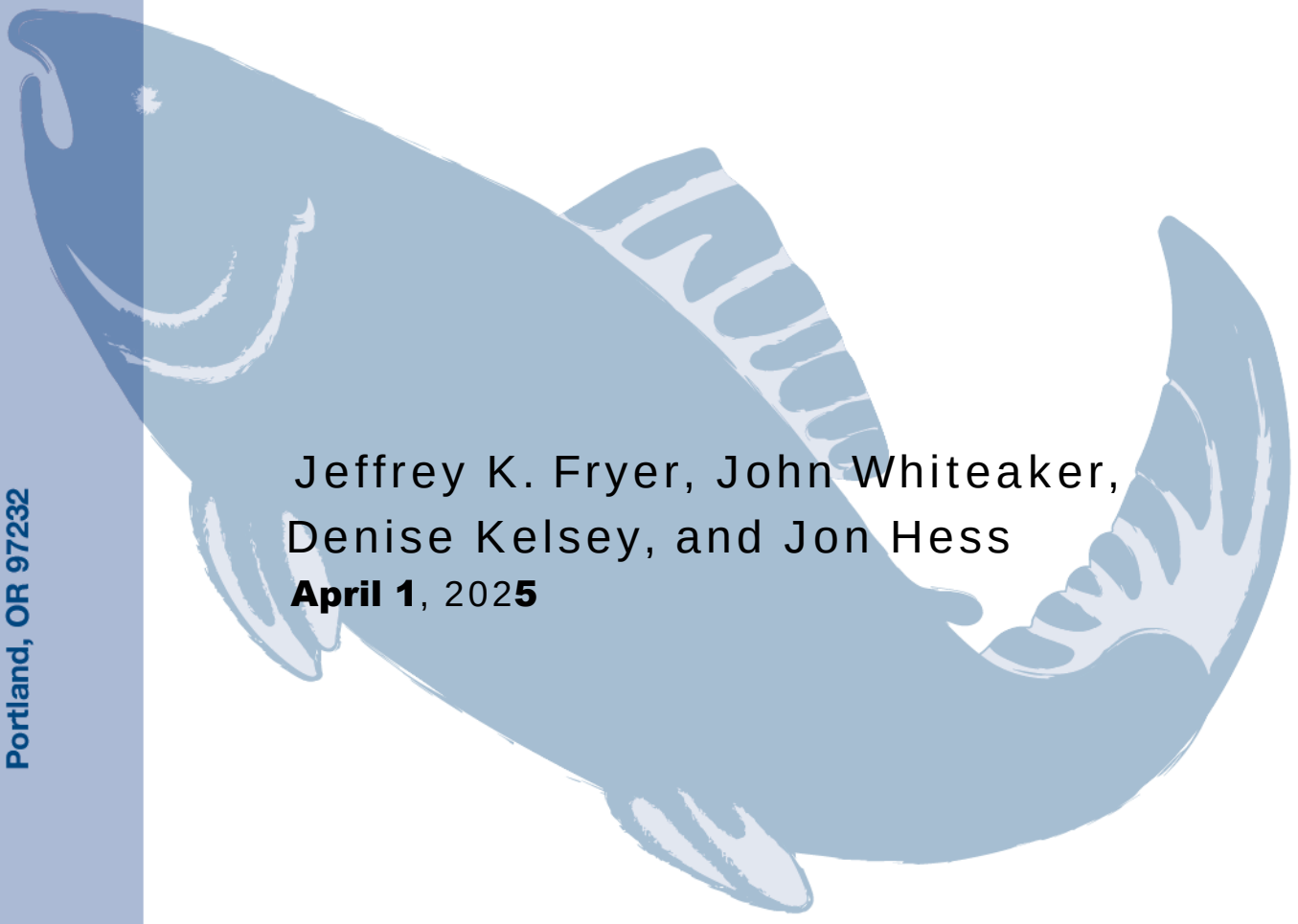
CRITFC
TECHNICAL REPORT 25-02

Upstream Migration Timing of Columbia Basin Chinook and Sockeye Salmon and Steelhead in 2022



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April 1, 2025

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ABSTRACT

Between April 21, and October 13, 2022, 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 1,102 spring Chinook, 530 summer Chinook, 1,472 fall Chinook, 862 steelhead, and 1,354 Sockeye Salmon.

