8	0.0
Lower Granite	105	3.8	41.9	4.8	41.0	6.7	0.0	1.9	0.0

[5] The Bonneville estimates in this table differ from those presented in Tables 11-13 due to Table 15 does not including Chinook not detected at Bonneville Dam as well as estimated this table being unweighted by weekly run size while tables 12-14 are weighted.

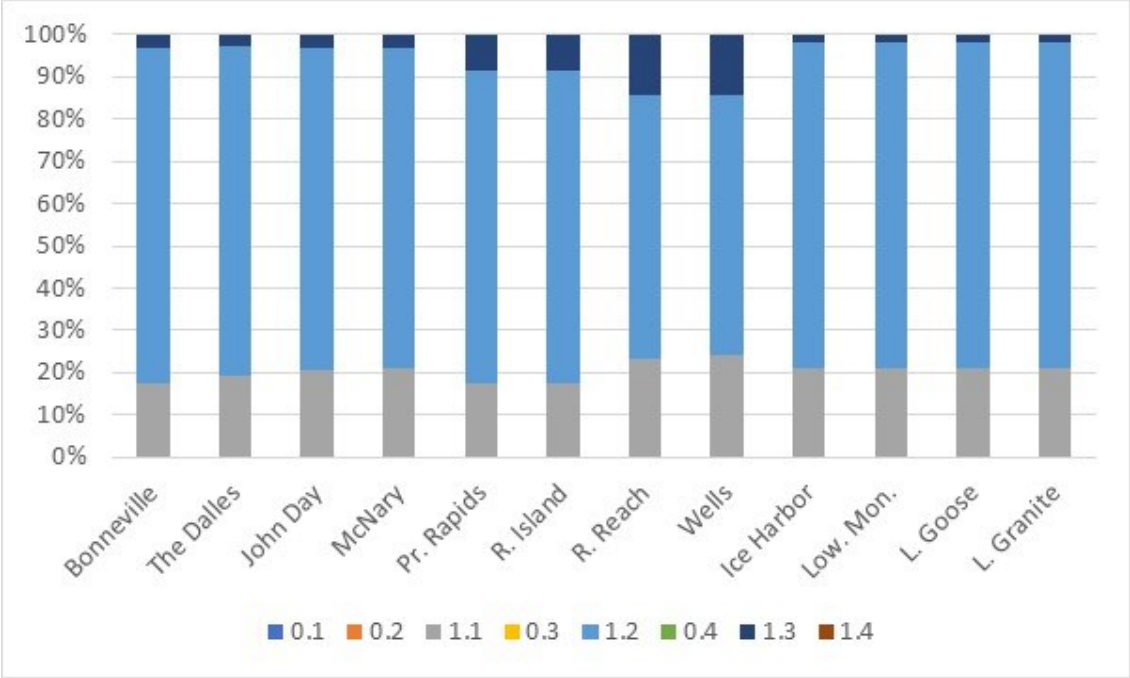


Figure 14. Spring Chinook age composition at Columbia and Snake River dams estimated using PIT-tagged Chinook tracked by this project. Summer Chinook are defined as passing Bonneville Dam between June 1 and July 31, 2021.

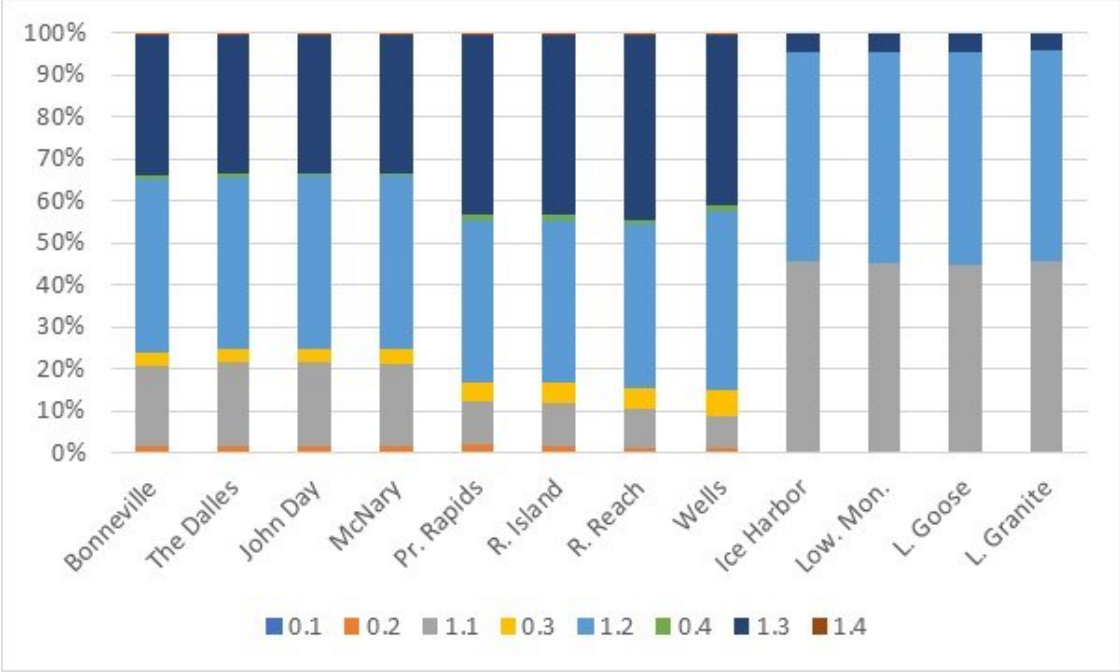


Figure 15. Summer Chinook age composition at Columbia and Snake River dams estimated using PIT-tagged Chinook tracked by this project. Summer Chinook are defined as passing Bonneville Dam between June 1 and July 31, 2021.

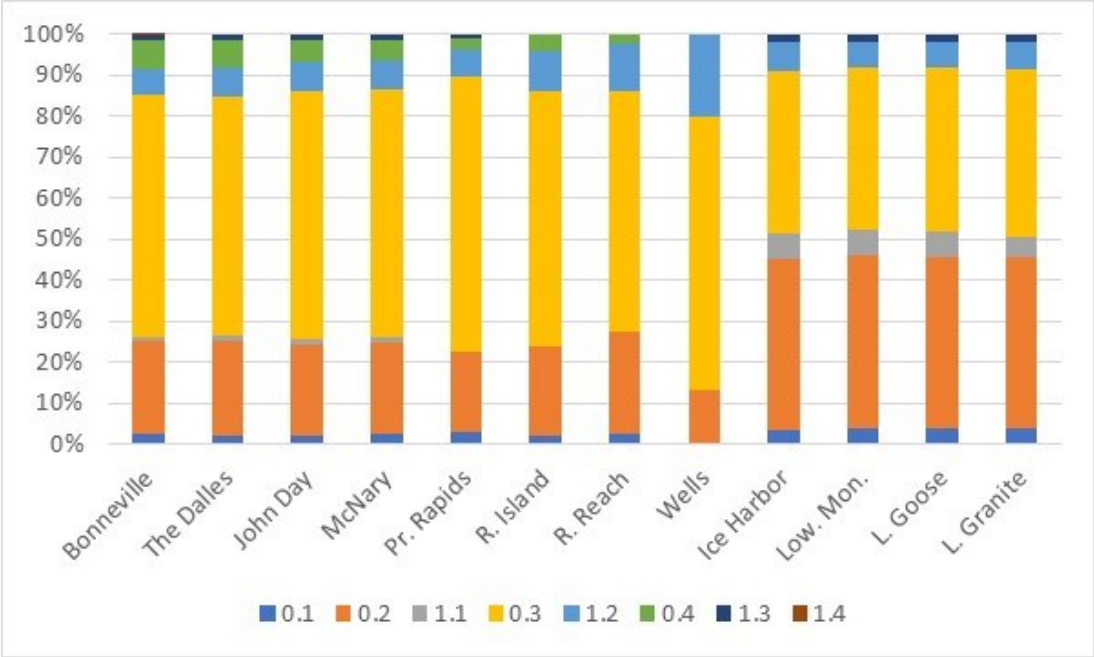


Figure 16. Fall Chinook age composition at Columbia and Snake River dams estimated using PIT-tagged Chinook tracked by this project. Fall Chinook are defined as passing Bonneville Dam on or after August 1, 2021.

Table 15. Spring Chinook Salmon length-at-age composition, as estimated by PIT tag detections at upstream dams of fish aged using scale pattern analysis that passed Bonneville Dam on or before May 31 at Columbia and Snake River dams in 2021.

Dam	Statistic	Brood Year and Age Class							
		2019	2018		2017		2016		2015
		0.1	0.2	1.1	0.3	1.2	0.4	1.3	1.4
Bonneville	μ			492		715		834	
	s			39		62		63	
	n			184		822		35	
The Dalles	μ			490		713		835	
	s			39		65		65	
	n			171		693		26	
John Day	μ			489		715		841	
	s			38		67		59	
	n			164		596		25	
McNary	μ			489		716		841	
	s			37		67		59	
	n			157		561		25	
Priest Rapids	μ			487		734		866	
	s			37		84		33	
	n			29		121		14	
Rock Island	μ			487		734		866	
	s			37		84		33	
	n			29		121		14	
Rocky Reach	μ			483		720		869	
	s			42		51		37	
	n			16		43		10	
Wells	μ			487		722		869	
	s			40		51		39	
	n			15		38		9	
Ice Harbor	μ			488		710		804	
	s			36		62		73	
	n			112		400		10	
Lower Monumental	μ			488		710		812	
	s			36		62		72	
	n			111		397		9	
Little Goose	μ			487		710		812	
	s			36		62		72	
	n			108		390		9	
Lower Granite	μ			488		710		812	
	s			36		62		72	
	n			107		387		9	

Table 16. Summer Chinook Salmon length-at-age composition, as estimated by PIT tag detections at upstream dams of fish aged using scale pattern analysis that passed Bonneville Dam between June 1-July 31 at Columbia and Snake River dams in 2021.

		Brood Year and Age Class							
		2019	2018		2017		2016		2015
Dam	Statistic	0.1	0.2	1.1	0.3	1.2	0.4	1.3	1.4
Bonneville	μ	398	580	521	788	718	907	826	838
	s	32	74	45	66	63	92	61	38
	n	2	10	163	26	349	6	282	3
The Dalles	μ	398	591	520	793	717	907	827	838
	s	32	69	45	59	63	92	61	38
	n	2	9	152	23	310	6	249	3
John Day	μ	398	591	518	793	716	880	829	838
	s	32	69	44	59	64	72	61	38
	n	2	9	140	23	289	5	231	3
McNary	μ	398	591	519	793	716	880	830	838
	s	32	69	43	59	64	72	61	38
	n	2	9	134	23	281	5	224	3
Priest Rapids	μ	398	584	525	793	711	880	829	838
	s	32	71	55	59	71	72	59	38
	N	2	8	51	23	192	5	212	3
Rock Island	μ	375	598	525	793	711	880	828	838
	s	--	65	55	59	70	72	58	38
	N	1	7	50	23	188	5	207	3
Rocky Reach	μ	375	614	524	801	708	879	826	820
	s	--	61	57	54	68	83	57	28
	n	1	4	39	20	162	4	183	2
Wells	μ		614	531	799	711	879	824	820
	s		61	67	55	68	83	60	28
	n		4	23	19	131	4	124	2
Ice Harbor	μ			515		726		861	
	s			30		45		62	
	n			75		82		7	
Lower Monumental	μ			514		726		861	
	s			30		45		62	
	n			73		82		7	
Little Goose	μ			514		726		861	
	s			31		45		62	
	n			72		82		7	
Lower Granite	μ			514		727		852	
	s			31		45		62	
	n			71		78		6	

Table 17. Fall Chinook Salmon length-at-age composition, as estimated by PIT tag detections at upstream dams of fish aged using scale pattern analysis that passed Bonneville after July 31 for fall Chinook Salmon at Columbia and Snake River in 2021.

Dam	Statistic	Brood Year and Age Class							
		2019	2018		2017		2016		2015
		0.1	0.2	1.1	0.3	1.2	0.4	1.3	1.4
Bonneville	μ	451	640	583	748	744	825	852	805
	s	69	49	43	48	42	53	43	--
	n	27	243	14	640	72	75	16	1
The Dalles	μ	442	636	580	747	739	825	860	
	s	73	48	44	48	41	49	43	
	n	19	189	13	482	60	54	12	
John Day	μ	453	637	598	747	743	821	859	
	s	74	45	44	48	39	50	48	
	n	16	146	8	403	48	35	9	
McNary	μ	453	638	598	745	741	820	848	
	s	76	45	44	47	39	46	34	
	n	15	137	8	368	46	29	8	
Priest Rapids	μ	470	624		736	726	829	845	
	s	132	47		42	40	45	--	
	n	5	26		93	9	4	1	
Rock Island	μ	553	625		734	725	858		
	s	209	59		48	37	53		
	n	2	10		31	5	2		
Rocky Reach	μ	553	625		728	725	895		
	s	209	59		50	37	--		
	n	2	10		26	5	1		
Wells	μ	700	620		708	732			
	s	--	--		39	46			
	n	1	1		10	3			
Ice Harbor	μ	456	647	596	745	734		818	
	s	39	43	47	54	27		39	
	n	4	47	7	45	8		2	
Lower Monumental	μ	456	647	596	746	737		818	
	s	39	43	47	55	28		39	
	n	4	47	7	44	7		2	
Little Goose	μ	456	647	596	746	737		818	
	s	39	43	47	55	28		39	
	n	4	46	7	44	7		2	
Lower Granite	μ	456	650	598	746	737		818	
	s	39	38	56	55	28		39	
	n	4	44	5	43	7		2	

Fallback

Estimated fallback rates, based on Chinook Salmon reascending fish ladders or being detected downstream after ascending a fish ladder, ranged from 0.0% spring Chinook at Priest Rapids and Rock Island dams to 29.2% for fall Chinook at Priest Rapids Dam (Table 18). These rates likely underestimate the true fallback rates as they do not include any fish that ascended a dam, fell back, and then were not subsequently detected. Of the 32 fall Chinook fallbacks estimated at Priest Rapids Dam, 28 were subsequently detected at Priest Rapids Hatchery located 4 km downstream and one at Ringold Hatchery located 68 km downstream.

Table 18. Estimated minimum Chinook Salmon fallback rates by race at Columbia Basin dams with PIT tag detection in 2021 as estimated by PIT tags[6].

Dam	% Spring Chinook	% Summer Chinook	% Fall Chinook
Bonneville	1.3	1.2	0.4
The Dalles	2.8	2.8	3.3
John Day	4.4	2.4	1.2
McNary	4.8	1.4	12.5
Priest Rapids	0.0	1.3	29.2
Rock Island	0.0	0.3	0.0
Rocky Reach	3.9	2.2	6.7
Wells	2.9	3.8	12.5
Ice Harbor	4.7	3.9	5.3
L. Monumental	2.6	1.1	4.6
Little Goose	3.0	1.7	7.8
Lower Granite	5.0	1.8	9.9
Tumwater	7.1	8.3	NA
Weighted Mean	**3.2%**	**1.9%**	**4.9%**

[6] Fallback rates do not include Chinook Salmon which may have fallen back over a dam and were not subsequently detected.

A total of 293 Chinook (excluding minijacks and Tules) generated 478 fallback events at mainstem dams with adult PIT tag detection (Table 19). A total of eight Chinook had more than one fallback event with three Chinook falling back 10 times each and one Chinook with 8 fallbacks. Figures showing the movement of some of these Chinook are in the Appendix C (Figures C27 – C30).

Table 19. Frequency of fallback events for spring, summer, and fall Chinook Salmon tagged by this project in 2021. (Tules and minijacks excluded)

Frequency of Fallback Events per Chinook	Total Number of Chinook
1	210
2	43
3	16
4	9
5	7
6	3
7	1
8	1
9	0
10	3
Number of Chinook falling back at least once	**293**
Percentage of Chinook with at least one fallback event	**8.4**
Total fallback events	**478**
Number of Chinook (excluding minijacks and Tules) in study	**3487**
Fallback events per Chinook	**0.14**

Night Passage

Night passage (2000-0400 Pacific Standard Time) of tagged Chinook Salmon was under 10% at all mainstem dams except for spring Chinook at Rock Island Dam and fall Chinook at Rocky Reach Dam (Table 20). Higher percentages of night passage were estimated at tributary dams, but sample sizes are relatively small (for example, 6 of only 14 summer Chinook and 5 of 9 fall Chinook passed Prosser Dam at night, Table 20).

Table 20. Chinook Salmon night passage (2000-0400) in 2021 at Columbia Basin dams as estimated by PIT tag detections.

Site	% Spring Chinook	% Summer Chinook	%Fall Chinook
Bonneville	0.0%	0.4%	0.1%
The Dalles	1.0%	2.9%	0.2%
John Day	0.2%	0.5%	0.6%
McNary	0.9%	1.9%	0.7%
Priest Rapids	4.4%	1.9%	3.1%
Rock Island	14.2%	3.1%	4.5%
Rocky Reach	7.5%	1.0%	10.0%
Wells	7.2%	3.1%	0.0%
Ice Harbor	0.5%	2.2%	0.9%
Lower Monumental	1.7%	2.3%	1.8%
Little Goose	0.7%	5.1%	1.8%
Lower Granite	0.9%	3.6%	0.0%
Prosser	16.4%	7.1%	0.0%
Roza	13.6%	0.0%	NA
Tumwater	6.9%	6.4%	NA

Straying

Estimated Chinook stray rates by stock using PBT for those stocks with more than 10 fish that were designated as either putative strays or on-target, ranged from 55.5% for Dworshak hatchery stock to 0% for Clearwater, Entiat, Leavenworth, Sawtooth, and Spring Creek Hatchery stocks as well as for Yakima Basin (Roza integrated) and Imnaha stocks (Table 21). The hatchery with the greatest number of strays was Dworshak Hatchery with 61 last detected primarily in the South Fork Salmon (33 Chinook) and above Rock Island Dam (18). The combined stray rate estimated using PBT for all stocks was 12.0% with 1.7% categorized as putative overshoots.

Estimated Chinook stray rates by stock using GSI for those stocks with more than 10 fish that were designated as either putative strays or on-target, ranged from 87.5% for the Hells Canyon group (with strays last detected in the Salmon, Imnaha, Grande Ronde, Yakima, Wenatchee, and Methow rivers) to 13.3% for the Deschutes fall Chinook group (Table 22). The combined stray rate estimated using GSI was 20.3%.

Table 21. Table showing final-PIT-fate categories by hatchery in 2021 using Parental Based Tagging (PBT). Fate categories are categorized by color. Grey is neutral (meaning last detected on route to expected destinations), green is on target (meaning last detected at their expected destination), yellow is putative overshoot meaning a fish last detected in an area adjacent to its expected destination, and red is putative stray meaning a fish was last detected in tributaries or the mainstem outside their normal route to their expected destination. Stray rates are also tabulated.

Basin or Dam	Bonneville Dam				Bonneville Pool Sites							The Dalles		Deschutes		John Day Dam			Umatilla River		McNary Dam		
Stock Classification Using Parental Based Tagging	Oregon Shore Ladder	Spillway Ladder	Lower Washington Shore Ladder	Upper Washington Shore Ladder	Carson Hatchery	Upper Wind River rkm 30	Spring Creek Hatchery	Hood River Mouth	Lyle Falls Fishway, Klickitat R	Klickitat Floating Array at RKM5	Summit Creek, Klickitat	The Dalles-East Ladder	The Dalles-North Ladder	Shear's Falls, Deschutes	Warm Springs River PIT array	John Day Juvenile Bypass	John Day Dam-Oregon Shore	John Day Dam-WA Shore	Three Mile Dam, Umatilla	Umatilla-Feed Dam	McNary-Oregon Shore	McNary-WA Shore	Nursery Bridge-Walla Walla
PTAGIS site	BO1	BO2	BO3	BO4	CAL	WRU	SCL	HRM	LFF	KLR	SUC	TD1	TD2	DSF	WSH	JDJ	JO1	JO2	TMF	UMW	MC1	MC2	NBA
Carson Hatchery	0	0	0	3	2	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Chief Joseph Hatchery (summer/Fall)	0	0	0	13	0	0	0	0	0	0	0	4	1	0	0	0	1	1	0	0	0	0	0
Clearwater Hatchery	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clearwater-Powell Creek Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Deschutes (Hatchery)	0	0	0	0	0	0	0	0	0	0	0	1	0	3	1	0	0	0	0	0	0	0	0
Dworshak Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastbank Hatchery (Summer)	0	0	1	21	0	0	0	0	0	0	0	9	0	0	0	0	2	0	0	0	0	1	0
Entiat Hatchery (Summer)	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	2	0	0	0	0	0	0
Imnaha	1	0	0	4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Klickitat Hatchery	0	0	1	10	0	0	0	0	7	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Leavenworth Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little White Hatchery (fall)	0	0	3	164	0	65	0	2	10	4	0	17	3	0	0	0	3	0	0	1	4	2	0
Little White Salmon (Spring)	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lookingglass hatchery	0	0	0	4	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
McCall Hatchery	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Methow River	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Methow River (Hatchery)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nez Perce Hatchery	0	0	1	5	0	0	0	0	0	0	0	4	2	0	0	0	2	2	0	0	2	0	0
Pahsimmeroi Hatchery	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Parkdale Fish Facility	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Priest Rapids Hatchery (fall)	1	1	3	51	0	0	0	0	0	0	0	8	2	0	0	0	12	4	0	0	58	28	0
Priest Rapids Hatchery (fall)-Ringold	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rapid River Hatchery	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0
Sawtooth Hatchery	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spring Creek (Hatchery)	6	2	2	96	0	1	19	1	0	0	0	3	1	0	0	0	0	1	0	0	0	0	0
Umatilla	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Washougal Hatchery	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wells Hatchery	0	0	0	8	0	0	0	0	0	0	0	5	0	0	0	1	1	1	0	0	0	1	0
Yakima River Basin-Roza integrated	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0
Total	9	3	12	403	2	70	19	4	18	4	1	58	10	3	1	1	26	10	1	1	66	35	1

Basin or Dam	Snake River Ice Harbor-Lower Granite							Clearwater Basin							Grand Ronde		Salmon Basin							Imnaha Basin				Yakima	
Stock Classification Using Parental Based Tagging	Ice Harbor Dam	Lower Monumental Ladders	Lower Tucannon River	Little Goose Dam Ladders	Lower Granite Ladders	Lower Granite Juvenile Bypass	Lower Granite Spillway	SF Clearwater rkm 1	SF Clearwater rkm 2	Lower Lochsa	Upper Lochsa	Lower Selway River	Upper Selway River	Dworshak Hatchery	Wallow River rkm 32	Catherine Creek Weir	South Fork Salmon km 15	SF Salmon-Krassel Cr	Upper Grand Ronde	Big Creek	Upper Salmon rkm 437	Upper Salmon rkm 460	Yankee Fork	Imnaha River km 41	Imnaha Weir Adult Ladder	Lower Imnaha	Lower Imnaha	Prosser Dam	Roza Dam
PTAGIS site	ICH	LMA	LTR	GOA	GRA	GRJ	GRS	SC1	SC2	LRL	LRU	SW1	SW2	DWL	WR2	CCW	SFG	KRS	UGS	TAY	USE	USI	YFK	IR3	IML	IR4	IR5	PRO	ROZ
Carson Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chief Joseph Hatchery (summer/Fall)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clearwater Hatchery	0	0	0	0	1	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clearwater-Powell Creek Facility	0	0	0	0	1	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deschutes (Hatchery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dworshak Hatchery	0	0	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastbank Hatchery (Summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Entiat Hatchery (Summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Imnaha	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	1	5	0	0
Klickitat Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leavenworth Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little White Hatchery (fall)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Little White Salmon (Spring)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lookingglass hatchery	0	0	0	0	3	0	0	0	0	0	0	0	0	0	6	2	0	0	2	0	0	0	0	0	0	0	0	0	0
McCall Hatchery	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	11	0	0	0	0	0	0	0	0	0	0	0
Methow River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Methow River (Hatchery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nez Perce Hatchery	0	0	0	1	20	1	0	2	3	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pahsimmeroi Hatchery	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0
Parkdale Fish Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Priest Rapids Hatchery (fall)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Priest Rapids Hatchery (fall)-Ringold	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rapid River Hatchery	0	0	0	0	14	0	2	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Sawtooth Hatchery	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	8	1	0	0	0	0	0	0
Spring Creek (Hatchery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Umatilla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Washougal Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wells Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Yakima River Basin-Roza integrated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	9
Total	3	0	1	2	50	1	3	6	6	3	5	3	2	1	6	2	2	11	2	1	7	13	1	2	11	1	5	3	9

Basin or Dam					Wenatchee									Rocky Reach			Entiat				Methow						Okanogan											
Stock Classification Using Parental Based Tagging	Ringold Hatchery	Priest Rapids Hatchery	Priest Rapids Ladder	Rock Island Dam Ladder	Lower Wenatchee River	Icicle Creek	Leavenworth Hatchery	Tumwater Dam Ladder	Lower Chiwawa	Upper Chiwawa	Upper Wenatchee	Lower Nason Creek	Upper Nason Creek	Rocky Reach ladders	Rocky Reach Juvenile Bypass	East Bank Hatchery	Lower Entiat River	Entiat Hatchery	Wells Dam	Wells Hatchery	Methow	Methow River at Carlton	Upper Chewuch	Spring Creek Acclimation Pond	Methow River at Winthrop	Methow Hatchery	Lower Okanogan River	Zosel Dam	Neutral	On Target	Putative Stray	Putative overshoot	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target))
PTAGIS site	RSH	PRH	PRA	RIA	LWE	ICL	LNF	TUF	CHL	CHU	UWE	NAL	NAU	RRF	RRJ	EBO	ENL	EHL	WEA	WEH	LMR	MRC	CRW	SCP	MRW	MSH	OKL	ZSL									
Carson Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	2	1	33.3%	33.3%	22.2%	11.1%	40.0%
Chief Joseph Hatchery (summer/Fall)	0	0	2	2	1	0	0	0	0	0	0	0	0	3	0	0	0	0	73	8	1	0	0	0	0	0	55	1	108	56	2	0	65.1%	33.7%	1.2%	0.0%	3.4%
Clearwater Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	0	0	44.4%	55.6%	0.0%	0.0%	0.0%
Clearwater-Powell Creek Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	0	0	22.2%	77.8%	0.0%	0.0%	0.0%
Deschutes (Hatchery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4	1	0	16.7%	66.7%	16.7%	0.0%	20.0%
Dworshak Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	25.0%	75.0%	0.0%	0.0%	0.0%
Eastbank Hatchery (Summer)	0	0	3	2	16	2	0	7	1	3	1	4	5	23	2	6	3	0	64	13	6	17	1	0	1	0	5	0	39	180	0	0	17.8%	82.2%	0.0%	0.0%	0.0%
Entiat Hatchery (Summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	5	26	1	0	0	0	0	0	0	0	1	0	8	31	1	1	19.5%	75.6%	2.4%	2.4%	3.1%
Imnaha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	18			33.3%	66.7%	0.0%	0.0%	0.0%
Klickitat Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	7	2	0	55.0%	35.0%	10.0%	0.0%	22.2%
Leavenworth Hatchery	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		2			0.0%	100.0%	0.0%	0.0%	0.0%
Little White Hatchery (fall)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	167	81	14	20	59.2%	28.7%	5.0%	7.1%	14.7%
Little White Salmon (Spring)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	25.0%	75.0%	0.0%	0.0%	0.0%
Lookingglass hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	3	0	42.1%	42.1%	15.8%	0.0%	27.3%
McCall Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	11	2	0	23.5%	64.7%	11.8%	0.0%	15.4%
Methow River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0	0	1	3	0	1	20.0%	60.0%	0.0%	20.0%	0.0%
Methow River (Hatchery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2	1	0	0	0	3	3	0		50.0%	50.0%	0.0%	0.0%	0.0%
Nez Perce Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	40	10	1	0	78.4%	19.6%	2.0%	0.0%	9.1%
Pahsimmeroi Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	7	0	0	30.0%	70.0%	0.0%	0.0%	0.0%
Parkdale Fish Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	75.0%	25.0%	0.0%	0.0%	0.0%
Priest Rapids Hatchery (fall)	47	143	38	2	1	0	0	0	0	0	0	0	0	3	0	4	0	0	2	2	0	0	0	0	0	0	0	0	167	190	14	38	40.8%	46.5%	3.4%	9.3%	6.9%
Priest Rapids Hatchery (fall)-Ringold	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	100.0%	0.0%	0.0%	0.0%	NA
Rapid River Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	16	2	0	28.0%	64.0%	8.0%	0.0%	11.1%
Sawtooth Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	13	14	1	0	46.4%	50.0%	3.6%	0.0%	6.7%
Spring Creek (Hatchery)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	106	19	8	0	79.7%	14.3%	6.0%	0.0%	29.6%
Umatilla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	50.0%	50.0%	0.0%	0.0%	0.0%
Washougal Hatchery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	100.0%	0.0%	0.0%	0.0%	NA
Wells Hatchery	0	0	1	2	0	0	0	0	0	0	0	0	0	2	1	0	1	0	25	37	4	0	0	0	0	0	0	0	48	37	6	0	52.7%	40.7%	6.6%	0.0%	14.0%
Yakima River Basin-Roza integrated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	9	1	0	28.6%	64.3%	7.1%	0.0%	10.0%
Total	48	144	44	8	18	3	1	7	1	3	1	4	5	32	5	10	9	26	169	60	11	17	2	2	2	2	62	1	762	720	59	61	47.6%	44.9%	3.7%	3.8%	7.6%

Table 22. Table showing final-PIT-fate categories by hatchery in 2021 using Genetic Stock Identification (GSI). Fate categories are categorized by color. Grey is neutral (meaning last detected on route to expected destinations), green is on target (meaning last detected at their expected destination), yellow is putative overshoot meaning a fish last detected in an area adjacent to its expected destination, and red is putative stray meaning a fish was last detected in tributaries or the mainstem outside their normal route to their expected destination. Stray rates are also tabulated.

Stock Classification using Genetic Stock Identification	Bonneville-Oregon Shore	Bonneville-WA Shore Ladder	Bonneille WA Ladder Slots	Little White Salmon Hatchery	Spring Creek Hatchery	Lyle Falls Fishway, Klickitat R	The Dalles-East Ladder	The Dalles-North Ladder	Deschutes Sherars Falls	Warm Springs River PIT Array	Warm Springs River PIT array	John Day Dam-Oregon Shore	John Day Dam-WA Shore	John Day River, McDonald Ferry	Upper John Day River	Three Mile Dam	McNary-Oregon Shore	McNary-WA Shore	McNary Juvenile Bypass	Ice Harbor Dam	Lower Monumental Ladders	Little Goose Dam	Lower Granite	Lower Granite Spillway	Dworshak Hatchery	SF Clearwater rkm 2	Lower Lochsa	Upper Lochsa	Lower Selway River
	Bonneville Dam			Bonneville Pool					Deschutes					John Day R.			McNary Dam								Clearwater River				
	BO1	BO3	BO4	LWL	SCL	LFF	TD1	TD2	DSF	WSR	WSH	JO1	JO2	JD1	JDM	TMF	MC1	MC2	MCJ	ICH	LMA	GOA	GRA	GRS	DWL	SC2	LRL	LRU	SW1
	234	234	234	261	269	290	308	308	328	328	328	347	347	351	351	465	470	470	470	522	522	522	522	522	522	522	522	522	522
Estuary									3	1																			
Cowlitz		2	8				1																						
Willamette		1	4																										
Spr Crk Tule	1		41	1	5			1									1												
Klickitat			1																										
Deschutes			1								2																		
John Day			1												2														
Yakima			1				1							1				1			2								
UpColSp			2										1	1			1	1					1		1	1			1
Hells Canyon			9				5					3	1	1	2								6			1		1	1
SF Salmon			5											1									1				1		
Upper Salmon																							1						
MF Salmon																						1	1						
Upper Salmon	1		3					1													1		7						
SR Fall		4	29				23	3	4	1		6	3				17	15		1	1		25	1		1			2
Deschutes Fall			5				14	1	12	1																			
Upper Columbia Summer	3	8	149	4		3	88	12	3			29	8			1	197	150	1	1	2		23			1			
Total	5	15	259	5	5	3	132	18	22	3	2	38	13	4	4	1	216	167	1	2	6	1	65	1	1	4	1	1	4

Stock Classification using Genetic Stock Identification	Wallowa River at river km 14	Minam River	Wallow River rkm 32	Upper Grande Ronde	Secesh River at Zena Cr. Ranch	EFSF Salmon River at Parks Cr.	SF Salmon-Krassel Cr	Big Creek at Taylor Ranch	Bear Valley Adult Video Weir	Marsh Creek	Lemhi River Weir	Upper Salmon rkm 437	Upper Salmon rkm 460	Valley Creek, Downstream Site	Valley Creek, Upstream Site	Lower Imnaha	Big Sheep Creek	Lower Imnaha	Prosser Dam	Sunnyside Instream Array	Roza Dam	Ringold Hatchery	Priest Rapids Hatchery	Priest Rapids Ladder	Rock Island Dam Ladder	Lower Wenatchee River	Icicle Creek	Tumwater Dam Ladder
	Grande Ronde				Salmon River											Imnaha			Yakima River							Wenatchee River		
	WR1	MR1	WR2	UGR	ZEN	ESS	KRS	TAY	BRC	MAR	LRW	USE	USI	VC2	VC1	IR2	BSC	IR5	PRO	SUN	ROZ	RSH	PRH	PRA	RIA	LWE	ICL	TUF
	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	539	539	539	567	635	639	730	754	754	754
Estuary																												
Cowlitz																												
Willamette																												
Spr Crk Tule																												
Klickitat																			1									
Deschutes																												
John Day																												
Yakima																			1		9							
UpColSp	1	4					1			1		1									1						1	2
Hells Canyon	1	1	2	1			3	1		1	1	1					1	1		1								
SF Salmon					8	4	3	1				2						1										
Upper Salmon																												
MF Salmon							1	2	3	2																		
Upper Salmon						1				1		3	4	1	2													
SR Fall																1			1			2		6				
Deschutes Fall																								1	1			
Upper Columbia Summer																			4	1		2	39	44	7	17	2	14
Total	2	5	2	1	8	5	8	4	3	5	1	7	4	1	2	1	1	2	7	2	10	4	39	51	8	17	3	16

Stock Classification using Genetic Stock Identification	Lower Chiwawa River	Upper Chiwawa	Upper Wenatchee	Lower Nason Creek	Upper Nason Creek	Little Wentachee	Rocky Reach Dam	Rocky Reach Bypass	Lower Entiat River	Entiat Hatchery	Upper Entiat rkm 17	Wells Dam Ladders	Wells Hatchery	Methow	Methow River at Carlton	Upper Chewuch	Spring Creek Acclimation Pond	Lower Okanogan Weir	Zosel Dam Combined	Okangan Channel near Oliver, BC	Penticton Channel PIT Array	Total	Neutral	On Target	Putative Stray	Putative overshoot	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target)
	Wenatchee River								Entiat					Methow River				Okanogan River													
	CHL	CHU	UWE	NAL	NAU	LWN	RRF	RRJ	ENL	EHL	ENA	WEA	WEH	LMR	MRC	CRU	SCP	OKL	ZSL	OKC	OKP										
	754	754	754	754	754	754	763	763	778	778	778	830	830	843	843	843	843	858	858	858	858										
Estuary														1								5	0	0	5	0	0.0%	0.0%	100.0%	0.0%	100.0%
Cowlitz																						11	0	0	1	10	0.0%	0.0%	9.1%	90.9%	100.0%
Willamette																						5	0	0	0	5	0.0%	0.0%	0.0%	100.0%	NA
Spr Crk Tule																						50	42	6	1	1	84.0%	12.0%	2.0%	2.0%	14.3%
Klickitat											1											3	1	0	2	0	33.3%	0.0%	66.7%	0.0%	100.0%
Deschutes																						3	1	2	0	0	33.3%	66.7%	0.0%	0.0%	0.0%
John Day																						3	1	2	0	0	33.3%	66.7%	0.0%	0.0%	0.0%
Yakima																						16	3	10	3	0	18.8%	62.5%	18.8%	0.0%	23.1%
UpColSp	2	1		3							1											29	5	10	14	0	17.2%	34.5%	48.3%	0.0%	58.3%
Hells Canyon		1			1												1					48	24	3	21	0	50.0%	6.3%	43.8%	0.0%	87.5%
SF Salmon																						27	6	15	6	0	22.2%	55.6%	22.2%	0.0%	28.6%
Upper Salmon																						1	1	0	0	0	100.0%	0.0%	0.0%	0.0%	NA
MF Salmon																						10	2	7	1	0	20.0%	70.0%	10.0%	0.0%	12.5%
Upper Salmon																1						26	13	10	3	0	50.0%	38.5%	11.5%	0.0%	23.1%
SR Fall												2						6	1			155	133	3	19	0	85.8%	1.9%	12.3%	0.0%	86.4%
Deschutes Fall																						35	20	13	2	0	57.1%	37.1%	5.7%	0.0%	13.3%
Upper Columbia Summer			2			1	13	1	3	6	2	55	10	4	4			117	12	4	1	1048	648	362	35	3	61.8%	34.5%	3.3%	0.3%	8.8%
Total	2	2	2	3	1	1	13	1	3	6	4	57	10	5	4	1	1	123	13	4	1	1475	900	443	113	19	61.0%	30.0%	7.7%	1.3%	20.3%

RESULTS-STEELHEAD

Sample Size

A total of 641 steelhead were sampled at Bonneville Dam in 2021 of which 623 were PIT tagged (Table 23). After adding previously tagged fish (17) (which were sampled and therefore identified for the tracking study and included in our sample) and all 640 were tracked upstream (Table 23). Based on visual counts, 3.8% of the run passed during Week 32 when the AFF was closed due to high temperatures. An additional 1.7% of the run passed before sampling started and 3.3% passed after sampling stopped for the year.

Table 23. Number of steelhead PIT tagged at Bonneville Dam and tracked past Bonneville by date and statistical week in 2021.

Sampling Dates	Week	Percentage of Run	Sampled	PIT Tagged	Previously Tagged	Previously Tagged by this study	Not Detected After Release	Total Tracked	Days Sampling Restrictions in Effect		
									Reduced Sampling-Temp	Reduced Sampling-Shad or Salmon Abundance	No Sampling Due to Temp
No Sampling	16	1.7	No Sampling until April 20 due to insufficient target salmonids passing Bonneville								
4/20-4/23	17	0.1	3	3	0	0	0	3	0	0	0
4/27-4/30	18	0.1	1	1	0	0	0	1	0	0	0
5/3-5/7	19	0.0		0	0	0	0	0	0	0	0
5/10-5/14	20	0.0	1	1	0	0	0	1	0	0	0
5/17-5/21	21	0.0	1	1	0	0	0	1	0	0	0
5/24-5/28	22	0.1	2	0	2	0	0	2	0	0	0
6/1-6/4	23	0.1	1	1	0	0	0	1	0	0	0
6/7-6/11	24	0.1	5	5	0	0	0	5	0	1	0
6/14-6/18	25	0.2	1	1	0	0	0	1	0	5	0
6/21-6/25	26	0.7	2	2	0	0	0	2	0	5	0
6/28-7/2	27	1.4	5	5	0	0	0	5	0	5	0
7/6-7/9	28	2.8	9	9	0	0	0	9	4	0	1
7/12-7/15	29	4.7	16	16	0	0	0	16	4	0	1
7/19-7/22	30	4.7	38	37	1	0	0	38	4	0	1
7/26	31	4.2	4	4	0	0	0	4	1	0	4
No Sampling	32	3.8	AFF closed due to temperatures >22.2C						0	0	5
8/10	**33**	7.9	19	18	1	0	0	19	1	0	4
8/20	34	4.1	15	14	1	0	0	15	1	0	4
8/24-27	35	12.4	21	19	1	0	0	20	1	3	0
8/30,31,9/1-3	36	12.4	76	74	2	0	0	76	0	5	0
9/7-9/10	37	11.3	86	84	2	0	0	86	0	4	0
9/13-9/17	38	8.2	128	124	4	0	0	128	0	5	0
9/20-9/23	39	7.4	64	63	1	0	0	64	0	4	0
9/27-30,10/1	40	4.3	64	63	1	0	0	64	0	3	0
10/5-10/7	41	2.5	59	59	0	0	0	59	0	0	0
10/11-12	42	1.4	20	19	1	0	0	20	0	0	0
No Sampling	>42	3.3	No Sampling after Oct. 12 due to insufficient target salmonids passing Bonneville								
Total			**641**	**623**	**17**	**0**	**0**	**640**	**16**	**40**	**20**

Distribution of Sample

During weeks 31-34, a period in which visual counts estimate 32.8% of the steelhead run passed Bonneville Dam, we only sampled 59 steelhead which comprised only 9.2% of our total sample (Figure 17). This was due to the trap being closed entirely during Week 32 and only open one day weekly during weeks 31, 33, and 34 due to water temperatures above 22.2C.

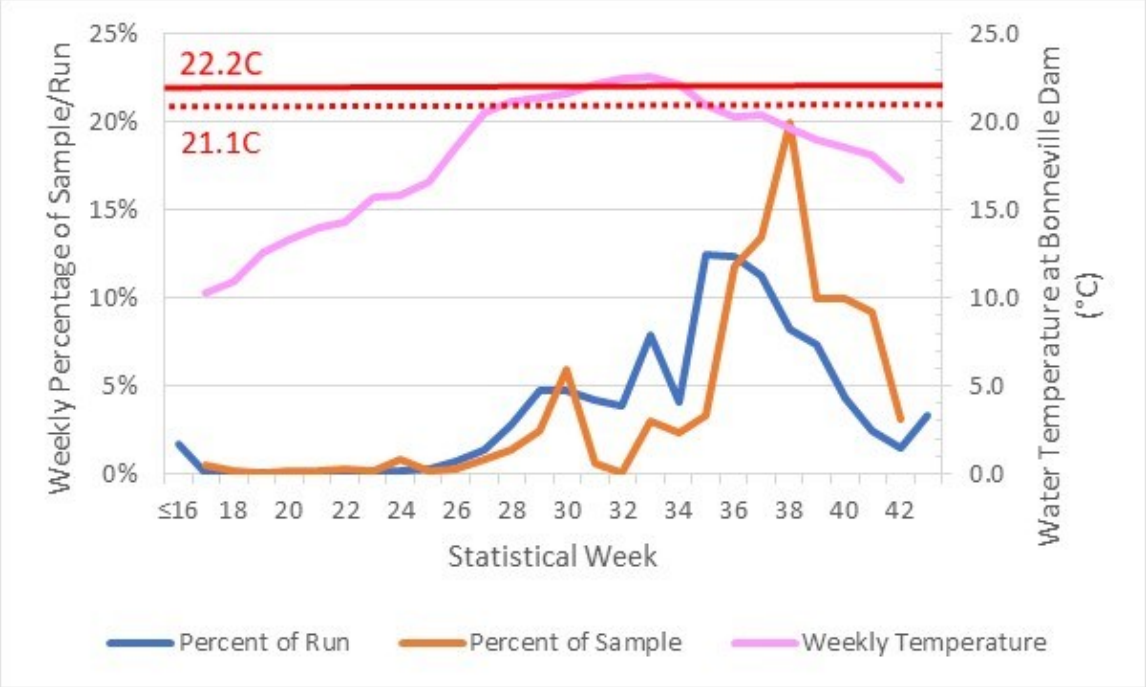


Figure 17. The weekly steelhead sample and run as a percentage of the total sample and run size at Bonneville Dam in 2021. Sampling was reduced at 21.1°C and halted at 22.2°C.

Detection Numbers

The 640 steelhead tracked in 2021 through December 31, 2022, generated 52,722 weir detections and 5,321 site detections at 124 sites. Maps and table of sites (Table C1 and Figures C1, C17-C21) found in Appendix C show the categorical ranges of detection numbers at the sites throughout the Columbia Basin.

Bonneville Dam Steelhead Age Composition

The predominant age for 2021 steelhead was 1.1, comprising an estimated 29.7% of the run (Figure 18, Table 24) while Age 1.2 comprised 23.5% and Age 2.1 was 16.0%. Only 604 steelhead (out of 641 sampled) could be aged due to unreadable scales and scale cards missing for weeks 18 (1 fish), 25 (1 fish), 28 (3 fish), and 36 (19 fish) and three steelhead for which all scales were unreadable. An additional scale card of 10 steelhead from Week 36 was omitted because of

numerous scale ages were not consistent with fork lengths suggesting scales were placed in the wrong location or that this scale card may have been mislabeled.