Chinook Salmon median migration rates between mainstem dams ranged from 17.6 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. An estimated 39.7% of spring Chinook sampled passed into the Snake Basin upstream of Ice Harbor Dam, while an estimated 57.4% of summer Chinook passed into the portion of the Columbia Basin upstream of Priest Rapids Dam. Among fall Chinook, the primary terminal areas were downstream of The Dalles Dam which was not passed by 43.6% of the run (though this would include harvest) and between McNary Dam (passed by 36.6% of fall Chinook and Ice Harbor (passed by 13.8% of the run) and Priest Rapids Dam (passed by 5.7% of the run) which is where the Hanford Reach spawning grounds are located as well as Priest Rapids and Ringold hatcheries.

Steelhead median migration rates between mainstem dams ranged from 7.6 km/day between Bonneville and John Day dams to 41.7 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), 95.2% were detected in the Snake Basin. The percentage of steelhead classified as B-run at Bonneville Dam reached its highest level at 71.4% of the run in Statistical Week 38. The number of B-run steelhead also peaked in Week 38 at 9,076 steelhead while the number of A-run (<78 cm) peaked in Week 31 at 11,605 fish. A total of 78 steelhead PIT tagged and tracked in 2022 were detected moving downstream (mostly in juvenile bypasses) after spawning, recovered or detected in kelt programs, or detected moving upstream in summer/fall 2023 and were designated as kelt.

For Sockeye the median migration rates between mainstem dams ranged between 28.5 km/day John Day and McNary dams) and 45.8 km/day (between Bonneville and McNary dams).

The principal age components for spring Chinook were Age 1.2 (87.3% of the run), Age 1.1 (10.1%), and 1.3 (2.3%), for summer Chinook Age 1.2 (55.0%), Age 1.3, (22.1%), and Age 1.1 (15.6%) and for fall Chinook Age 0.2 (44.4%), and 0.3 (21.2%). The steelhead run was 50.7% Age 1.2, 18.0% Age r.2, and 12.2% Age 2.2%. The Sockeye run was 94.8% Age 1.2, 2.1% Age 1.3 and 2.0% Age 1.1.

Stray rates were estimated using both Genetic Stock Identification (GSI) and Parental Based Tagging (PBT) and site of last PIT tag detection. The overall stray rate was 15.3% for PBT-classified steelhead and 43.7% for GSI-classified steelhead. For Chinook, the overall stray rate was 31.6% for PBT-classified Chinook and 16.6% for GSI-classified Chinook. For Sockeye, the stray rate estimated by this project using either PBT or GSI was 1.5%.

ACKNOWLEDGMENTS

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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 21 through October 11, 2022, 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. They were measured for fork length to the nearest 5 mm and six scales (four scales

[1] The protocols can be found at https://pweb.crohms.org/tmt/documents/fpp/2022/final/FPP22_AppG.pdf.

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 2022), although for management purposes June 15 is used as the end date of the spring Chinook migration. 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.

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 (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).