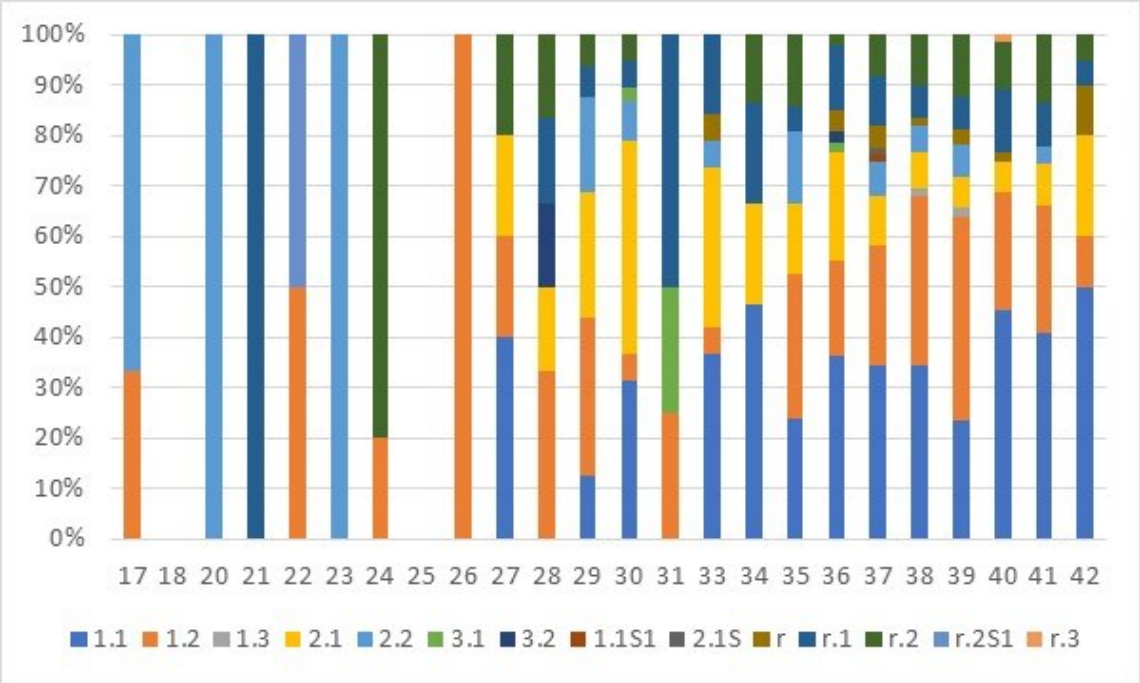


Figure 18. Weekly age composition of steelhead at Bonneville Dam as estimated from scale patterns for age classes in 2021.

Table 24. Weekly and total age composition of steelhead at Bonneville Dam as estimated from scale patterns in 2021. Composite age composition estimates are weighted by the percentage of the run passing Bonneville Dam in each week. (r = unreadable)

Week	Percentage of Run	N	Brood Year and % Age Class											Repeat Spawners
			2019	2018		2017			2016	Freshwater Zone Unageable				
			1.1	1.2	2.1	1.3	2.2	3.1	3.2	r	r.1	r.2	r.3	
17	0.1	3	0.0	33.3	0.0	0.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.1	0												
19	0.0	0												
20	0.0	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
22	0.1	2	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0
23	0.1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.1	5	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.0	0.0	0.0
25	0.2	0												
26	0.7	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1.4	5	40.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
28	2.8	6	0.0	33.3	16.7	0.0	0.0	0.0	16.7	0.0	16.7	16.7	0.0	0.0
29	4.7	16	12.5	31.3	25.0	0.0	18.8	0.0	0.0	0.0	6.3	6.3	0.0	0.0
30	4.7	38	31.6	5.3	42.1	0.0	7.9	2.6	0.0	0.0	5.3	5.3	0.0	0.0
31	4.2	4	0.0	25.0	0.0	0.0	0.0	25.0	0.0	0.0	50.0	0.0	0.0	0.0
32	3.8	AFF closed due to temperatures >22.2C												
33	7.9	19	36.8	5.3	31.6	0.0	5.3	0.0	0.0	5.3	15.8	0.0	0.0	0.0
34	4.1	15	46.7	0.0	20.0	0.0	0.0	0.0	0.0	0.0	20.0	13.3	0.0	0.0
35	12.4	21	23.8	28.6	14.3	0.0	14.3	0.0	0.0	0.0	4.8	14.3	0.0	0.0
36	12.4	47	36.2	19.1	21.3	0.0	0.0	2.1	2.1	4.3	12.8	2.1	0.0	0.0
37	11.3	84	34.5	23.8	9.5	0.0	7.1	0.0	0.0	4.8	9.5	8.3	0.0	2.4
38	8.2	128	34.4	33.6	7.0	1.6	5.5	0.0	0.0	1.6	6.3	10.2	0.0	0.0
39	7.4	64	23.4	40.6	6.3	1.6	6.3	0.0	0.0	3.1	6.3	12.5	0.0	0.0
40	4.3	64	45.3	23.4	6.3	0.0	0.0	0.0	0.0	1.6	12.5	9.4	1.6	0.0
41	2.5	59	40.7	25.4	8.5	0.0	3.4	0.0	0.0	0.0	8.5	13.6	0.0	0.0
42	1.4	20	50.0	10.0	20.0	0.0	0.0	0.0	0.0	10.0	5.0	5.0	0.0	0.0
Total	**95.0**	**604**	**29.7**	**23.5**	**16.0**	**0.3**	**6.0**	**1.6**	**0.8**	**2.3**	**11.3**	**8.2**	**0.1**	**0.3**
SE			**2.1**	**2.1**	**1.8**	**0.1**	**1.2**	**1.0**	**0.5**	**0.6**	**1.7**	**1.3**	**0.1**	**2.1**

Estimated unweighted age composition was similar at all mainstem dams with little difference in age composition for those steelhead bound for the Snake River (above Ice Harbor Dam) and above Priest Rapids Dam (Table 25 and Figure 19). Upstream length-at-age estimates are in Table 26.

Table 25. Unweighted age composition of steelhead at mainstem dams in 2021 for principal age groups (excluding those steelhead with freshwater zones where age could not be determined).

Dam	N ageable	% 1.1	% 1.2	% 2.1	% 1.3	% 2.2	% 3.1	% 3.2	% Repeat Spawners
Bonneville	429	44.5	31.7	15.2	0.5	6.8	0.7	0.5	0.5
The Dalles	420	45.5	32.1	14.0	0.5	6.4	0.7	0.5	0.2
John Day	401	46.1	31.7	14.2	0.2	6.2	0.7	0.5	0.2
McNary	378	48.4	33.1	11.4	0.3	5.8	0.5	0.3	0.3
Priest Rapids	18	44.4	5.6	38.9	0.0	5.6	5.6	0.0	0.0
Rock Island	18	44.4	5.6	38.9	0.0	5.6	5.6	0.0	0.0
Rocky Reach	11	63.6	9.1	18.2	0.0	9.1	0.0	0.0	0.0
Wells	6	66.7	16.7	16.7	0.0	0.0	0.0	0.0	0.0
Ice Harbor	350	49.1	34.9	9.1	0.3	6.0	0.3	0.3	0.0
Lower Monumental	348	48.9	35.1	9.2	0.3	6.0	0.3	0.3	0.0
Little Goose	342	49.7	35.4	8.5	0.3	5.6	0.3	0.3	0.0
Lower Granite	129	46.5	35.7	11.6	0.8	5.4	0.0	0.0	0.0

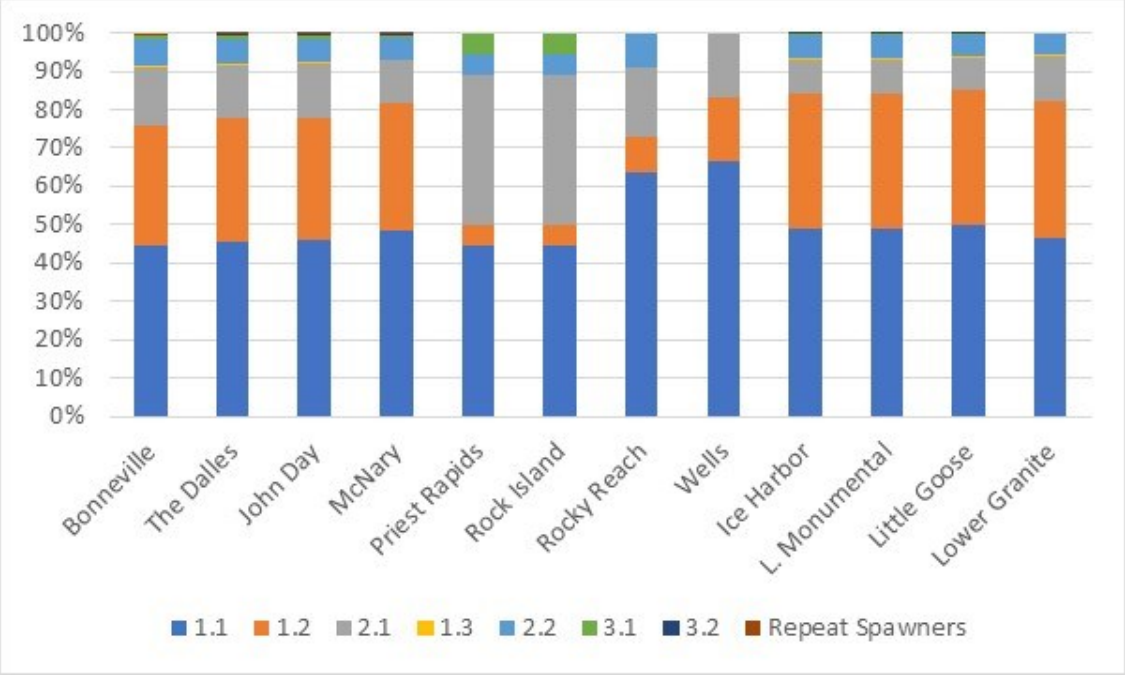


Figure 19. Unweighted age composition of steelhead at mainstem dams in 2021 for principal age groups (excluding those steelhead with freshwater zones where age could not be determined).

Table 26. Steelhead length-at-age composition at mainstem Columbia Basin dams, as estimated by upstream PIT tag detections of steelhead sampled at Bonneville Dam in 2021. (r = unreadable, S=spawning check mark in the scale)

		Age Class										
Dam	**Statistic**	**1.1**	**1.2**	**2.1**	**1.3**	**2.2**	**3.1**	**3.2**	**r**	**r.1**	**r.2**	**r.3**
Bonneville	μ	574	771	564	862	728	557	773	648	579	751	925
	s	39	73	41	38	73	40	74	94	46	87	--
	n	201	152	77	3	33	3	2	14	54	58	1
The Dalles	μ	575	770	565	840	731	557	773	652	578	755	925
	s	39	71	42	7	76	40	74	96	45	84	--
	n	190	131	71	2	27	3	2	13	51	48	1
John Day	μ	576	775	566	835	735	557	773	652	579	753	925
	s	38	68	43	--	77	40	74	96	46	85	--
	n	187	126	67	1	25	3	2	13	47	44	1
McNary	μ	576	773	569	835	736	557	773	654	580	747	925
	s	38	68	43	--	80	40	74	100	47	86	--
	n	183	121	62	1	22	3	2	12	45	40	1
Priest Rapids	μ	582	680	577		635	600			596	603	
	s	35	17	34		--	--			56	67	
	n	9	3	7		1	1			5	2	
Rock Island	μ	587	670	580		635	600			596	603	
	s	31	--	36		--	--			56	67	
	n	7	1	6		1	1			5	2	
Rocky Reach	μ	587	670	586		635	600			578	603	
	s	31	--	44		--	--			43	67	
	n	7	1	4		1	1			4	2	
Wells	μ	587	670	586			600			578	603	
	s	31	--	44			--			43	67	
	n	7	1	4			1			4	2	
Ice Harbor	μ			568						670		
	s			18						--		
	n			2						1		
Lower Monumental	μ	576	775	580	835	749	550	825	662	580	762	925
	s	39	68	38	--	72	--	--	101	47	76	--
	n	172	115	37	1	20	1	1	11	37	36	1
Little Goose	μ	576	775	580	835	749	550	825	662	580	762	925
	s	39	68	38	--	72	--	--	101	47	76	--
	n	172	115	37	1	20	1	1	11	37	36	1
Lower Granite	μ	576	775	581	835	749	550	825	672	582	762	925
	s	39	68	39	--	72	--	--	101	47	76	--
	n	168	115	35	1	20	1	1	10	36	36	1

Mainstem Dam Recoveries, Mortality, and Escapement Estimates

Data on tag detections through December 31, 2022, was downloaded from www.ptagis.org. An estimated 60.2% of the run was last detected at or above Ice Harbor Dam compared to 8.0% at or above Priest Rapids Dam in 2021 (Figure 20).

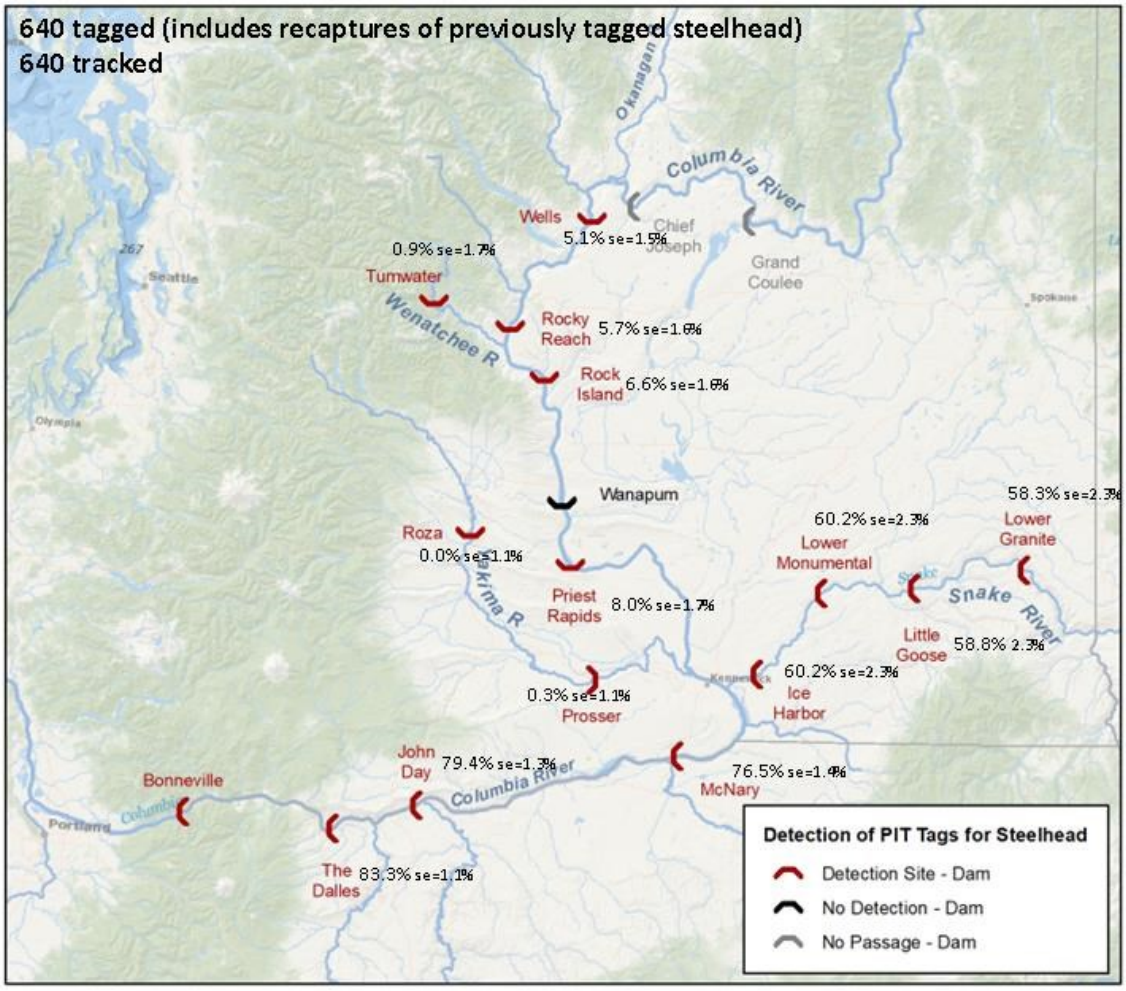


Figure 20. Map of the Columbia River Basin from Bonneville to Wells and Lower Granite dams showing the number of steelhead PIT tagged at Bonneville Dam, and the percentage (with SE) estimated to pass upstream dams in 2021.

Steelhead last detected in the Snake River dominated the run after the early portion of the run (Table 27, Figures 21-22).

Table 27. Most upstream detection by Statistical Week and region for steelhead tracked by this study in 2021.

Statistical Week	% of Run	Sample Size	At main-stem dams between Bonneville- and McNary	Tributaries between Bonneville and McNary Dams	Between McNary and Priest Rapids Dams	Above Priest Rapids Dam	Above Ice Harbor (Snake River)
<=16	1.7						
17	0.1	3	66.7%	33.3%	0.0%	0.0%	0.0%
18	0.1	1	100.0%	0.0%	0.0%	0.0%	0.0%
19	0.0	0					
20	0.0	1	100.0%	0.0%	0.0%	0.0%	0.0%
21	0.0	1	100.0%	0.0%	0.0%	0.0%	0.0%
22	0.1	2	100.0%	0.0%	0.0%	0.0%	0.0%
23	0.1	1	0.0%	100.0%	0.0%	0.0%	0.0%
24	0.1	5	60.0%	0.0%	0.0%	0.0%	40.0%
25	0.2	1	0.0%	0.0%	0.0%	0.0%	100.0%
26	0.7	2	0.0%	0.0%	0.0%	0.0%	100.0%
27	1.4	5	0.0%	20.0%	0.0%	20.0%	60.0%
28	2.8	9	22.2%	0.0%	11.1%	22.2%	44.4%
29	4.7	16	37.5%	18.8%	0.0%	12.5%	31.3%
30	4.7	38	28.9%	10.5%	21.1%	2.6%	36.8%
31	4.2	4	0.0%	0.0%	25.0%	25.0%	50.0%
32	3.8	0					
33	7.9	19	15.8%	5.3%	15.8%	5.3%	57.9%
34	4.1	15	20.0%	0.0%	20.0%	13.3%	46.7%
35	12.4	20	0.0%	0.0%	5.0%	20.0%	75.0%
36	12.4	76	10.5%	3.9%	10.5%	6.6%	68.4%
37	11.3	86	7.0%	0.0%	2.3%	4.7%	86.0%
38	8.2	128	6.3%	2.3%	1.6%	3.1%	86.7%
39	7.4	64	18.8%	0.0%	1.6%	3.1%	76.6%
40	4.3	64	17.2%	4.7%	4.7%	1.6%	71.9%
41	2.5	59	16.9%	5.1%	0.0%	5.1%	72.9%
42	1.4	20	5.0%	5.0%	0.0%	0.0%	90.0%
>=43	3.3						
Weeks 17-18, 20-31,33-42	**91.1%**	**640**	**11.4%**	**3.3%**	**7.1%**	**8.1%**	**61.3%**

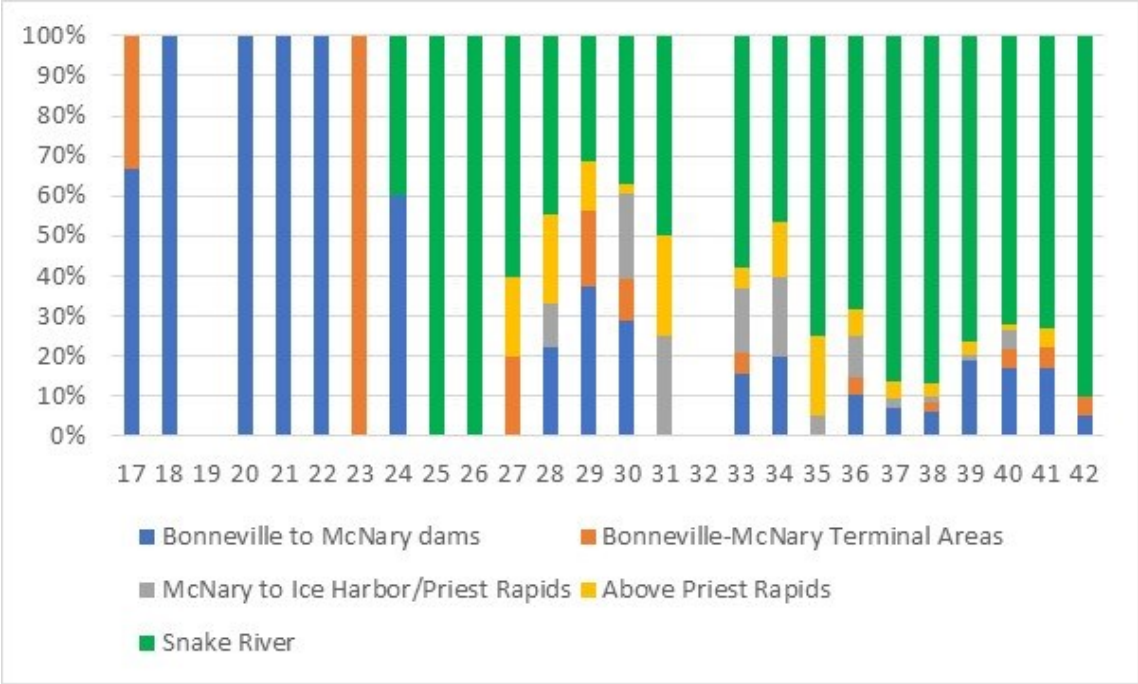


Figure 21. Most upstream detection by Statistical Week and region for steelhead tracked by this study in 2021 as a percentage of the weekly run.

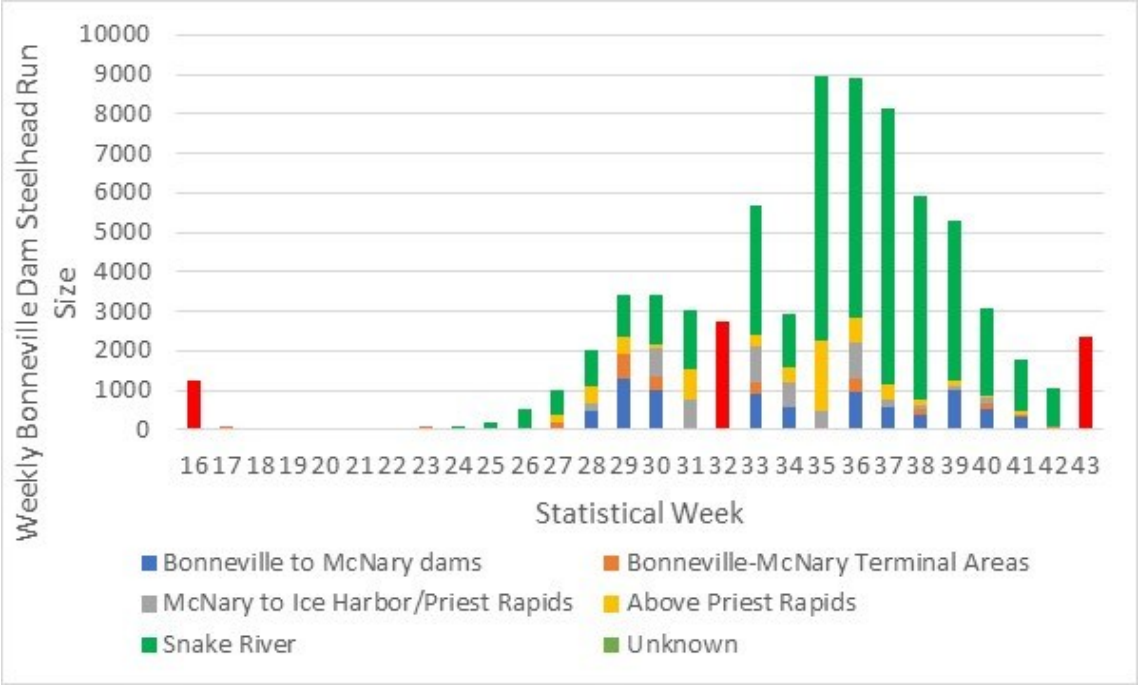


Figure 22. Most upstream detection by Statistical Week and region for steelhead tracked by this study in 2021 as estimated by numbers of fish passing Bonneville Dam by week.

The percentage of PIT-tagged steelhead passing a dam without detection exceeded 1% at John Day (2.0%), McNary (1.4%), Lower Monumental (1.3%), and

Ice Harbor (1.1%) dams while at 5 dams (Bonneville, Priest Rapids, Rock Island, Rocky Reach and Wells dams) no steelhead tagged by this project missed detection (Table 28).

Table 28. Percentages of steelhead passing a dam undetected that were subsequently detected upstream in 2021.

Dam	Percent not Detected
Bonneville	0.0
The Dalles	0.9
John Day	2.0
McNary	1.4
Priest Rapids	0.0
Rock Island	0.0
Rocky Reach	0.0
Wells	0.0
Ice Harbor	1.1
Lower Monumental	1.3
Little Goose	0.7
Lower Granite	0.2
Mean (weighted by number passing each dam)	**0.9**

Migration Rates and Passage Time

The fastest median migration rate between mainstem dams, as measured in kilometers per day, was between John Day and McNary dams (41.8 km/day), while the slowest was 24.1 km/day between Bonneville and John Day dams (Table 29).

Table 29. Steelhead migration rate between Columbia Basin dams as estimated by PIT tag detections in 2021.

Dam Pair	Distance (km)	Median Migration Rate (km/day)
Bonneville-The Dalles	74	27.1
The Dalles-John Day	39	30.9
John Day-McNary	123	41.8
Bonneville-John Day	113	24.1
Bonneville - McNary	231	29.9
McNary - Priest Rapids	167	34.3
Priest Rapids - Rock Island	89	24.4
Rock Island - Rocky Reach	33	31.5
Rocky Reach - Wells	65	31.7
Rock Island - Tumwater	68	10.9
Bonneville – Rock Island	487	29.2
Bonneville - Wells	585	29.5
McNary - Ice Harbor	67	32.5
Ice Harbor - Lower Granite	156	25.9
Bonneville-Lower Granite	461	25.4

Lower Granite, Wells, McNary, Bonneville, and Rock Island dams had the greatest median passage time from first to last PIT tag detection among mainstem Columbia Basin dams (Table 30). Passage times at Wells, Lower Granite, Priest Rapids, and Bonneville dams may be inflated because of fish trapping programs delaying fish passage. At many dams, passage times are very short, which reflects the very short distance between lower-most and upper-most PIT tag antennas.

Table 30. Steelhead median passage times from time of first detection at a dam to time of last detection and the percentage of steelhead taking more than 12 hours between first detection and last detection in 2021.

Dam	Median Passage Time (minutes)	Percentage with more than 12 hours between first detection and last detection at a dam
Bonneville	54.7	4.8
The Dalles	0.1	5.8
John Day	1.1	2.6
McNary	73.7	5.3
Priest Rapids	4.9	3.1
Rock Island	28.7	3.8
Rocky Reach	4.1	4.5
Wells	95.9	9.1
Ice Harbor	3.5	4.2
Lower Monumental	0.2	3.7
Little Goose	0.0	3.0
Lower Granite	153.6	11.2

Fallback

Estimated minimum fallback rates based on steelhead either reascending fish ladders or steelhead subsequently detected downstream for mainstem Columbia Basin dams ranged from 0.0% at Priest Rapids, Rock Island, and Rocky Reach dams to 6.8% at The Dalles Dam in 2021 (Table 31). These rates likely underestimate the true fallback rates as they do not include any fish that ascended a dam, fell back, and then were not subsequently detected. Steelhead migrating downstream through a fish ladder were not considered fallbacks. Steelhead were detected falling back up to nine times over dams (Table 32). Figure showing examples of the movements of a steelhead with eight fallbacks are in Appendix C (Figure C31).

Table 31. Estimated minimum steelhead fallback at mainstem Columbia Basin dams in 2021 as estimated by PIT tag[7] detections.

Dam	Number of Fallbacks	Percent Fallback
Bonneville	5	0.8
The Dalles	39	6.8
John Day	7	1.3
McNary	10	1.9
Priest Rapids	0	0.0
Rock Island	0	0.0
Rocky Reach	0	0.0
Wells	1	4.8
Ice Harbor	13	2.9
Lower Monumental	1	0.2
Little Goose	5	1.1
Lower Granite	16	3.6

Table 32. Frequency of fallback events for steelhead tagged by this project in 2020.

Number of Dams Fallen Back Over	Total Number of Steelhead
1	47
2	11
3	4
4	0
5	1
6	0
7	0
8	0
9	1
Number of steelhead falling back at least once	**64**
Precent of steelhead with at least one fallback event	**10.0**
Total fallback events	**95**
Number of steelhead in study	**640**
Fallback events per steelhead	**0.15**

Night Passage

Night passage (2000-0400 Pacific Standard Time) by tagged steelhead ranged for the mainstem dams from 0.9% at Bonneville Dam to 18.2% at Rocky Reach Dam (Table 33). The Bonneville Dam estimate is likely biased low as sampling generally took place between 0600 and 1400. Given the median Bonneville Dam passage time of 54.7 minutes (Table 30), steelhead tagged by this project would be expected to pass during daytime hours.

[7] Fallback rates do not include steelhead that may have fallen back over a dam and were not subsequently detected.

Table 33. Estimated steelhead night passage (2000-0400 PST) at Columbia Basin dams in 2021.

Site	Percentage Night Passage
Bonneville	0.9
The Dalles	4.7
John Day	4.4
McNary	6.0
Priest Rapids	3.1
Rock Island	11.5
Rocky Reach	18.2
Wells	14.3
Ice Harbor	7.4
Lower Monumental	9.5
Little Goose	8.7
Lower Granite	4.3

B-Run Analyses

A total of 136 B-run steelhead were sampled in 2021 (where B-run is defined as steelhead greater than or equal to 78.0 cm fork length). Among the weeks sampled, the percentage of steelhead sampled and tagged that were classified as B-run peaked in Statistical Week 39 at 39.1% (Figure 23, Table 34). The estimated B-Run escapement at Bonneville Dam (estimated by multiplying the weekly run size, using counting window data, by the percentage B-run in that week estimated by this project) peaked in Week 35 at 2,132 fish while the A-run steelhead peaked in Week 36 at 7,734 fish (Table 34). Among steelhead sampled and detected above McNary Dam and in tributaries between Bonneville and McNary dams (thereby eliminating most of the steelhead that may have been captured in the Zone 6 fishery in the mainstem Columbia between those dams), 95.3% of steelhead with fork lengths 78.0 cm (Table 34) and greater were destined for the Snake Basin, all of which passed Bonneville on or after Week 35 (Figure 24). Among the B-run steelhead sampled at Bonneville Dam where ocean age could be estimated, two-ocean steelhead was comprised of 96.9% of the B-run and 3.1% of three-ocean fish compared to A-run steelhead which were 73.8% one-ocean and 26.2% two-ocean (Table 35).

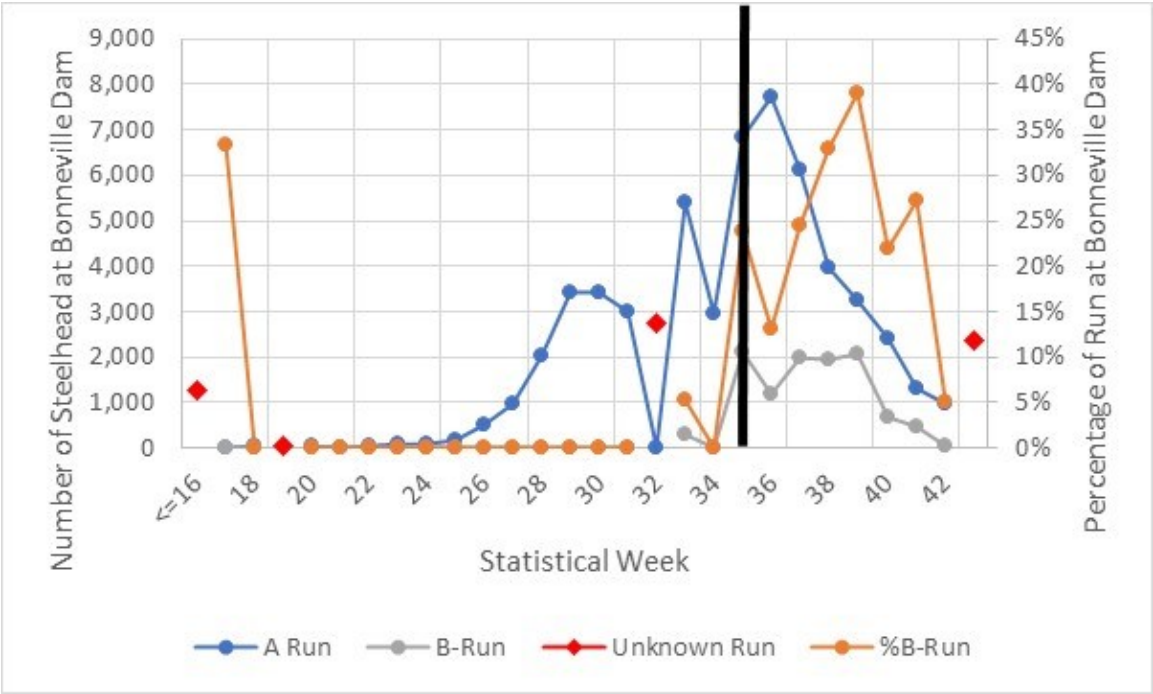


Figure 23. Percentage of B-run steelhead and estimated A- and B-run escapement at Bonneville Dam by statistical week in 2021. The vertical line shows approximately August 25, which is considered the date that separates A- and B-run steelhead. Steelhead are classified as "Unknown Run" if they passed during weeks that no steelhead were sampled (weeks prior to 17, week 32, and after week 42).

Table 34. Percentage and number of A- and B-run steelhead estimated at Bonneville Dam by Statistical Week in 2021.

Week	% of Run	Sample Size	A-Run Samples	B-Run Samples	% A Run	% B Run	% Unknown	# A Run	# B Run	# Unknown	% B-Run (of those in terminal areas) in Snake River
<17	1.7	No Sampling					100.0	0	0	1253	NA
17	0.1	3	2	1	66.7	33.3		27	14	0	0.0
18	0.1	1	1	0	100.0	0.0		46	0	0	0.0
19	0.0	0	0	0			100.0	0	0	29	NA
20	0.0	1	1	0	100.0	0.0		33	0	0	0.0
21	0.0	1	1	0	100.0	0.0		13	0	0	0.0
22	0.1	2	2	0	100.0	0.0		44	0	0	0.0
23	0.1	1	1	0	100.0	0.0		80	0	0	0.0
24	0.1	5	5	0	100.0	0.0		90	0	0	0.0
25	0.2	1	1	0	100.0	0.0		172	0	0	0.0
26	0.7	2	2	0	100.0	0.0		505	0	0	0.0
27	1.4	5	5	0	100.0	0.0		981	0	0	0.0
28	2.8	9	9	0	100.0	0.0		2019	0	0	0.0
29	4.7	16	16	0	100.0	0.0		3412	0	0	0.0
30	4.7	38	38	0	100.0	0.0		3414	0	0	0.0
31	4.2	4	4	**0**	100.0	0.0		3017	0	0	0.0
32	3.8	No Sampling					100.0	0	0	2744	NA
33	7.9	19	18	1	94.7	5.3		5382	299	0	100.0
34	4.1	15	15	0	100.0	0.0		2936	0	0	0.0
35	12.4	21	16	5	76.2	23.8		6821	2132	0	100.0
36	12.4	76	66	10	86.8	13.2		7734	1172	0	100.0
37	11.3	86	65	21	75.6	24.4		6133	1982	0	100.0
38	8.2	128	86	42	67.2	32.8		3963	1936	0	94.3
39	7.4	64	39	25	60.9	39.1		3239	2076	0	100.0
40	4.3	64	50	14	78.1	21.9		2413	676	0	90.0
41	2.5	59	43	16	72.9	27.1		1304	485	0	90.0
42	1.4	20	19	1	95.0	5.0		984	52	0	100.0
>42	3.3	No Sampling					100.0	0	0	2356	NA
Total	**100.0%**	**641**	**505**	**136**	**76.1**	**15.0**	**8.9**	**54763**	**10822**	**6382**	**95.3[8]**

Table 35. Ocean age composition of A- (<78 cm fork length) and B-run (≥78 cm fork length) steelhead sampled at Bonneville Dam in 2021 (weighted by run size).

Run	N	One-Ocean (x.1)	Two-Ocean (x.2)	Three Ocean (x.3)
A-Run	461	73.8%	26.2%	0.0%
B-Run	128	0.0%	96.9%	3.1%
All Steelhead	**589**	**57.7%**	**41.6%**	**0.7%**

[8] Weighted by the estimated weekly B-run abundance.

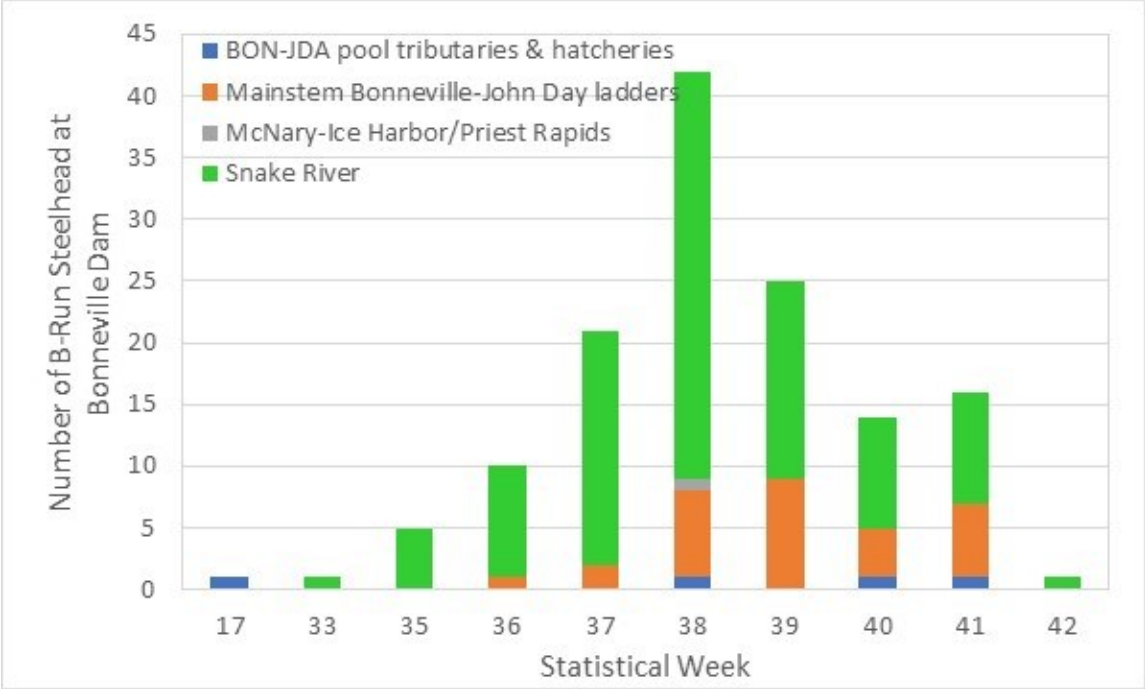


Figure 24. Most upstream detection site for B-run steelhead (≥78 cm fork length) by Statistical Week sampled at Bonneville Dam in 2021.

Kelt Analyses

A total of 70 steelhead PIT tagged in 2021 were detected migrating downstream in the Columbia Basin in late winter, spring, and summer of 2022, presumably attempting to return to the ocean after spawning (kelts), or detected moving back upstream later in 2022 as repeat spawners, or as part of the Kelt Reconditioning Project (Hatch et al. *multiple years*) as spawned-out and moving back downriver or moving back into reaches as reconditioned fish ready to spawn (Tables 36 and C2). For 2021 steelhead we looked for kelt/repeat spawner behavior to December 31, 2022. At the start of this study in 2009, we assigned a cutoff date of March 31st to define kelts so that any steelhead moving downstream before April 1st were assumed to still be wandering the basin and would eventually spawn. However, in the last few years, as more and more PIT detector systems have been placed in the Columbia Basin, we can now track and observe that several steelhead move out of the system before April 1st after visiting the upper reaches of tributaries (assumed to spawn); usually these fish spawn in the tributaries between Bonneville and McNary dams. Therefore, each year we assess and add several more steelhead that have left the system before the cutoff date to the list of kelts, based on the detailed movements of these fish. In 2021, three steelhead were moving downriver after spawning before April 1st (Tables 36 and C3) so identified as kelts for a total of 73 analyzed. The highest percentage of kelt

passing Bonneville for weeks where 10 or more steelhead were sampled was in week 35 at 31.3% (n=16). The greatest number of kelt (n≥10) was also estimated to be in Week 35 at 2,798 steelhead (Figures 25 and 26)[9].

[9] The abundance of kelt in Week 31 was estimated to be 3,017, however only 2 steelhead were sampled in this week, both of which were kelt.

Table 36. Some biological and detection information on the steelhead moving in the Columbia Basin system in 2021 that were determined to be kelts (CRITFC Kelt Project) or repeat spawners and potential kelts (because of their behavior). Please see Appendix C for more details on the detected behavior of the steelhead. (last 3 columns not corrected)

					Most Upstream Site		Last Site Detected		Moving Downstream at Last Detection	Upstream in Summer/ Fall 2022	In Kelt Program
PIT Tag	Date Encountered at AFF	Fin Clip	Age	Fork Length	Basin and Site	Date	Basin and Site	Date			
3DD.003D8294B4	7/7/2021		2.1	525	Columbia (WEA)	8/9/2021	Columbia (RRJ)	4/23/2022	X		
3DD.003D8294B5	7/7/2021		r.2	620	Grande Ronde (MR1)	5/14/2022	Columbia (BCC)	5/31/2022	X		
3DD.003D82957D	6/29/2021		2.1	555	Wenatchee (PES)	5/21/2022	Wenatchee (PES)	5/21/2022	X		
3DD.003D8295E4	6/29/2021		r.2	705	Snake (GRJ)	6/13/2022	Snake (GRJ)	6/13/2022	X		
3DD.003D829821	9/7/2021	AD	1.1	545	Methow (LBC)	6/1/2022	Columbia (RRJ)	6/4/2022	X		
3DD.003D829832	9/7/2021		1.1	550	Snake (GRS)	6/9/2022	Snake (GRS)	6/9/2022	X		
3DD.003D82983A	9/7/2021		2.1	605	Imnaha (IR3)	5/21/2022	Columbia (BCC)	6/5/2022	X		
3DD.003D82984B	9/7/2021		2.1	525	Snake (GRJ)	5/9/2022	Snake (GRJ)	5/9/2022	X		X
3DD.003D829852	9/7/2021		2.1S	700	Yakima (PRO)	11/10/2021	Yakima (PRO)	11/10/2021			X
3DD.003D82986E	8/30/2021	AD	r.1	505	Snake (GRS)	5/26/2022	Snake (GRS)	5/26/2022	X		
3DD.003D829876	8/30/2021		3.1	600	Okanogan(OKL)	11/2/2021	Columbia (RRJ)	4/29/2022	X		
3DD.003D82987B	8/30/2021		2.1	570	Snake (GRA)	9/23/2021	Columbia (B2J)	5/21/2022	X		
3DD.003D82989E	8/27/2021		r.1	570	Columbia (WEA)	9/18/2021	Columbia (RRJ)	5/29/2022	X		
3DD.003D8298A8	8/27/2021		2.2	635	Entiat (ENL)	4/9/2022	Entiat (ENL)	4/9/2022	X		
3DD.003D829B7E	9/9/2021		2.1	585	Methow (MRC)	4/30/2022	Columbia (RRJ)	5/21/2022	X		
3DD.003D829B89	9/9/2021		r.2	775	Clearwater (SC2)	4/14/2022	Clearwater (SC2)	4/14/2022	X		
3DD.003D829B9A	9/8/2021		2.1	580	Tucannon (MTR)	4/9/2022	Tucannon (LTR)	4/10/2022	X		
3DD.003D829BA9	9/8/2021		1.1	565	Salmon (YFK)	4/19/2022	Columbia (BCC)	7/5/2022	X		
3DD.003D829BD5	9/9/2021		r.1	575	Imnaha (IR5)	5/26/2022	Snake (GRJ)	6/2/2022	X		X
3DD.003D829C20	8/31/2021		NA	565	Columbia (MC1)	9/6/2021	Umatilla (TMF)	5/14/2022	X		
3DD.003D829C26	8/31/2021	AD	NA	580	Salmon (RFL)	5/15/2022	Columbia (BCC)	6/1/2022	X		
3DD.003D829C52	9/1/2021		2.1	580	Snake (GRS)	5/7/2022	Columbia (BCC)	5/19/2022	X		
3DD.003D829C57	9/1/2021		3.2	825	Salmon (TAY)	5/26/2022	Snake (GRA)	11/27/2022	X		X
3DD.003D829C64	9/2/2021		r.1	560	Okanogan(OKL)	10/1/2021	Columbia (RRJ)	5/11/2022	X		

PIT Tag	Date Encountered at AFF	Fin Clip	Age	Fork Length	Most Upstream Site		Last Site Detected		Moving Downstream at Last Detection	Upstream in Summer/ Fall 2022	In Kelt Program
					Basin and Site	Date	Basin and Site	Date			
3DD.003D829C88	9/1/2021		2.1	630	Walla Walla (MBD)	3/24/2022	Walla Walla (MDW)	5/3/2022	X		
3DD.003D82A080	9/13/2021		2.1	575	Snake (GRS)	4/17/2022	Snake (GRS)	4/17/2022	X		
3DD.003D82A316	7/12/2021		r.1	670	Wenatchee (ICL)	4/21/2022	Wenatchee (ICL)	4/21/2022	X		
3DD.003D82A36C	7/20/2021		2.1	550	Yakima (PRO)	11/10/2021	Columbia (JO1)	9/21/2022		X	
3DD.003D82A3A5	7/15/2021		2.1	555	Klickitat (KLR)	7/23/2021	Columbia (BCC)	5/22/2022	X		
3DD.003D82A503	7/12/2021		2.2	680	Snake (GRS)	5/6/2022	Columbia (BCC)	5/16/2022	X		
3DD.003D82A69E	7/22/2021	AD	1.2	690	Columbia (MC2)	10/14/2021	Columbia (BCC)	3/11/2022	X		
3DD.003D82A6A4	7/22/2021		2.2	590	Snake (GRS)	4/26/2022	Snake (GRS)	4/26/2022	X		
3DD.003D82A6B4	7/21/2021		2.1	435	Columbia (MC2)	12/2/2021	Columbia (BCC)	5/20/2022	X		
3DD.003D82A6DE	8/24/2021		2.2	795	Salmon (ESS)	5/4/2022	Snake (GRS)	6/14/2022	X		
3DD.003D82A6F4	8/25/2021		2.1	570	Grande Ronde (WR2)	3/25/2022	Snake (GRS)	5/2/2022	X		
3DD.003D82A739	7/26/2021		3.1	520	Columbia (MCJ)	10/7/2021	Umatilla (FDC)	3/29/2022	X		
3DD.003D82A73B	8/10/2021		2.1	545	Columbia (MC1)	10/20/2021	Columbia (BCC)	4/2/2022	X		
3DD.003D82A749	7/22/2021		2.1	570	Imnaha (GCM)	5/30/2022	Snake (GRJ)	6/4/2022	X		X
3DD.003D82A74B	8/24/2021		2.1	560	Columbia (PRA)	9/5/2021	Imnana (IR2)	6/2/2022	X		
3DD.003D82A758	8/20/2021		2.1	540	Columbia (MC2)	10/2/2021	John Day (SJ1)	5/7/2022	X		
3DD.003D82A75C	8/10/2021		2.1	545	Tucannon (UTR)	3/17/2023	Tucannon (UTR)	12/30/2022	X	X	
3DD.003D82A763	8/10/2021	AD	1.1	565	Snake (ICH)	8/27/2021	Columbia (BCC)	6/24/2022	X		
3DD.003D82A76E	8/10/2021		2.1	565	Imnana (IR2)	3/28/2022	Snake (GRS)	5/11/2022	X		
3DD.003D82A77F	8/20/2021		r.1	500	Asotin (ACB)	5/3/2022	Columbia (BCC)	6/2/2022	X		
3DD.003D82A788	7/26/2021	AD	r.1	640	Methow (MRC)	4/4/2022	Methow (MRC)	4/4/2022	X		
3DD.003D82A904	10/4/2021		2.1	610	Methow (TWR)	3/19/2022	Columbia (RRJ)	5/14/2022	X		
3DD.003D82A928	10/12/2021		2.1	650	Clearwater (LC2)	4/8/2022	Columbia (BCC)	5/20/2022	X		
3DD.003D82A96F	10/11/2021		2.1	555	Umatilla (TMF)	5/19/2022	Umatilla (TMF)	5/19/2022	X		
3DD.003D82A977	10/7/2021		r.2	740	Clearwater (SC1)	5/1/2022	Clearwater (SC1)	5/1/2022	X		

PIT Tag	Date Encountered at AFF	Fin Clip	Age	Fork Length	Most Upstream Site		Last Site Detected		Moving Downstream at Last Detection	Upstream in Summer/ Fall 2022	In Kelt Program
					Basin and Site	Date	Basin and Site	Date			
3DD.003D82A978	10/11/2021		2.1	530	Asotin (ACB)	5/5/2022	Asotin (ACM)	5/13/2022	X		
3DD.003D82A981	10/11/2021		2.1	600	Snake (GRA)	10/27/2021	Snake (GOJ)	5/16/2022	X		
3DD.003D82AAE7	9/28/2021		r.1	525	Snake (ICH)	10/10/2021	Tucannon (HST)	5/29/2022	X		
3DD.003D82AAF2	9/28/2021	AD	1.1	655	Clearwater (SC2)	4/26/2022	Snake (GRS)	5/2/2022	X		
3DD.003D82AAF4	9/27/2021	AD	r.1	560	The Dalles (TD1)	9/30/2021	Columbia (BO4)	8/20/2022		X	
3DD.003D82AB30	9/29/2021		2.1	635	Clearwater (LRU)	6/1/2022	Clearwater (LRU)	6/1/2022	X		
3DD.003D82AB3E	9/30/2021	AD	r.2	775	Snake (GRS)	4/9/2022	Snake (GRS)	4/9/2022	X		
3DD.003D82AB52	9/30/2021		2.1	540	Tucannon (BBT)	3/27/2022	Tucannon (HST)	5/16/2022	X		
3DD.003D82AB6A	9/30/2021		r.2	765	Clearwater (SC1)	3/18/2022	Snake (GRS)	4/14/2022	X		
3DD.003D82AB73	10/1/2021		r.1	640	Salmon (TAY)	4/26/2022	Snake (GOJ)	6/20/2022	X		
3DD.003D82AB81	9/21/2021	AD	1.1	555	Salmon (USI)	4/16/2022	Snake (GRS)	5/28/2022	X		
3DD.003D82AB96	9/21/2021		r	805	Clearwater (SC2)	4/11/2022	Snake (GRS)	4/28/2022	X		
3DD.003D82AD2A	9/21/2021	AD	1.1	576	Salmon (USE)	4/25/2022	Salmon (USE)	4/25/2022	X		
3DD.003D82AD56	9/21/2021		2.2	715	Salmon (WB1)	4/9/2022	Snake (GRS)	5/1/2022	X		
3DD.003D82AE8E	9/14/2021	AD	1.1	495	Snake (GRJ)	5/19/2022	Snake (GRJ)	5/19/2022	X		X
3DD.003D82AE91	9/13/2021		2.1	590	Snake (GRS)	6/25/2022	Columbia (BCC)	7/9/2022	X		
3DD.003D82AEA5	9/16/2021	AD	1.2	535	Snake (GRS)	5/19/2022	Snake (GRS)	5/19/2022	X		
3DD.003D82AEBA	9/16/2021		2.1	560	Snake (GRS)	5/7/2022	Snake (GRS)	5/7/2022	X		
3DD.003D82AEEA	9/16/2021	AD	1.1	560	Salmon (USI)	3/26/2022	Snake (GRS)	5/2/2022	X		
3DD.003D82AF28	9/17/2021		2.1	610	Salmon (KRS)	5/2/2022	Snake (GRJ)	6/8/2022	X		X
3DD.003D82AF49	9/17/2021		r.2	830	Clearwater (LC2)	4/27/2022	Clearwater (LC1)	4/28/2022	X		
3DD.003D82AF52	9/20/2021		2.2	670	Salmon (KRS)	6/21/2022	Snake (GRS)	6/27/2022	X		
3DD.003D82AF5F	9/17/2021		2.2	780	Clearwater (LRU)	3/15/2022	Snake (GOJ)	5/9/2022	X		
3DD.0077BCD2A1	10/7/2021		2.1	510	John Day (JDM)	5/22/2022	John Day (JDM)	5/22/2022	X		

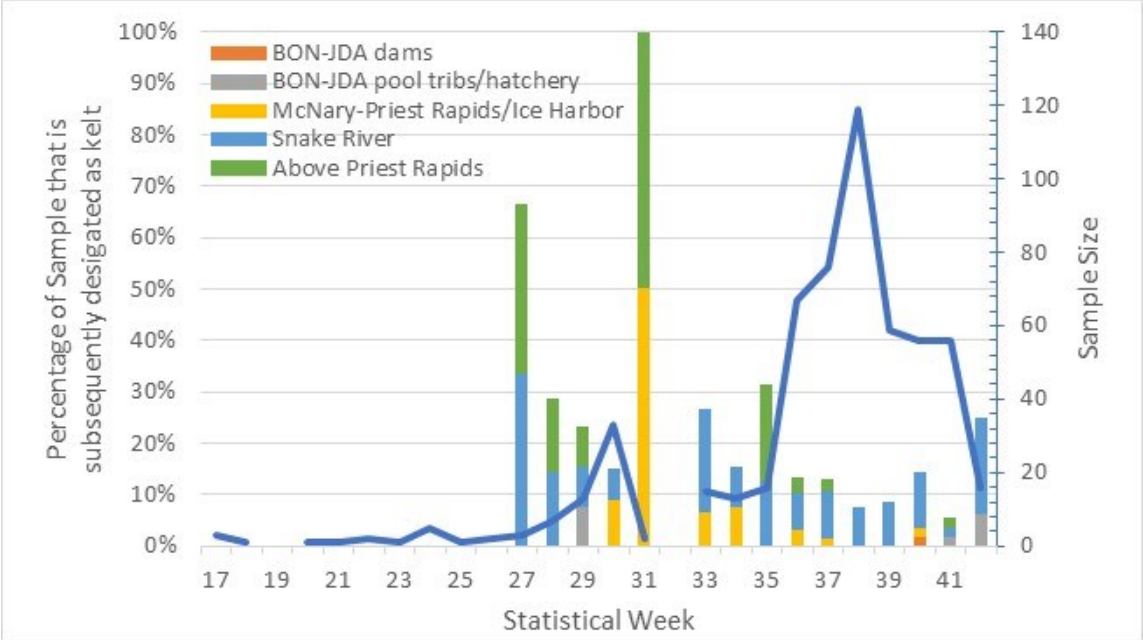


Figure 25. Percentage of run designated as kelt by week sampled in 2021 at Bonneville Dam and the most upstream detection area.

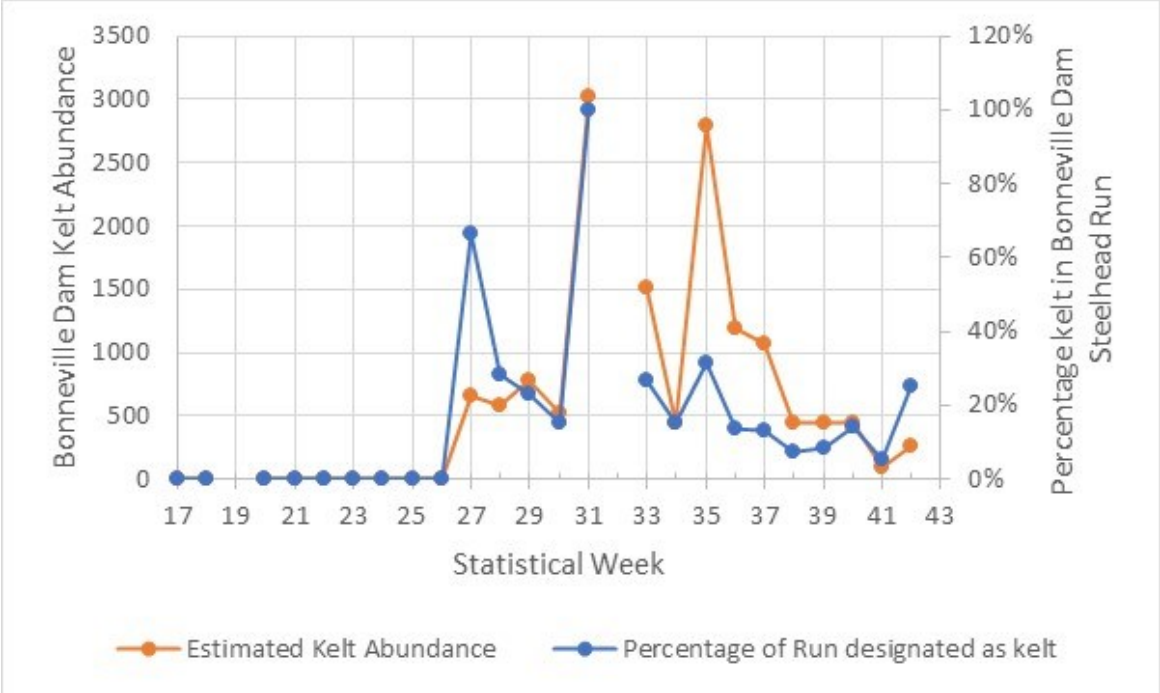


Figure 26. Percentage and number of kelt estimated to be passing Bonneville Dam by Statistical Week as estimated by this project in 2021.

Many kelts that are detected moving out of the system are last detected in the juvenile bypasses of the major Columbia and Snake dams. For 2021 tagged fish, the juvenile bypass at these dams detected kelts: Bonneville (1), Little Goose (3), Lower Granite (6), and Rocky Reach (7) (Table 37 and C2). Another major exit location for kelts is the Bonneville Dam Corner Collector, where 14 steelhead tagged by this study were last detected migrating downstream in spring and summer 2022. In addition, an antennas at a Lower Granite Dam spillway (GRS) detected a total of 17 steelhead assigned as kelts as they were detected at the spillway after April 1, 2022. All 17 of these steelhead had their last detection at GRS. Of the 73 identified kelts, 22 were tracked into the Columbia River tributaries; many had multiple detections in the tributaries as they made their way to the spawning grounds and back out after spawning. This year, 7 steelhead were collected by the CRITFC Kelt Program, with 1 collected at Prosser Dam and the other 6 collected at Lower Granite Dam as they were moving downstream after spawning. Three steelhead tagged and tracked in 2021 behaved like repeat spawners as they were tracked upriver, and in most cases into tributaries, during 2021 and spring of 2022, and then tracked again in either the late summer, fall, or early winter 2022, moving upstream through the Bonneville Dam fish ladders and also detected further upriver.

We have also updated information on kelts/repeat spawners from several past annual reports with data from 2018 through 2020 movements. Some steelhead already identified as kelts or repeat spawners in the past reports have new information added; others are newly added because they were detected a year or two later moving upriver again to spawn. Up to three past years of tagged steelhead have appeared in the detection system; see Table C4 in Appendix C for new information on steelhead tagged in 2018 (three records), 2019 (five records) and 2020 (three records).

Table 37. PIT-tagged steelhead sampled at Bonneville Dam subsequently designated as kelt by being last detected moving downstream the year after sampling or being last detected moving upstream the year after sampling for sampling years 2009-2021. Data is categorized by last detection site.

	Tag Year												
Last site	**2021**	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**
Bonneville Corner Collector	14	33	24	17	14	32	25	38	30	25	10	23	61
Bonneville Juvenile Bypass	1	1	6	2	6	1	5	3	6	5	1	4	7
Bonneville Dam Bradford Island Ladders heading downstream	0	0	1	0	0	0	2	1	3	2	0	0	0
Bonneville Dam ladders heading downstream	0	0	1	1	1	0	0	0	0	0	0	0	0
Estuary Trawl or Pile Dikes (TWX or PD7)	0	1	0	2	1	1	0	0	2	2	0	0	1
Ice Harbor Juvenile Bypass	0	0	1	0	0	2	1	0	0	0	1	6	0
Ice Harbor Ladders heading downstream	0	0	0	0	0	0	0	0	1	0	NA	NA	NA
John Day Juvenile Bypass	0	2	3	3	3	20	6	2	8	6	3	11	3
Little Goose Juvenile Bypass	3	1	5	7	5	11	5	2	9	5	11	13	6
Lower Granite Juvenile Bypass	6	1	5	11	7	5	0	3	4	3	4	10	3
Lower Monumental Juvenile Bypass	0	0	5	5	5	4	0	2	7	1	12	9	4
Lower Granite Dam adult ladders moving downstream	0	0	0	1	0	0	0	0	0	0	0	0	0
Lower Granite Spillway (new in 2019)	17	34	24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington Shore McNary Dam ladder downstream	0	0	0	3	1	3	0	1	0	0	0	2	1
McNary Dam Juvenile Bypass	0	2	1	2	3	4	1	1	4	4	3	2	4
Rocky Reach Juvenile Bypass	7	9	3	9	5	1	2	10	1	0	4	6	7
Migrating downstream in tributaries	22	70	35	22	9	2	6	NA	4	3	0	0	0
Repeat spawners, at Bonneville Dam or above migrating upstream	3	3	3	0	4	4	4	5	12	1	NA	NA	NA
Trapped by CRITFC Kelt Program													
Snake Basin	6	0	3	10	6	7	5	4	11	NA	NA	NA	NA
Yakima Basin	1	7	6	4	0	1	1	6	6	1	NA	NA	NA
Total[10]	**73**	**158**	**121**	**85**	**64**	**98**	**63**	**77**	**108**	**58**	**49**	**86**	**97**
Estimated kelt as percentage of run	**11.4%**	**10.7%**	**14.9%**	**9.5%**	**7.6%**	**6.1%**	**5.3%**	**4.5%**	**7.2%**	**4.0%**	**3.1%**	**5.2%**	**4.8%**
Additional steelhead detected migrating upstream in subsequent migration year not previously reported	**7**	**1**	**2**	**9**	**7**	**0**	**0**	**2**	**5**	**13**	**3**	**9**	**5**
Minimum number of kelts	**80**	**159**	**123**	**94**	**71**	**98**	**63**	**79**	**113**	**71**	**52**	**95**	**102**

[10] Since some kelt were both detected downstream and trapped by the CRITFC Kelt Program, the total may exceed the sum of the detections by site plus the number trapped by the Kelt Program.

Among the 338 steelhead sampled at Bonneville Dam where ocean age could be estimated, when kelt were compared to non-kelt, kelt had a higher percentage of one-ocean fish (75.4% vs. 55.2%) and lower percentage of two ocean fish (24.6% vs. 44.0%) (Table 38). The mean length of non-kelt was 65.8 cm compared to 60.6 cm for kelt.

Table 38. Ocean age composition of steelhead designated as kelt or non-kelt sampled at Bonneville Dam in 2021.

Run	Number Ageable for Ocean Age	One-Ocean (x.1)	Two-Ocean (x.2)	Three-Ocean (x.3)
Kelt	52	75.4%	24.6%	0.0%
Non-Kelt	286	55.2%	44.0%	0.8%

Straying

Steelhead stray rates by stock were estimated with stock classification by two different criteria. The first was for stock that could be designated by PBT, presumably the most accurate genetic stock classification (Table 39). For those fish for which PBT was not available, stock classifications were made using Genetic Stock Identification (GSI) (Table 40). The overall stray rate for PBT-classified steelhead was 14.4% and 20.5% for GSI-classified steelhead.

Table 39. Showing final-PIT-fate categories by stock as determined using PBT for fish tagged in 2021. Fate categories are categorized by color. Grey is neutral (meaning last detected on route to expected destinations), green is on target (meaning last detected at their expected destination), yellow is putative overshoot meaning a fish last detected in an area adjacent to its expected destination, and red is putative stray meaning a fish was last detected in tributaries or the mainstem outside their normal route to their expected destination. Stray rates are also tabulated.

	Bonneville Dam, WA Shore Ladder	Trout Creek, Wind River	Lyle Falls Ladder	Klickitat River	Little Klickitat River Array	Oregon Shore	Washington Shore	Sherar's Falls	Warm Springs River	Warm Springs Hatchery	Pelton Dam Ladder	Oregon Shoreq	Washington Shore	Thirty Mile Creek,John Day	Middle Fork John Day Ritter	SF John Day (Murderer's)	Upper John Day	Three Mile Dam Fishway	Umatilla R Recycled Water Fac	Feed Canal, Umatilla	McNary Oregon Shore Ladder	McNary Washington Shore Ladder	McNary Dam Juvenile	Touchet River-Bolles Bridge	Juvenile Pond Touchet	Mill Creek Dam	Burlingame Dam	Nursery Bridge Adult	Ice Harbor Dam (Combined)	Lower Monumental Adult Ladders	Middle Tucannon River	Upper Tucannon River	Little Goose Fish Ladder	Lower Granite Dam Adult	Lower Granite Dam Juvenile	Lower Granite Dam Spillway	Jacks Creek Clearwater	Dworshak NFH adult trap	Upper Lolo Creek at rkm 25	Lower SF Clearwater R at rkm 1	Lower SF Clearwater R at rkm 2	Lochsa River Upper Site	Upper Selway River Array	Lower SF Clearwater R at rkm 60	Asotin Creek at Cloverland Bridge	Joseph Creek	Wallowa River at rkm 4	Minam River at river km 0.5	Wallowa River at rkm 32	Upper Grande Ronde at rkm 155	White Bird Creek	EFSF Salmon River at Parks Cr.	SF Salmon River at Krassel Cr.	Big Creek at Taylor Ranch	Marsh Cr at Lola Cr Campground	Lower Lemhi River	Upper Salmon River at rkm 437	Upper Salmon River at rkm 460	Yankee Fork Salmon River	Valley Creek, Downstream Site	Redfish Lake Creek	Lower Imnaha River ISA @ km 10	Big Sheep Creek	Upper Imnaha River ISA @ km 41	Grouse Creek Mouth	Imnaha Weir Upstream Array	Prosser Diversion Dam Combined	Priest Rapids Adult	Lower Wenatchee River	Peshastin Creek	Lower Icicle Instream Array	Upper Wenatchee River	Lower Entiat River	Wells Dam, DCPUD Adult Ladders	Wells Dam Hatchery	Wells Dam Juvenile	Libby Creek	Methow River at Carlton	Lwr Twisp Rvr near MSRF Ponds	Chemuch River Middle Lower	Spring Creek Acclimation Pond	Lower Okanogan Instream Array	Loup Loup Creek	Okanagan Channel at VDS-3	Total	Neutral	On Target	Putative Stray	Putative overshoot	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target))
			Klickitat River			The Dalles		Deschutes Basin				John Day		John Day River				Umatilla B.			McNary Dam			Walla Walla Basin							Tucannon			L. Granite Dam			Clearwater Basin									Grande Ronde Basin					Salmon River Basin											Imnaha Basin							Wenatchee Basin									Methow Basin					Okanogan												
Columbia RKM	234	251	290	290	290	308	308	328	328	328	328	347	347	351	351	351	351	465	465	465	470	470	470	509	509	509	509	509	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	539	639	754	754	754	754	778	830	830	830	843	843	843	843	843	858	858	858										
	BO4	TRC	LFF	KLR	LKR	TD1	TD2	DSF	WSR	WSH	PEL	JO1	JO2	30M	MJ2	SJ2	JDM	TMF	UMW	FDC	MC1	MC2	MCJ	BBT	JPT	MBD	BGM	NBA	ICH	LMA	MTR	UTR	GOA	GRA	GRJ	GRS	JA1	DWL	LC2	SC1	SC2	LRU	SW2	SC3	ACB	JOC	WR1	MR1	WR2	UGR	WB1	ESS	KRS	TAY	MAR	LLR	USE	USI	YFK	VC2	RFL	IR2	BSC	IR3	GCM	IR5	PRO	PRA	LWE	PES	ICL	UWE	ENL	WEA	WEH	WEJ	LBC	MRC	TWR	CML	SCP	OKL	LLC	OKC	Color	15	43	3	6					
Dworshak	19	0	0	0	0	0	1	1	0	1	0	8	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	96	0	1	0	27	0	10	16	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	190	128	58	4	0	67.4%	30.5%	2.1%	0.0%	6.5%
Lyons Ferry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	1	7	0.0%	0.0%	12.5%	87.5%	100.0%
MGILCS	1	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	7	6	0	0	53.8%	46.2%	0.0%	0.0%	0.0%
Oxbow	2	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	5	24	1	0	16.7%	80.0%	3.3%	0.0%	4.0%
Pahsimmeroi	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	30	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	7	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	4	53	0	0	7.0%	93.0%	0.0%	0.0%	0.0%
Parkdale-Hood Riv	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	100.0%	0.0%	0.0%	0.0%	
Sawtooth	5	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	11	15	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	55	25	28	2	0	45.5%	50.9%	3.6%	0.0%	6.7%
Skamania	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	1	0	66.7%	0.0%	33.3%	0.0%	100.0%
Upper Salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	100.0%	0.0%	0.0%	0.0%	
Wallowa	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	2	21	0	3	0	0	0	0	0	0	0	0	0	0	3	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	45	32	10	3	0	71.1%	22.2%	6.7%	0.0%	23.1%
Wells	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	1	1	0	0	1	0	1	0	10	6	4	0	0	60.0%	40.0%	0.0%	0.0%	0.0%
Winthrop	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	100.0%	0.0%	0.0%	0.0%	
Total	33	0	1	0	0	5	1	4	0	2	1	10	1	1	0	1	0	0	0	0	2	1	1	0	0	0	0	0	2	2	0	1	3	197	2	7	0	27	0	10	16	0	0	5	0	0	3	0	7	0	0	0	0	0	1	0	24	22	3	0	1	3	0	0	0	0	0	4	0	0	0	0	0	3	0	1	1	1	0	0	1	1	1	1	414	212	183	12	7	51.2%	44.2%	2.9%	1.7%	6.2%

Table 40. Showing final-PIT-fate categories by stock as determined using GSI for fish tagged in 2021. Fate categories are categorized by color. Grey is neutral (meaning last detected on route to expected destinations), green is on target (meaning last detected at their expected destination), yellow is putative overshoot meaning a fish last detected in an area adjacent to its expected destination, and red is putative stray meaning a fish was last detected in tributaries or the mainstem outside their normal route to their expected destination. Stray rates are also tabulated.

Stock Classification using Genetics Stock Identification (GSI)	Upper Washington Shore Ladder	Trout Creek, Wind River	Lyle Falls Ladder	Klickitat River	Little Klickitat River Array	Oregon Shore	Washington Shore	Sherar's Falls	Warm Springs River	Warm Springs Hatchery	Pelton Dam Ladder	Oregon Shoreq	Washington Shore	Thirtymile Crk John Day Basin	Middle Fork John Day Ritter	SF John Day (Murderer's)	Upper John Day	Three Mile Dam Fishway	Umatilla R Recycled Water Fac	Feed Canal, Umatilla	McNary Oregon Shore Ladder	McNary Washington Shore Ladder	McNary Dam Juvenile	Touchet River-Bolles Bridge	Juvenile Pond Touchet	Mill Creek Dam	Burlingame Dam	Nursery Bridge Adult	Ice Harbor Dam (Combined)	Lower Monumental Adult Ladders	Middle Tucannon River	Upper Tucannon River	Little Goose Fish Ladder	Lower Granite Dam Adult	Lower Granite Dam Juvenile	Lower Granite Dam Spillway	Jacks Creek Clearwater	Dworshak NFH adult trap	Upper Lolo Creek at rkm 25	Lower SF Clearwater R at rkm 1	Lower SF Clearwater R at rkm 2	Lochsa River Upper Site	Upper Selway River Array	Lower SF Clearwater R at rkm 60	Asotin Creek at Cloverland Bridge	Joseph Creek	Wallowa River at rkm 4	Minam River at river km 0.5	Wallowa River at rkm 32	Upper Grande Ronde at rkm 155	White Bird Creek	EFSF Salmon River at Parks Cr.	SF Salmon River at Krassel Cr.	Big Creek at Taylor Ranch	Marsh Cr at Lola Cr Campground	Lower Lemhi River	Upper Salmon River at rkm 437	Upper Salmon River at rkm 460	Yankee Fork Salmon River	Valley Creek, Downstream Site	Redfish Lake Creek	Lower Imnaha River ISA @ km 10	Big Sheep Creek	Upper Imnaha River ISA @ km 41	Grouse Creek Mouth	Imnaha Weir Upstream Array	Prosser Diversion Dam Combined	Priest Rapids Adult	Lower Wenatchee River	Peshastin Creek	Lower Icicle Instream Array	Upper Wenatchee River	Lower Entiat River	Wells Dam, DCPUD Adult Ladders	Wells Dam Hatchery	Wells Dam Juvenile	Libby Creek	Methow River at Carlton	Lwr Twisp Rvr near MSRF Ponds	Chemuch River Middle Lower	Spring Creek Acclimation Pond	Lower Okanogan Instream Array	Loup Loup Creek	Okanagan Channel at VDS-3	Total	Neutral	On Target	Putative Stray	Putative overshoot	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target))
			Klickitat Basin			The Dalles		Deschutes Basin				John Day		John Day Basin				Umatilla Basin			McNary Dam			Walla Walla Basin							Tucannon						Clearwater Basin									Grande Ronde Basin					Salmon River Basin											Imnaha Basin							Wenatchee									Methow Basin					Okanogan Basin												
	BO4	TRC	LFF	KLR	LKR	TD1	TD2	DSF	WSR	WSH	PEL	JO1	JO2	30M	MJ2	SJ2	JDM	TMF	UMW	FDC	MC1	MC2	MCJ	BBT	JPT	MBD	BGM	NBA	ICH	LMA	MTR	UTR	GOA	GRA	GRJ	GRS	JA1	DWL	LC2	SC1	SC2	LRU	SW2	SC3	ACB	JOC	WR1	MR1	WR2	UGR	WB1	ESS	KRS	TAY	MAR	LLR	USE	USI	YFK	VC2	RFL	IR2	BSC	IR3	GCM	IR5	PRO	PRA	LWE	PES	ICL	UWE	ENL	WEA	WEH	WEJ	LBC	MRC	TWR	CML	SCP	OKL	LLC	OKC	N	15	43	3	6					
Lower Columbia	6	1																																																																																			7	0	0	1	6	0.0%	0.0%	14.3%	85.7%	100.0%
Skamania	2		1			1																																																																																4	2	1	0	1	50.0%	25.0%	0.0%	25.0%	0.0%
Klickitat				1		1							1																																																																								3	0	1	1	1	0.0%	33.3%	33.3%	33.3%	50.0%
MGICLS	11					3	1	4	1	1	1	3	1		1		1	2	1	1	9	5	2	1	1	1	2	1	4	2	1	1	3	45	1	7		1		2	1				3	1	3	1	6			1					3		1			5		2	2	1		3	1	1				2			1	1	1	1	1	2			165	41	32	47	45	24.8%	19.4%	28.5%	27.3%	59.5%
Yakima	1					1																																																													1																			3	2	1	0	0	66.7%	33.3%	0.0%	0.0%	0.0%
Upper Columiba	1									1																								1																													1								1		1	3		2		1		1		1	1		15	1	0	14	0	6.7%	0.0%	93.3%	0.0%	100.0%
SF Clearwater	22						1	1		1		8				1					1												1	114		2	1	27	3	9	17	2		6													4		1																										222	149	65	8	0	67.1%	29.3%	3.6%	0.0%	11.0%
Upper Clearwater	1																												1													3	2																																												7	2	5	0	0	28.6%	71.4%	0.0%	0.0%	0.0%
SF Salmon												1																						2	1																	1	2																																		7	4	0	3	0	57.1%	0.0%	42.9%	0.0%	100.0%
MF Salmon																																		3		1																		2																																	6	4	2	0	0	66.7%	33.3%	0.0%	0.0%	0.0%
Upper Salmon	9					6						1	1	1							3	3	1						1	2		1		74	2	4						1							3	1	1				1	1	21	23	1	1	1			1			1	2				1												1	170	106	50	13	1	62.4%	29.4%	7.6%	0.6%	20.6%
Total	53	1	1	1	0	12	2	5	1	3	1	13	3	1	1	1	1	2	1	1	13	8	3	1	1	1	2	1	6	4	1	2	4	239	4	14	1	28	3	11	18	6	2	6	3	1	3	1	9	1	1	2	2	2	1	1	28	23	3	1	1	5	1	3	2	1	2	5	1	1	1	1	1	5	0	2	1	2	1	2	1	3	1	1	609	311	157	87	54	51.1%	25.8%	14.3%	8.9%	35.7%

RESULTS-SOCKEYE[11]

Bonneville Sample Size and Upstream Detection

In 2021, a total of 1582 Sockeye Salmon were sampled for this project at Bonneville Dam Adult Fish Facility between June 1 and August 10 (Table 41). A total of 40 fish were excluded from analysis. There was missing data from one group of Sockeye sampled on June 25, 2021, (a missing scale card representing 20 fish preventing aging) so the data were omitted. Also in this group was one Sockeye Salmon that was PIT tagged twice. Another scale card for fish sampled on June 28, 2021, had a series of Sockeye where the age of the fish did not agree with the corresponding fish length and the stock as indicated by the final PIT tag detection site did not agree with the stock assigned by GSI. These have been found to be virtually non-existent in past years and, but when they do occur, they are almost always in pairs suggesting that data, likely genetics samples, have been placed in the wrong location on the Whatman sheet.

After removing the 40 Sockeye with data mix-ups described in the previous paragraph and accounting for Sockeye for which no tag was read (likely due to a bad tag, improper tag placement, or PIT tag reader problems), a total of 1499 Sockeye were tagged by this project. The 5 recaptured Sockeye tagged as juveniles were offset by the 5 mortalities of fish tagged by CRITFC. A total of 24 Sockeye were not detected after tagging, and 72 were last detected at antennas at BO2 and BO3 with a total of 1400 tagged Sockeye detected at the upper most antennas at BO1 or BO4 or upstream of Bonneville Dam. Sampling restrictions were in place for 30 days over the 8 weeks Sockeye were sampled with reduced sampling on 27 days due to high temperatures or shad abundance, and 3 days of no sampling due to high temperatures.

[11] The information presented in this section of the report is a summary of Fryer et al. 2021.

Table 41. Number of Sockeye Salmon sampled, and PIT tagged at Bonneville Dam and tracked upstream by date and statistical week in 2021.

Dates Sockeye Salmon Sampled	Statistical Week[12]	Percent of Run	Sampled (N)[13]	Excluded Due to Bad/Missing Data	Number Tagged	Previously Tagged		Mortalities	Not Detected After Tagging	Last Detected at Bonneville downstream of exit antennas	Detected at or upstream of Bonneville ladder exit antennas	Days Sampling Restrictions in Effect		
						At AFF by this Project	Tagged as Juveniles by Other Agencies					Reduced Sampling-Temperature	Reduced Sampling-Shad and Salmon Abundance	No Sampling -Temperature
6/1-6/4	23	0.1%	12	0	12	0	0	0	0	0	12	0	0	0
6/7-6/11	24	1.8%	62	0	62	0	0	0	0	0	62	0	5	0
6/14-6/18	25	6.5%	159	0	157	0	1	1	1	7	149	0	5	0
6/20-6/25	26	33.2%	423	20	383	0	0	2	5	7	371	0	5	0
6/28-6/30,7/1-7/2	27	31.1%	445	20	405	0	2	0	8	29	366	0	5	0
7/6-7/9	28	17.7%	202	0	202	0	1	2	2	13	186	4	0	1
7/12-7/15	29	6.8%	198	0	198	0	0	0	7	12	179	4	0	1
7/19-22,7/26, 8/10	30[14]	2.7%	81	0	80	0	1	0	1	4	75	4	0	1
Total			**1582**	**40**	**1499**	**0**	**5**	**5**	**24**	**72**	**1400**	**12**	**20**	**3**

Sockeye Salmon were tracked upstream through the Columbia Basin. Maps and table of sites found in the Appendix C (Table C1 and Figures C1, C22-C26) show the sites and the categorical ranges of detection numbers at the sites throughout the basin. The percentage of Sockeye missing detection at each dam was calculated. At Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams it is possible for Sockeye to pass through navigation locks undetected. All other Columbia and Snake River dams with PIT tag detection arrays have antennas in fish ladders that Sockeye Salmon must navigate, though data from 2006-2022 indicate that, even at those dams without navigation locks, PIT-tagged Sockeye Salmon can and do avoid detection as they migrate upstream (Table 42).

[12] Statistical weeks are sequentially numbered calendar-year weeks. Excepting the first and last week of most years, statistical weeks are seven days long beginning on Sunday and ending on Saturday. In 2021, for instance, statistical week 23 began on May 30 and ended on June 5.

[13] Data problems resulted in the removal of data from a scale card (20 Sockeye) from analysis on both June 25 and June 28. The June 25 scale card was missing while the June 28 scale card had numerous mismatches between age and length in addition to genetics classification and final PIT tag destination.

[14] One Sockeye was sampled on July 26 (Week 31) and one on August 10 (Week 33); these fish were pooled with Week 30.

Based on Sockeye Salmon PIT tagged at Bonneville Dam by this study, the mainstem dam with the highest percentage passing upstream undetected in 2021 was John Day Dam (2.8%, Table 42).

Table 42. Percentage of Bonneville Dam PIT-tagged Sockeye Salmon not detected at upstream dams and in-stream PIT tag arrays on their migration route for 2006-2021.

		Percentage Not Detected by Dam and Year																
Dam/Array	**Type**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
Bonneville (BO1 & BO4)	A	0.2	2.1	0.4	0.6	0.7	0.5	1.8	0.4	0.7	1.6	2.8	0.2	1.1	1.5	1.0	1.8	1.1
The Dalles	A	--	--	--	--	--	--	--	1.6	0.3	0.6	0.4	2.1	0.9	0.5	1.4	0.8	1.0
John Day	A	--	--	--	--	--	--	--	--	--	--	--	--	2.8	3.3	4.5	2.8	3.4
McNary	A	3.1	6.5	10.1	5.0	3.8	1.6	12.1	2.1	3.8	1.1	2.4	5.2	2.9	2.9	2.9	1.6	4.2
Priest Rapids	B	0.0	0.8	0.3	0.3	0.6	0.2	0.4	0.0	0.2	0.4	0.3	0.0	0.1	0.0	0.0	0.0	0.2
Rock Island	B	1.3	6.8	6.9	2.6	6.2	4.4	5.4	4.4	41.5	10.2	2.9	5.9	28.3	4.1	2.8	0.1	8.4
Rocky Reach	B	12.3	0.7	0.2	0	0.5	0.7	1.4	0.0	0.3	0.0	0.0	0.7	0.2	0.0	0.0	0.0	1.1
Wells	B	--	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ice Harbor	A	--	--	0.0	20.0	0.0	--	0.0	--	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7
Lower Monumental	A	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0
Little Goose	A	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0
Lower Granite	A	--	--	--	--	--	--	--	--	0.0	--	0.0	0.0	0.0	0.0	--	0.0	0.0
Tumwater	B	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.0	0.1
Zosel (ZSL)	C	--	--	--	--	--	98.6	83.0	87.3	0.9	0.0	1.6	74.5	57.5	0.0	76.2	0.0	43.6
Lower Wenatchee (LWE)	D	--	--	--	--	--	--	--	--	48.0	17.9	54.7	49.6	68.4	33.3	78.4	32.6	47.9
Upper Wenatchee (UWE)	D	--	--	--	--	--	--	--	--	52.7	24.6	9.7	9.3	9.9	3.2	11.3	49.4	21.3
Lower Okanagan (OKL)	D	--	--	--	--	--	--	--	--	68.9	13.8	59.4	47.4	50.1	66.7	40.4	83.7	53.8
Okanagan Channel (OKC)	D	--	--	--	--	--	--	--	--	--	--	16.9	--	7.7	5.3	5.7	0.0	7.1
Skaha (SKA)	C	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0	41.5	0.0	13.8

Detection Type

A	**Antennas in fish ladders at a dam with navigation locks providing upstream migrating PIT-tagged fish a means to pass undetected**
B	**Antennas in fish ladders at a dam with no passage route for upstream migrating PIT-tagged fish other than through ladder PIT tag antennas**
C	**Antennas in fish ladders at a dam where, at high flows, upstream migrating PIT-tagged fish can pass through unmonitored spillways**
D	**In-stream antennas where PIT-tagged salmonids can pass undetected. In general, the higher the flow, the lower the detection rate.**

Age Composition

The predominant age group was Age 1.2 comprising 57.4% of the run with Age 1.1 group comprising 27.3% of the run and the Age 1.3 group 13.7% (Table 43). The age composition of female Sockeye Salmon in 2021 was 73.3% Age 1.2 and 12.0% Age 1.1 in 2021 compared to 45.6% Age 1.2 and 38.6% Age 1.1 for males (Table 43). The difference in the percentage of Age 1.1 and 1.2 Sockeye by sex was significant (α=0.10).

Table 43. Weekly and total age composition of Sockeye Salmon at Bonneville Dam as estimated from scale patterns in 2021. (Composite estimates are weighted by the percentage of the run passing Bonneville Dam in each week.)

Statistical Week	% of Run	% Females	N Ageable	% Age Class				
				1.1	1.2	2.1	1.3	2.2
23	0.1	25.0	12	8.3	91.7	0.0	0.0	0.0
24	1.8	46.7	60	16.7	80.0	1.7	1.7	0.0
25	6.5	32.5	155	37.7	56.5	0.6	3.9	1.3
26	33.2	37.9	373	23.6	66.2	0.5	9.7	0.0
27	31.1	47.1	395	28.6	56.2	0.8	13.9	0.5
28	17.7	41.9	198	27.3	47.5	1.0	22.7	1.5
29	6.8	47.1	194	27.8	48.5	3.1	18.6	2.1
30-33	2.7	48.0	77	39.0	35.1	2.6	23.4	0.0
Composite	**100.0%**	**42.1%**	**1463**	**27.3%**	**57.4%**	**0.9%**	**13.7%**	**0.7%**
Standard Error		**1.3%**		**1.2%**	**1.3%**	**0.3%**	**0.3%**	**0.2%**
F statistic for linear regression between age and stat. week				**5.81**	**41.49**	**6.511**	**76.1**	**1.15**
P value				**0.053**	**<0.001**	**0.043**	**<0.001**	**0.325**
Females			**616**	**12.0%**	**73.3%**	**1.2%**	**12.8%**	**0.6%**
Standard Error				**1.4%**	**1.9%**	**0.4%**	**1.4%**	**0.3%**
Males			**837**	**38.6%**	**45.6%**	**0.8%**	**14.4%**	**0.6%**
Standard Error				**1.8%**	**1.8%**	**0.3%**	**1.3%**	**0.3%**
T-test p value for males vs females by age				**<0.01**	**<0.01**	**0.54**	**0.54**	**0.56**

There was a significant linear relationship (α=0.05) between statistical week and the weekly percentage of Age 1.2, 2.1, and 1.3 (Table 43, Figure 27) for fish tagged in 2021.

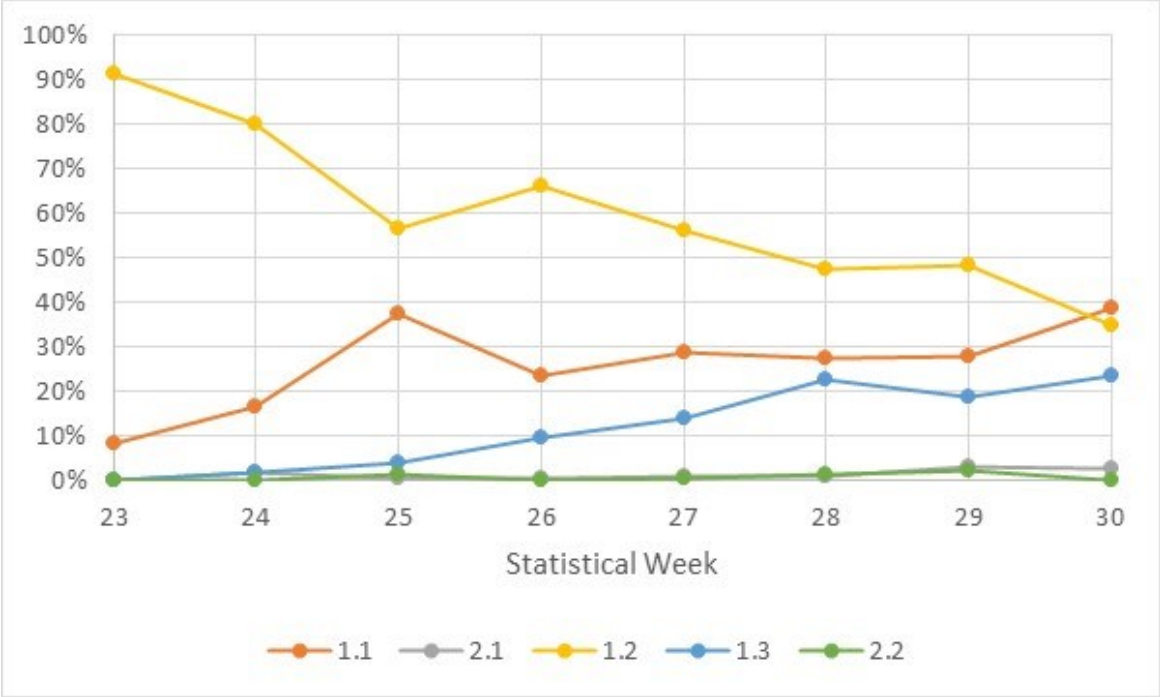


Figure 27. Weekly age composition estimates by statistical week for Sockeye Salmon sampled at Bonneville Dam in 2021.

The percentage of the run that was females showed a significant increase as the run progressed in 2021 (p=0.04) (Table 43, Figure 28).