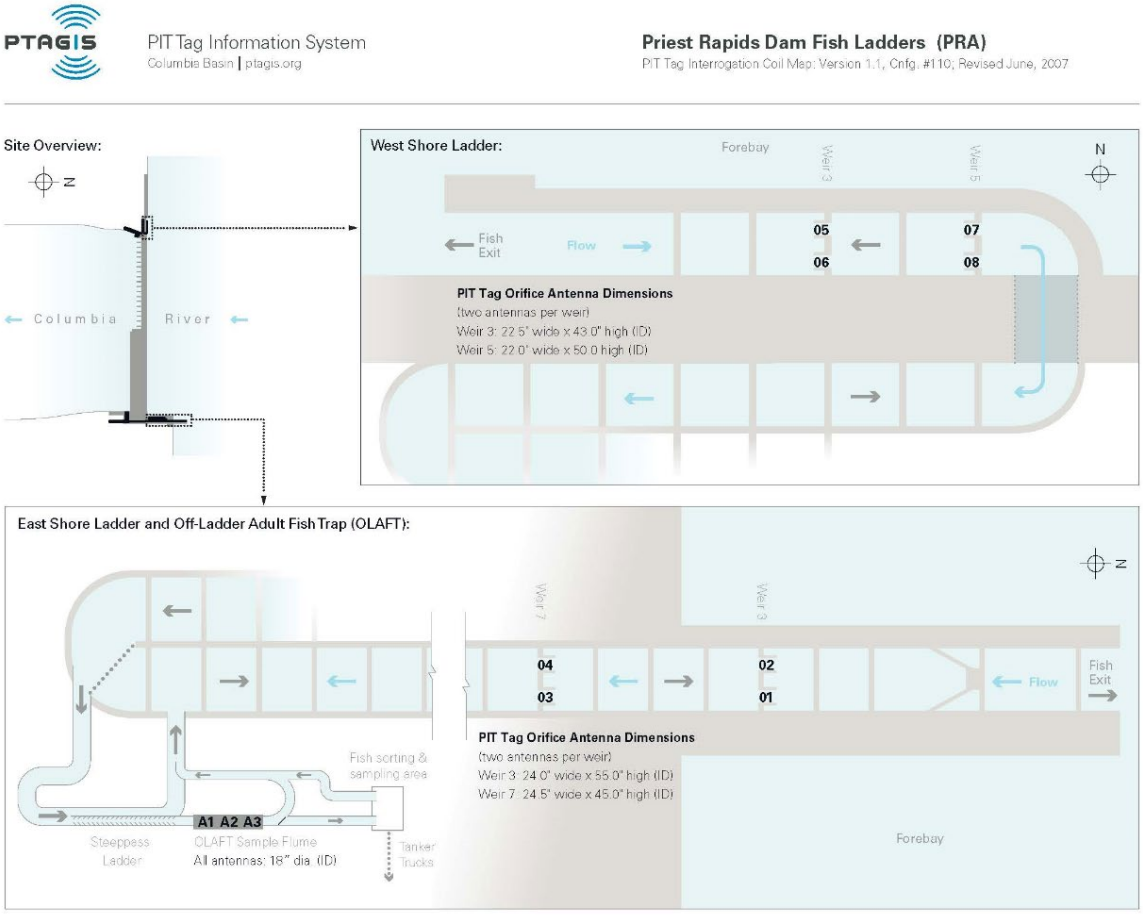


Figure 1. PIT tag detection configuration at Priest Rapids Dam showing two adjoining antennas at two weirs in each fish ladder (Figure from www.ptagis.org.)

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

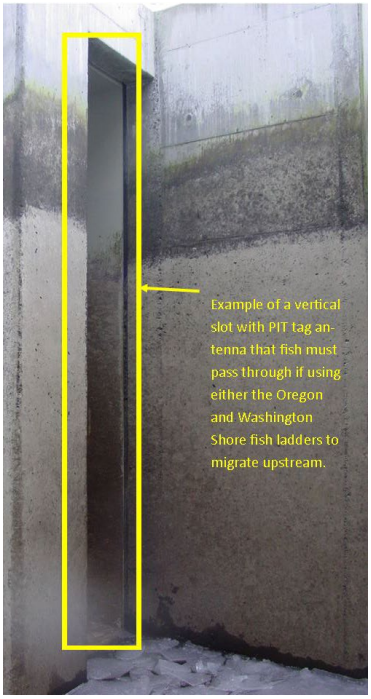
Day, McNary, Ice Harbor, Little Goose, Lower Monumental, and Lower Granite dams) where PIT-tagged salmon can pass undetected. The percentage of PIT-tagged fish missed at each dam with PIT tag detection arrays was calculated by looking at the fish detected upstream of the site in question and estimating 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

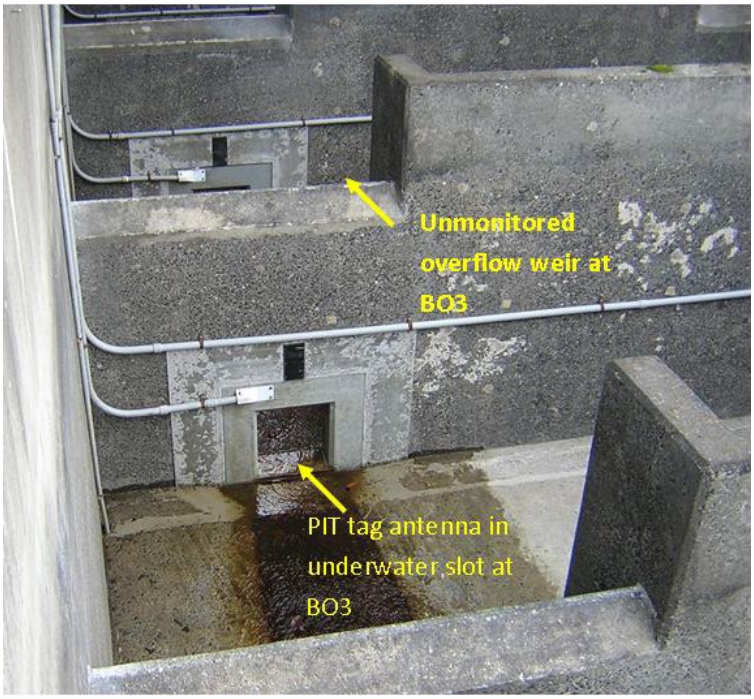


Figure 2. Pictures of the two types of PIT tag antennas at Bonneville Dam. The vertical slot antennas are at the upper end of both ladders, while the underwater antennas are in the lower parts of the ladders. Photos courtesy of PTAGIS.