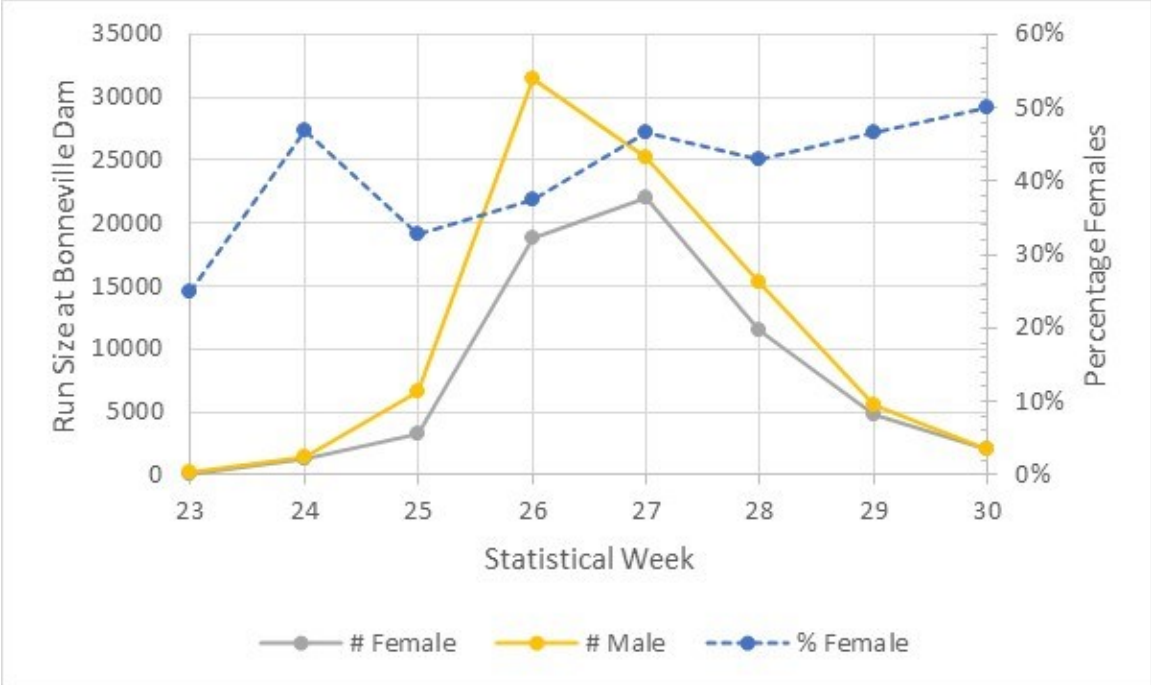


Figure 28. Weekly percentage and total number of females at Bonneville Dam estimated by this study for 2021.

Upstream Recoveries, Mortality, and Escapement

The percentage of Sockeye Salmon passing Bonneville Dam that were estimated to pass upstream sites (Figure 29) was lower in 2021 than the 2006-2021 mean at all sites (Table 44)[15].

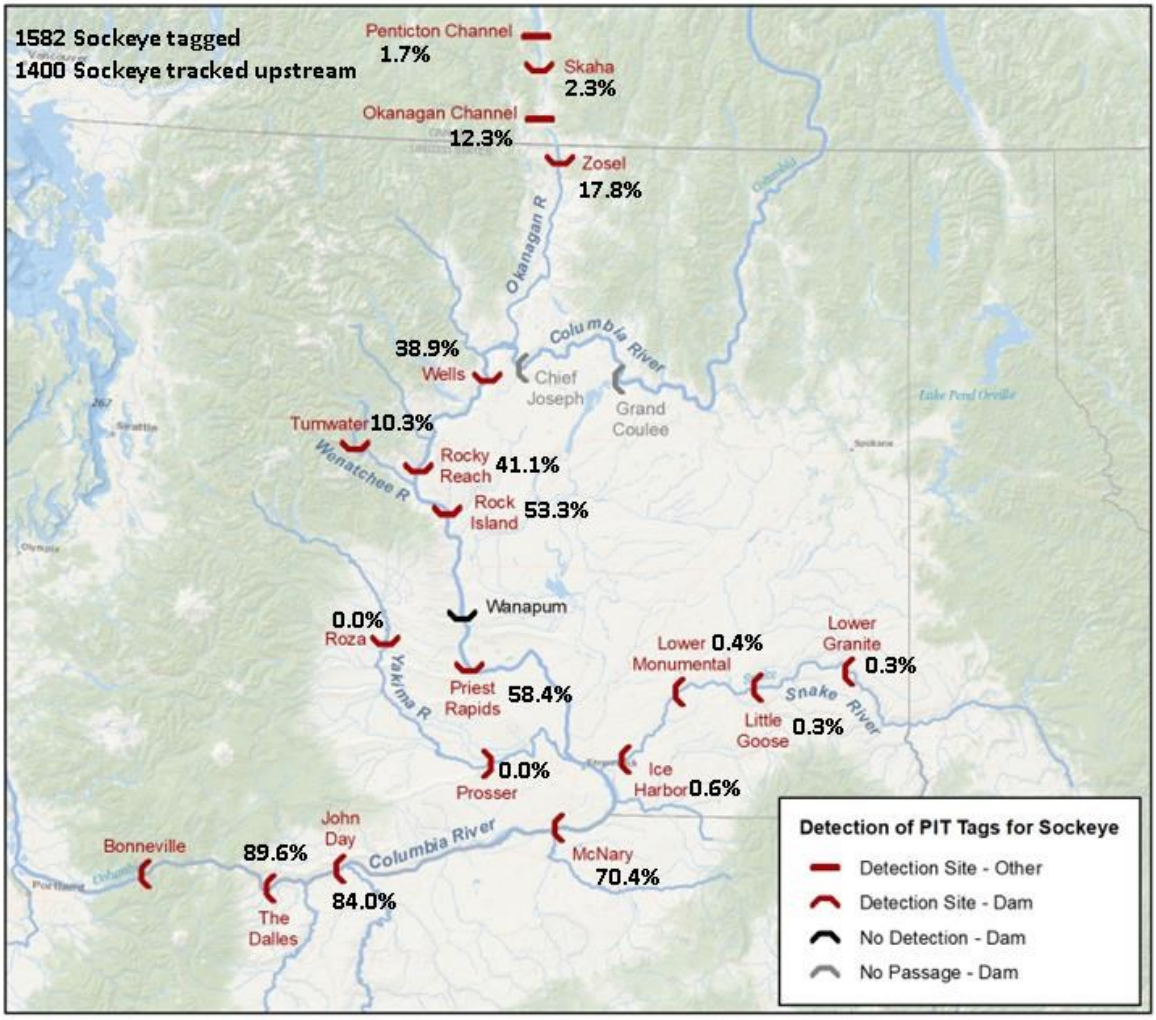


Figure 29. Map of the Columbia River Basin showing the number of Sockeye PIT tagged at Bonneville Dam, and the percentage of the run estimated to pass upstream dams in 2021.

[15] Tumwater Dam is only passed by Wenatchee stock Sockeye Salmon so differences to Tumwater Dam (as well as Rocky Reach and Wells dams) also reflect annual variations in stock composition.

Table 44. Estimated percentage of Sockeye Salmon PIT tagged at Bonneville Dam passing upstream dams and OKC in years 2006-2021.

	Percentage by Year																
Dam or Site	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
The Dalles	--	--	--	--	--	--	--	89.5	93.1	82.8	94.0	89.3	93.3	94.6	95.0	89.6	91.5
John Day	--	--	--	--	--	--	--	--	--	--	--	--	90.9	92.7	92.1	84.0	91.9
McNary	88.4	84.0	89.4	85.7	81.5	76.1	82.4	83.6	88.3	54.0	89.2	81.7	88.9	84.2	90.4	70.4	83.2
Priest Rapids	84.8	77.4	86.3	82.1	78.4	71.9	77.3	78.6	84.5	44.9	85.3	74.6	85.4	82.4	84.9	58.4	78.6
Rock Island	81.1	73.4	85.8	80.2	76.3	68.9	75.0	74.2	79.5	40.6	81.6	70.8	80.7	81.6	77.3	53.3	75.1
Rocky Reach	58.8	62.2	73.7	67.1	63.7	55.3	62.1	52.4	65.3	31.6	60.5	43.7	73.9	73.4	65.0	41.1	60.6
Wells	53.8	60.9	71.1	65.2	62.6	53.9	60.8	50.5	64.2	29.4	59.3	42.5	72.7	72.4	63.7	38.9	58.9
Tumwater	--	--	9.4	12.2	13.3	14.2	12.9	20.9	13.6	8.3	20.8	25.8	6.0	8.7	11.2	10.3	13.6
Okanagan Channel (OKC)	--	--	--	--	32.5	40.2	25.9	30.7	22.5	2.2	38.1	25.1	45.7	44.6	33.5	12.3	31.0

The estimated escapement based on upstream PIT tag detections of the Bonneville-tagged Sockeye Salmon in 2021 was greater than the number of Sockeye Salmon counted at The Dalles, John Day, and Priest Rapids dams but less at all other dams with visual counts (Table 45, Figure 30). The PIT tag estimates show a consistent decrease in Sockeye Salmon escapement estimates as the run progresses upstream which is to be expected as fisheries and other sources of mortality take their toll. However, the visual dam counts show an irregular pattern of increases and decreases as the Sockeye Salmon run progresses upstream. There were more Sockeye Salmon counted at Rock Island Dam (109,367) than at Priest Rapids Dam downstream (76,855) and the sum of the Rocky Reach plus Tumwater counts (113,469) exceeded that of Rock Island Dam (109,367).

Table 45. Estimated Sockeye Salmon escapement using both PIT tag and visual means, and the difference between the PIT tag and visual escapement estimate at Columbia Basin dams in 2021.

Dam	Visual Dam Count	Escapement Estimate Using Bonneville PIT-Tagged Sockeye Salmon	Difference Between Bonneville PIT Tag and Visual Estimates
Bonneville	151,765	--	--
The Dalles	128,223	135,972	6.0%
John Day	126,708	127,445	0.6%
McNary	111,756	106,808	-4.4%
Priest Rapids	76,855	88,658	15.4%
Rock Island	109,367	80,909	-26.0%
Rocky Reach	82,643	62,412	-24.5%
Wells	76,255	59,028	-22.6%
Tumwater	30,826	15,654	-49.2%
Ice Harbor	954	946	-0.9%
L. Monumental	953	543	-43.0%
Little Goose	713	408	-42.8%
Lower Granite	645	408	-36.8%
Prosser	134	0	-100.0%
Roza	95	0	-100.0%

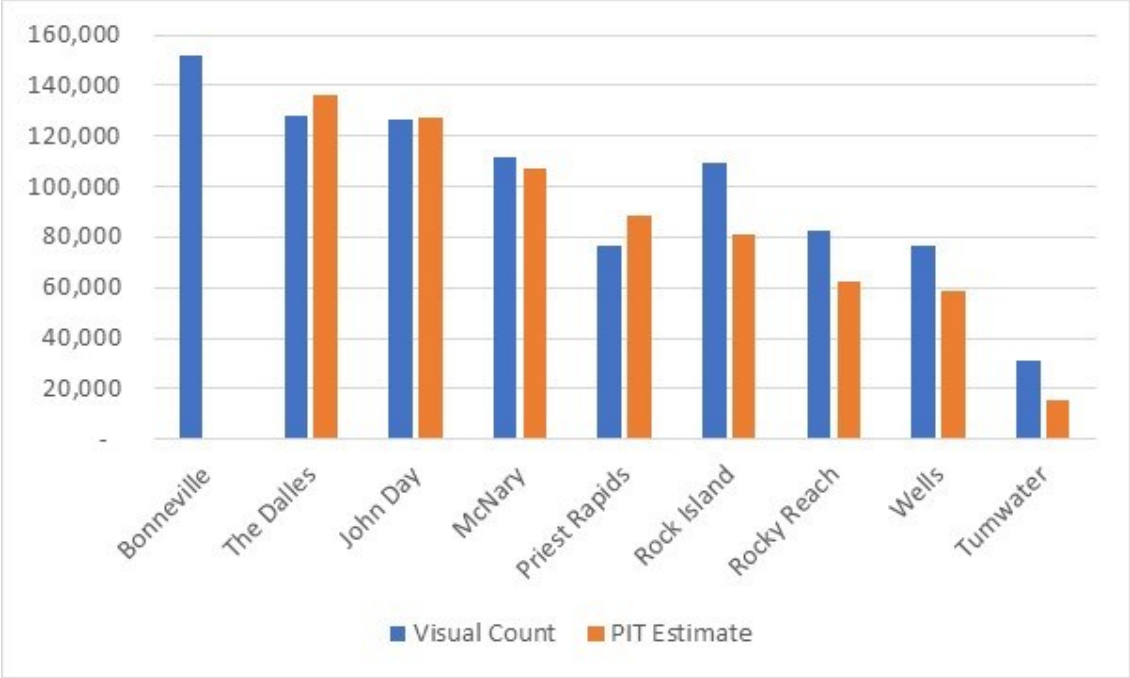


Figure 30. Estimated PIT tag and visual count estimates of escapement at Columbia River dams and Tumwater Dam in 2021.

There was a significant decrease in survival to upstream dams over the period of the run in 2021 (Table 46, Figure 31).

Table 46. Sockeye Salmon survival through selected reaches by statistical week as estimated by PIT tag detections in 2021 and the p-value for a linear regression between weekly reach survival and statistical week.

Statistical Week at Bonneville Dam	Survival from Bonneville for Sockeye Salmon Tagged as Adults at Bonneville Dam				
	The Dalles	John Day	McNary	Priest Rapids	Rock Island
23	100.0%	91.7%	83.3%	83.3%	83.3%
24	98.4%	98.4%	93.5%	87.1%	87.1%
25	96.6%	96.0%	91.9%	87.2%	86.6%
26	94.3%	92.2%	87.9%	80.3%	76.0%
27	89.3%	85.2%	73.0%	58.7%	50.0%
28	87.1%	73.7%	43.5%	23.7%	19.4%
29	74.9%	62.6%	35.2%	22.9%	21.8%
30-33	64.0%	50.7%	21.3%	12.0%	9.3%
Composite[16]	**89.6%**	**84.0%**	**70.4%**	**58.4%**	**53.3%**
p-value	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**

[16] Composite estimates for Bonneville Dam Sockeye Salmon tagged as adults are weighted by statistical week, juvenile estimates are unweighted.

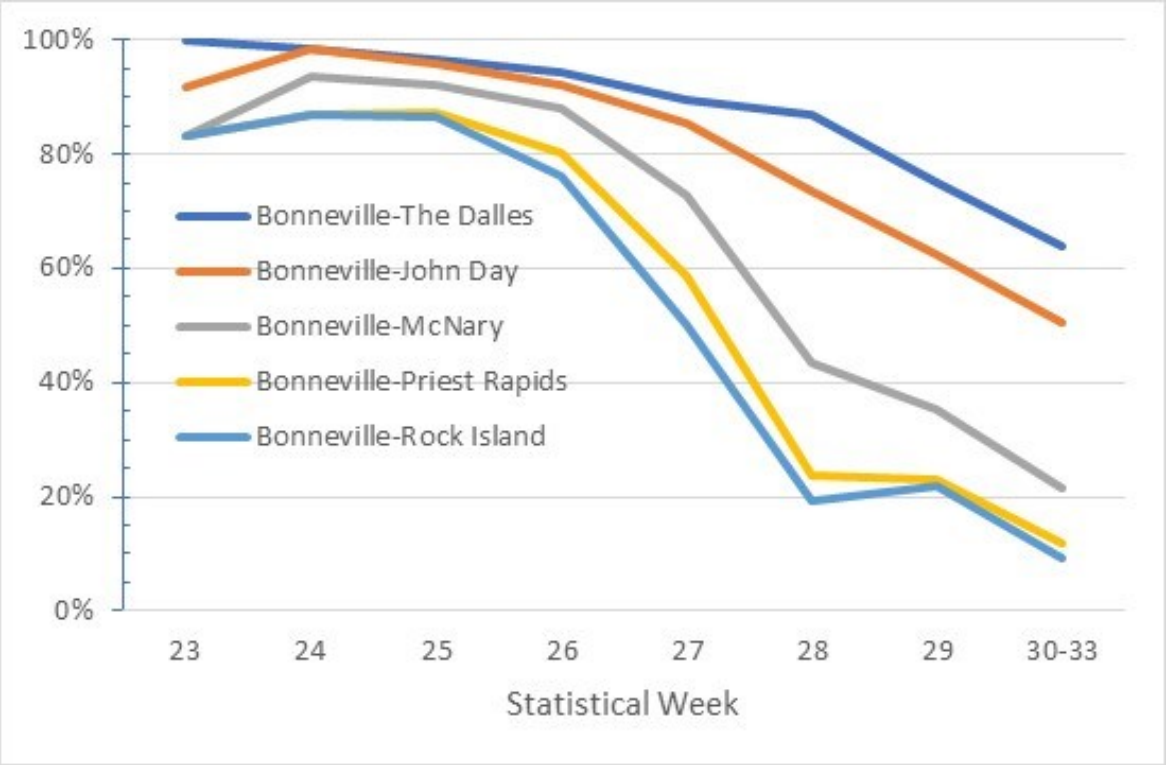


Figure 31. Survival of Sockeye Salmon PIT tagged at Bonneville Dam to The Dalles, John Day, McNary, Priest Rapids, and Rock Island dams by statistical week in 2021.

Migration Rates and Passage Time

Adult Sockeye Salmon traveled quickly upstream in 2021 with median migration rates between adjacent mainstem dams (which does not include Tumwater Dam) ranging between 29.7 and 48.8 km/day (Table 47).

Table 47. Median Sockeye Salmon migration rates and travel time between dams as estimated by PIT tag detections in 2021.

Dam Pair	Distance (km)	Median Travel Time (days)	Median Migration Rate (km/day)
Bonneville-The Dalles	74	1.6	46.3
The Dalles-John Day	39	0.8	48.8
John Day-McNary	63	2.1	30.0
McNary-Priest Rapids	167	4.0	41.8
Priest Rapids-Rock Island	89	3.0	29.7
Rock Island-Rocky Reach	33	1.1	30.0
Rocky Reach-Wells	65	1.9	34.2
Rock Island-Tumwater	73	10.0	7.3
Bonneville-John Day	113	2.4	47.1
Bonneville-McNary	231	4.7	49.1
Bonneville-Priest Rapids	329	8.8	37.4
Bonneville-Rock Island	487	12.0	40.6
Bonneville-Tumwater	560	22.8	24.6
Bonneville-Wells	585	15.0	39.0

Unlike most previous years, there was not a significant linear relationship (α=0.05) between the statistical week passing Bonneville Dam and travel time to upstream Columbia River dams (Table 48). The only significant relationship in Table 48 is from Bonneville and Wells dams to Zosel Dam. Median travel times between the Okanagan and Wenatchee stocks differed by 1.3 days or less for all dam pairs listed that are in the normal migration corridor for both stock while differences between males and females differed by 1.0 days or less. The nine Wenatchee-stock Sockeye Salmon which were detected at Wells Dam had longer migration times from Bonneville Dam to Rocky Reach and Wells dams than did Okanagan Sockeye Salmon on their usual migration route.

Table 48. Adult Sockeye Salmon tagged at Bonneville Dam median travel time in days between dam pairs by statistical week, the p-value for a linear regression between travel time and statistical week, and mean travel time by stock as estimated using PIT tags in 2021. Cells with yellow shading indicate travel outside the normal migration corridor for the stock in question. NA indicates no data between the two sites in question.

Statistical Week at Bonneville Dam	BON to TDA	BON to JDA	BON to MCN	BON to PRA	BON to RIA	BON to TUF	BON to RRF	BON to WEA	BON to ZSL	WEL to ZSL	RIA to TUF
23	1.7	2.9	4.7	11.9	16.5	NA	18.0	20.3	NA	NA	NA
24	1.8	2.7	4.8	10.8	14.8	NA	16.0	18.7	64.6	46.6	NA
25	1.7	2.6	4.8	9.6	12.9	24.8	14.1	15.9	58.4	42.9	10.6
26	1.5	2.3	4.7	8.6	11.6	21.3	12.5	14.4	52.0	37.8	8.9
27	1.5	2.2	4.7	8.0	11.2	23.1	12.1	14.0	45.4	31.5	10.6
28	1.4	2.2	4.4	8.9	12.0	20.9	12.6	14.6	37.5	22.5	8.1
29	1.7	2.6	4.8	9.0	13.0	25.5	12.9	15.2	31.0	16.6	12.1
30	1.9	3.0	6.0	31.4	34.9	49.6	13.0	14.6	21.4	9.3	14.7
p-value	**0.38**	**0.55**	**0.10**	**0.22**	**0.27**	**0.12**	**0.16**	**0.11**	**<0.01**	**<0.01**	**0.73**
Stock											
Okanagan	1.6	2.4	4.7	8.7	11.8	NA	12.9	15.0	50.7	36.2	NA
Wenatchee	1.6	2.3	4.8	9.1	13.1	22.8	15.4	17.8	NA	NA	10.0
Males	1.4	2.3	4.7	8.7	11.8	22.0	12.8	14.9	51.1	36.5	9.9
Females	1.7	2.6	4.8	8.9	12.2	23.0	13.1	15.1	50.1	35.6	10.3

The median passage time at a dam for Sockeye Salmon tagged at Bonneville Dam in 2021 was 19.5 minutes (Table 49). Dams with the greatest times were those with more comprehensive networks of detection within ladders (e.g., Bonneville, McNary, Rock Island, and Lower Granite) or trapping activities which can slow migration (e.g., Bonneville, Priest Rapids, Tumwater, and Lower Granite). The one exception is the 578 minute median migration time for Sockeye tagged at Bonneville Dam passing Lower Monumental Dam due to two of four passing Sockeye falling back over this dam thus generating long passage times as estimated by the difference between first to last detection times.

Table 49. Sockeye Salmon median passage time (from time of first detection at a dam to last detection at a dam) and the percentage of Sockeye Salmon taking greater than 12 hours between first detection and last detection in 2021.

Dam	N	Median Passage (Minutes)	%>12 Hours
Bonneville	1378	72.8	12.8%
The Dalles	1229	0.1	1.1%
John Day	1130	1.0	8.6%
McNary	680	0.4	2.5%
Priest Rapids	801	9.1	2.4%
Rock Island	740	28.0	0.7%
Rocky Reach	579	5.8	2.1%
Wells	547	8.3	5.3%
Zosel	238	1.3	5.0%
Tumwater	131	37.7	9.9%
Ice Harbor	7	6.0	0.0%
Lower Monumental	4	578.0	50.0%
Little Goose	3	0.1	33.3%
Lower Granite	3	163.4	0.0%
Weighted Mean (by number of detections)		**19.5**	**5.3%**

Fallback

Fallback rates at mainstem Columbia River dams for adults tagged at Bonneville Dam in 2021 ranged from 0.4% at Bonneville Dam to 5.7% at John Day Dam (Table 50).

Of the 134 Sockeye Salmon tagged as adults by this project in 2021 which fell back over at least one dam, 14 fell back over two dams and 3 fell back over three dams (Table 51). The mean number of fallback events per Sockeye Salmon was 0.11.

Table 50. Estimated minimum fallback rates for Sockeye Salmon at dams in 2021[17]. The sample size (n) is the number of tagged Sockeye Salmon detected moving upstream past Bonneville Dam.

Dam	Bonneville AFF (n=1400)
Bonneville	0.4%
The Dalles	2.2%
John Day	5.7%
McNary	0.5%
Priest Rapids	1.6%
Rock Island	1.2%
Rocky Reach	1.9%
Wells	0.7%
Tumwater	2.3%
Zosel	4.2%
Skaha	0.0%
Ice Harbor	14.3%
Lower Monumental	25.0%
Little Goose	33.3%
Lower Granite	0.0%

[17] Does not include Sockeye Salmon that fell back over a dam and were not subsequently detected.

Table 51. Number of fallback events by tag group for returning Sockeye Salmon tagged as juveniles and as adult Sockeye Salmon included in our Bonneville adult tagging study in 2021.

Fallback Events	Bonneville Dam AFF
1	117
2	14
3	3
Number of Sockeye Salmon falling back at least once	**134**
Percentage of Sockeye Salmon with at least one fallback event	**9.7**
Total fallback events	**154**
Number of Sockeye Salmon detected at or upstream of Bonneville Dam	**1378**
Mean fallbacks events per Sockeye Salmon	**0.11**

Night Passage

Okanagan Sockeye Salmon tagged at Bonneville Dam passed PIT tag antennas at night (2000-0400 hours) at a higher rate than Wenatchee Sockeye Salmon at all six Columbia River dams passed by both stocks on their typical migration route (Bonneville, The Dalles, John Day, McNary, Priest Rapids and Rock Island) for 2021 (Table 52).

Table 52. Estimated Sockeye Salmon night passage (2000-0400) by stock at Columbia River, Zosel, and Tumwater dams in 2021. Dams outside the typical migratory corridor for the stock in question are shaded yellow.

Dam	% Adults Tagged at Bonneville Dam		
	All Adults	Okanagan	Wenatchee
Bonneville	1.5	1.9	0.3
The Dalles	9.4	9.7	8.5
John Day	8.1	8.8	6.2
McNary	8.4	8.6	8.5
Priest Rapids	4.1	5.2	0.6
Rock Island	3.4	3.8	1.8
Rocky Reach	10.2	10.1	10.0
Wells	12.6	12.9	0.0
Tumwater	3.1	NA	3.1
Zosel	42.0	42.0	NA

Stock Composition Estimates

Similar to Chinook and steelhead GSI and PBT were used to classify tissue samples from all Sockeye Salmon sampled at Bonneville Dam and compared with those derived from the location of last PIT tag detection (Table 35). There was one Sockeye, tagged on June 24, 2021, classified by GSI as being of Okanagan stock last detected in the Wenatchee River. However, the subsequent Sockeye Sampled was classified by GSI as being a Wenatchee Sockeye stock last detected at Wells Dam, suggesting the likelihood of a sample mix-up. This has also been observed in base years. Therefore, both GSI samples were removed from further analysis.

In 2021, stock composition estimates concurred for 384 out of 386 (99.5%) Sockeye for which both PIT Tag and GSI stock could be derived (Table 35). Thirteen Sockeye Salmon were classified as being of Snake River origin, however, only two of these were last detected at or above Lower Granite Dam[18]. Six Snake River Sockeye were last detected at Bonneville Dam and one each at The Dalles, John Day, and McNary dams with one not detected after release.

Table 53. Comparison of stock composition estimates for individual Sockeye Salmon sampled at Bonneville Dam in 2021. Green shading indicates agreement between the two methods orange indicates disagreement. Yakima Sockeye Salmon are primarily from Okanagan and Wenatchee broodstock thus no determination on agreement could be made for Sockeye Salmon returning to the Yakima River that were classified by GSI as being of Okanagan or Wenatchee origin.

Stock Estimated Using PIT Tags	Stock Estimated by Genetics (PBT or GSI)					
	Okanagan	Wenatchee	Snake	Yakima	Unknown[19]	Total
Okanagan	244				3	**247**
Wenatchee	1	138			1	**140**
Snake	0		2	1		**3**
Unknown[20]	812	267	11	17	5	**1072**
Total	**1057**	**405**	**13**	**18**	**9**	**1502**

Three Sockeye Salmon were last detected in the Yakima River, all at Roza Dam, and all were previously detected at the Priest Rapids fish trap and are presumed to have been transported to Cle Elum Lake. They then moved downstream where they were detected at Roza Dam (ROZ). All three were

[18] For one of the 13 Snake River sockeye, no PIT tag was recorded.
[19] Either no genetics sample available, the sample did not classify to a particular stock, or GSI data removed by a suspected data collection error.
[20] No PIT tag or not detected in terminal area (at or upstream of OKL, LWN, PRO, or GRA or upstream of DRM). This also includes 20 Sockeye Salmon sampled on 6/23 where there was a suspected mix up of genetics samples.

classified by GSI as being of Okanagan stock (Table 53).

Among the 18 Sockeye classified by PBT as being of Yakima origin, none were detected in the Yakima River (Table 54). Twelve were last detected in the Columbia River downstream of the confluence with the Snake River (4 at Bonneville, 3 at John Day, and 5 at McNary) while 3 were detected upstream of the Yakima River in the Columbia Basin (1 each at Priest Rapids Dam, Rocky Reach Dam, and the Methow River) and 3 in the Snake River (2 at Ice Harbor and 1 in the Clearwater River.) The Sockeye last detected in the Clearwater River (3DD.003D82A3C4) passed McNary Dam June 29, Priest Rapids Dam on July 3, Priest Rapids again on July 15, and Ice Harbor Dam on July 19 before proceeding up the Snake River. This behavior suggests that the fish may have been waiting for the Yakima River to cool before eventually giving up and moving up the Snake River.

Table 54. Final stock classification of Sockeye Salmon by using GSI, PBT, and last detection area/site for Sockeye Salmon PIT tagged at Bonneville Dam in 2021.

Area (Site) of Last Detection	Final Stock Classification Using GSI, PBT, and Last PIT Tag Detection as described in This Report					
Non-Terminal Areas	**Okanagan**	**Wenatchee**	**Snake**	**Yakima**	**Unknown[21]**	**Total**
Bonneville (BCC, BO1, BO2, BO3, BO4)	166	57	6	4	2	235
The Dalles (TD1, TD2)	46	34	1	0	0	81
John Day Dam (JO1, JO2, JDJ)	108	85	1	3	0	197
McNary Dam (MC1, MC2, MCJ)	100	44	1	5	0	150
Priest Rapids Dam (PRA, PRH, RSH)	40	17	0	1	0	58
Rock Island Dam (RIA)	18	5	0	0	0	23
Rocky Reach Dam (RRF, RRJ)	8	1	0	1	0	10
Entiat River (ENL)	2	0	0	0	0	2
Wells Dam (WEA,WEJ)	289	4	0	0	3	296
Wells Hatchery (WEH)	1	0	0	0	0	1
Methow River (LMR, MRC)	0	0	0	1	0	1
Snake River below GRA (ICH, LMA)	1	0	1	2	0	4
Yakima River (ROZ but not detected at PRO)	3	0	0	0	0	3
Terminal Areas						
Wenatchee River (ICL, LWE, LWN, TUF, UWE, WTL)	0	153	0	0	1	154
Okanagan River (LLC, OKC, OKL, OKM, OKP, OKS, SKA, ZSL)	254	0	0	0	0	254
Snake River above GRA (GRA, LRU)	0	0	2	1	0	3
Fish Not Part of Analysis						
No Tag or Tag Not Subsequently Detected	23	5	1	0	1	30
Total	**1059**	**405**	**13**	**18**	**7**	**1502**

Straying

The Sockeye stray rate estimated by this project is 2.7% (Table 55) for GSI, 2.8% if PBT results are included (Table 56). A reintroduction program at Cle Elum Lake in the Yakima Basin complicates stray analysis. Some Yakima stock Sockeye can be identified using PBT (Table 56), but those are rare. Sockeye not identified by PBT are classified using GSI, which cannot differentiate between a Wenatchee or Okanagan stock Sockeye and the offspring of Wenatchee or Okanagan stock Sockeye Salmon whose parents spawned in the Yakima Basin. It is likely that the three “Okanagan” stock Sockeye Salmon last detected in the Yakima River were actually offspring of Okanagan stock Sockeye Salmon which spawned upstream of Cle Elum Lake. It is also likely that Okanagan and Wenatchee strays into the

[21] Either no genetics sample available or the sample did not classify to a particular stock.

Snake River are from the Cle Elum program. PBT did not assign any of these fish to the Cle Elum program, but this has happened in past years.

Table 55. Showing final-PIT-fate categories by stock as determined using Genetics Stock Identification for fish tagged in 2021. Fate categories are categorized by color. Grey is neutral (meaning last detected on route to expected destinations), green is on target (meaning last detected at their expected destination), yellow is putative overshoot meaning a fish last detected in an area adjacent to its expected destination, and red is putative stray meaning a fish was last detected in tributaries or the mainstem outside their normal route to their expected destination. Stray rates are also tabulated.

	Bonneville Dam					The Dalles		John Day Dam			McNary Dam			Snake Basin				Yakima				Wenatchee Basin						Rocky Reach			Wells Dam/Hat.				Okanagan Basin														
Genetic Stock Identifaction Classification	Corner Collector	Oregon Shore Ladder	Bradford Island Ladder	Lower Washington Shore Ladder	Upper Washington Shore Ladder	Oregon Shore	Washington Shore	Juvenile Bypass	Oregon Shoreq	Washington Shore	McNary Oregon Shore Ladder	McNary Washington Shore Ladder	McNary Dam Juvenile	Ice Harbor Dam (Combined)	Lower Monumental Adult Ladders	Lower Granite Dam Adult	Lochsa River Upper Site	Roza Diversion Dam (Combined)	Ringold Springs Hatch. Outfall	Priest Rapids Adult	Rock Island Adult	Lower Wenatchee River	Lower Icicle Instream Array	Tumwater Dam Adult Fishway	Upper Wenatchee River	White River, Wenatchee	Little Wenatchee River	Rocky Reach Fishway	Rocky Reach Dam Juvenile	Lower Entiat River	Wells Dam	Wells Dam Hatchery	Wells Dam Juvenile	Methow-Lower Twisp River	Lower Okanogan Instream Array	Loup Loup Creek	Zosel Dam Combined	Okanagan Channel at VDS-3	McIntyre Dam	Skaha Dam	Okanagan-Shingle Creek	Okanagan River-Penticton	Neutral	On Target	Putative Stray	Putative overshoot	Likely Cle Elum program	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target)
Columbia RKM	234	234	234	234	234	308	308	347	347	347	470	470	470	522	522	522	522	539	567	639	730	754	754	754	754	754	754	763	763	778	830	830	830	843	858	858	858	858	858	858	858	858										
Stock/Site	BCC	BO1	BO2	BO3	BO4	TD1	TD2	JDJ	JO1	JO2	MC1	MC2	MCJ	ICH	LMA	GRA	LRU	ROZ	RSH	PRA	RIA	LWE	ICL	TUF	UWE	WTL	LWN	RRF	RRJ	ENL	WEA	WEH	WEJ	TWR	OKL	LLC	ZSL	OKC	OKM	SKA	OKS	OKP										
Osoyoos	2	8	1	67	87	35	11	5	90	14	68	31	1	1				3	1	38	18					1		7	1	2	287	1	1		15	1	76	129	1	8	5	16	790	235	4	0	3	76.8%	22.8%	0.4%	0.0%	1.7%
Redfish		1			5	1			1		1					1	2																										12	0	0	0	0	100.0%	0.0%	0.0%	0.0%	
Wenatchee		2		6	52	19	15	1	74	12	34	15		2			1		2	16	5	19	4	32	14	69	14	2			5			1								274	129	6	7	0	65.9%	31.0%	1.4%	1.7%	4.4%
Total	2	11	1	73	144	55	26	6	165	26	103	46	1	3	1	2	1	3	3	54	23	19	4	32	14	70	14	9	1	2	292	1	1	1	15	1	76	129	1	8	5	16	1076	364	10	7		73.9%	25.0%	0.7%	0.5%	2.7%

Table 56. Showing final-PIT-fate categories by stock as determined using Parental Based Tagging for fish tagged in 2021. Fate categories are categorized by color. Grey is neutral (meaning last detected on route to expected destinations), green is on target (meaning last detected at their expected destination), yellow is putative overshoot meaning a fish last detected in an area adjacent to its expected destination, and red is putative stray meaning a fish was last detected in tributaries or the mainstem outside their normal route to their expected destination. Stray rates are also tabulated.

	Bonneville Dam					The Dalles		John Day Dam			Mcnary Dam			Snake Basin				Yakima				Wenatchee Basin						Rocky Reac			Wells Dam/Hat.				Okanagan Basin													
	Corner Collector	Oregon Shore Ladder	Bradford Island Ladder	Lower Washington Shore Ladder	Upper Washington Shore Ladder	Oregon Shore	Washington Shore	Juvenile Bypass	Oregon Shoreq	Washington Shore	McNary Oregon Shore Ladder	McNary Washington Shore Ladder	McNary Dam Juvenile	Ice Harbor Dam (Combined)	Lower Monumental Adult Ladders	Lower Granite Dam Adult	Lochsa River Upper Site	Roza Diversion Dam (Combined)	Ringold Springs Hatch. Outfall	Priest Rapids Adult	Rock Island Adult	Lower Wenatchee River	Lower Icicle Instream Array	Tumwater Dam Adult Fishway	Upper Wenatchee River	White River, Wenatchee	Little Wenatchee River	Rocky Reach Fishway	Rocky Reach Dam Juvenile	Lower Entiat River	Wells Dam	Wells Dam Hatchery	Wells Dam Juvenile	Methow-Lower Twisp River	Lower Okanogan Instream Array	Loup Loup Creek	Zosel Dam Combined	Okanagan Channel at VDS-3	McIntyre Dam	Skaha Dam	Okanagan-Shingle Creek	Okanagan River-Penticton	Neutral	On Target	Putative Stray	Putative overshoot	Likely Cle Elum Program	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target)
	BCC	BO1	BO2	BO3	BO4	TD1	TD2	JDJ	JO1	JO2	MC1	MC2	MCJ	ICH	LMA	GRA	LRU	ROZ	RSH	PRA	RIA	LWE	ICL	TUF	UWE	WTL	LWN	RRF	RRJ	ENL	WEA	WEH	WEJ	TWR	OKL	LLC	ZSL	OKC	OKM	SKA	OKS	OKP										
Columbia RKM	234	234	234	234	234	308	308	347	347	347	470	470	470	522	522	522	522	539	567	639	730	754	754	754	754	754	754	763	763	778	830	830	830	843	858	858	858	858	858	858	858	858										
Osoyoos	2	8	1	67	86	35	11	5	90	14	68	31	1	1				3	1	38	18					1		7	1	2	287	1	1		15	1	76	129	1	8	5	16	774	250	4	0	3	75.1%	24.2%	0.4%	0.0%	1.6%
Redfish		1			5	1			1		1				1	2																											12	0	0	0	0	100.0%	0.0%	0.0%	0.0%	NA
Wenatchee		2		5	50	19	15	1	71	12	31	15							1	14	5	19	4	32	14	69	14	1			5												263	129	1	6	0	65.9%	32.3%	0.3%	1.5%	0.8%
Yakima				1	3				3		3			2			1		1	2								1					1										10	0	6	2	0	55.6%	0.0%	33.3%	11.1%	100.0%
Total	2	11	1	73	144	55	26	6	165	26	103	46	1	3	1	2	1	3	3	54	23	19	4	32	14	70	14	9	1	2	292	1	1	1	15	1	76	129	1	8	5	16	1059	379	11	8	3	72.5%	26.0%	0.8%	0.5%	2.8%

DISCUSSION

In 2021, this project tracked a total of 3,486 Chinook, 1,324 steelhead, and 1,221 Sockeye (Table 57) upstream to estimate parameters such as upstream escapement, age composition, length composition, and migration rates at and between mainstem dams and other tributary interrogation sites. The year 2021 marked the 16^{h} year of Sockeye Salmon PIT tagging, the 15th year of Chinook Salmon PIT tagging and the 13th year of steelhead PIT tagging at Bonneville Dam. Over this time, the number of PIT tag detection sites in the Columbia Basin has continually increased, increasing our understanding about the movement of tagged salmonids.

Table 57. Total number of Chinook and Sockeye salmon and steelhead PIT tags tracked by year (includes recaptures of previously PIT tagged fish) 2009-2021.

	Total Tracked				Percent of Run Tracked			
Year	Chinook	Steelhead	Sockeye	Total	Chinook	Steelhead	Sockeye	Total
2009	2,968	2,485	838	6,291	0.42	0.41	0.47	0.42
2010	2,579	1,741	913	5,233	0.29	0.42	0.24	0.31
2011	3,253	1,377	763	5,393	0.38	0.37	0.41	0.38
2012	3,438	1,451	1,601	6,496	0.50	0.62	0.31	0.45
2013	3,406	1,276	772	5,454	0.26	0.55	0.42	0.32
2014	3,869	1,717	1,400	6,986	0.27	0.63	0.27	0.33
2015	3,563	898	901	5,362	0.25	0.33	0.18	0.24
2016	3,396	1,610	1,653	6,659	0.44	0.86	0.48	0.51
2017	2,805	836	1,079	4,720	0.69	0.71	1.23	0.87
2018	3,178	893	1,848	5,919	0.95	0.87	0.95	0.94
2019	3,483	820	972	5,275	0.79	1.06	1.54	0.92
2020	3,272	1,474	1,730	6,475	0.54	1.29	0.51	0.61
2021	3,486	640	1,400	5,526	0.61	0.89	0.92	0.70
Mean	**3,284**	**1,324**	**1,221**	**5,830**	**0.49%**	**0.69%**	**0.61%**	**0.54%**
All Years	**42,696**	**17,218**	**15,870**	**75,789**				

For both Chinook Salmon and steelhead, there are management concerns regarding the timing of run components. One question of interest to fish managers is the definition of a summer Chinook Salmon. Traditionally, spring Chinook Salmon were defined as those migrating past Bonneville Dam through May 31, with summer Chinook Salmon passing from June 1 through July 31, and fall

Chinook Salmon defined as passing on or after August 1. Dates of defining a Chinook run at upstream dams are lagged to take into account migration times from Bonneville Dam to the upstream dam in question. However, in 2005, for management purposes the spring-summer differentiation at Bonneville Dam was moved from June 1 to June 16 (though visual counts are typically reported using the old cutoff). Managers moved this date because radio tagging studies suggested that many of the Chinook Salmon migrating in early June are from the Snake River (many spring/summer Chinook in the Snake River Basin are listed as endangered under ESA), while Chinook migrating in late June are mid-Columbia summers. The PIT tag detection data from this project showed that in 2019 the percentage of Chinook Salmon at Bonneville Dam, which ultimately passed Ice Harbor Dam, peaked at 45.9% of the run for Statistical Week 19, which started May 5 (Figure 10). By Week 23 (which started June 2), the percentage of Chinook tagged at Bonneville that were detected at Priest Rapids Dam exceeded that at Ice Harbor, and by Week 27 (June 9), the percentage that ultimately passed Ice Harbor Dam had declined to under 10% of the run. The percentage detected above Priest Rapids Dam exceeded 80% for those Chinook tagged in Week 28 and remained above 50% through Week 31 when sampling ceased until Week 32, when the percentage of tagged Chinook above Priest Rapids Dam was under 10% (Figure 10).

As at Bonneville Dam, Chinook runs (spring, summer, and fall) passing dams upstream of Bonneville Dam are differentiated based on the date they pass, and these dates are based on fixed migration rates assumed by managers. For instance, spring Chinook transition to summer Chinook on June 1 at Bonneville Dam, June 11 at Ice Harbor Dam and June 13 at Priest Rapids Dam. This means that the same Chinook traveling slower than expected could be classified differently at different dams. For example, a “spring” Chinook passing Bonneville Dam on May 31 would be a “summer” Chinook passing Priest Rapids Dam on June 13. Using PIT tag data, this study found that an estimated 10.3% of spring and 1.4% of summer Chinook at Bonneville Dam were classified differently at Priest Rapids Dam (Table 7). This study also found that 0.9% of spring and 22.5% of summer Chinook at Bonneville Dam were classified differently at Ice Harbor Dam.

Tules, which are mature, very dark colored fall Chinook primarily bound for lower Columbia River hatcheries and tributaries, have not normally been included in our sample due to the fact that scales are very difficult to remove for aging, and aging is difficult if not impossible due to the extreme resorption of the outer part of

the scales. In addition, Tules are of less interest to fishery managers. However, in 2021, we did sample 144 Tules between weeks 35 and 41. Of these, 57 were last detected at Bonneville Dam (55 of which were at the upper antennas prior to entering Bonneville Pool), 72 were last detected at Spring Creek Hatchery, 6 at The Dalles Dam, 5 at John Day Dam, 2 at Priest Rapids hatchery, and 1 at McNary Dam (Figure C16 in Appendix C).

PBT classification for Tules sampled in 2021 was 108 Spring Creek Hatchery, 2 Priest Rapids Hatchery, 2 Lyons Ferry Hatchery, and 1 each classified as Bonneville, Kalama, and Nez Perce hatcheries. The Priest Rapids and Nez Perce Hatchery fish were likely extremely mature Chinook which had a Tule coloration and not of the Tule race.

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APPENDIX A

Section on Adult Trap Protocols out of the 2021 Fish Passage Plan for Bonneville Adult Fish Facility. Full document can be found at https://pweb.crohms.org/tmt/documents/fpp/2021/final/FPP21_AppG.pdf

1. BONNEVILLE DAM ADULT FISH FACILITY

The following protocols will be implemented by agencies conducting research in the Bonneville Dam second powerhouse Adult Fish Facility (AFF). These protocols were coordinated with fish agencies and tribes through FPOM. The purpose of these protocols is to provide measures to limit mortality resulting from stress when handling fish.

1.1. General Facility Protocols.

1.1.1. Users must have appropriate documentation for conducting research at the dam (see *Guide for Researchers at Bonneville Dam*). This includes valid state and federal permits that cover all ESA-listed species passing the project during the trapping period. Users shall comply with all fish handling conditions in the permits. *If permit conditions are more restrictive than the following protocols, users must follow permit conditions*.

1.1.2. The Corps reserves the right to terminate trapping operations at any time.

1.1.3. Users will be trained in the proper operation of the AFF to ensure safety of fish and personnel. Users may request training through the Project Biologists.

1.1.4. Bridge crane certification is required prior to operating the overhead crane. The Corps will not provide this training.

1.1.5. Hard hats, long pants or raingear, and steel-toed shoes or rubber boots are to be worn at all times. Shorts, tennis shoes, or sandals are not permitted in the lab.

1.1.6. Water temperatures should be observed upon arrival and periodically during the day.

1.1.7. Personnel conducting research are required to be present in the AFF to divert desired fish into the anesthetic tank using the flume swing gates. While the AFF is in operation, flumes shall be open and a researcher must be on-site.

1.1.8. Undesired fish will be bypassed to the return pool.

1.1.9. Researchers shall not perform any maintenance on Corps owned/installed equipment. Nets may be mended as necessary.

1.1.10. Qualified users may lower the main ladder picket leads and downstream exit bulkhead when they arrive, and must raise the picket leads when they are completed for the day. The downstream exit bulkhead may be left down when shad and lamprey are attempting to pass.

1.1.11. Users will be permitted to operate valves 9 and 10 to control flow down the flumes at their discretion and to operate the raw water booster pump. Users may operate valve 12 to provide flow in the holding pool and valve 15 to drain water at the return pool.

1.1.12. Users must use a sanctuary net large enough to safely handle the largest fish passing the project during the trapping period.

1.1.13. Fish larger than 100 cm forklength may be diverted into the main anesthetic tank or returned to the ladder untouched. These fish will not be diverted into auxiliary anesthetic tanks.

1.2. Notification & Documentation.

1.2.1. Users will notify the control room when they set up and close down the lab.

1.2.2. Users will record the times picket leads are lowered and raised and which agency they are representing on the sheet provided by the project biologists.

1.2.3. Lamprey may be held up to 48 hours in the AFF. Researchers will notify Project Fisheries and the Control Room whenever lamprey are held.

1.2.4. All mortalities must be immediately reported to a Project Biologist. The Project Biologist will examine the mortality and take photos. The researcher shall give a detailed report including:

(a) Species;
(b) Origin;
(c) Length;
(d) Weight;
(e) Marks and injuries;
(f) Cause and time of death;
(g) Future preventative measures.

1.2.5. All mortalities will be reported in a *Memo for the Record* (MFRs) sent to the Portland District Columbia River Coordinator for distribution to FPOM.

1.2.6. Project Fisheries will notify FPOM as soon as Weir 37 consistently violates FPP criteria.

1.3. Trapping Protocols – Ladder Water Temperatures < 70°F.

1.3.1. There will be no start time restriction for trapping operations.

1.3.2. There will be no more than 4 Chinook, or 4 steelhead, or 6 sockeye, or any combination of 4 adult salmonids allowed in the anesthetic tank at one time. This assumes that users can effectively track the duration of time that fish stay in the anesthetic tank.

1.3.3. Anesthetic tank water will be replaced at least two times per day. Water temperatures in the anesthetic tank will be maintained within 2°F of the fish ladder water temperature. *If anesthetic tank water temperature exceeds 70°F, protocols in* ***section 4*** *go into effect.*

1.3.4. Observation Tanks.

(a) There will be no more than 2 adult fish in one observation tank at one time. The brail pool is the primary and preferred recovery area.

(b) Observation tanks will primarily be used for fish in "*distress*", defined as fish that have sustained injury during the trapping and sampling process; fish that have a previous injury (e.g., fish in "*fair*" or "*poor*" condition upon trapping due to marine

mammal injuries or similar), or fish that are showing symptoms of heavy sedation (e.g., diminishing gill movement, reduced gasp response when out of water).

(c) Fish will be released from the observation tanks when they are in the state of "*Partial Equilibrium*", defined as: gilling normally, making weak tailing movements, unable to swim upright and swims off course without avoiding obstacles; not strongly trying to break free of handlers.

(d) All fish in an observation tank must be continuously observed by a dedicated observer to ensure adult fish do not recover beyond partial equilibrium prior to return to the brail pool. No lid or restraining device shall be installed on top of the observation tanks.

(e) Observation tanks may be used for study objectives such as monitoring recovery time from anesthetic, if approved by FPOM and USACE.

(f) Water in the observation tanks will be running continuously to allow a constant exchange of water through the tank.

1.3.5. Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it take no longer than 25 minutes to transition fish from entry into the anesthetic tank to release back into the return ladder or transportation tank.

1.3.6. Personnel shall ensure that fish are fully recovered from anesthesia prior to release into the return ladder. Fish may volitionally leave the brail pool when they are ready.

1.3.7. When trapping is done for the day, users will properly shut down the lab.

1.3.8. Four picket leads will be allowed during trap operations for up to four hours. After all picketed leads are raised, fish already in the AFF can be sampled for one additional hour. The picketed lead operations are as follows[1]:

0–6,000: All 4 picket leads can be lowered for 4 continuous hours.

6,000–12,000: All 4 picket leads down for 3 hours. At the 3rd hour, raise at least 1 picket lead for ½ hour, and then continue sampling for additional 1 hour.

12,000–25,000: All 4 picket leads down for 2 hours. At the 2nd hour, raise at least 2 picket leads for ½ hour, and then continue sampling for an additional 2 hours.

25,000–35,000: Two picket leads down for four hours.

> 35,000: No picket leads down.

1.3.9. Researchers will also be required to monitor the ladder every hour to ensure there is no crowding. If evidence of crowding is observed, at least two picket leads will be raised.

[1] All counts are of adult salmonids (including jacks) for the previous day at the Washington Shore count station. Assumes 4 shad = 1 salmonid (e.g., 6,000 salmonids + 4,000 shad = 7,000 total).

1.3.10. Project biologists retain the authority to raise additional picket leads depending on fish densities and ladder conditions.

1.4. Trapping Protocols – Ladder Water Temperatures >= 70°F.

1.4.1. Trapping will not occur when fish ladder water temperatures meet or exceed 70°F as measured in the brail pool. The only exception is for *US v Oregon* requirements and for nighttime lamprey trapping. Nighttime is defined as official sunset to sunrise.

1.4.2. Project Biologists will use the Corps temperature probe reading as the official temperature.

1.4.3. Temperatures are both instantaneous readings and 24-hour (0000–2400) averages. Researchers can review daily average, minimum, and maximum temperatures[2] to determine if the trap is within temperature criteria prior to traveling to BON. Instantaneous temperatures will be used to determine if trapping operations will continue for the day.

1.4.4. Project biologists will collect temperature data weekly from the data logger in the exit ladder. Daily checks may be requested when temperatures approach 70°F.

1.4.5. At water temperatures of 70–72°F, sampling will be permitted as defined below for up to four days per week from 0600-1030 hours to allow for *U.S. v Oregon* requirements. This operation will remain in effect until daily average water temperature drops to ≤ 69.9°F. All sampling will cease when temperature reaches 72°F. No sampling may resume until daily average water temperature drops to ≤ 71.9°F. An exception is that nighttime lamprey trapping will be permitted up to 73.9°F for tagging and transport purposes. All nighttime trapping for lamprey will cease when temperatures reach 74°F.

1.4.6. Researchers may continue to work through fish in the holding pool for one hour after picket leads have been raised.

1.4.7. The density criteria for picket lead operations will be altered and the operations will be as follows (density criteria and adult ladder monitoring outlined above in **1.3.9** also apply[1]):

0–3,000: All 4 picket leads can be lowered for 4 continuous hours.

3,000–6,000: All 4 picket leads down for 3 hours. At the 3rd hour, raise at least 1 picket lead for ½ hour and then continue sampling for an additional 1 hour.

6,000–9,000: All 4 picket leads down for 2 hours. At the 2nd hour, raise at least 1 picket lead for ½ hour and then continue sampling for an additional 2 hours.

9,000–18,000: 2 leads down for 4 hours. All picket leads raised by 10:30 am.

> 18,000: No picket leads down.

1.4.8. There will be no more than 3 adult Chinook or steelhead, or 4 sockeye in the anesthetic tank at a time. A combination of salmonids is allowed, with the maximum of either 2 Chinook or

[2] Temperature data for Lower Columbia River projects: pweb.crohms.org/tmt/documents/ops/temp/

steelhead and 1 sockeye, or 1 Chinook or steelhead and 2 sockeye. This assumes users can effectively track the duration of time that fish stay in the anesthetic tank.

1.4.9. The brail pool is the primary and preferred recovery pool.

1.4.10. The observation tanks will be used for fish in distress under guidelines established in 3.3.1 through 3.3.4.

1.4.11. If used, water in the observation tanks will be running continuously allowing a constant exchange of water through the tank.

1.4.12. Ensure oxygen levels are maintained at saturation in the anesthetic and recovery tanks. There will be no depression in oxygen levels in the anesthetic or recovery tanks. To ensure this, water in the anesthetic tank will be replaced at least every three hours.

1.4.13. Maintain the anesthetic and recovery tank water temperatures 1-2°F lower than the ladder water temperature. If ice is used to cool the anesthetic or recovery tank water, the ice should be from river water or from an un-chlorinated water source and should be added in individual sealed containers. Do not exceed a 2°F difference between the anesthetic or recovery tank water and fish ladder water.

1.4.14. Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it take no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the return ladder or transportation tank.

1.4.15. Personnel shall ensure fish are fully recovered from anesthetization prior to release. Fish may volitionally leave the brail pool when they are ready.

1.4.16. Project biologists retain the authority to raise additional picket leads depending on fish densities and ladder conditions.

1.5. Winter Trapping Protocols (December 1 – March 14).

The purpose of these protocols is to provide measures to limit passage delay and stress from overcrowding in the brail pool. Personnel conducting research during this time are not required to be present in the AFF. Users are allowed to activate the flume swing gates to divert all fish into the brail pool.

1.5.1. Fish will not be permitted to remain in the brail pool longer than 24 hours. It is recommended that handling of fish occurs daily by 1800 hours. This ensures that if fish are sampled at the end of the day, most of the fish captured are only held from the morning until afternoon since passage at night is minimal, thus reducing delay.

1.5.2. During sampling, the brail pool should be raised and one adult salmonid netted, via a sanctuary net, and placed into the anesthetic tank at a time. After removing fish from the brail pool into the anesthetic tank, the brail pool will be lowered back to its full depth.

1.5.3. There will be no more than three adult salmonids in the anesthetic tank at a time. This assumes users can effectively track the duration of time fish are in the anesthetic tank.

1.5.4. There will be no more than two adult salmonids in the recovery tank at a time.

1.5.5. Water in the recovery tank will be running continuously, allowing a constant exchange of water through the tank.

1.5.6. Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it take no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the return ladder or transportation tank.

1.5.7. Personnel shall ensure fish are fully recovered from anesthesia prior to release.

1.5.8. If daily sampling is not to occur within 24 hours, the main ladder picket leads and downstream exit gate will be raised. The lab will be properly returned to bypass mode.

APPENDIX B

Table B1. Table showing picket lead protocols used by week that affected sampling of salmonids in 2021. Pickets are used to direct fish into the trap ladder and the number that can be used is affected by temperature and fish abundance numbers.

Protocols specified at different temperatures and abundances (based on previous day count at Bonneville Dam Washington Shore ladder (DART Adult Passage Ladder Summary for All Species | Columbia Basin Research (washington.edu)) for AFF operations (FPP Appendix G (crohms.org))												
Temperature (F)	<70	<70	<70	<70	<70	≥70	≥70	≥70	≥70	≥70	≥72	
Abundance	0-6000	6000-12000	12000-25000	25000-35000	.35000	0-3000	3000-6000	6000-9000	9000-18000	>18000		
Picket Leads	All 4 lowered 4 hours	4 down 3 hours, 1 up for ½ hour, sample 1 more hour	4 down 2 hours, raise 2 pickets for ½ hour, sampled 2 more hours	Two down for 4 hours	No pickets down	All 4 lowered 4 hours	4 down 3 hours, 1 up for ½ hour, sample additional 1 hour	4 down 2 hours, raise 1 picket for ½ hour, sample 2 more hours	2 leads down 4 hours, all pickets up at 10:30 AM	No pickets down	No pickets down	No pickets down
Week	**<70 Protocol (a)**	**<70 Protocol (b)**	**<70 Protocol (c)**	**<70 Protocol (d)**	**<70 Protocol (e)**	**>70 Protocol (a)**	**>70 Protocol (b)**	**>70 Protocol (c)**	**>70 Protocol (d)**	**>70 Protocol (e)**	**No Sampling Protocol**	**No Sampling Other**
17	4	0	0	0	0	0	0	0	0	0	0	0
18	4	0	0	0	0	0	0	0	0	0	0	0
19	5	0	0	0	0	0	0	0	0	0	0	0
20	5	0	0	0	0	0	0	0	0	0	0	0
21	5	0	0	0	0	0	0	0	0	0	0	0
22	5	0	0	0	0	0	0	0	0	0	0	0
23	4	0	0	0	0	0	0	0	0	0	0	0
24	0	4	0	1	0	0	0	0	0	0	0	0

25	0	2	3	0	0	0	0	0	0	0	0	0
26	0	0	5	0	0	0	0	0	0	0	0	0
27	0	0	4	1	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	2	2	0	0	1
29	0	0	0	0	0	4	0	0	0	0	1	0
30	0	0	0	0	0	4	0	0	0	0	1	0
31	0	0	0	0	0	1	0	0	0	0	4	0
32	0	0	0	0	0	0	0	0	0	0	5	0
33	0	0	0	0	0	1	0	0	0	0	4	0
34	0	0	0	0	0	1	0	0	0	0	4	0
35	0	2	0	1	0	0	0	0	1	0	0	1
36	0	0	5	0	0	0	0	0	0	0	0	0
37	0	0	4	0	0	0	0	0	0	0	0	1
38	0	1	4	0	0	0	0	0	0	0	0	0
39	0	0	4	0	0	0	0	0	0	0	0	1
40	2	3	0	0	0	0	0	0	0	0	0	0
41	4	0	0	0	0	0	0	0	0	0	0	1
42	2	0	0	0	0	0	0	0	0	0	0	0
Total	**40**	**12**	**29**	**3**	**0**	**11**	**0**	**2**	**3**	**0**	**19**	**5**

Four picket leads will be allowed during trap operations for up to four hours. After all picketed leads are raised, fish already in the AFF can be sampled for one additional hour. Abundances are the previous day's Washington Shore ladder count (DART Adult Passage Ladder Summary for All Species | Columbia Basin Research (washington.edu)). The picketed lead operations are as follows:

APPENDIX C

Table C1. List of PTAGIS interrogation sites (three letter code, name, and description) to use with maps that follow. Out of 308 active sites, 173 sites detected the fish tagged in 2021.

Site Code	Site Name	Site Description
30M	Thirtymile Crk John Day Basin	This site is located at rkm 0.5 on Thirtymile Creek, a tributarty to the John Day River.
ACB	Asotin Cr. at Cloverland Brdg.	The site is located near Cloverland Bridge (RKM 4.5) on Asotin Creek, a tributary of the Snake River.
ACM	Asotin Creek near mouth	Near the mouth of Asotin Creek 50 m upstream of the Highway 129 bridge spanning the mainstem of Asotin Creek in two serial sets of two antennas.
B2J	Bonneville PH2 Juvenile	Bonneville Dam PH2 Juvenile Bypass and Sampling Facility.
BBT	Touchet River at Bolles Bridge	The Bolles Bridge site is located about 200 feet above the State HWY 124 bridge on the Touchet River, near Bolles Road, at River Kilometer 65.2.
BCC	BON PH2 Corner Collector	Bonneville Dam 2nd Powerhouse Corner Collector Outfall Channel.
BGM	Burlingame Dam and Canal	Burlingame Diversion Dam is located on the lower Walla Walla River.
BO1	Bonneville Bradford Is Ladder	Bradford Island Adult Fishway at Bonneville Dam.
BO2	Bonneville Cascades Is Ladder	Cascades Island Adult Fishway at Bonneville Dam.
BO3	Bonneville WA Shore Ladder/AFF	Washington Shore Adult Fishway and AFF at Bonneville Dam; replaces B2A and BWL.
BO4	Bonneville WA Ladder Slots	Washington Shore Fishway Vertical Slots at Bonneville Dam.
BR0	Bridge Creek Gauge	Located near the USGS flow gauge site on Bridge Creek
BRC	Bear Valley Adult Video Weir	Interrogation system on the existing Bear Valley Creek Chinook adult monitoring weir.
BSC	Big Sheep Creek ISA at KM 6	The site is located in Big Sheep Creek at rkm 6.
CAL	Carson NFH Adult Return Ladder	Hatchery adult spring Chinook return ladder from the Wind River to Carson NFH.
CCU	Catherine Creek at Union	Site is on private land approximately 25 rkm upstream.
CCW	Catherine Creek Ladder/Weir	Instream detection array located in the adult return fish ladder at the Catherine Creek weir.
CHL	Lower Chiwawa River	Chiwawa River rkm 1, located between the Chiwawa smolt trap and the Chiwawa Acclimation Ponds.
CHU	Upper Chiwawa River	Chiwawa River rkm 12, located above the Forest Road 62 bridge and below Alder Creek.
CML	Chewuch River Middle Lower	Instream detection array located approximately 7 rkm up the Chewuch River.
CMU	Chewuch River Middle Upper	Instream detection array located approximately 8 rkm up the Chewuch River.
CRU	Upper Chewuch instream Array	Instream PIT tag interrogation site at RKM 28.35 on the Chewuch River.
CRW	Chewuch River above Winthrop	Chewuch River at river km 1, above Winthrop, WA.
CZY	Crazyman Creek at 0.6 KM	Located in the Imnaha River basin on Crazyman Creek.
DRP	Dryden Acclimation Pone	Detection system monitors releases from the Dryden Acclimation Pond aproximately 26 rkm upstream.
DSF	Deschutes Sherars Falls	Site consists of two monitored weirs in the main fishway and two monitored weirs in the high flow fishway; one antenna per weir.
DWL	Dworshak NFH adult trap	Located at the terminus of the Dworshak National Hatchery adult fish ladder in the North Fork Clearwater River.
EBO	East Bank Hatchery Outfall	This site is located in the East Bank Hatchery outfall channel.
EFD	East Fork Diversion Fishway	Site is located in a fish ladder at a irrigation diversion site for the East Fork Irrigation District on the East Fork of
EHL	Entiat NFH Adult Ladder	This adult interrogation site is located in the Entiat National Fish Hatchery adult ladder.
ENA	Upper Entiat River at rkm 17.1	The site is located approximately 400 meters above the mouth of the Mad River near the township of Ardenvoir
ENF	Upper Entiat River at rkm 40.6	The site is located approximately 600 meters below the beginning of Forest Service Property within the upper portion of the Entiat River at rkm 40.6.
ENL	Lower Entiat River	Entiat River rkm 2, located immediately upstream of Entiat, WA.
ESS	EFSF Salmon River at Parks Cr	East Fk South Fk Salmon River (rkm 21) near Parks Creek.
EVL	Eagle Valley Ranch - Lower	This site is located at the downstream end of a restoration zone at Eagle Valley Ranch on the Lemhi River, near rkm 16.
EVU	Eagle Valley Ranch - Upper	This site is located at the upstream end of a restoration zone at Eagle Valley Ranch on the Lemhi River, near rkm 20.
FDC	Feed Canal	Feed Canal, on the Umatilla River at rkm 47.
GCM	Grouse Creek Mouth	Located in Grouse Creek in the Imnaha River Basin approximately 25m upstream from the confluence with the Imnaha River.
GLC	Gold Creek, Methow River	The site is located at rkm 0.18 of Gold Creek in the Methow River Basin.
GOA	Little Goose Fish Ladder	Adult Fishway at Little Goose Dam.
GOJ	Little Goose Dam Juvenile	Little Goose Dam Juvenile Fish Bypass/Transportation Facility.
GRA	Lower Granite Dam Adult	Lower Granite Dam Adult Fishway and Fish Trap.
GRJ	Lower Granite Dam Juvenile	Lower Granite Dam Juvenile Fish Bypass/Transportation Facility.
GRS	Lower Granite Dam Spillway	This site is located 173 rkm on the Snake River at the spillway 1 for the Lower Granite Dam.
HRM	Hood River Mouth	Located at the mouth of the Hood River against the west side jetty just inside the bar where the Hood River meets the Columbia River.
HST	Touchet River at Harvey Shaw	Site at RKM 50 on the Touchet river.
ICH	Ice Harbor Dam (Combined)	Ice Harbor Dam Adult Fishways (both) and Full Flow Bypass.
ICL	Lower Icicle Instream Array	Located at rkm 0.4 on Icicle Creek (Wenatchee River Basin), near Leavenworth, WA.
ICM	Middle Icicle Instream Array	Site at RKM 7 on Icicle Creek.
IML	Imnaha River Weir Adult Ladder	Located in the adult return fish ladder at the Imnaha River weir. Site is on public land.
IR1	Lower Imnaha River ISA at km 7	Lower Imnaha River at river km 7 (N 45.761162, W -116.750658).
IR2	Lower Imnaha River ISA at km 10	Lower Imnaha River at river km 10 (N 45.742839 W -116.764563).
IR3	Upper Imnaha River ISA at km 41	Upper Imnaha River at river km 41 (N 45.49004 W 116.80393).
IR4	Imnaha Weir Downstream Array	Located downstream of the Oregon Dept. of Fish and Wildlife (ODFW) fish weir on the Imnaha River.
IR5	Imnaha Weir Upstream Array	Located upstream of the Oregon Dept. of Fish and Wildlife (ODFW) fish weir on the Imnaha River.

Table C1. Continued.

Site Code	Site Name	Site Description
JA1	Jacks Creek Seasonal IPTDS	The site is downstream of rkm 1 on Jacks Creek.
JD1	John Day River, McDonald Ferry	John Day River in-stream detection, near McDonald Ferry at 20 rkm.
JDJ	John Day Dam Juvenile	John Day Dam Juvenile Fish Bypass and Sampling Facility.
JDM	Upper John Day Array	Located on the Upper Mainstem John Day River approximately 7 miles upstream of Dayville, Oregon.
JO1	John Day Dam South Fish Ladder	The interrogation site at the John Day Dam south fish ladder.
JO2	John Day Dam North Fish Ladder	The interrogation site at the John Day Dam north fish ladder.
JOC	Joseph Creek ISA at km 3	Joseph Creek, Grande Ronde basin at river km 3 (N 46.030016, W -117.016042).
JPT	Juvenile Pond Touchet	The site is at rkm 87.5 on the Touchet River.
KLR	Klickitat River Floating Array	The array is located in the lower Klickitat River, Klickitat County, Washington.
KRS	SF Salmon River at Krassel Creek	This in-stream interrogation system is located near Krassel Creek at rkm 65 on the South Fork Salmon River.
LBC	Libby Creek, Methow River	Instream PIT tag interrogation site at 1 rkm on Libby Creek.
LC1	Lower Lolo Creek at rkm 21	Lolo Creek, a tributary to the Clearwater River located at river km 522.224.087.021 (N 46.294434 W -115.976119).
LC2	Upper Lolo Creek at rkm 25	Lolo Creek, a tributary to the Clearwater River located at river km 522.224.087.025 (N 46.290562 W -115.934153.
LFF	Lyle Falls Fishway	The Lyle Falls Fishway in Klickitat River.
LKR	Little Klickitat River Array	The array is located in the Little Klickitat River, a tributary to the Klickitat River, Klickitat County, Washington, approximately 0.4 kilometers upstream from the confluence.
LLC	Loup Loup Creek Instream Array	This site is located 0.42 km from the confluence with the Okanogan River on Loup Loup Creek which enters the Okanogan River at RKM 27.2, within the city of Malott, WA.
LLR	Lower Lemhi River	Lower Lemhi River in Salmon, ID.
LMA	Lower Monumental Adult Ladders	This interrogation site is in both ladders at Lower Monumental Dam.
LMJ	Lower Monumental Dam Juvenile	Lower Monumental Dam Juvenile Fish Bypass/Transportation Facility.
LMR	Lower Methow River at Pateros	Lower Methow River near the WDFW 'Miller Hole' access site on the lower Methow River immediately upstream
LMT	Lower Mainstem Teanaway River	Mouth of the Teanaway river, under the HWY 10 bridge.
LNF	Leavenworth NFH Adult Ladder	Located in the Leavenworth National Fish Hatcheries adult ladder and holding pond.
LRL	Lower Lochsa River Array Site	Site is located in lower 1km of the mainstem Lochsa River.
LRU	Lochsa River Upper Site	Site is located in lower 3km of the mainstem Lochsa River.
LRW	Lemhi River Weir	Lemhi River above the mouth of Hayden Creek and below the IDFG weir.
LTR	Lower Tucannon River	Near the mouth of the Tucannon River. The upstream array group was located at an abandoned railroad bridge abutment upstream of Hwy 261 on the Tucannon River downstream from Starbuck. The CO in-stream array was relocated below the Hwy 261 bridge on Sept. 29, 2010.
LWE	Lower Wenatchee River	Wenatchee River rkm 2.
LWL	Ltl. White Salmon NFH returns	Adult fish ladder allowing passage from the Little White Salmon River into the adult holding ponds at Little White Salmon NFH.
LWN	Little Wenatchee River	Instream PIT tag interrogation site at rkm 4 located at the old fish weir.
MAD	Mad River, Entiat River Basin	This site is at Mad River rkm 1, located at Ardenvoir, WA.
MAR	Marsh Cr at Lola Cr Campground	The site is on Marsh Creek at Lola Creek Campground.
MBD	Mill Crk Bennington Diversion	Installed in the low flow spillway of the Mill Creek Bennington Diversion dam.
MC1	McNary Oregon Shore Ladder	Oregon Shore Adult Fishway at McNary Dam.
MC2	McNary Washington Shore Ladder	Washington Shore Adult Fishway at McNary Dam.
MCJ	McNary Dam Juvenile	McNary Dam Juvenile Fish Bypass/Transportation Facility.
MDW	Mill Creek Diversion Works	Site in the updated Mill Creek Division Works fish ladder.
MJ1	Middle Fork John Day Array	The site is on the Middle Fork John Day River, near the current confluence with Mosquito Creek on Malheur National Forest Service Land.
MJ2	Middle Fork John Day Ritter	The site is located on the Middle Fork John Day River at RKM 24 at Ritter Oregon.
MR1	Minam River at River KM 0.5	The site is located in the Minam River approximately 0.5 km upstream of the confluence of the Minam and Wallowa Rivers (lat 45.619623°, lon -117.726570°).
MRC	Methow River at Carlton	Located in the mainstem Methow River near the town of Carlton at rkm 45.
MRW	Methow River at Winthrop	Methow River. During 2009 and early 2010, the array was located at river km 81, above Winthrop, WA near
MSH	Methow Fish Hatchery Outfall	On the outlet of the Washington Department of Fish and Wildlife (WDFW) Methow Hatchery located on the Methow River at Rk 82.3 from the confluence with the Columbia River.
MTR	Middle Tucannon River	The Middle Tucannon River site is located about 250 feet above the River Ranch Ln bridge on the Tucannon River, at River Kilometer 19.5.
MVF	Moving Falls Fish Ladder	Located in the fish ladder at a site known as Moving Falls on the West Fork of the Hood River.
NAL	Lower Nason Creek	Nason Creek rkm 1, located within Lake Wenatchee State Park.
NAU	Upper Nason Creek	Nason Creek rkm 19 (Wenatchee River Basin).
NBA	Nursery Bridge Adult	Nursery Bridge Dam Fishways (both), Walla Walla River at Milton-Freewater, OR.
NMC	Ninemile Creek Instream Array	The site is located on Ninemile Creek, 0.78 km upstream from the confluence with Lake Osoyoos. north of the town of Oroville, WA.
OKC	Okanagan Channel at VDS-3	The OKC site is located in the Okanagan (Canadian spelling) Channel at 310th Avenue/Road 18 upstream from Osoyoos Lake.
OKL	Lower Okanogan Instream Array	Site at RKM 24.9 on the mainstem Okanogan River, upstream of Chiliwist area in Okanogan County.
OKM	McIntyre Dam	The site montiors each side of spill bay 1 at McIntyre Dam. The dam is located downstream of Vaseux Lake and upstream of Okanagan Lake, in Canada.
OKP	Penticton Channel PIT Array	Penticton Channel, is the channelized portion of the Okanagan River connecting Okanagan Lake with Skaha Lake, within the city of Penticton BC.
OKS	Shingle Creek	The site is on Shingle Creek, a tributary to the Okanagan River in Canada, and is located immediately adjacent to the Okanagan Nation Alliance (ONA) Fish Hatchery.
PCA	Panther Creek Array	The array is on Panther Creek approximately 5 rkm from the confluence with Salmon River.
PEL	Pelton Dam Ladder - Deschutes	Site in the ladder at PGE's Pelton Dam on the Deschutes River (rkm 328.161).

Table C1. Continued.

Site Code	Site Name	Site Description
PES	Peshastin Creek	Site at rkm 3 located on Peshastin Creek below the bridge at Smithson's property.
PRA	Priest Rapids Adult	Priest Rapids Dam Adult Fishways (both).
PRH	Priest Rapids Hatchery Outfall	Priest Rapids Hatchery outfall channel. The site is located just upstream of the typical point of inundation in the channel.
PRO	Prosser Diversion Dam Combined	Adult Fishways (all three) and Juvenile Bypass/Sampling Facility at Prosser Dam.
RCT	Roaring Creek Temporary Array	Located at rkm 0.3 on Roaring Creek (Entiat River basin).
RFL	Redfish Lake Creek	The site is located on Redfish Lake Creek approximately one half mile upstream from the confluence with the Salmon River.
RIA	Rock Island Adult	Rock Island Dam Adult Fishways (all three).
ROZ	Roza Diversion Dam (Combined)	Roza Dam Smolt Bypass.
RPJ	Rapid River Hatchery Pond	This site monitors the outfall of the Rapid River Fish Hatchery pond.
RRF	Rocky Reach Fishway	Rocky Reach Dam Adult Fishway.
RRJ	Rocky Reach Dam Juvenile	Juvenile Fish Bypass Surface Collector.
RSH	Ringold Springs Hatch. Outfall	PIT tag detection system located in the Ringold Springs Hatchery outfall channel.
SC1	Lower SF Clearwater R at rkm 1	Lower South Fork Clearwater River at river km 0.9 (N 46.13685 W -115.98091).
SC2	Lower SF Clearwater R at rkm 2	Lower South Fork Clearwater River at river km 2 (N 46.12749 W -115.97730).
SC3	South Fork Clearwater Site 3	Array is located just upstream of Peasley Creek on the mainstem South Fork Clearwater River, Idaho.
SC4	South Fork Clearwater Site 4	Array is located just upstream of Forest Road 492 bridge and below Leggett Creek in the mainstem South Fork Clearwater River, Idaho.
SCL	Spring Creek NFH Adult Ladder	Fish ladder allowing passage from the Columbia River into the adult holding ponds at Spring Creek NFH.
SCP	Spring Creek Acclimation Pond	Juvenile releases from and adults returning to Winthrop National Fish Hatchery.
SFG	SF Salmon at Guard Station Br.	Located at rkm 30 near the lower South Fork Salmon River Guard Station on the South Fork Salmon River.
SJ1	SF John Day (Mid)	This site is an in-stream array located on the South Fork John Day River south of Dayville on the PW Schneider Wildlife Management Area (ODFW) near rkm 10.
SJ2	SF John Day (Murderer's)	System located on the South Fork John Day River south of Dayville.
SKA	Skaha Dam Fish Ladder	Skaha Dam is located within the community of Okanagan Falls at the south end of Skaha Lake, BC along the Okanagan River. The fishway is at the western edge of the dam.
SUC	Summit Creek, Klickitat	The site is located 400m up Summit Creek, from the confluence with Klickitat River.
SUN	Sunnyside Instream Array	Located 600 M below Sunnyside Dam on the Yakima River.
SW1	Lower Selway River Array	PIT tag array is located 5 rkm upstream of the mouth of the Selway River in the upper Clearwater Basin Idaho.
SW2	Upper Selway River Array	PIT tag array is located 13 rkm upstream of the mouth of the Selway River in the upper Clearwater Basin Idaho.
SWT	Sweetwater Cr. near its Mouth	This is an in-stream interrogation system approximately 0.1 rkm upstream from the mouth of Sweetwater Creek.
TAY	Big Creek at Taylor Ranch	Centered around the bridge at Taylor Ranch, Big Creek, ID.
TD1	The Dalles East Fish Ladder	East Fish Ladder at The Dalles Dam.
TD2	The Dalles North Fish Ladder	North Fish Ladder at The Dalles Dam.
TFH	Tucannon Fish Hatchery	The Tucannon Fish Hatchery site is located about 200 feet above the Tucannon Fish Hatchery Adult Trap and Water Intake System on the Tucannon River, at River Kilometer 59.4.
TMF	Three Mile Falls Dam Combined	Adult Fishway and Juvenile Bypass/subsampling facility at Three Mile Falls Dam.
TRA	Trout Creek Auxillary Site	The site si in Trout Creek, WA at rkm 2.
TRC	Trout Creek, Wind River	The site is located at rkm 2 upstream from the confluence with Wind River (WA) above Hemlock Lake on Trout Creek.
TUF	Tumwater Dam Adult Fishway	Adult Fishway at Tumwater Dam.
TWR	Lwr Twisp Rvr near MSRF Ponds	Lower Twisp River adjacent to the Methow Salmon Recovery Foundation Ponds.
UGR	Upper Grande Ronde at rkm 155	Grand Ronde River located at river km 522.271.155 (45. 593338, -117.903124).
UGS	Upper Grande Ronde Starkey	In-stream detection array near the upper Grande Ronde weir at Starkey.
UMW	Umatilla R Recycled Water Fac	The site is an instream detection array in the Umatilla River adjacent to the City of Hermiston's Recycled Water Plant.
USE	Upper Salmon River at rkm 437	Located in the Salmon River at river km 522.303.437 (N45.028939 W-113.915892).
USI	Upper Salmon River at rkm 460	Located in the mainstem Salmon River at river km 522.303.460 (N44.890380 W-113.962575).
UTR	Upper Tucannon River	The Upper Tucannon River site is located about 200 yards above Don Howards House on the Tucannon River, at River Kilometer 53.2.
UWE	Upper Wenatchee River	Located at rkm 81.2 on the Wenatchee River, near Plain, WA.
VC2	Valley Creek, Downstream Site	Located on Valley Creek below Stanley, ID., in the Upper Salmon River.
WB1	White Bird Cr Seasonal IPTDS	The site is located at rkm 2.
WEA	Wells Dam, DCPUD Adult Ladders	Wells Dam Adult Fishways (both).
WEH	Wells Dam Hatchery	Points of detection include the adult fish handling facility, juvenile pond outflows and adult volunteer channel.
WEJ	Wells Dam Bypass Bay Sample	Site is located in Bypass Bay 2 on the right (west) side of Wells dam on the Columbia River, Washington.
WEN	Wenaha River Mouth	Array on the Wenaha River near Troy, Oregon.
WR1	Wallowa River at river km 14	Instream array located in the Wallowa River, Oregon rkm 522.271.131.014 (N 45.633769 ° W -117.73369°).
WR2	Wallowa River at Rkm 32	The array is located in the Wallowa River at approximately river km 32 just upstream of Lower Diamond Road bridge near the town of Wallowa, OR.
WRA	Upper Wind River Auxillary	The site is in the Wind River, WA at rkm 27.
WRU	Upper Wind River (WA) rkm 30	At rkm 30 of the Wind River, WA. The site is at the FR3065 bridge over the Wind River.
WSH	Warm Springs Hatchery	Adult Fishway at Warm Springs NFH.
WSR	Warm Springs River PIT Array	The Warm Springs River PIT tag array is installed end-to-end across the entire river channel.
WTL	White River, Wenatchee Basin	A permanent instream PIT tag interrogation site at RKM 2.88 on the White River.
WWB	Walla Walla River Barge	Site is a floating barge anchored in place at roughly 5 rkm upstream from the mouth.
YFK	Yankee Fork Salmon River	The site is located 3.14 rkm upstream from the confluence with the Salmon River at an elevation of 1855m.
ZEN	Secesh River at Zena Cr Ranch	Near the Zena Creek Ranch.
ZSL	Zosel Dam Adult Fishways	Zosel Dam is located at Okanogan River km 132, approximately 3 km downstream from the outlet of Lake Osoyoos in the town of Oroville, Washington.

Table C2. Season by season activities of steelhead tagged in 2021 and labeled later as kelts or repeat spawners when they began migrating downstream (after March 31st) and upstream in spring, summer, or fall of 2022, presumably to and from the ocean.

Tag Year	Tag Number	First Detection After Tagging 2021 in All Seasons	Summer/Fall 2021	Winter 2021/22	Spring 2022	Summer 2022	Fall 2022	Comments
2021	3DD.003D829C26	The Dalles East Ladder - October 1st	Lower Granite - October 14th		Upper Salmon - March 30th Redfish Lake Creek (Salmon) - May 15th	Bonneville Corner Collector - June 1st		
2021	3DD.003D829C52	The Dalles East Ladder - September 3rd	Lower Granite - September 16th		Lower Granite Spillway - May 7th Bonneville Corner Collector - May 19th			
2021	3DD.003D8294B5	The Dalles North Ladder - July 9th	Lower Granite - September 20th		Lower Wallowa (Grande Ronde) - March 30th Minam (Wallowa) - April 24th to May 14th Bonneville Corner Collector - May 31st			
2021	3DD.003D82A503	The Dalles East Ladder - August 30th	Lower Granite - September 14th		Lower Granite Spillway - May 6th Bonneville Corner Collector - May 16th			
2021	3DD.003D82A6B4	The Dalles East Ladder - July 23rd		McNary - December 3rd Three Mile Dam (Umatilla) - December 11th Lower Umatilla - December 24th	Bonneville Corner Collector - May 20th			
2021	3DD.003D82A3A5	Lower Klickitat - July 20th			Bonneville Corner Collector - May 22nd			
2021	3DD.003D82983A	The Dalles East Ladder - September 10th	Lower Granite - September 19th		Lower Imnaha - April 8th Upper Imnaha - May 4th to 21st Lower Granite Spillway - May 28th	Bonneville Corner Collector - June 5th		
2021	3DD.003D82A73B	The Dalles North Ladder - October 14th	McNary - October 20th		Bonneville Corner Collector - April 2nd			
2021	3DD.003D82A928	The Dalles East Ladder - October 14th	Lower Granite - October 25th		Lower Clearwater - April 8th Lower Clearwater - May 3rd Bonneville Corner Collector - May 20th			
2021	3DD.003D82A77F	The Dalles East Ladder - August 29th	Lower Granite - September 21st		Lower Asotin - March 4th Middle Asotin - May 3rd	Bonneville Corner Collector - June 2nd		
2021	3DD.003D82A763	The Dalles East Ladder - August 20th			Middle Touchet (Walla Walla) - April 23rd Upper Touchet (Walla Walla) - April 28th to 30th	Middle Touchet (Walla Walla) - June 18th Bonneville Corner Collector - June 24th		
2021	3DD.003D829BA9	The Dalles North Ladder - September 11th	Lower Granite - September 25th		Upper Salmon - March 27th Yankee Fork (Salmon) - April 19th	Little Goose Juvenile Bypass - June 23rd Bonneville Corner Collector - July 5th		
2021	3DD.003D82AE91	The Dalles East Ladder - September 16th	Lower Granite - September 27th			Little Granite Spillway - June 25th Bonneville Corner Collector - July 9th		
2021	3DD.003D82987B	The Dalles East Ladder - September 12th	Lower Granite - September 23rd		Bonneville Juvenile Bypass - May 21st			
2021	3DD.003D82AAF4	The Dalles East Ladder - September 30th				Bonneville Ladders - August 20th		Steelhead likely spawned in spring and then may have entered the ocean for a short period before heading back upriver.
2021	3DD.003D82A36C	The Dalles East Ladder - August 20th	Prosser Dam (Yakima) - November 10th				Bonneville Ladders - August 2nd John Day - September 21st	Steelhead likely spawned in spring and then may have entered the ocean for a short period before heading back upriver.
2021	3DD.003D82A981	The Dalles North Ladder - October 13th	Lower Granite - October 27th		Little Goose Juvenile Bypass - May 16th			
2021	3DD.003D82AB73	The Dalles East Ladder - October 2nd	Lower Granite - October 12th		Big Creek (Salmon) - May 16th	Little Goose Juvenile Bypass - June 20th		
2021	3DD.003D82AF5F	The Dalles East Ladder - September 19th	Lower Granite - October 15th		Upper Lochsa (Clearwater) - March 5th Upper Lochsa (Clearwater) - March 15th Little Goose Juvenile Bypass - May 9th			
2021	3DD.003D8295E4	The Dalles East Ladder - July 1st	Lower Granite - July 29th			Lower Granite Juvenile Bypass - June 13th		
2021	3DD.003D82986E	The Dalles East Ladder - September 2nd	Lower Granite - October 1st		Lower Granite Spillway - May 26th			
2021	3DD.003D82A6A4	The Dalles North Ladder - July 29th	Lower Granite - September 22nd		Lower Granite Spillway - April 26th			
2021	3DD.003D82A080	The Dalles East Ladder - September 20th	Lower Granite - November 23rd		Lower Granite Spillway - April 17th			
2021	3DD.003D82AB3E	The Dalles North Ladder - October 10th	Lower Granite - October 13th		Lower Granite Spillway - April 9th			
2021	3DD.003D82AEA5	The Dalles East Ladder - September 20th	Lower Granite - October 15th		Lower Granite Spillway - May 19th			
2021	3DD.003D829832	The Dalles East Ladder - September 10th	Lower Granite - September 28th			Lower Granite Spillway - June 9th		
2021	3DD.003D82AEBA	The Dalles East Ladder - September 20th	Lower Granite - November 1st		Lower Granite Spillway - May 7th			
2021	3DD.003D82A6F4	The Dalles East Ladder - September 21st	Lower Granite - October 3rd		Lower Wallowa (Grande Ronde) - March 23rd Upper Wallowa(Grande Ronde) - March 31st to April 18th Lower Granite Spillway - May 2nd			
2021	3DD.003D82A76E	The Dalles East Ladder - October 12th	Lower Granite - September 20th		Lower Imnaha - March 28th Lower Granite Spillway - May 11th			
2021	3DD.003D82AAF2	The Dalles East Ladder - October 1st	Lower Granite - October 11th	South Fork Clearwater - February 13th	South Fork Clearwater - April 26th Lower Granite Spillway - May 2nd			
2021	3DD.003D82AB81	The Dalles East Ladder - September 24th	Lower Granite - October 10th		Upper Salmon - April 10th to 16th Lower Granite Spillway - May 28th			
2021	3DD.003D82AB96	The Dalles East Ladder - September 23rd	Lower Granite - October 2nd		South Fork Clearwater - March 3rd South Fork Clearwater - April 11th Lower Granite Spillway - April 28th			
2021	3DD.003D82AF52	The Dalles East Ladder - September 23rd	Lower Granite - October 5th		EF of SF Salmon - May 4th	Middle SF Salmon - June 16th to 21st Lower Granite Spillway - June 27th		
2021	3DD.003D82A6DE	The Dalles East Ladder - September 14th	Lower Granite - September 27th			EF of SF Salmon - May 4th Lower Granite Spillway - June 14th		
2021	3DD.003D82AEEA	The Dalles East Ladder - September 19th	Lower Granite - September 30th		Upper Salmon - March 26th Lower Granite Spillway - May 2nd			
2021	3DD.003D82AD56	The Dalles East Ladder - September 24th	Lower Granite - November 28th		White Bird Creek (Salmon) - March 16th White Bird Creek (Salmon - April 9th Lower Granite Spillway - May 1st			
2021	3DD.003D82AB6A	The Dalles East Ladder - October 3rd		McNary - February 28th	McNary - March 3rd South Fork Clearwater - March 18th Lower Granite Spillway - April 14th			

Table C2 (Continued).