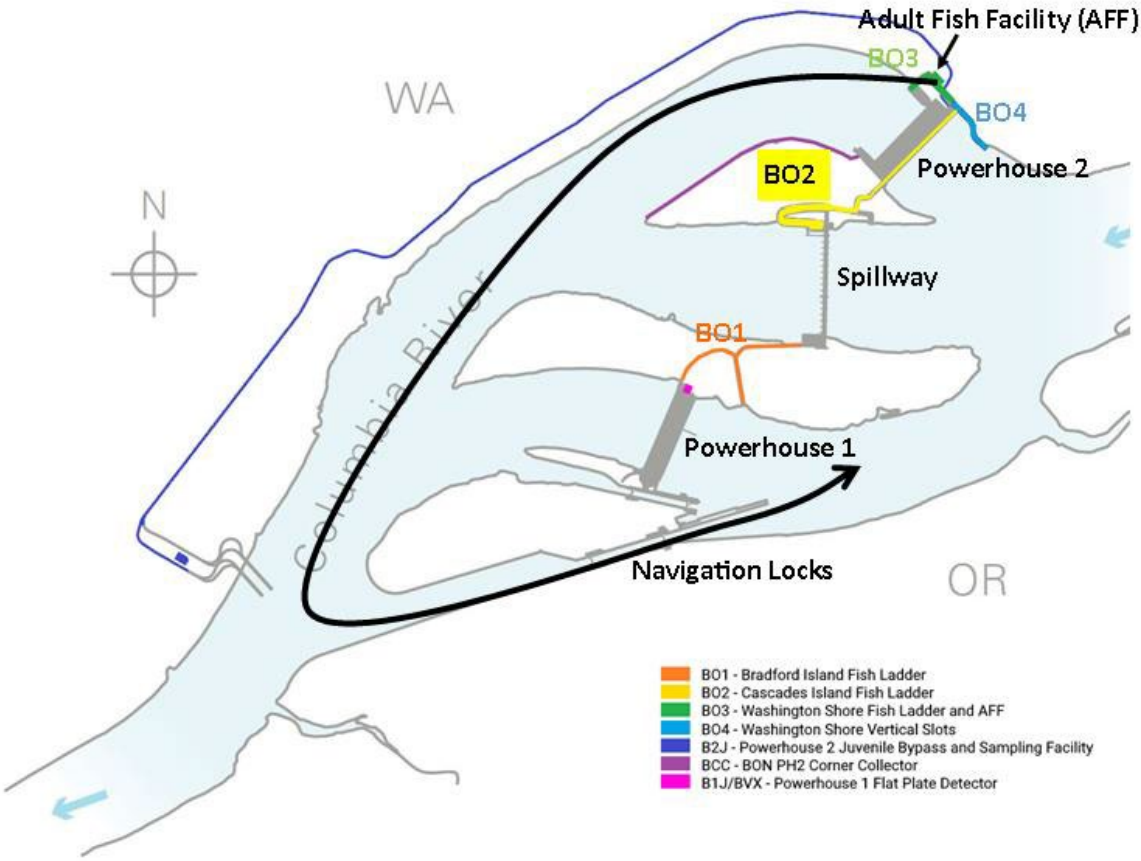


Figure 3. Site of Bonneville Dam PIT tag antennas and the most likely route for fish tagged at the Adult Fish Facility to pass upstream undetected (Figure from www.ptagis.org).

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. This r.y designation is used to provide continuity with ageing protocols prior to our taking over the project in 2007 as well as to provide ocean age on the much higher percentage of regenerated scales on steelhead

compared to Chinook or Sockeye. 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 2022, 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, 2022, 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 May 15 through September 30 (https://www.fpc.org/111_sharedfiles/adult_metadatav3.php), which is the span that over 90% of Chinook, steelhead, and Sockeye passed Bonneville in 2022. 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 1,118 spring Chinook, 536 summer Chinook, and 1,495 fall Chinook Salmon were sampled between April 21 and October 13, 2022[2] (Tables 1-3). A total of 1,118 spring Chinook, 522 summer Chinook, and 1,486 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 moving upstream at Bonneville Dam or upstream sites after tagging (due to shed tags, mortalities, malfunctioning tags, or PIT-tagged Chinook missing PIT tag antennas) and 6 Chinook which were accidently tagged twice, the numbers of Chinook tracked upstream and used in analysis consisted of 1,102 spring Chinook, 530 summer Chinook, and 1,472 fall Chinook Salmon (Table 1-3).