Tag Year	Tag Number	First Detection After Tagging 2021 in All Seasons	Summer/Fall 2021	Winter 2021/22	Spring 2022	Summer 2022	Fall 2022	Comments
2021	3DD.003D82A904	The Dalles East Ladder - October 6th	Middle Methow - October 25th		Twisp River (Methow) - March 5th Rocky Reach Juvenile Bypass - May 14th			
2021	3DD.003D829C64	The Dalles East Ladder - September 4th	Lower Okanagan - September 28th Lower Okanagan - October 1st		Lower Entiat - April 13th Roaring Creek (Entiat) - April 28th to 30th Lower Entiat - May 4th Rocky Reach Juvenile Bypass - May 11th			
2021	3DD.003D82989E	The Dalles East Ladder - August 29th	Wells - September 18th	Lower Entiat - December 14th	Lower Entiat - March 2nd Lower Entiat - May 28th Rocky Reach Juvenile Bypass - May 29th			
2021	3DD.003D829821	The Dalles East Ladder - September 10th	Lower Methow - October 26th		Gold Creek (Methow) - May 8th to 23rd Libby Creek (Methow) - May 23rd to June 1st	Rocky Reach Juvenile Bypass - June 4th		
2021	3DD.003D8294B4	The Dalles North Ladder - July 17th	Lower Enitat - September 17th		Upper Entiat - March 23rd Mad River (Entiat) -March 24th to April 6th Rocky Reach Juvenile Bypass - April 23rd			
2021	3DD.003D829876	The Dalles East Ladder - September 1st	Lower Okanagan - November 2nd		Middle Methow - March 30th Rocky Reach Juvenile Bypass - April 29th			
2021	3DD.003D829B7E	The Dalles East Ladder - September 12th	Lower Methow - September 30th		Libby Creek (Methow) - April 24th to May 11th Rocky Reach Juvenile Bypass - May 21st			
2021	3DD.003D82A316	The Dalles East Ladder - July 13th	Lower Wenatchee - September 26th		Icicle Creek (Wenatchee) - March 7th Icicle Creek (Wenatchee) - April 21st			
2021	3DD.003D82957D	The Dalles East Ladder - June 30th	Lower Wenatchee - July 14th		Peshastin Creek (Wenatchee) - April 24th Peshastin Creek (Wenatchee) - May 21st			
2021	3DD.003D8298A8	John Day North Ladder - August 29th	Rocky Reach - September 19th		Lower Entiat - March 4th Lower Entiat - April 9th			
2021	3DD.003D82A788	The Dalles East Ladder - September 6th	Lower Methow - September 22nd		Middle Methow - March 3rd Middle Methow - April 4th			
2021	3DD.003D82A758	The Dalles East Ladder - August 22nd	McNary - October 2nd		South Fork John Day - March 28th South Fork John Day - May 7th			
2021	3DD.0077BCD2A1	The Dalles East Ladder - October 14th	John Day - November 30th		Upper John Day - April 8th Upper John Day - May 22nd			
2021	3DD.003D829C20	The Dalles East Ladder - September 2nd	McNary - September 6th	Three Mile Dam (Umatilla) - January 25th	Three Mile Dam (Umatilla) - May 14th			
2021	3DD.003D82A96F	The Dalles East Ladder - October 15th	John Day - October 17th		Three Mile Dam (Umatilla) - March 10th Three Mile Dam (Umatilla) - May 19th			
2021	3DD.003D829C88	The Dalles East Ladder - September 4th	Lower Walla Walla - November 9th		Mill Creek (Walla Walla) - March 22nd Mill Creek (Walla Walla) - May 3rd			
2021	3DD.003D82AAE7	The Dalles East Ladder - September 30th	Ice Harbor - October 10th		Middle Touchet (Walla Walla) - March 12th Upper Touchet (Walla Walla) - March 18th to 20th Lower Touchet (Walla Walla) - May 29th			
2021	3DD.003D82AB52	The Dalles East Ladder - October 3rd	Lower Walla Walla River - October 26th		Middle Touchet (Walla Walla - March 8th Upper Touchet (Walla Walla) - March 14th to 27th Middle Touchet (Walla Walla - May 16th			
2021	3DD.003D829B9A	The Dalles East Ladder - September 11th	Lower Monumental - October 30th		Lower Tucannon - March 12th Middle Tucannon - March 20th to April 9th Lower Tucannon - April 10th			
2021	3DD.003D82A978	The Dalles East Ladder - October 14th	Lower Granite - October 27th		Lower Asotin - April 24th Lower Asotin - May 13th			
2021	3DD.003D829B89	The Dalles East Ladder - September 15th	Lower SF Clearwater - November 30th	Lower SF Clearwater - February 11th	Lower SF Clearwater - April 14th			
2021	3DD.003D82AB30	The Dalles East Ladder - October 1st	Lower Granite - October 12th		Lower Lochsa (Clearwater) - March 26th Upper Lochsa (Clearwater) - March 27th	Upper Lochsa (Clearwater) - June 1st		
2021	3DD.003D82A977	The Dalles North Ladder - October 9th	McNary - November 13th	Ice Harbor - December 14th	McNary - March 17th Lower SF Clearwater - April 4th Lower SF Clearwater - May 1st			This steelhead was tagged on August 26th, 2020 and had several fall back events passing Bonneville and The Dalles dams more then once. Also unknown where it was between November, 2020 and March 2021.
2021	3DD.003D82AF49	The Dalles East Ladder - September 20th	Lower Granite - October 2nd		Lower Lolo Creek (Clearwater) - April 1st Upper Lolo Creek (Clearwater) - April 2nd to 27th Lower Lolo Creek (Clearwater) - April 28th			This steelhead was tagged on September 18th, 2020, unknown where it was between September, 2020 and December 2020.
2021	3DD.003D82AD2A	The Dalles East Ladder - October 1st	Lower Granite - October 21st		Upper Salmon - April 3rd Upper Salmon - April 25th			
2021	3DD.003D82A74B	The Dalles North Ladder - August 27th	Lower Granite - October 1st		Lower Imnaha - March 26th Grouse Creek (Imnaha) - May 13th to 29th	Lower Imnaha - June 2nd		

Table C2 (Continued).

Tag Year	Tag Number	First Detection After Tagging 2021 in All Seasons	Summer/Fall 2021	Winter 2021/22	Spring 2022	Summer 2022	Fall 2022	Comments
2021	3DD.003D82984B	The Dalles East Ladder - September 10th	Lower Granite - September 21st		Lower Granite Juvenile Bypass - May 9th			Steelhead tagged at Bonneville AFF on September 7th, 2021. Steelhead was recaptured/released on May 29th, 2022 at Lower Granite Dam by CRITFC Kelt Project. Considered a kelt, by Kelt Project.
2021	3DD.003D829BD5	The Dalles East Ladder - September 12th	Lower Granite - September 26th		Lower Imnaha - April 20th Upper Imnaha - May 26th	Lower Granite Juvenile Bypass - June 2nd		Steelhead tagged at Bonneville AFF on September 9th, 2021. Steelhead was recaptured/retained on June 2nd, 2022 at Lower Granite Dam by CRITFC Kelt Project. Considered a kelt, by Kelt Project.
2021	3DD.003D829C57	The Dalles East Ladder - September 3rd	Lower Granite - October 6th		Big Creek (Salmon) - May 16th	Lower Granite Juvenile Bypass - June 20th	Lower Granite - November 27th	Steelhead tagged at Bonneville AFF on September 1st, 2021. Steelhead was recaptured/released on June 21st, 2022 at Lower Granite Dam by CRITFC Kelt Project. Released to spawn on Nov 21, 2022 in the Snake River. Considered a kelt, by Kelt Project.
2021	3DD.003D82A749	The Dalles East Ladder - September 1st	Lower Granite - September 15th		Lower Imnaha - April 8th Grouse Creek (Imnaha) - April 26th to May 30th	Lower Granite Juvenile Bypass - June 4th		Steelhead tagged at Bonneville AFF on July 22nd, 2021. Steelhead was recaptured/released on June 7th, 2022 at Lower Granite Dam by CRITFC Kelt Project. Considered a kelt, by Kelt Project.
2021	3DD.003D82AE8E	The Dalles East Ladder - September 16th	Lower Granite - October 10th		Lower Granite Juvenile Bypass - May 19th			Steelhead tagged at Bonneville AFF on September 14th, 2021. Steelhead was recaptured/released on May 20th, 2022 at Lower Granite Dam by CRITFC Kelt Project. Considered a kelt, by Kelt Project.
2021	3DD.003D82AF28	The Dalles East Ladder - September 19th	Lower Granite -September 29th		Lower Salmon - May 2nd	Lower Granite Juvenile Bypass - May 19th		Steelhead tagged at Bonneville AFF on September 17th, 2021. Steelhead was recaptured/retained on June 8th, 2022 at Lower Granite Dam by CRITFC Kelt Project. Considered a kelt, by Kelt Project.
2021	3DD.003D829852	The Dalles East Ladder - October 28th	Prosser Dam (Yakima) - November 10th		Prosser Dam (Yakima) - May 23rd			Steelhead tagged at Bonneville AFF on September 7th, 2021. Steelhead was recaptured/retained on May 23rd, 2022 at Prosser Dam by CRITFC Kelt Project. Considered a kelt, by Kelt Project.

Key - - - Upstream | Downstream | Spawning

Table C3. Season by season activities of steelhead tagged in 2021 and labeled later as kelts or repeat spawners when they began migrating downstream (before April 1st) and upstream in spring, summer, or fall 2021, presumably to and from the ocean.

Tag Year	Tag Number	First Detection After Tagging 2021 in Spring/Summer/Fall	Fall 2021	Winter 2021/22	Spring 2022	Summer 2022	Fall/Winter 2022	Comments
2021	3DD.003D82A69E	The Dalles East Ladder - September 27th	Deschutes Sherars Falls - November 22nd		Bonneville Corner Collector - March 11th			
2021	3DD.003D82A739	The Dalles East Ladder - September 13th	McNary Juvenile - October 7th	Three Mile Dam (Umatilla) - January 15th	Three Mile Feed Canal (Umatilla) - March 29th			
2021	3DD.003D82A75C	The Dalles East Ladder - September 14th	Lower Monumental - September 24th	Lower Tucannon - January 9th Middle Tucannon - January 20th	Upper Tucannon - March 7th to 15th Middle Tucannon - March 21st	Bonneville Ladders - August 23rd	Lower Monumental - October 3rd Lower Tucannon - December 30th	Steelhead likely spent several months in the ocean before returning to spawning again.

Key - - - Upstream | Downstream | Spawning

Table C4. Season by season activities of steelhead tagged in past years 2020, 2019, and 2018 and labeled later as kelts or repeat spawners when they began migrating downstream and upstream presumably to and from the ocean. Any new steelhead or steelhead with additional information from previous annual reports is included here as behavioral detections became available.

Tag Year	Tag Number	First Detection After Tagging and Spring/Summer Following Year	Fall	Winter	Spring	Comments
2020	3DD.003D53A965	The Dalles East Ladder - September 23rd, 2020 Bonneville Ladder - July 17th, 2022	Lower Granite - October 2nd, 2020 Lower Granite Spillway - September 29th, 2022			Steelhead was tagged at Bonneville on July 20th, did not pass The Dalles Dam until September. Likely spawned in Spring 2021 then went to the ocean until Summer 2022. New kelt/repeat spawner.
2020	3DD.003D365A5D	The Dalles East Ladder - August 19th, 2020	Lower Okanagan - September 29th, 2020		Zosel Dam - March 17th, 2021 Vasuex Creek (Okanagan) - April 18th, 2021 Vasuex Creek (Okanagan) - May 9th, 2021	New kelt.
2020	3DD.003D53B170	The Dalles East Ladder - September 23rd, 2020	Lower Monumental - September 29th, 2020 Lower Monumental - October 8th, 2021	Tucannon - February 28th, 2022	Tucannon - March 6th to 31st, 2021	Steelhead spawned in spring and then may have entered the ocean for a short period before heading back upriver. Information added.
2019	3DD.003D365070	The Dalles East Ladder - October 13, 2019	Lower Umatilla - October 19, 2019		Three Mile Dam (Umatilla) - May 5th, 2020	New kelt.
2019	3DD.003D364A6D	The Dalles East Ladder - August 25th, 2019	Lower Granite - September 23rd, 2019		Lapwai Creek (Clearwater) - March 23rd, 2020 Sweetwater Creek (Clearwater) - March 29th to May 4th, 2020 Lapwai Creek (Clearwater) - May 5th, 2020	New kelt.
2019	3DD.0077C0C904	Lower Klickitat - June 23rd, 2019 Bonneville - June 13th, 2021 Lower Klickitat - June 19th, 2021		Little Klickitat - February 6th to 27th, 2020 Lower Little Klickitat - February 19th to 28th, 2022	Lower Klickitat - March 29th, 2020	Steelhead may have spawned in spring and then entered the ocean for a year before heading back upriver and spawned again. Information added.
2019	3DD.003D3649DE	The Dalles East Ladder - July 22nd, 2019 Bonneville - July 5th, 2021	Middle Okanagan - October 25th, 2019 Middle Okanagan - October 25th, 2021		Icicle Creek (Wenatchee) - April 26th, 2020 Sunnyside Diversion Dam (Yakima) - March 26th, 2022	Information added.
2019	3DD.003D364AE9	The Dalles East Ladder - August 31st, 2019	Prosser Dam (Yakima) - October 23rd, 2019		Roza Dam (Yakima) - April 10th, 2020 Prosser Dam (Yakima) - May 27th, 2020 Roza Dam (Yakima) - March 19th, 2021 Sunnyside Dam (Yakima) - April 29th, 2021	Steelhead tagged at Bonneville AFF on August 28th, 2019. Steelhead was recaptured/retained on May 27th, 2019 at Prosser Dam by CRITFC Kelt Project. Released in the Yakima River on October 20th, 2020. Considered a kelt, by Kelt Project. Information added.
2018	3DD.0077C0E750	The Dalles North Ladder - October 11th, 2018	Lower Granite - November 13th, 2018		Lower Lolo Creek (Clearwater) - April 19th, 2019 Lower Lolo Creek (Clearwater) - May 8th, 2019	This steelhead's full information might not have been available in previous years. New kelt.
2018	3DD.0077BA8B3B	The Dalles East Ladder - October 9th, 2018	McNary - October 13th, 2018		Middle Touchet River (Walla Walla) - April 2nd, 2019 Middle Touchet River (Walla Walla) - April 30th, 2019	This steelhead's full information might not have been available in previous years. New kelt.
2018	3DD.0077BA8AE6	The Dalles East Ladder - September 2nd, 2018	Lower Wenatchee - September 24th, 2018		Lower Mission Creek (Wenatchee) - April 20th, 2019 Lower Mission Creek (Wenatchee) - May 25th,	This steelhead's full information might not have been available in previous years. New kelt.

Key - - - Upstream | Downstream | Spawning

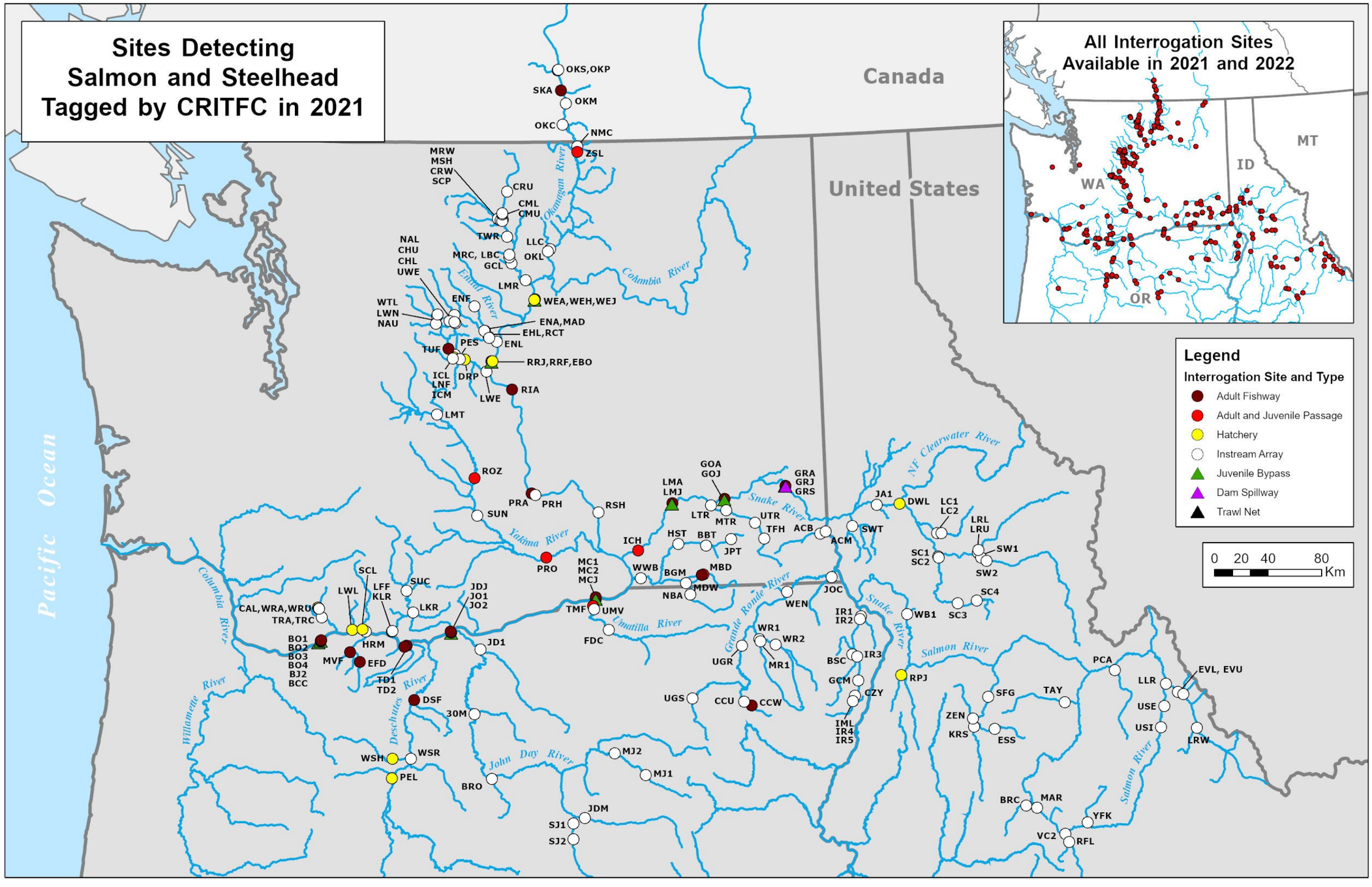

Figure C1. Map of Columbia River interrogation sites that detected Chinook and Sockeye salmon, and steelhead in 2021. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

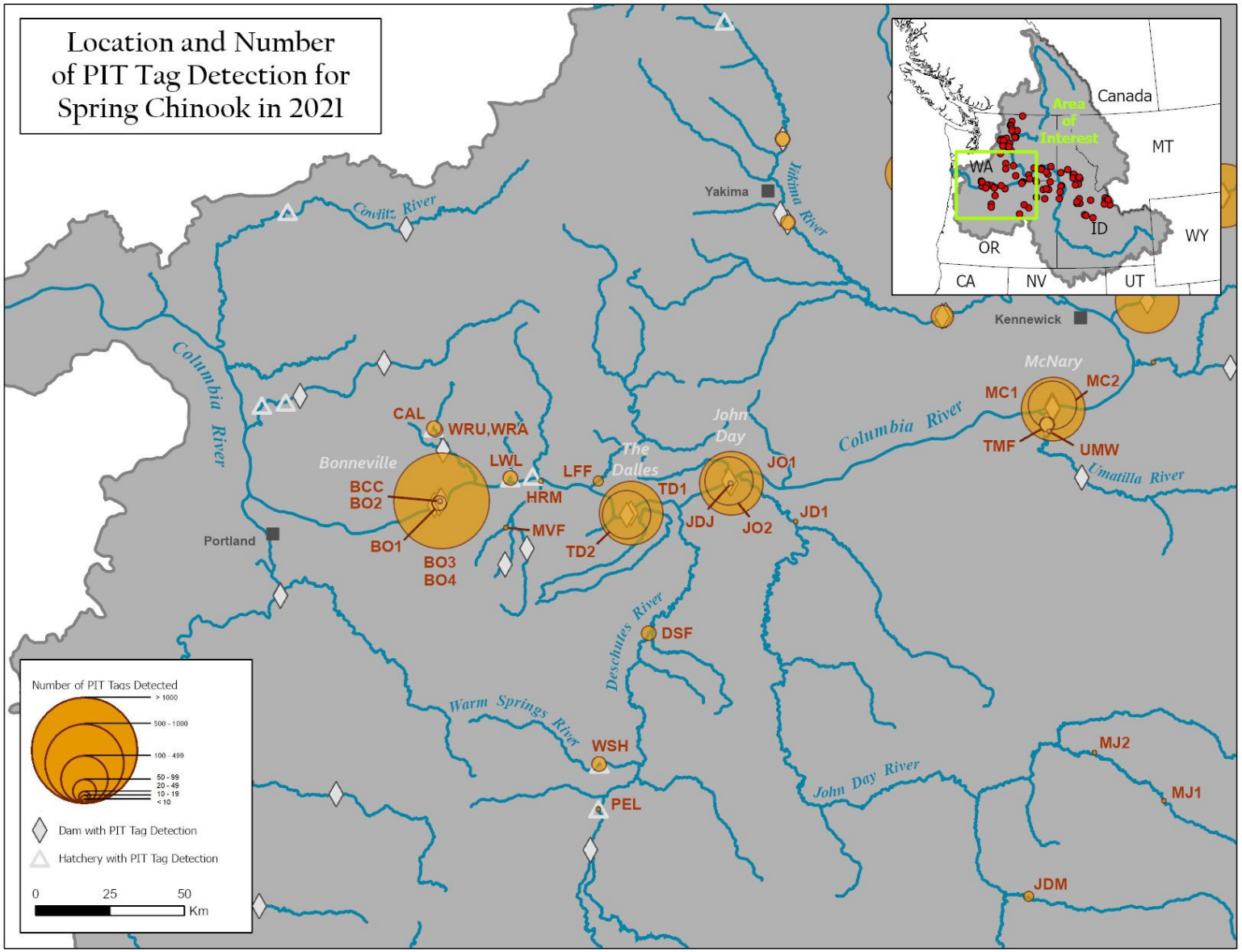

Figure C2. Map of Lower Columbia River detection sites (below Snake River) and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June 1.

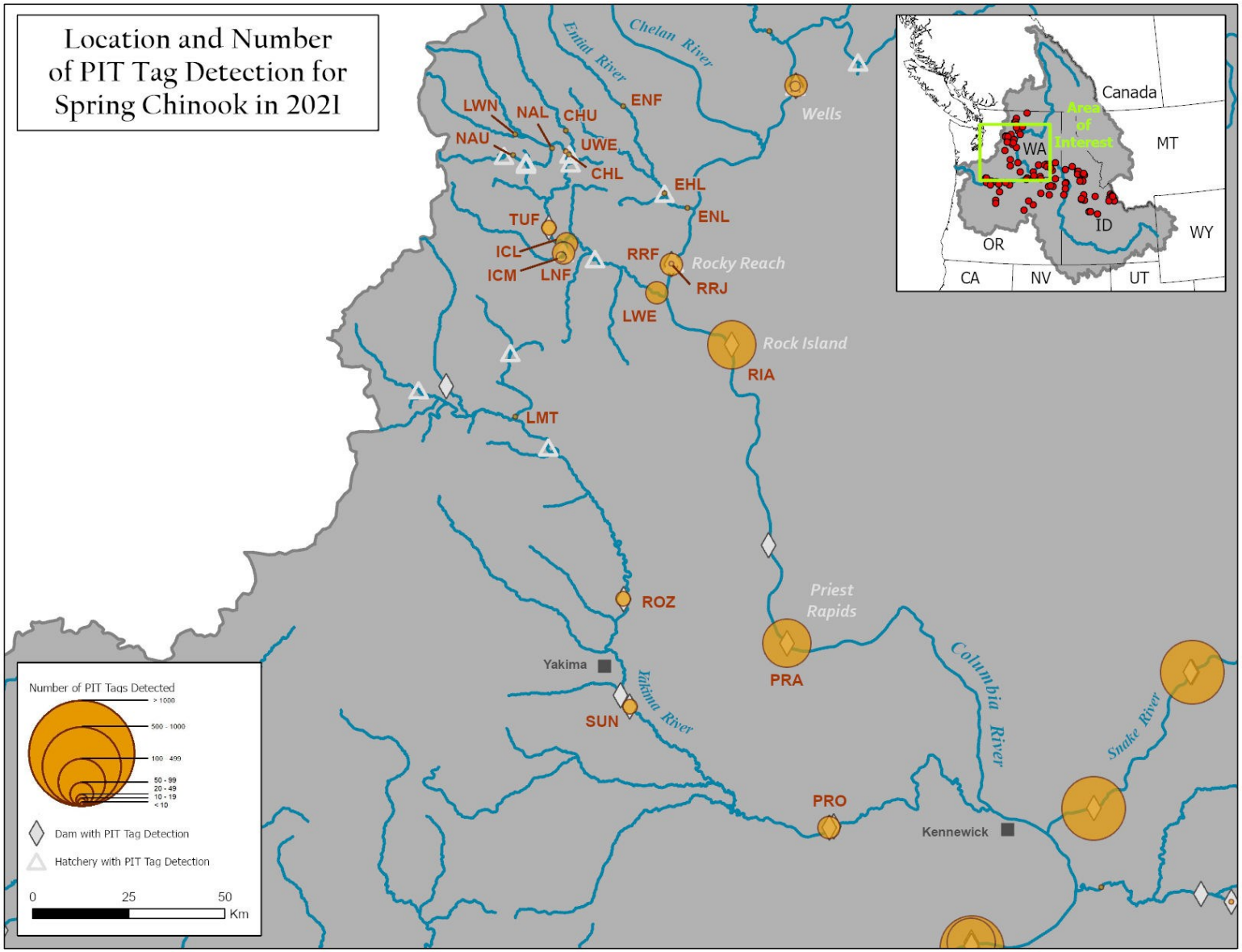

Figure C3. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June 1.

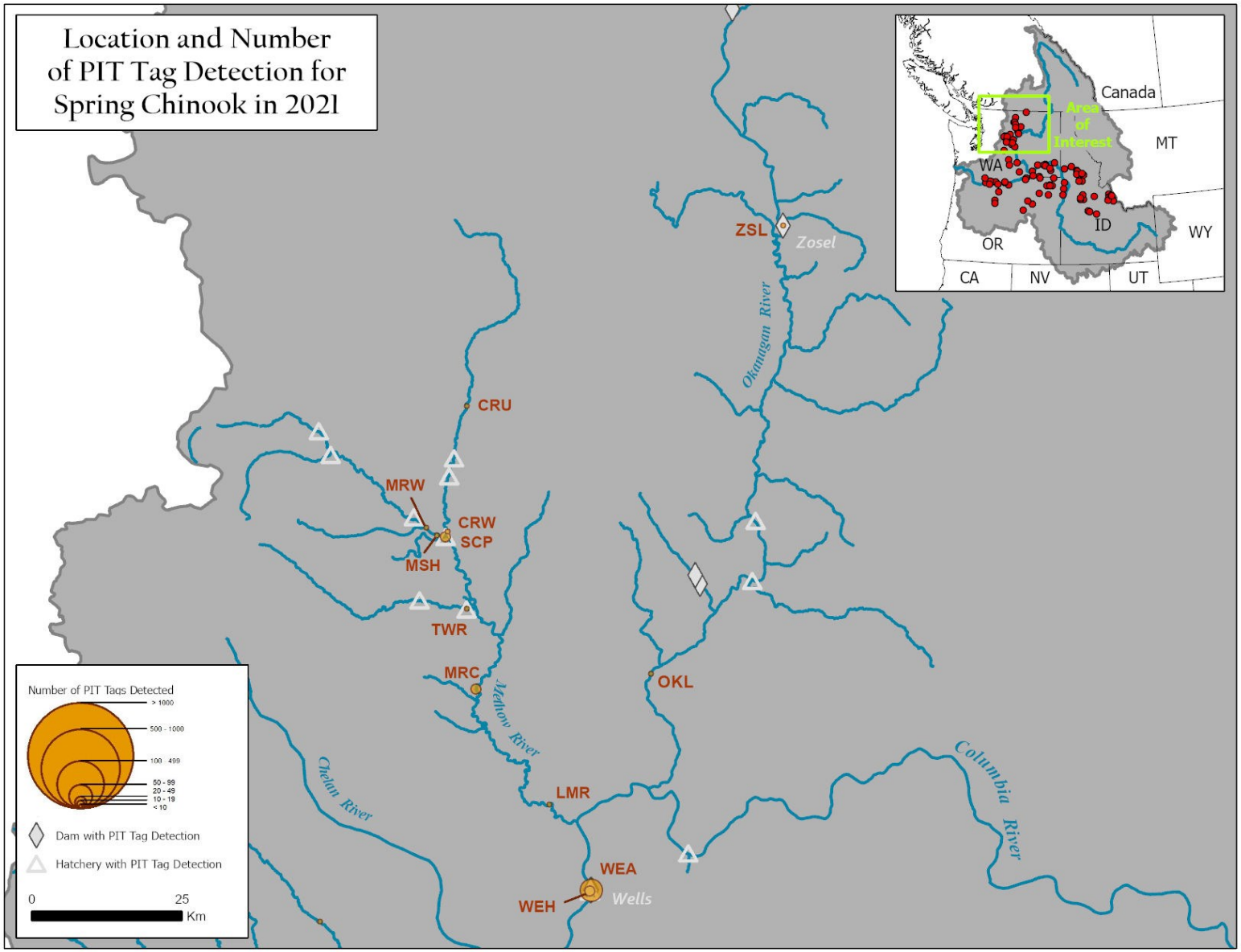

Figure C4. Map of Upper Columbia River (Wells Dam and above) detection sites and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June 1.

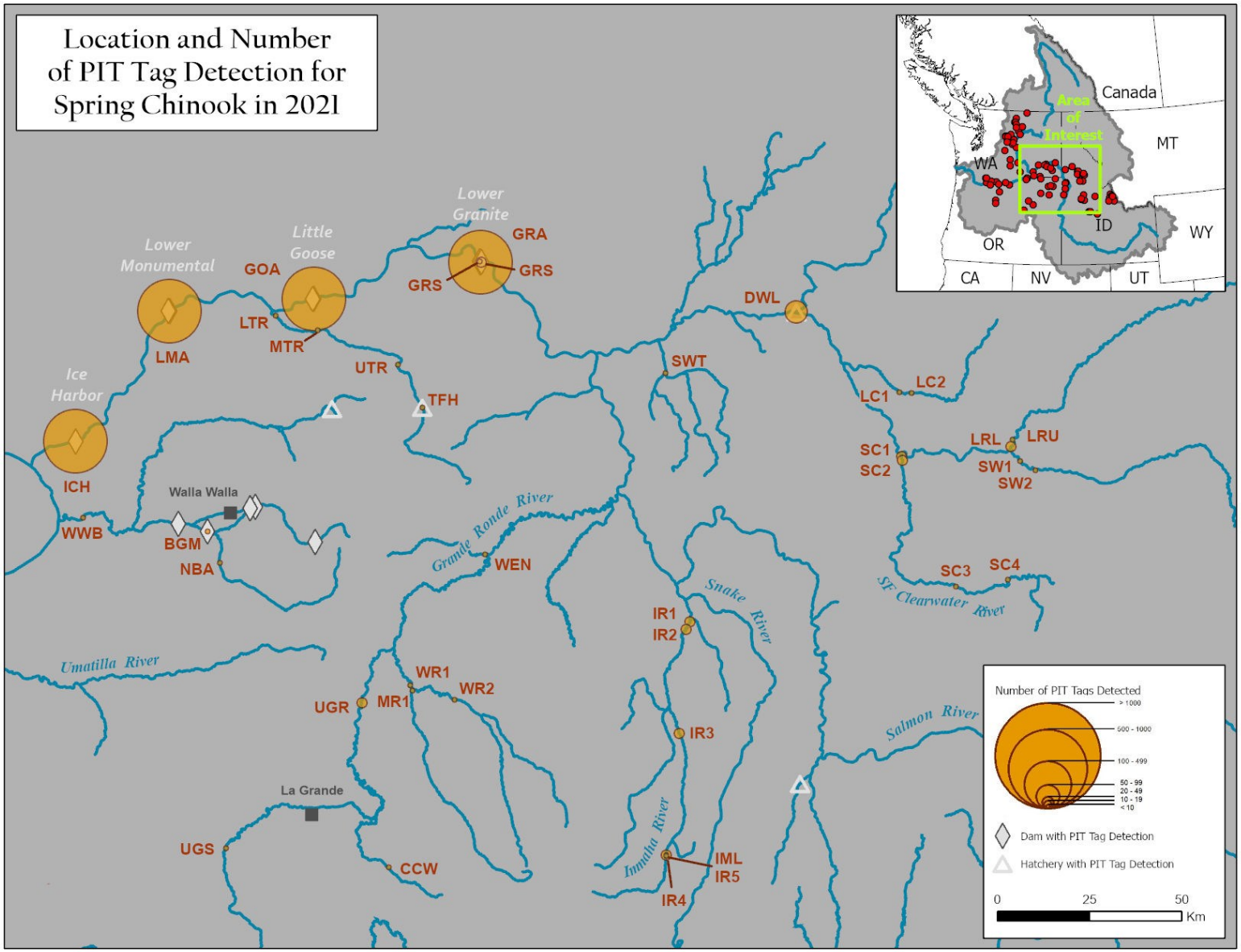

Figure C5. Map of Lower Snake River detection sites (Salmon River not included) and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June 1.

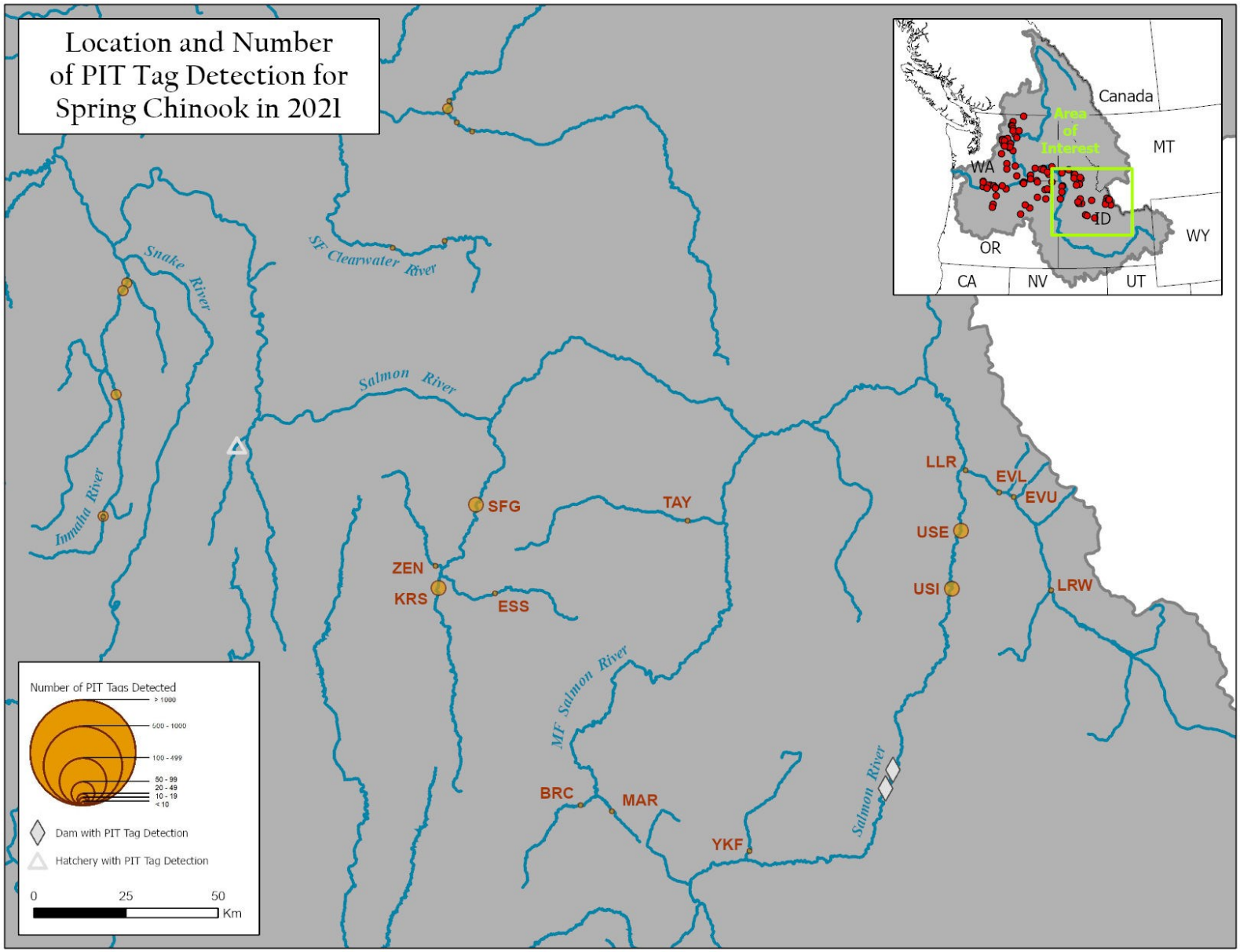

Figure C6. Map of Salmon River detection sites and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June 1.

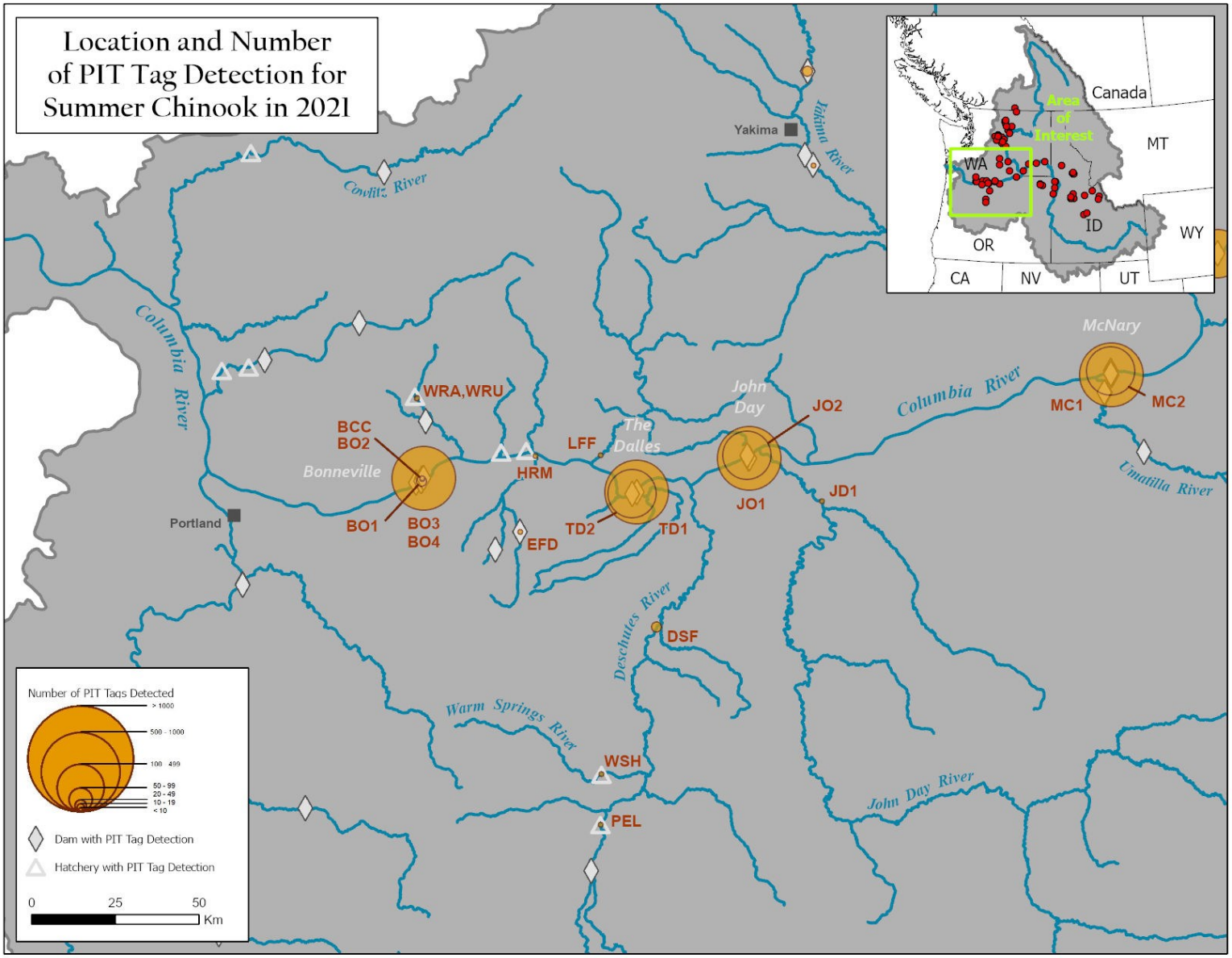

Figure C7. Map of Lower Columbia River detection sites (below Snake River) and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August 1.

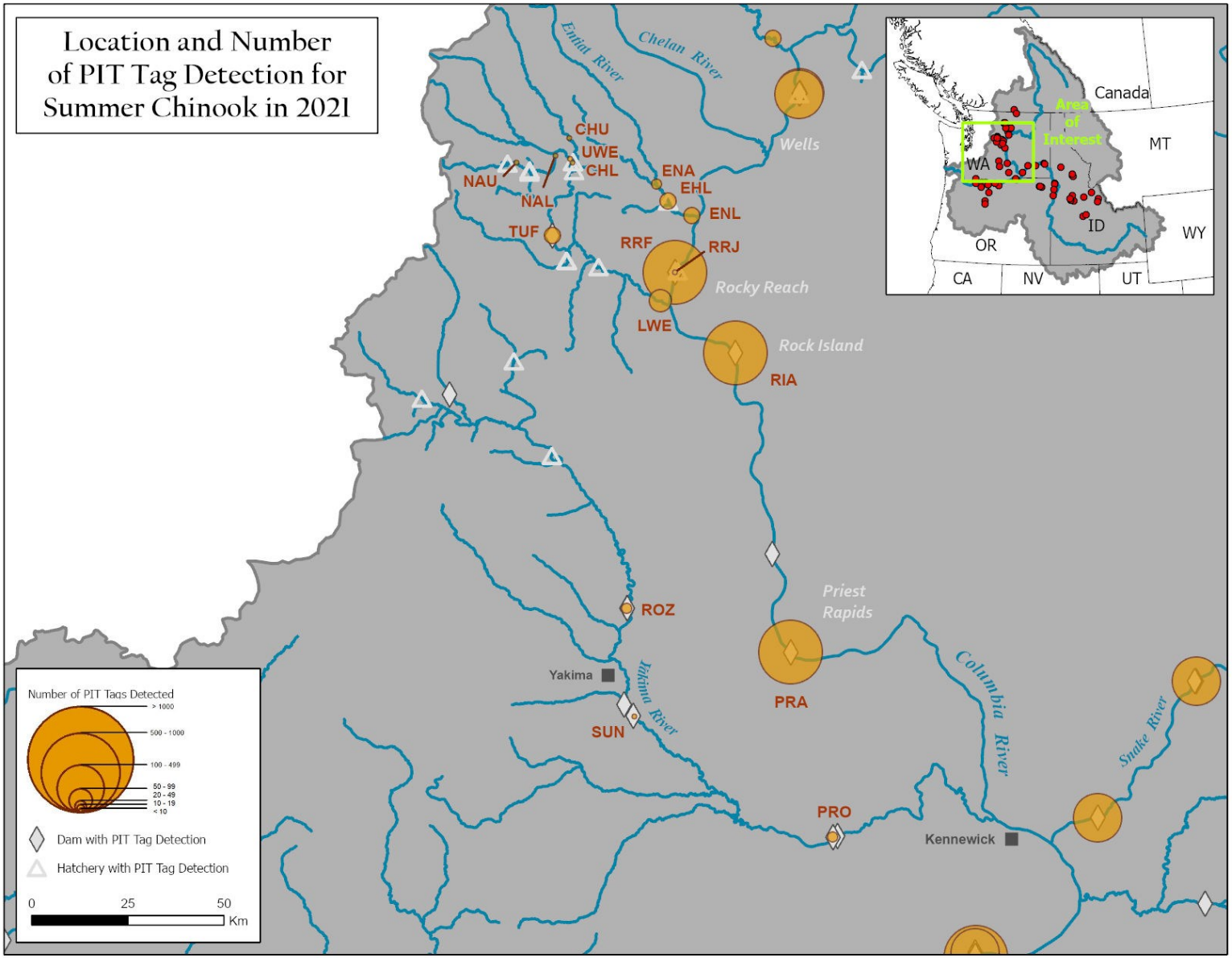

Figure C8. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August 1.

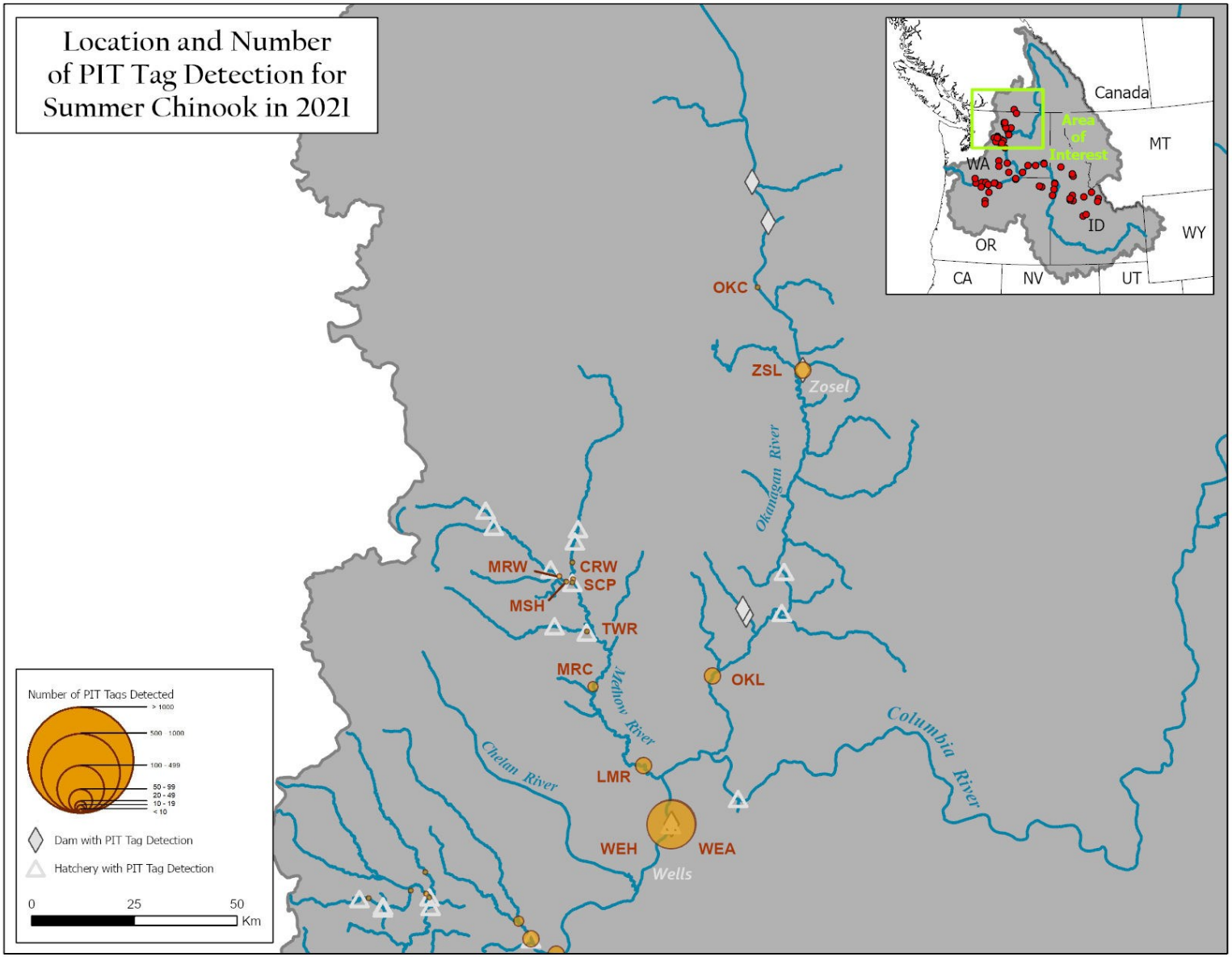

Figure C9. Map of Upper Columbia River (Wells Dam and above) detection sites and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August 1.

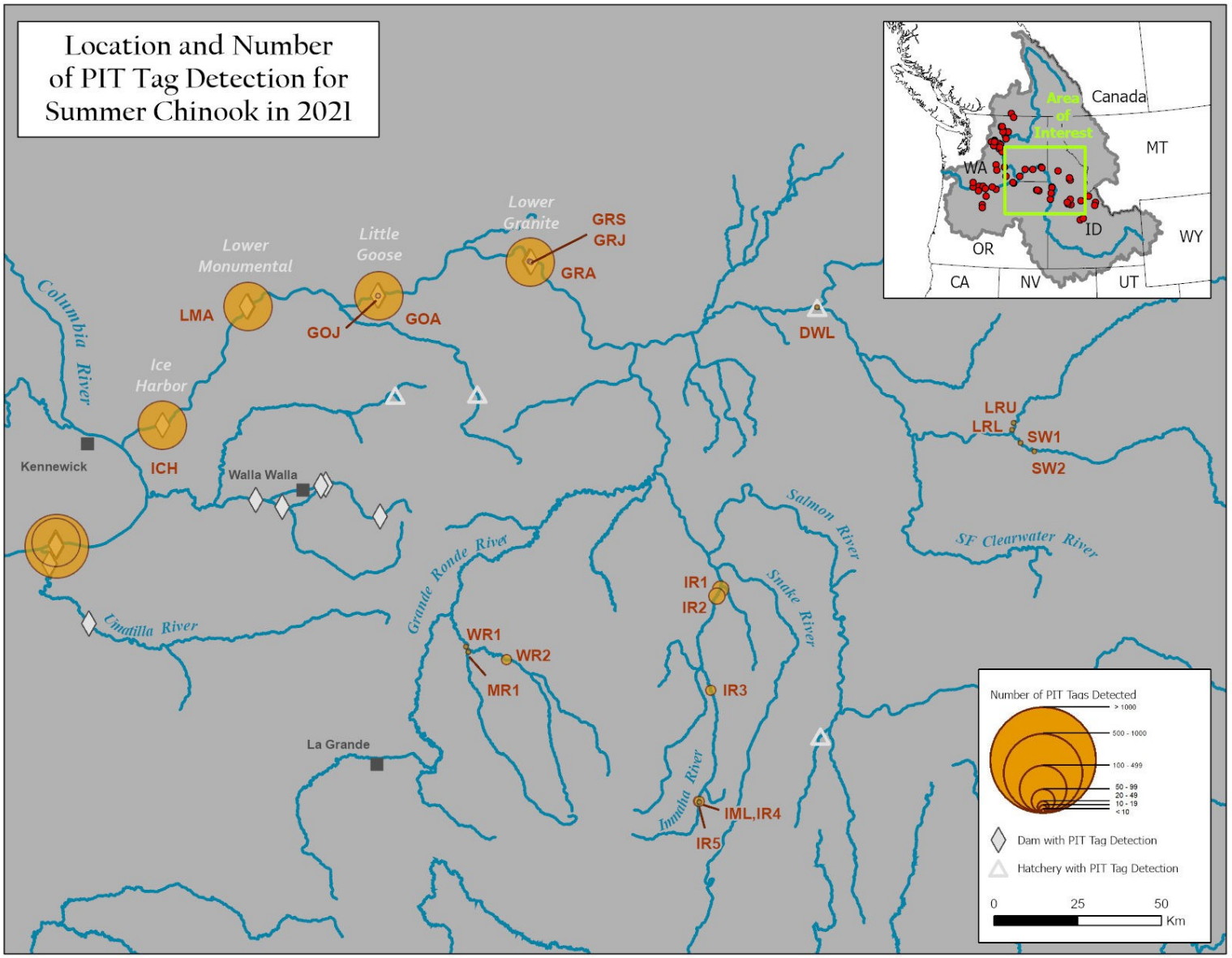

Figure C10. Map of Lower Snake River detection sites (Salmon River not included) and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August 1.

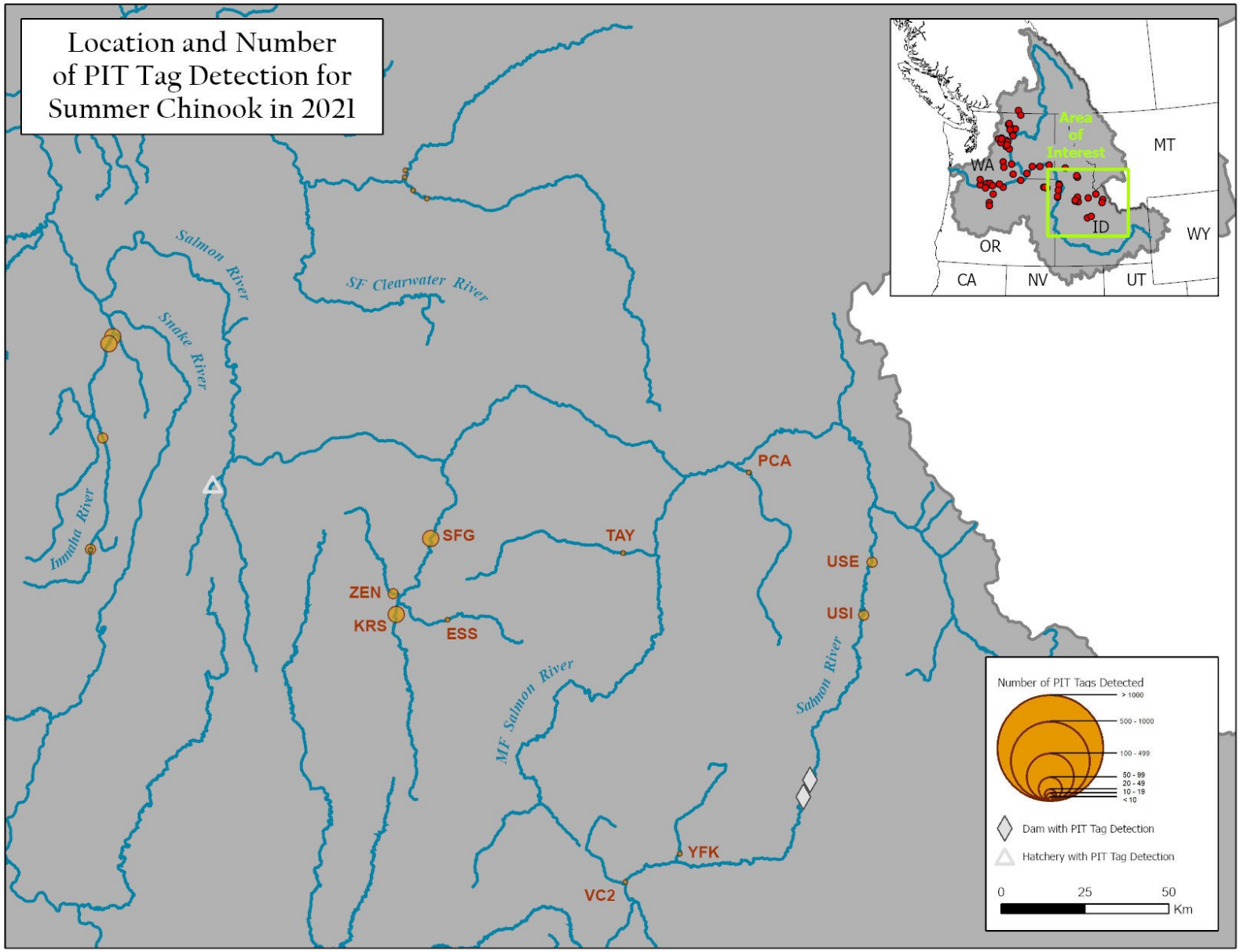

Figure C11. Map of Salmon River detection sites and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August 1.

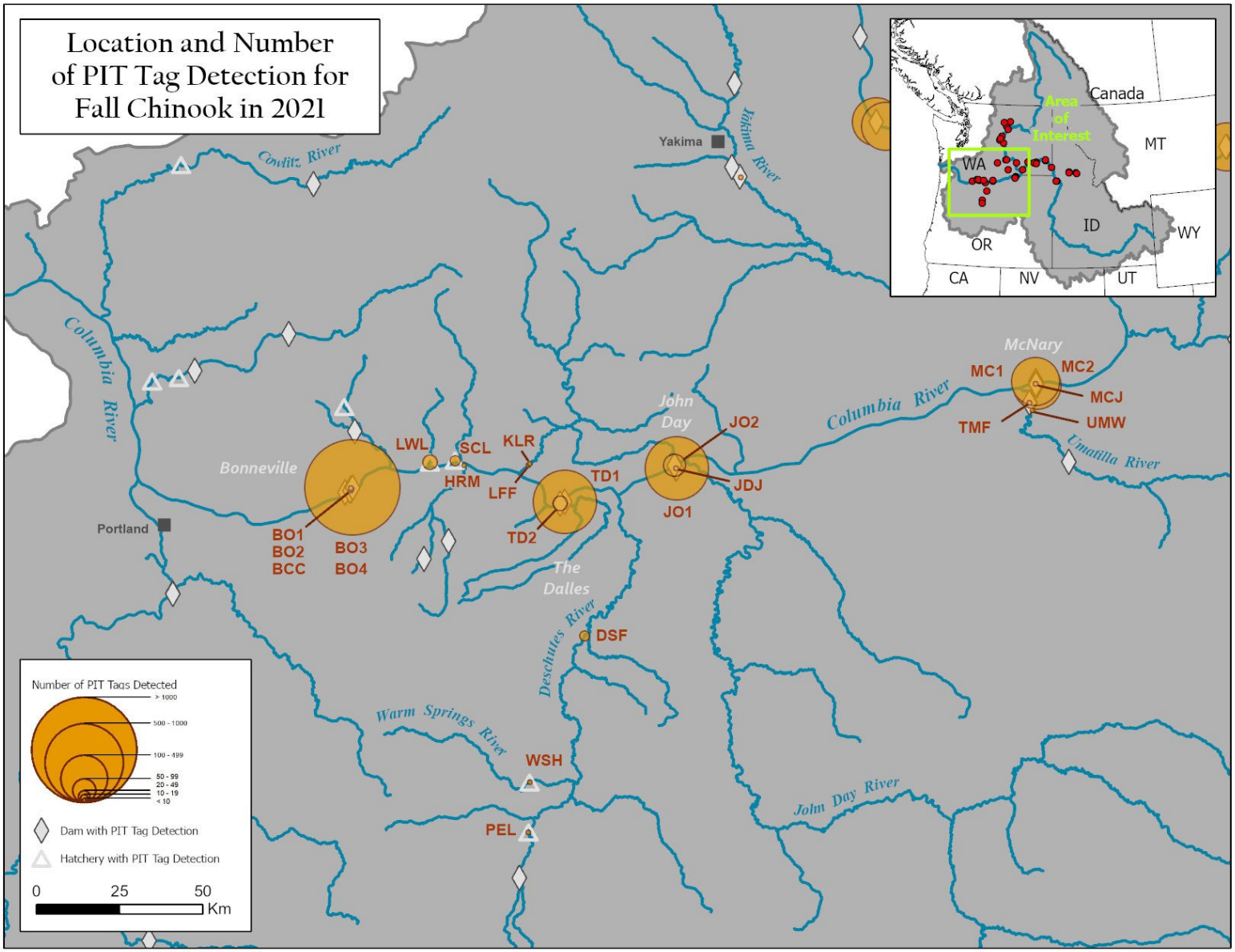

Figure C12. Map of Lower Columbia River detection sites (below Snake River) and number of fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Fall Chinook is defined as fish passing Bonneville Dam from August 1 to end of year.

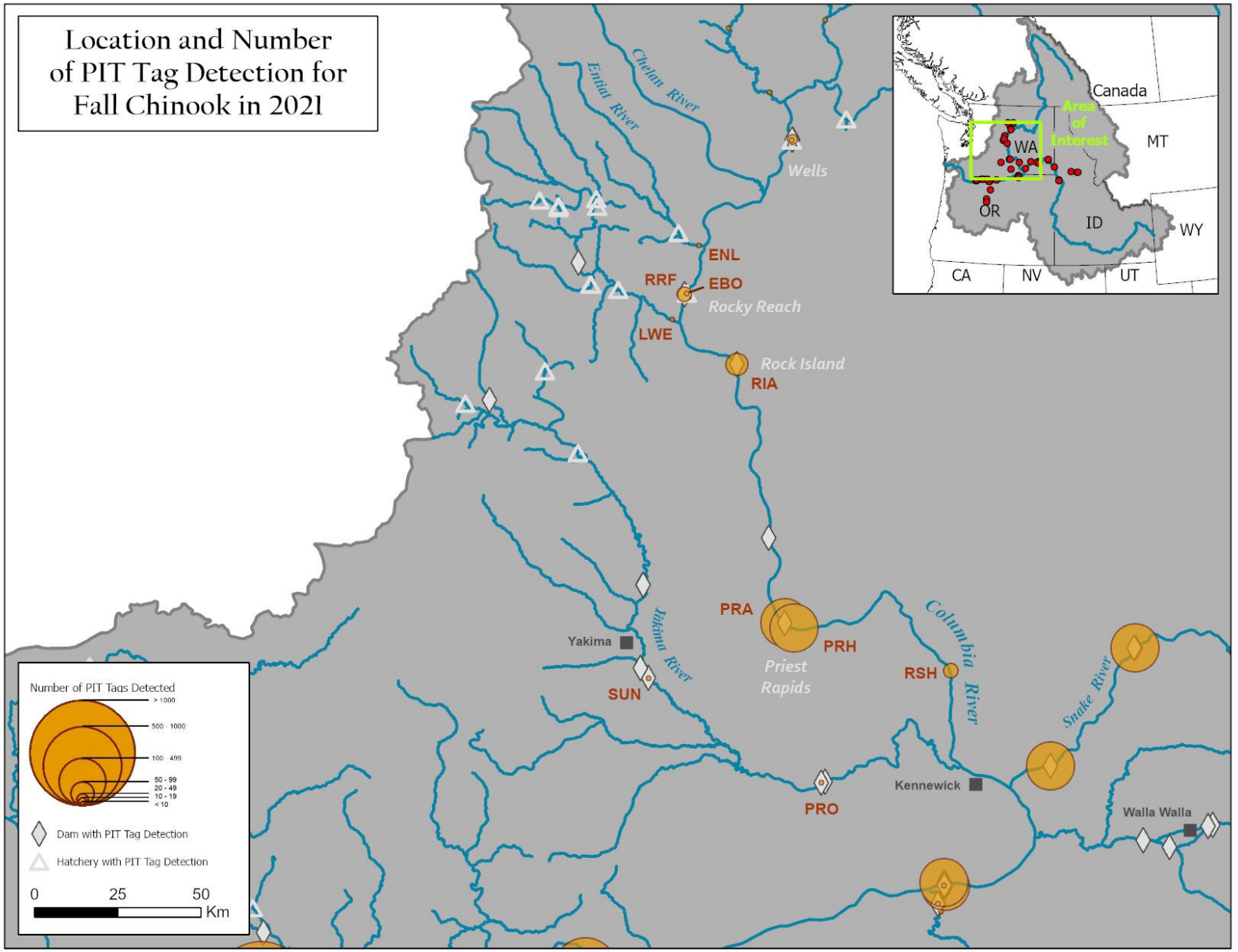

Figure C13. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

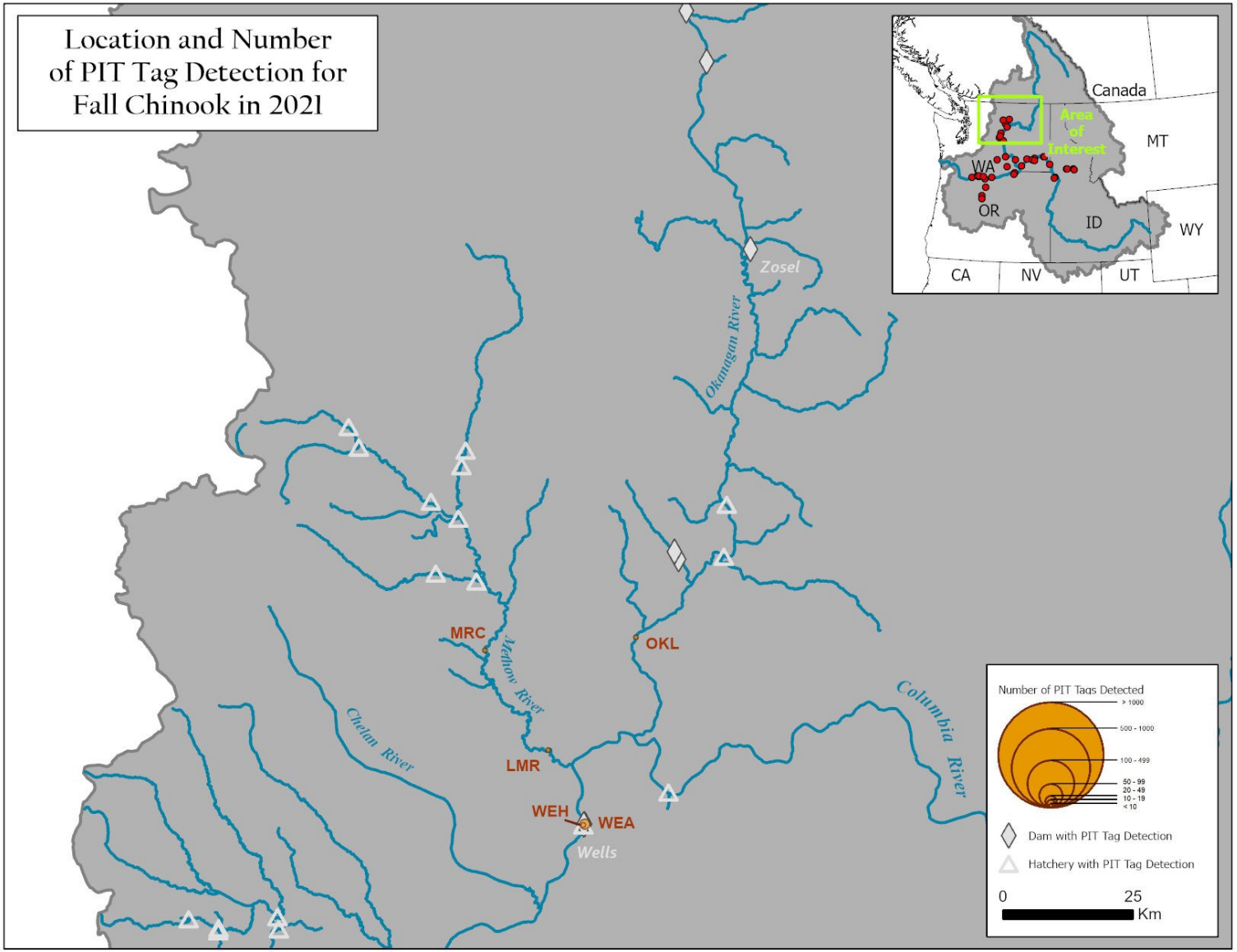

Figure C14. Map of Upper Columbia River detection sites (Wells Dam and above) and number of fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Fall Chinook is defined as fish passing Bonneville Dam from August 1 to end of year.

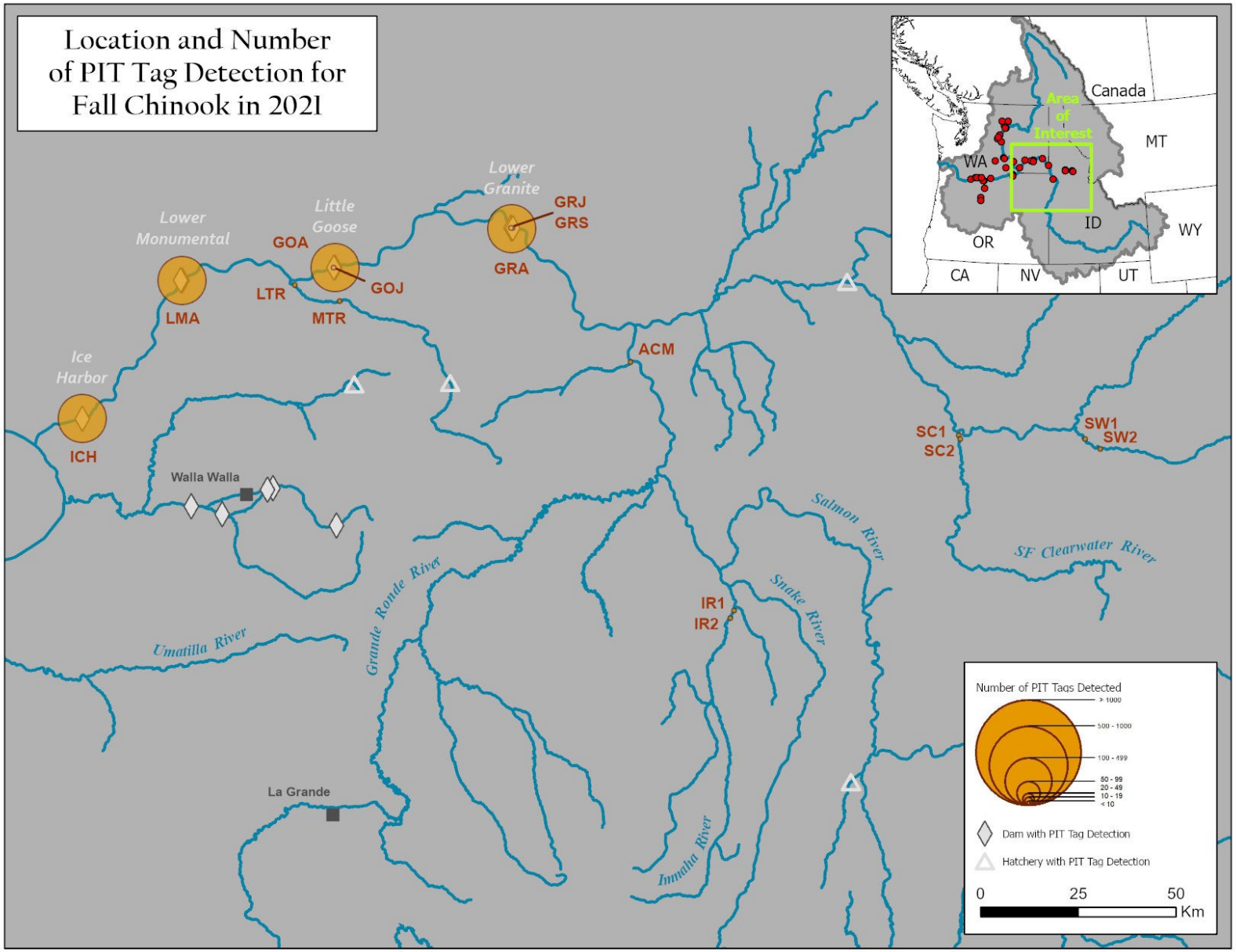

Figure C15. Map of Lower Snake River detection sites and number of fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Fall Chinook is defined as fish passing Bonneville Dam from August 1 to end of year.

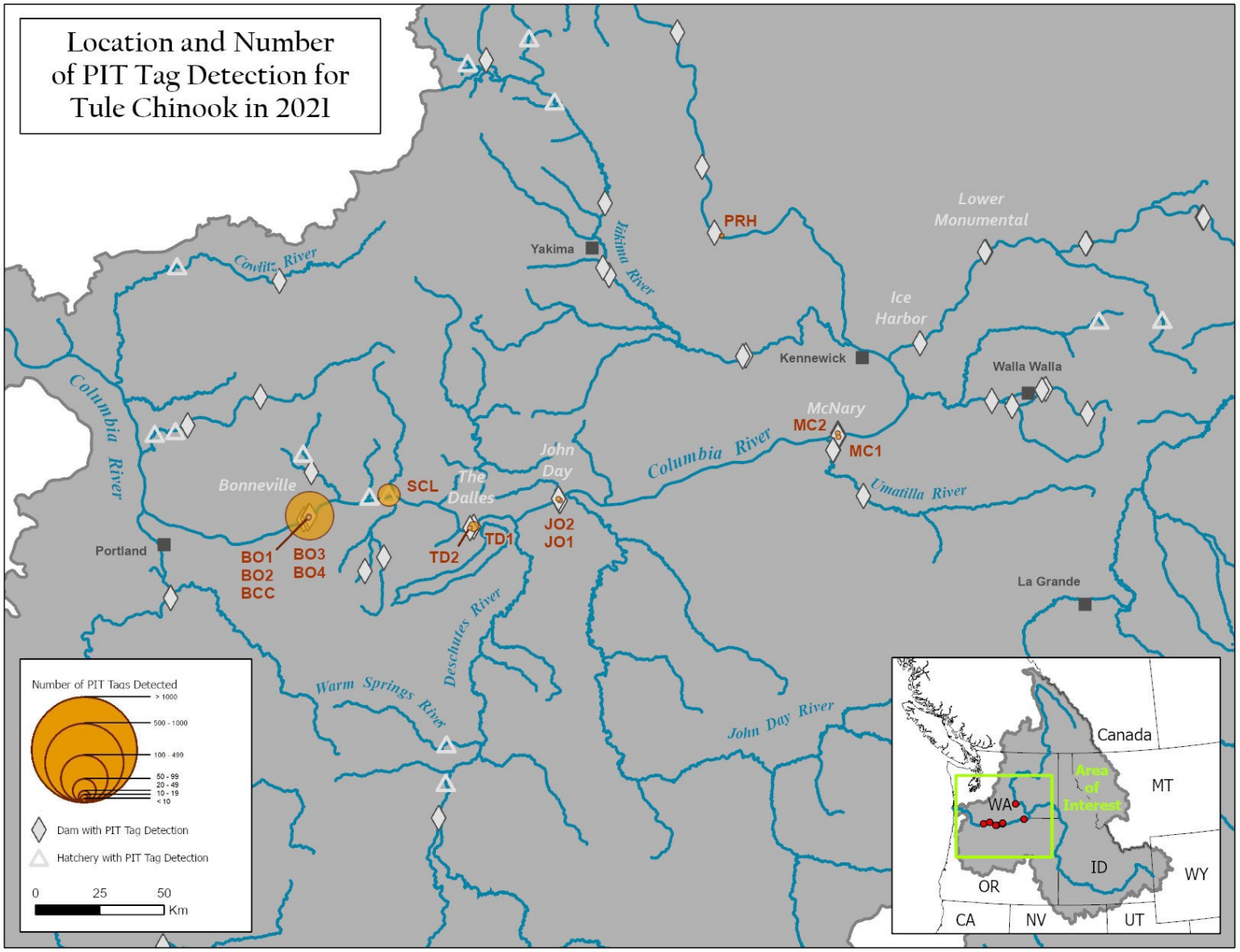

Figure C16. Map of Lower Columbia and Snake rivers detection sites and number of Tule fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Tule Chinook are defined as dark spawning mature fish passing Bonneville Dam near the end of the Chinook run.

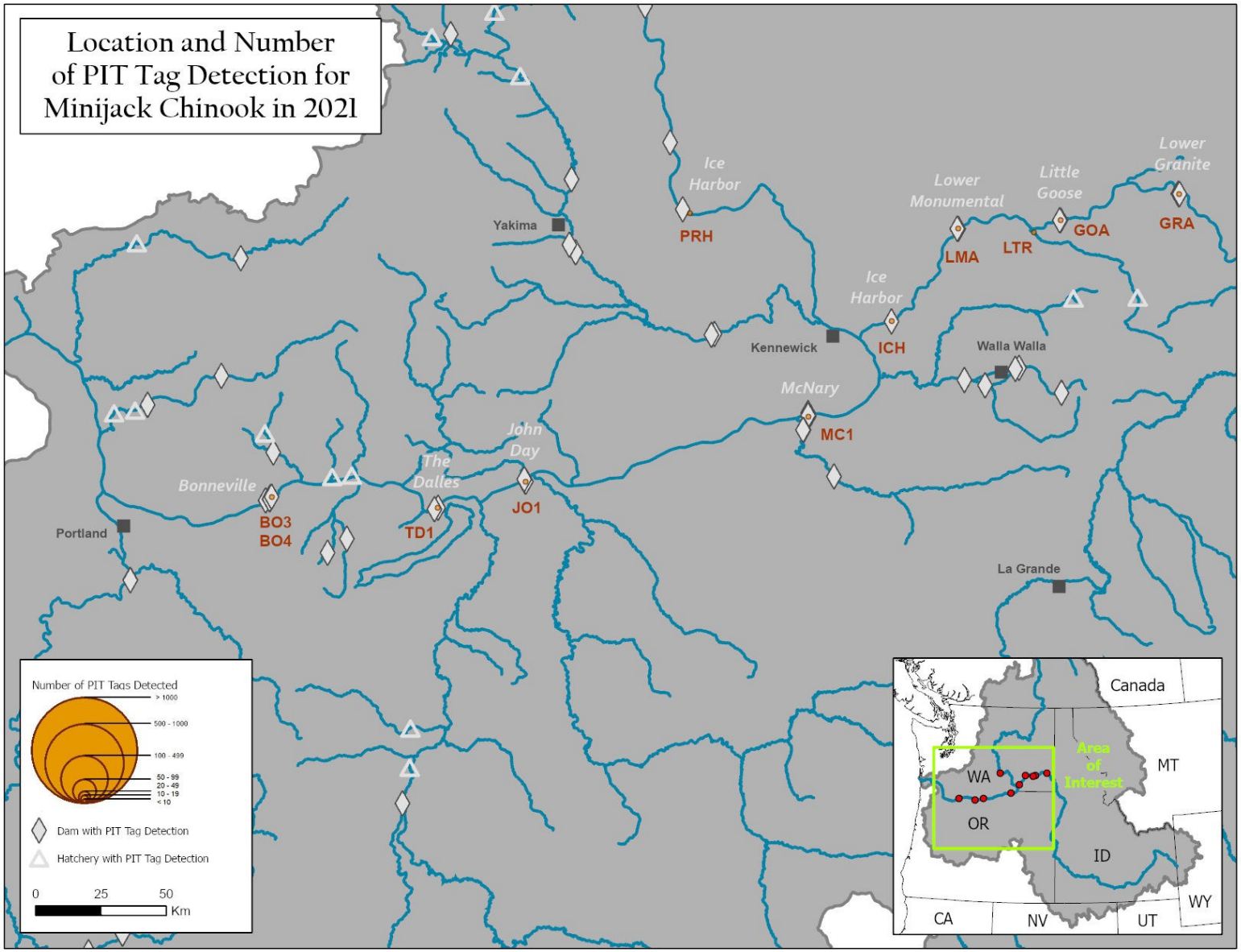

Figure C17. Map of Lower Columbia and Snake rivers detection sites and number of minijack Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Minijack Chinook are defined as early-maturing small chinook that have spent little to no time in the ocean, but are returning to spawn.

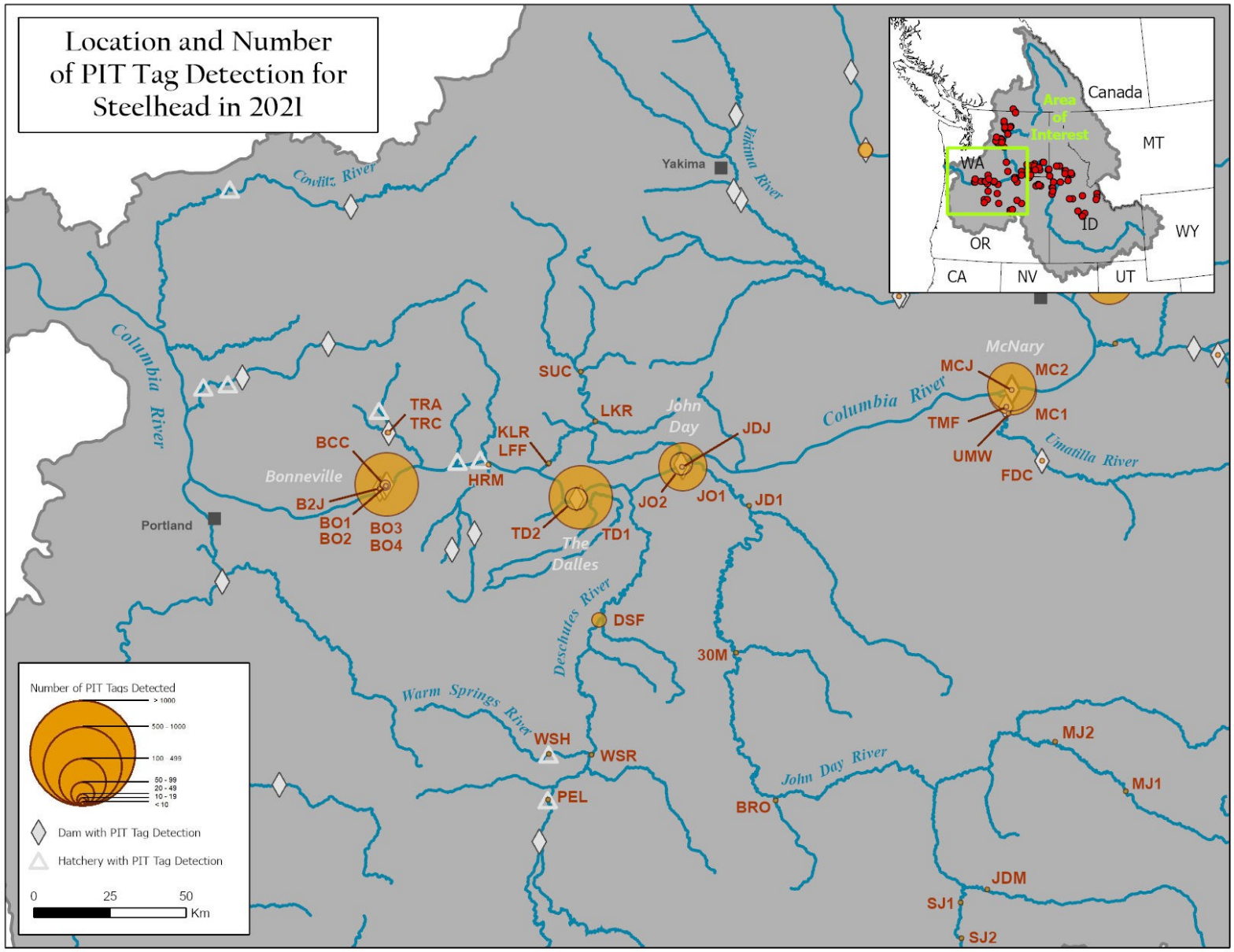

Figure C18. Map of Lower Columbia River detection sites (below Snake River) and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

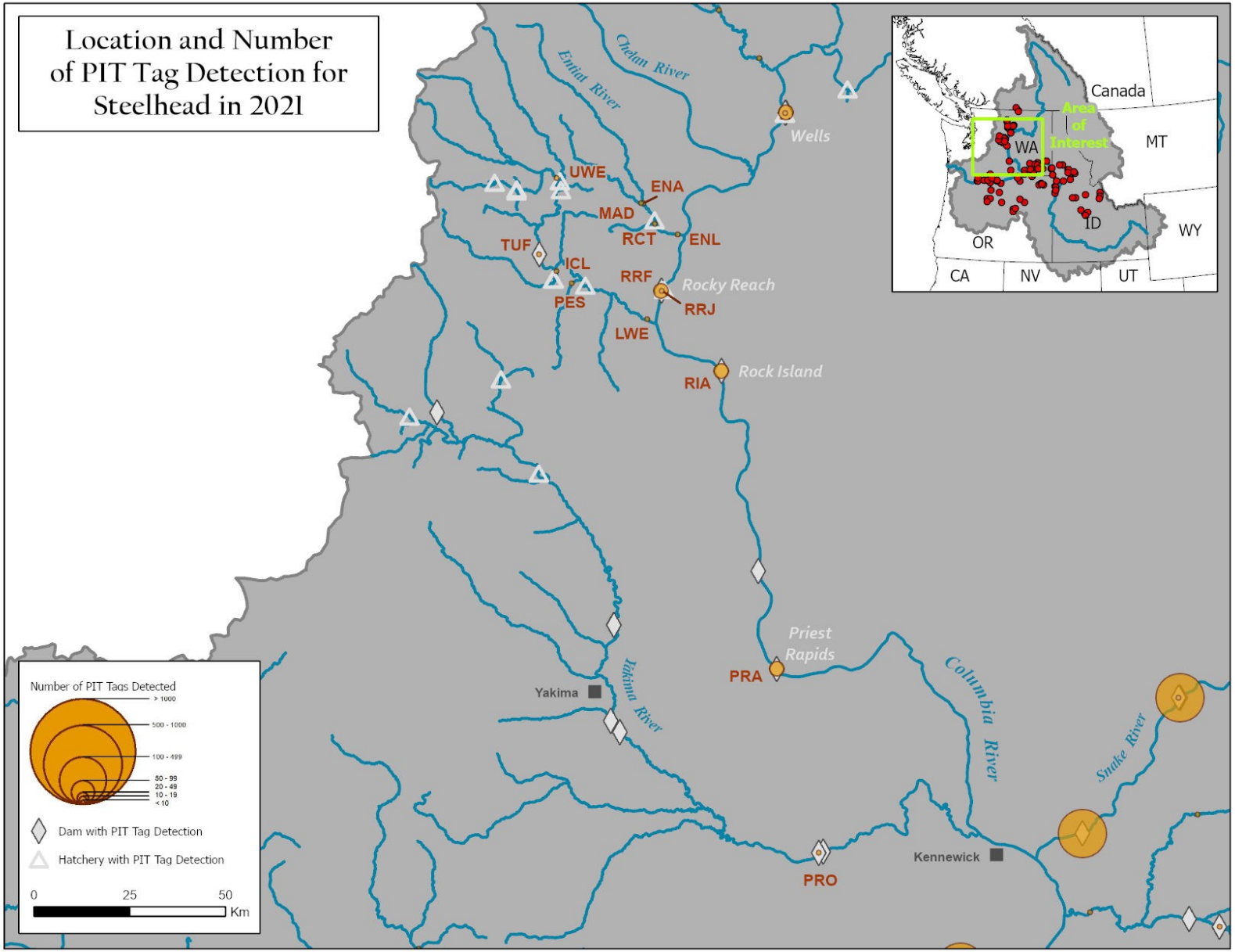

Figure C19. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

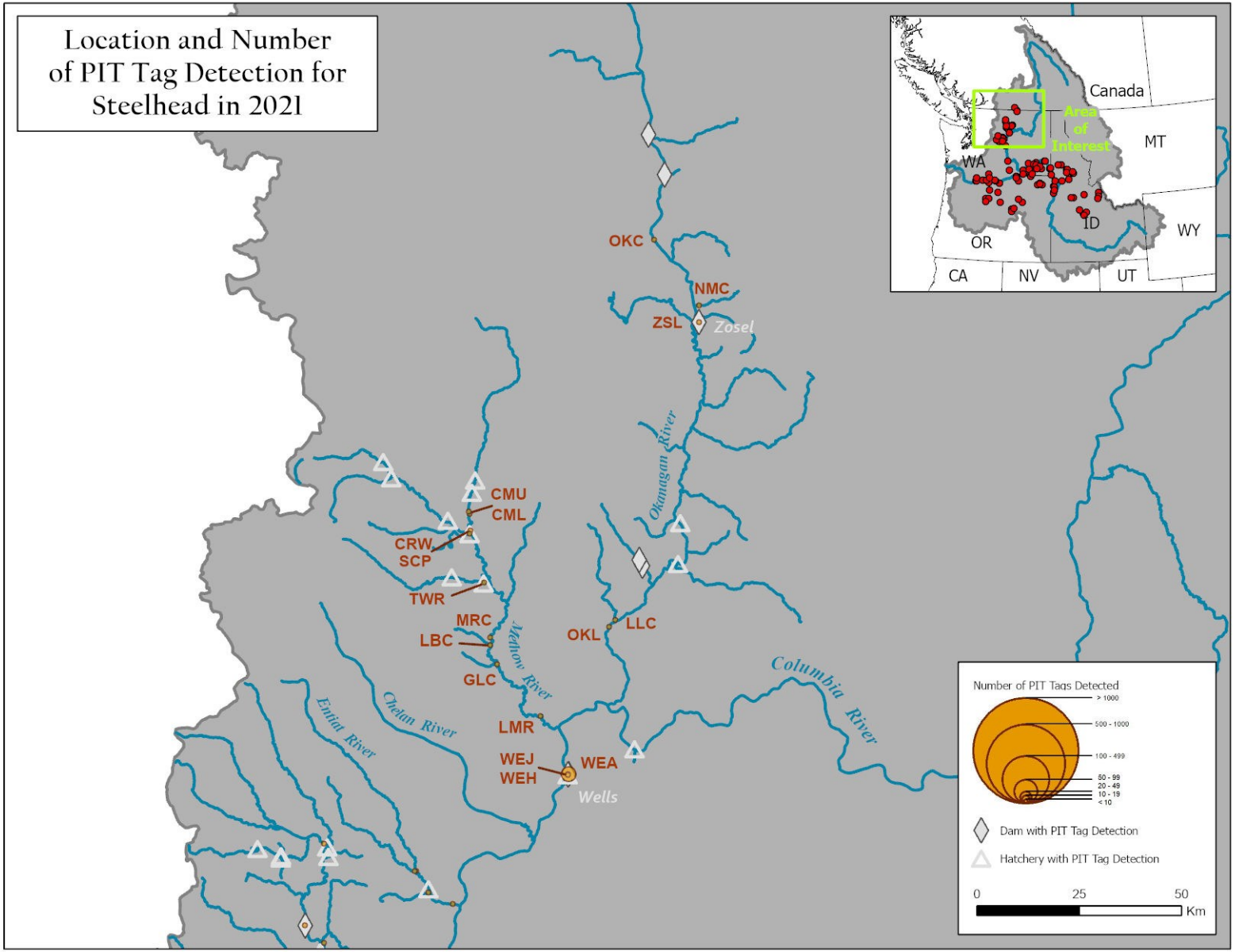

Figure C20. Map of Upper Columbia River (Wells Dam and above) detection sites and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

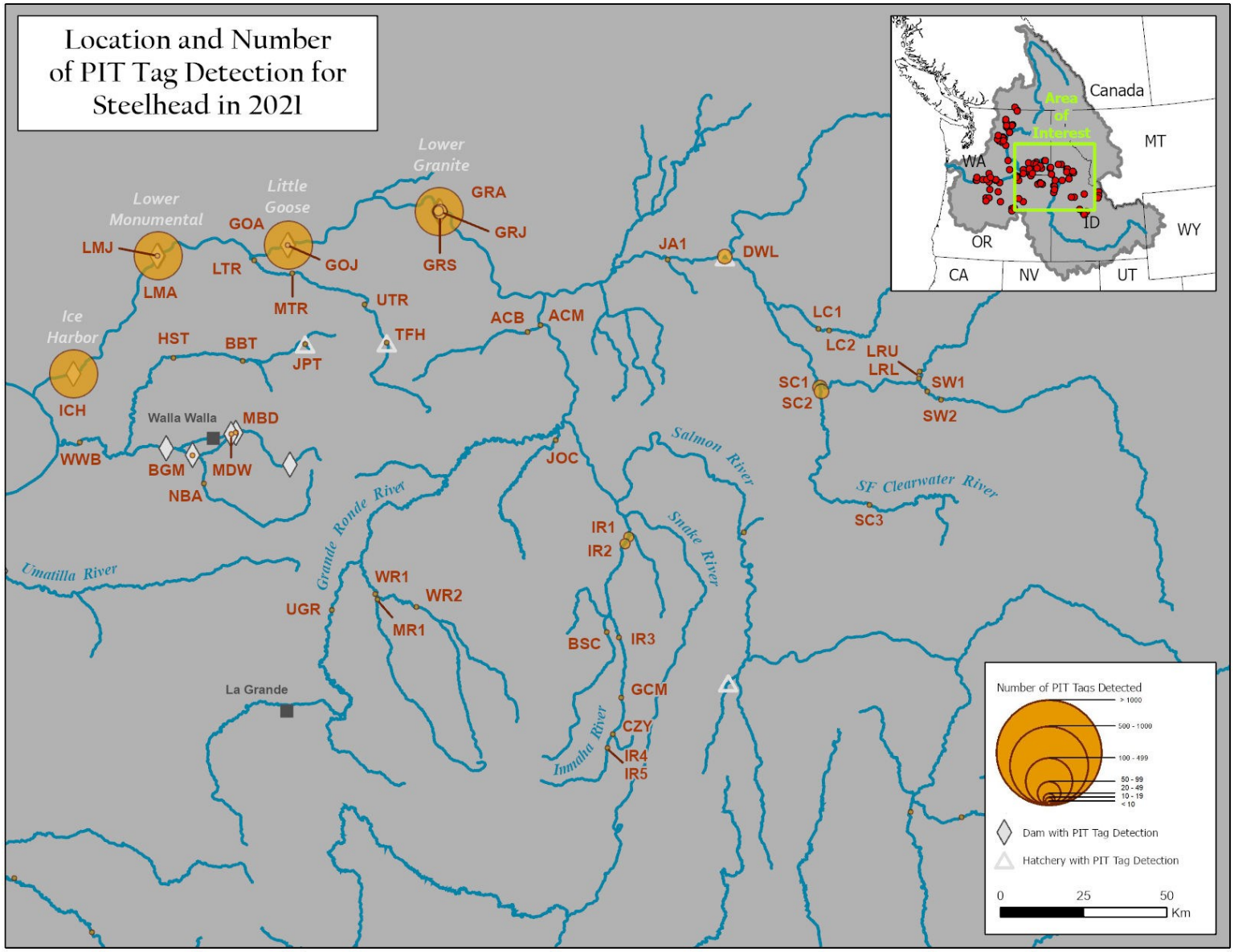

Figure C21. Map of Lower Snake River detection sites (Salmon River not included) and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

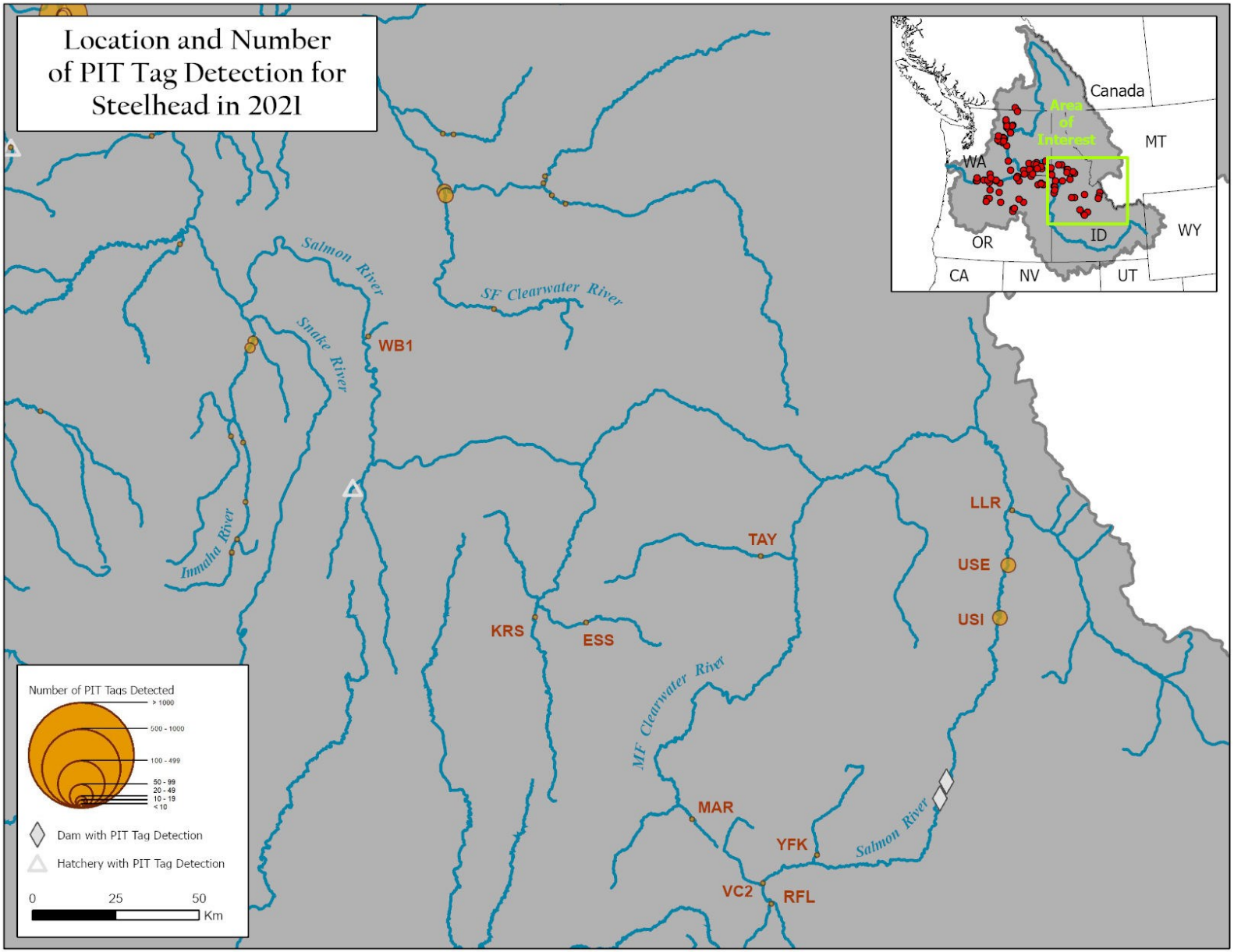

Figure C22. Map of Salmon River detection sites and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

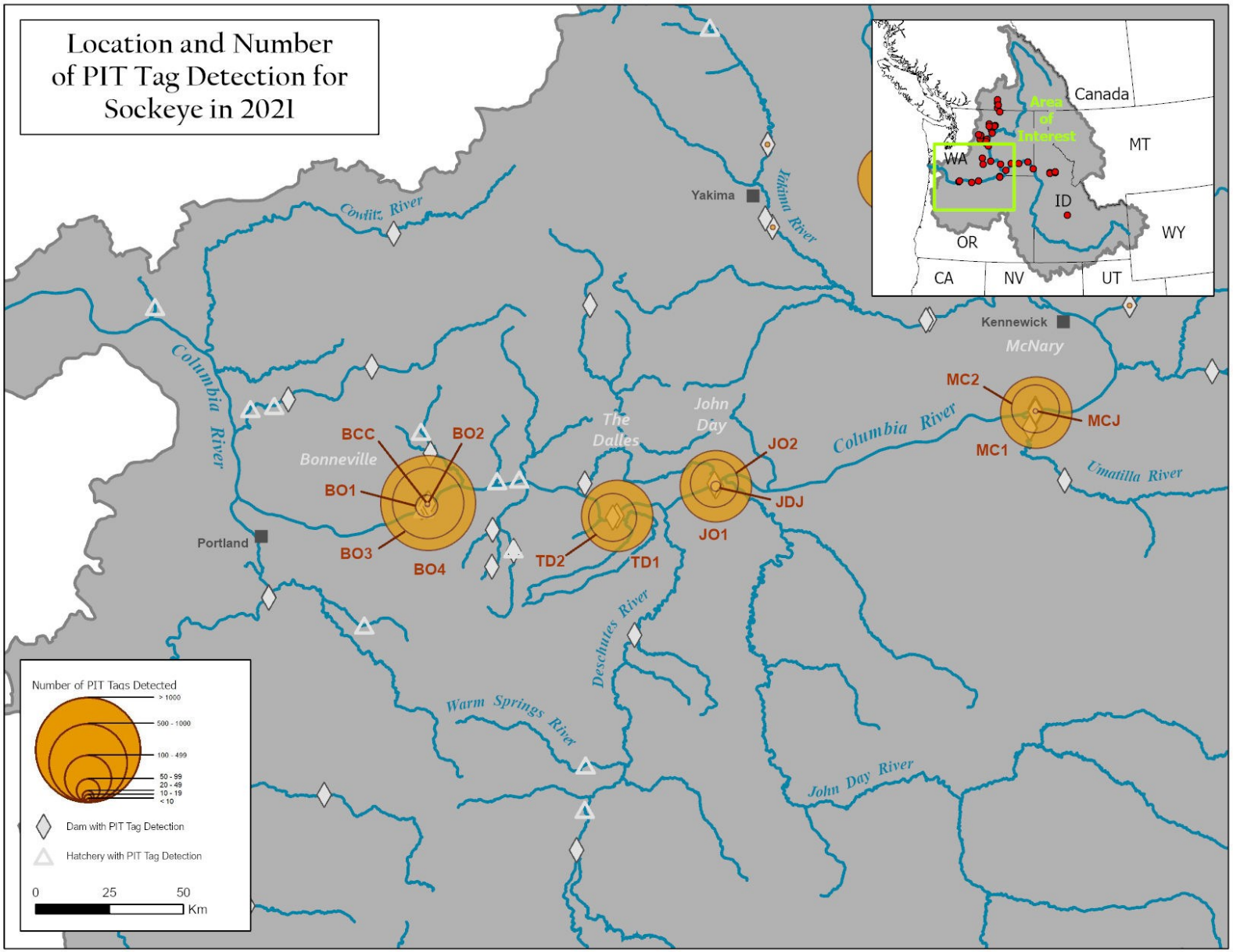

Figure C23. Map of Lower Columbia River detection sites (below Snake River) and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

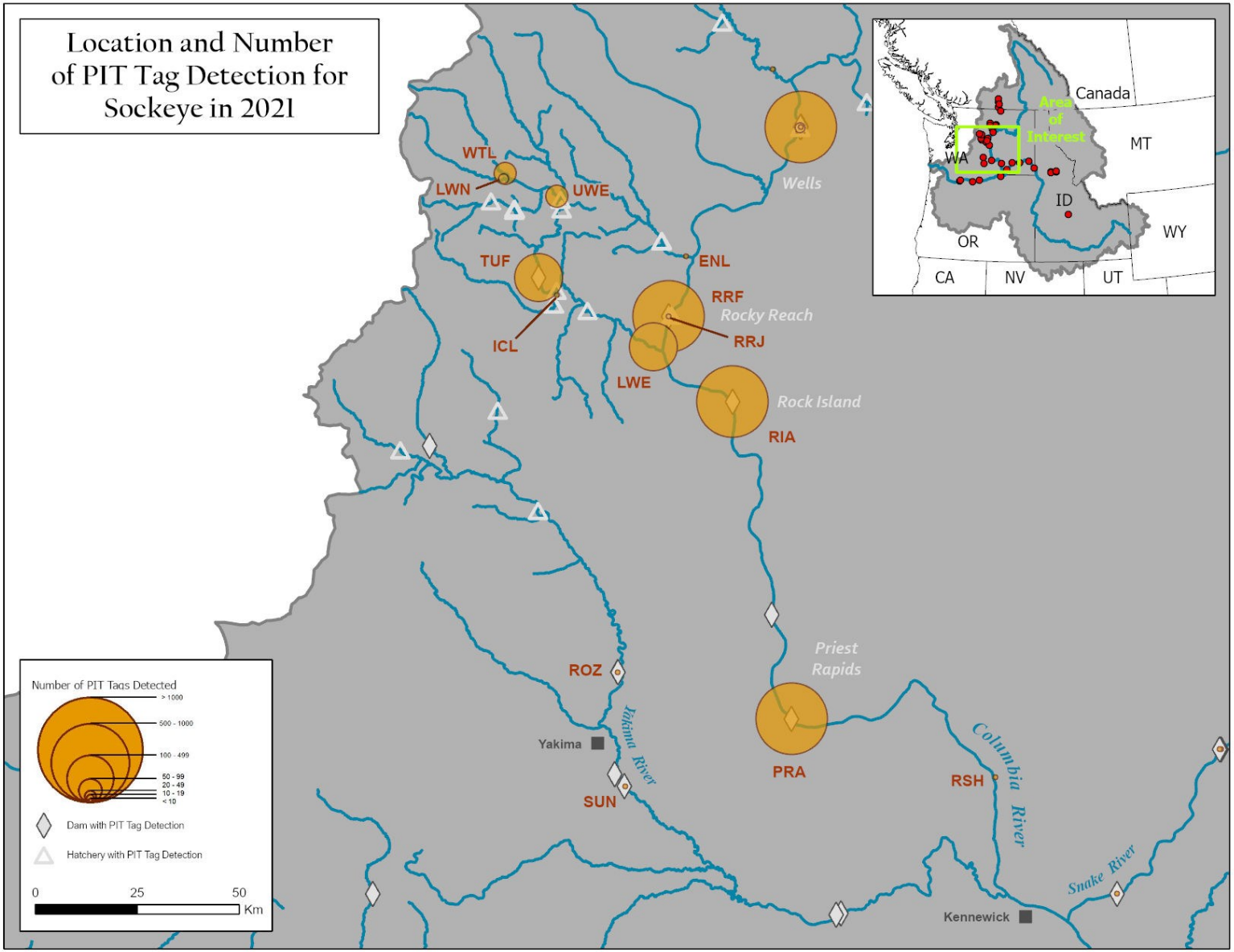

Figure C24. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

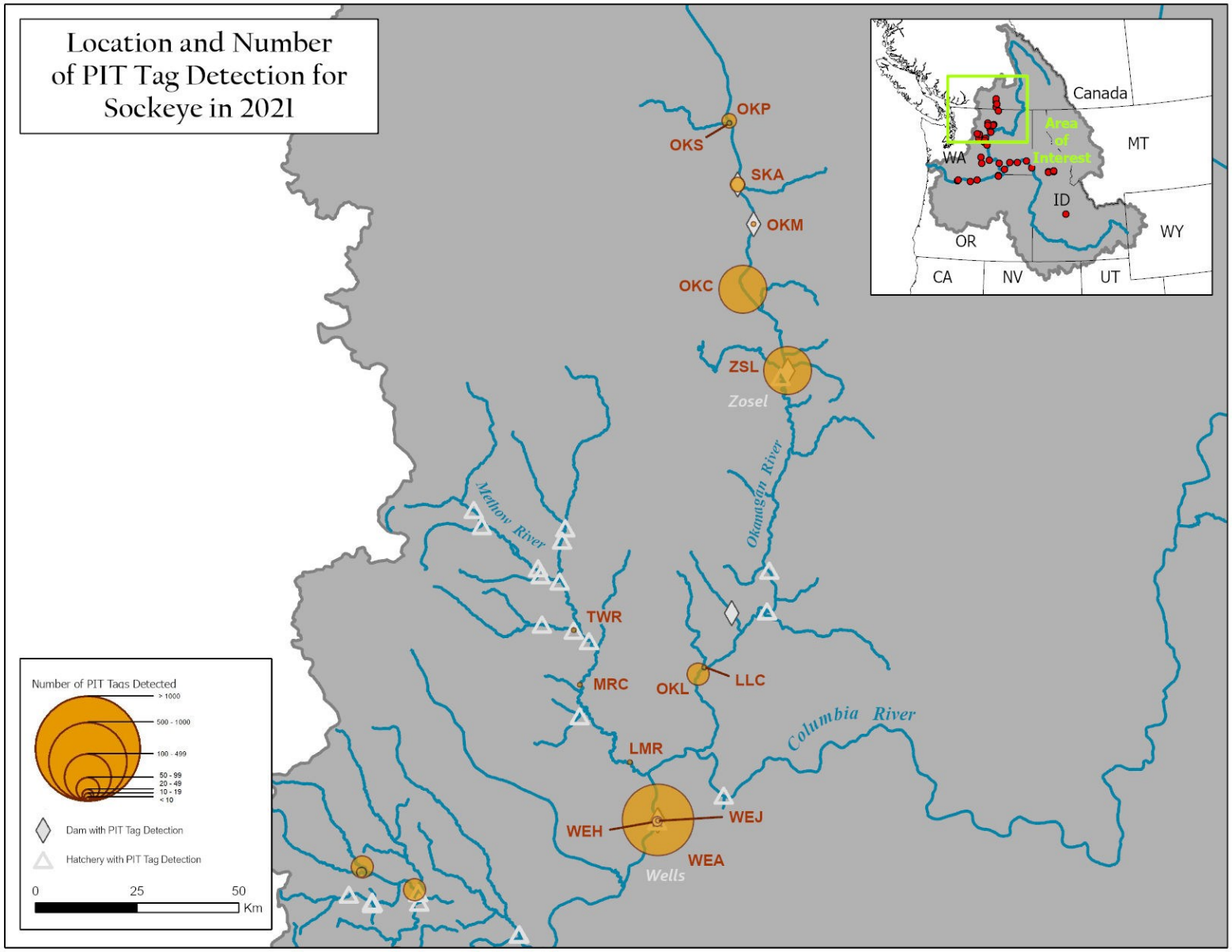

Figure C25. Map of Upper Columbia River (Wells Dam and above) detection sites and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

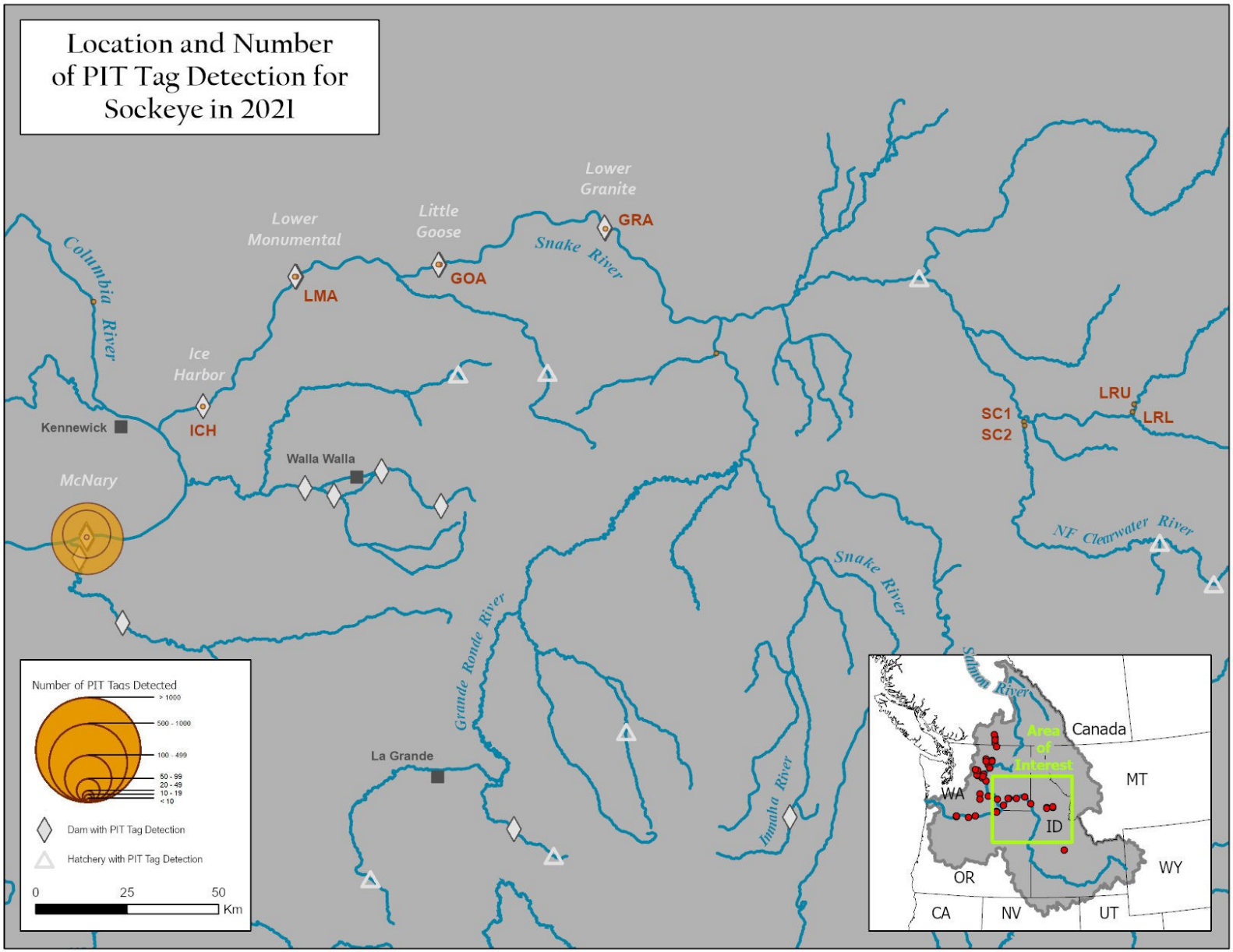

Figure C26. Map of Lower Snake River detection sites (Salmon River not included) and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

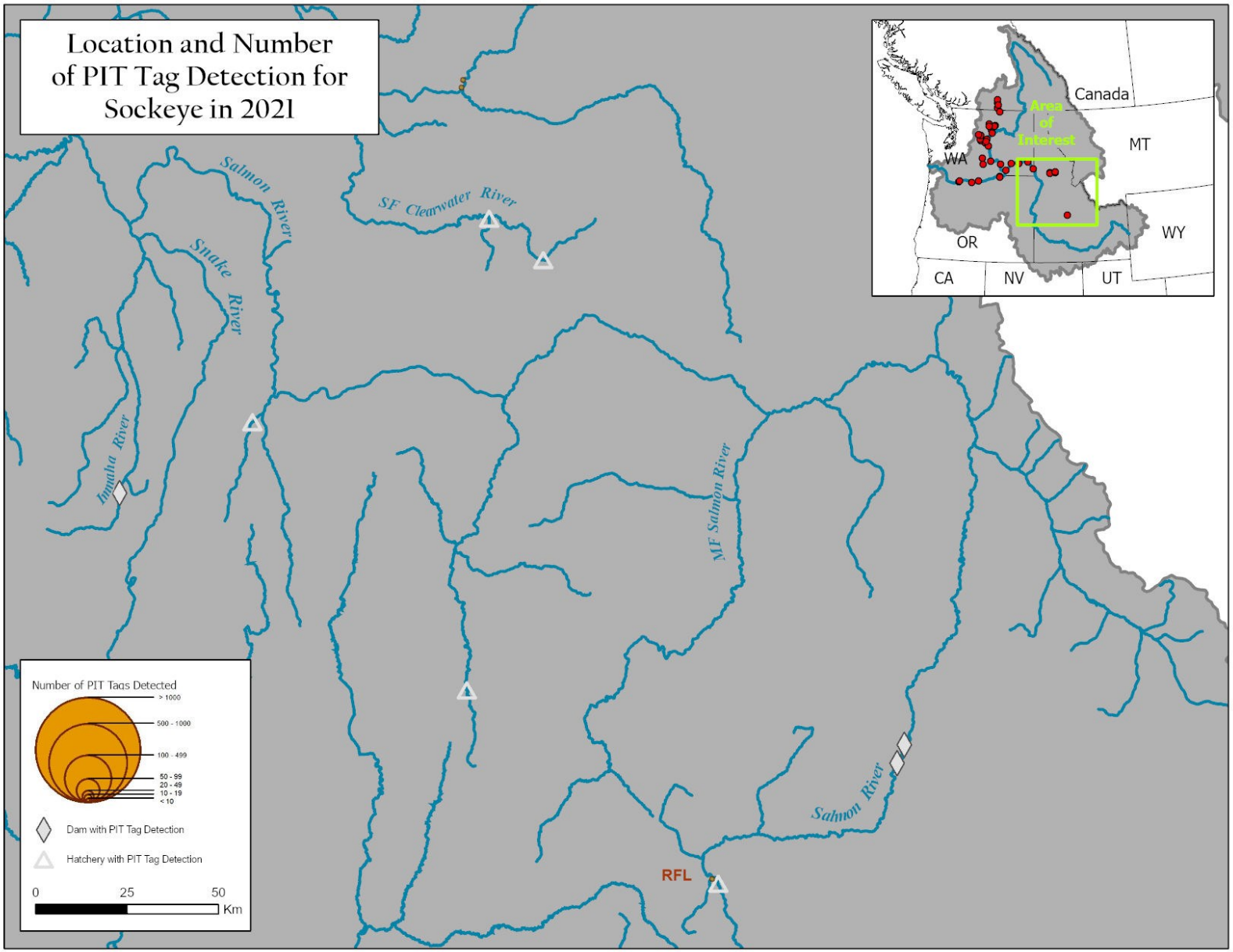

Figure C27. Map of Salmon River detection sites and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

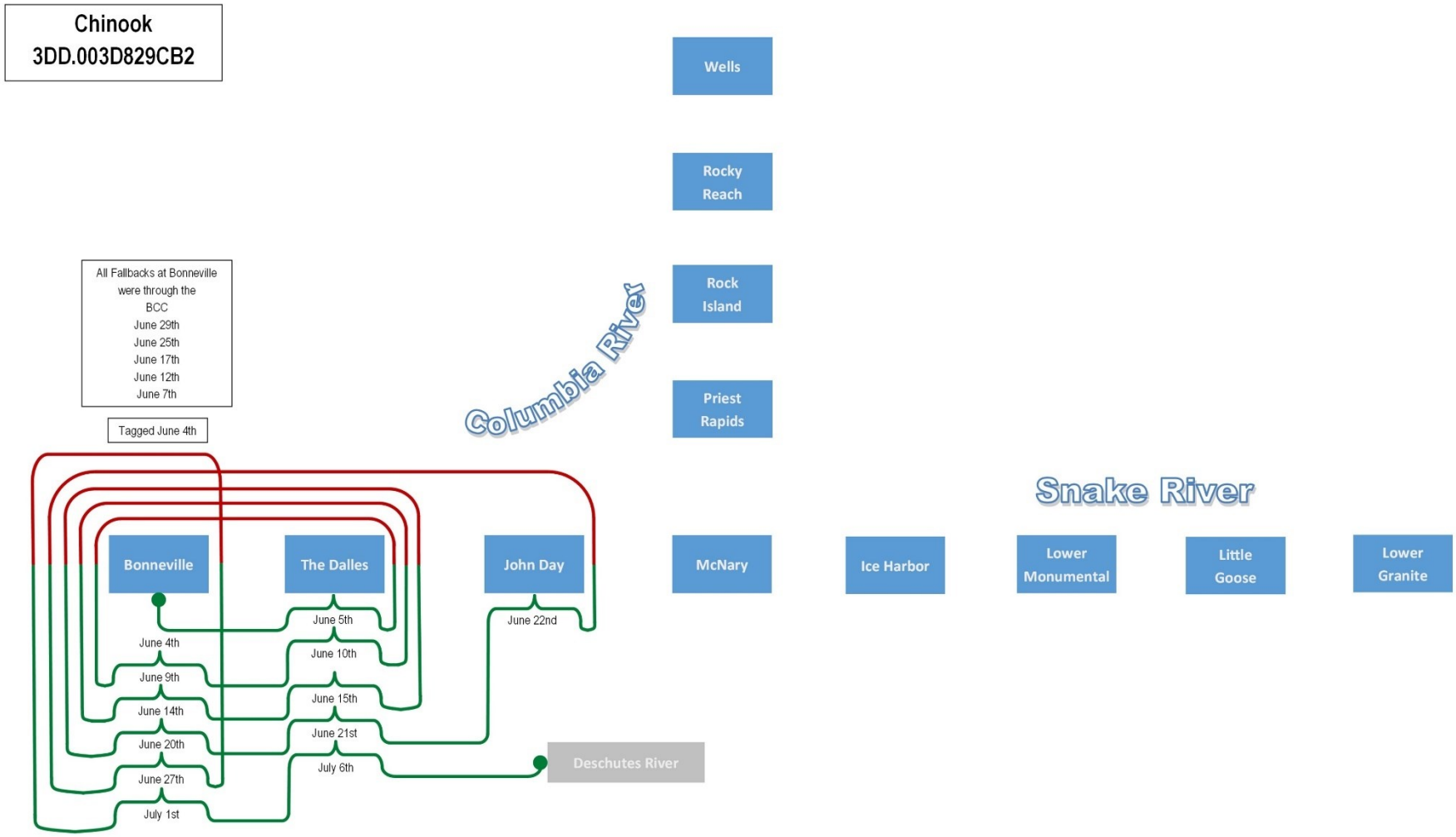
Chinook
3DD.003D829CB2
Wells
Rocky Reach
Rock Island
Priest Rapids
Columbia River
All Fallbacks at Bonneville were through the BCC
June 29th
June 25th
June 17th
June 12th
June 7th
Tagged June 4th
Snake River
Bonneville
The Dalles
John Day
McNary
Ice Harbor
Lower Monumental
Little Goose
Lower Granite
June 4th
June 9th
June 14th
June 20th
June 27th
July 1st
June 5th
June 10th
June 15th
June 21st
July 6th
June 22nd
Deschutes River

Figure C28. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for Chinook Salmon with PIT tag 3DD.003D829CB2, tagged and tracked in 2021.

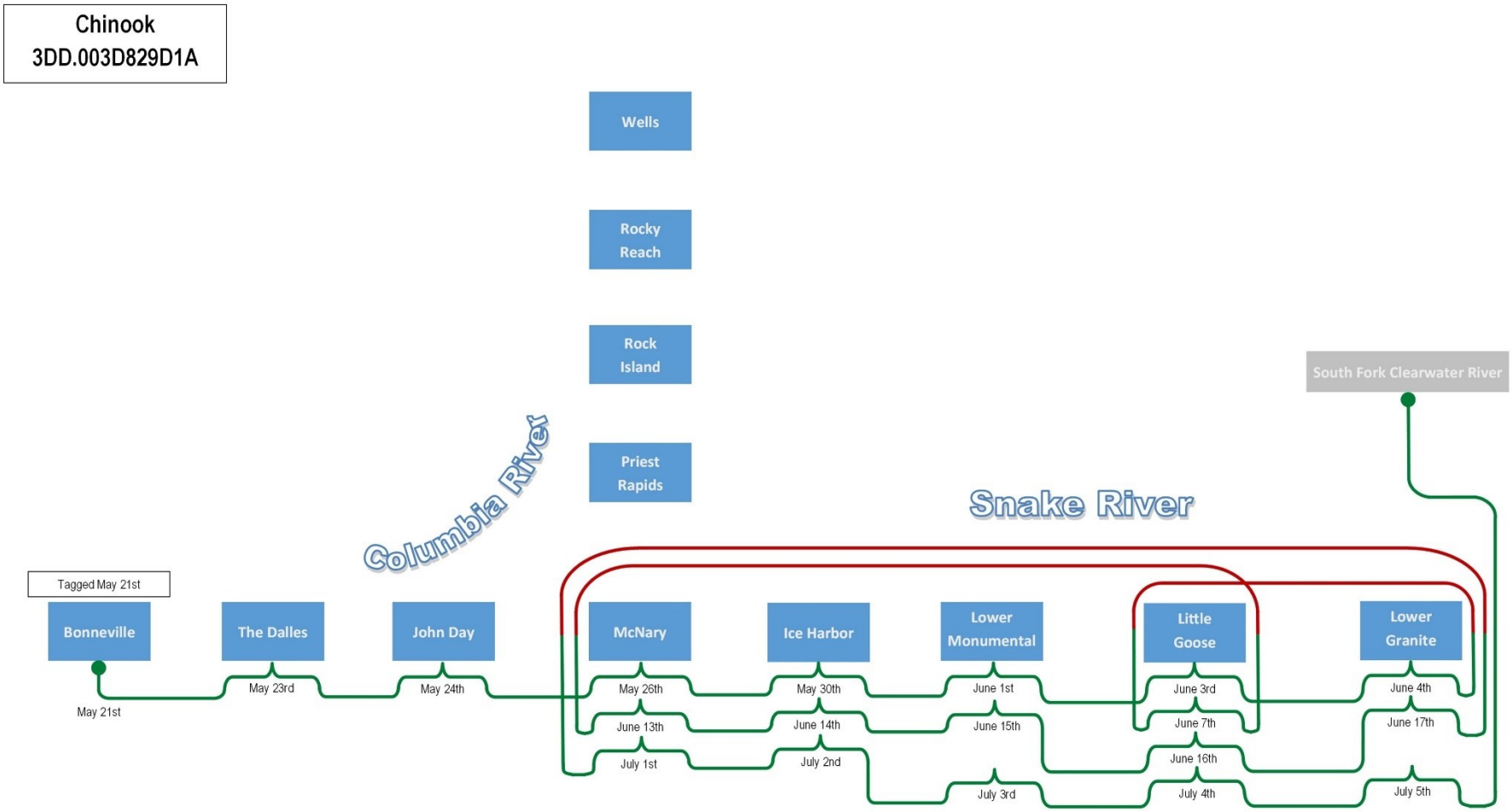

Figure C29. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for Chinook Salmon with PIT tag 3DD.003D829D1A, tagged and tracked in 2021.

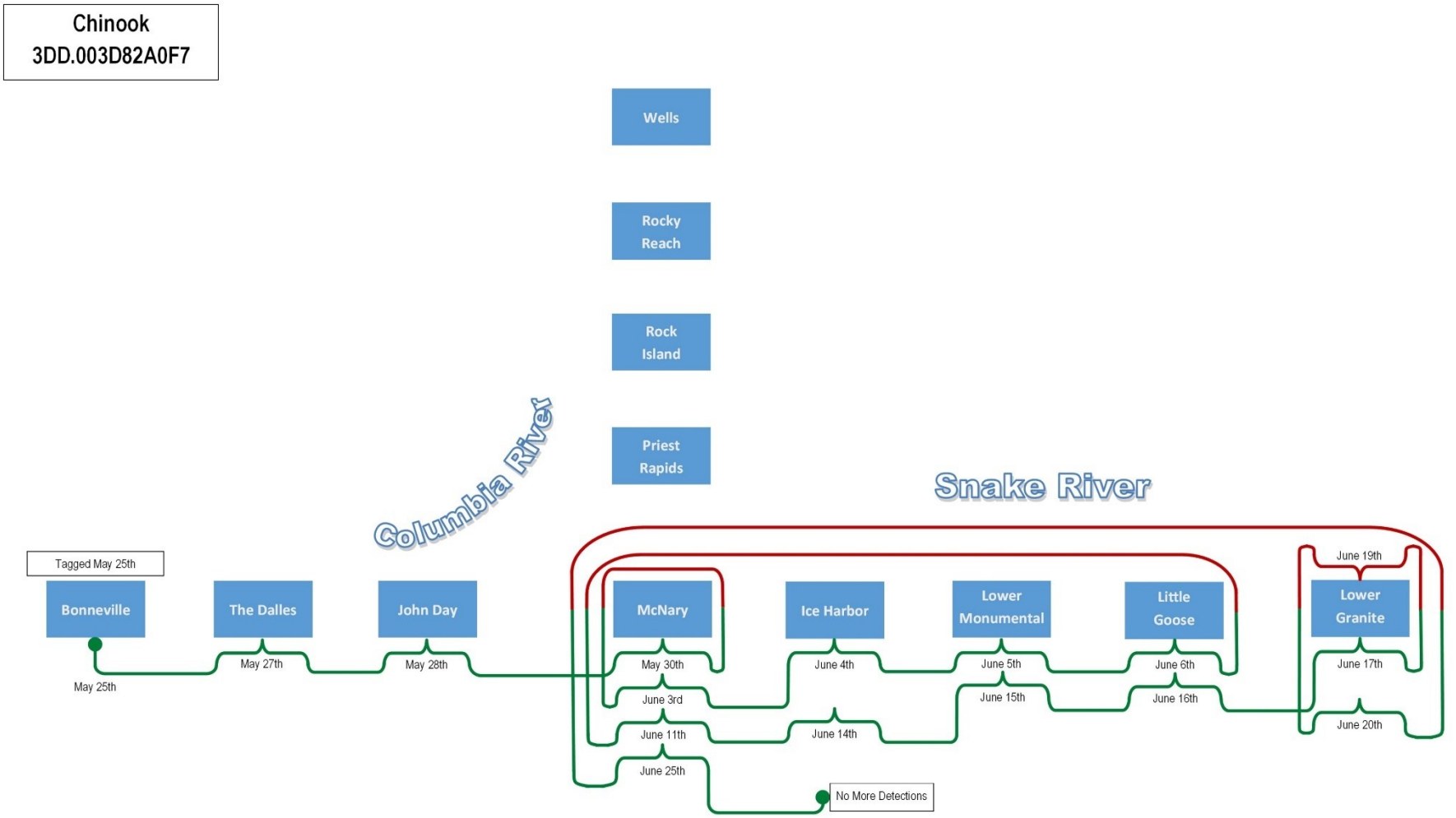

Figure C30. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for Chinook Salmon with PIT tag 3DD.003D82A0F7, tagged and tracked in 2021.

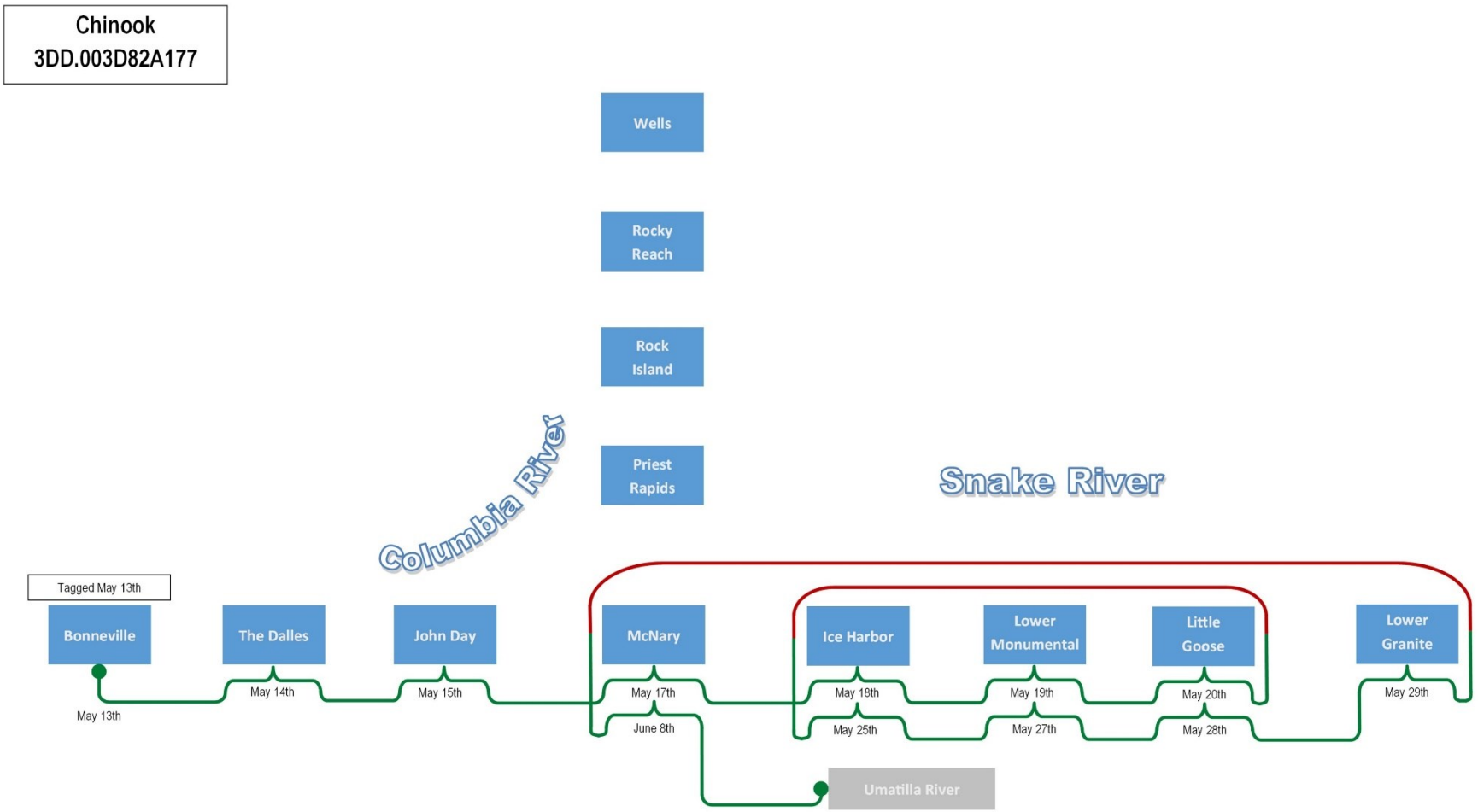

Figure C31. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for Chinook Salmon with PIT tag 3DD.003D82A177, tagged and tracked in 2021.

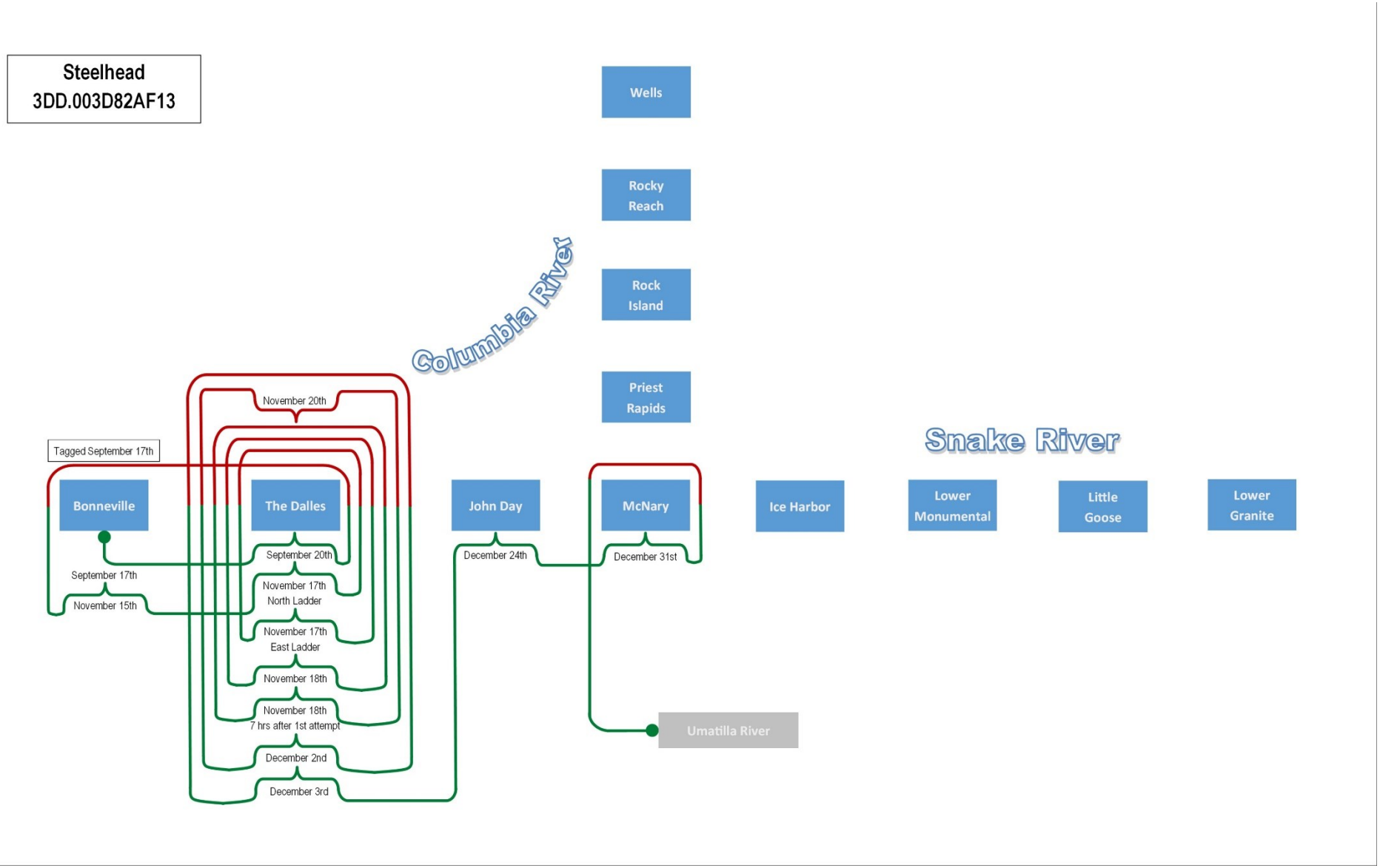

Figure C32. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for steelhead with PIT tag 3DD.003D82AF13, tagged and tracked in 2021.