[2] An addition 101 Tule Chinook (identified by their dark coloration) were sampled between July 28 and September 7, 2022, 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 2022.

Sample Dates	Week	Percentage of Run	Number Sampled	Number Tagged[3]	Previously Tagged	Previously tagged by CRITFC	Mortalities	Excluded as Double Tagged	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	1.3%												
4/21-4/22	17	2.6%	25	25	0	0	0	1	0	0	24	0	0	0
4/25-4/29	18	19.3%	213	210	3	0	0	3	1	0	209	0	0	0
5/3-5/6	19	29.5%	199	196	3	0	0	0	2	0	197	0	0	0
5/9-5/13	20	19.1%	184	183	1	0	0	0	3	0	181	0	0	0
5/16-5/20	21	15.4%	215	211	4	0	0	0	1	0	214	0	0	0
5/23-5/27	22	9.3%	232	221	10	0	0	2	2	0	227	0	0	0
5/31	23	3.5%	50	47	3	0	0	0	0	0	50	0	0	0
Total		**100.0**	**1118**	**1093**	**24**	**0**	**0**	**6**	**9**	**0**	**1102**	**0**	**0**	**0**

[3] Excludes six Chinook which were inadvertently tagged twice due to a malfunctioning PIT tag reader. These fish were either previously tagged Chinook given a CRITFC PIT tag or given two CRITFC PIT tags.

Table 2. Number of sampled and PIT-tagged summer Chinook Salmon at Bonneville Dam that were then tracked, by date and statistical week, in 2022.

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
6/1-6/3	23	7.2%	114	112	2	0	0	2	0	112	0	0	0
6/6-6/10	24	13.8%	168	166	2	0	0	1	0	167	0	5	0
6/13. 6/15-17	25	10.6%	42	42	0	0	0	0	0	42	0	5	0
6/21-6/23	26	17.7%	15	14	1	0	0	0	0	15	0	3	0
6/27,28-6/30	27	25.9%	9	8	1	0	0	1	0	8	0	4	0
7/5-8	28	10.9%	39	38	1	0	0	0	0	39	0	3	0
7/11-7/15	29	6.4%	75	70	5	0	0	0	0	75	0	3	0
7/18-7/22	30	3.7%	41	39	2	1	0	0	0	40	0	0	0
7/26-7/29	31	3.4%	33	33	0	0	0	1	0	32	2	0	0
No sampling	32	0.4%											
Total		100%	**536**	**522**	**14**	**1**	**0**	**5**	**0**	**530**	**2**	**23**	**0**

Table 3. Number of sampled and PIT-tagged fall Chinook Salmon at Bonneville Dam that were then tracked, by date and statistical week in 2022.

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
8/2,5	32	0.5%	15	15	0	0	0	0	0	15	2	0	3
8/8,11,12	33	1.1%	30	30	0	0	0	0	0	30	3	0	2
8/15-18	34	2.7%	45	44	1	0	0	0	0	45	4	0	1
8/23,24	35	8.4%	61	61	0	0	0	0	0	61	2	0	3
8/29-31	36	18.6%	152	148	4	0	0	5	0	147	3	0	2
9/6-9/9	37	35.9%	211	210	0	0	0	3	0	207	4	0	0
9/12-9/16	38	19.1%	269	269	0	0	0	5	0	264	4	0	1
9/19-9/23	39	8.0%	329	328	1	0	0	3	0	326	0	5	0
9/26-30	40	2.9%	219	217	2	0	0	3	0	216	0	1	0
10/3-10/7	41	1.7%	148	148	0	0	0	2	0	146	0	0	0
10/11-13	42	0.8%	16	16	0	0	0	1	0	15	0	0	0
No sampling	>42	0.4%											
Total			**1495**	**1486**	**8**	**0**	**0**	**22**	**0**	**1472**	**22**	**6**	**12**

Distribution of Sample

The number of spring Chinook sampled at Bonneville Dam was limited to approximately 200 per week between weeks 18 and 22 which was sufficient to meet sampling goals despite some staffing limitations (Figure 4). The percentage of the summer Chinook sample was greatly reduced relative to the percentage passing Bonneville Dam in weeks 26-27 due to concurrent sampling of Sockeye Salmon as well as sampling restrictions due to shad abundance (Figure 5). These restrictions caused all four picket leads to be raised for the entirety of Week 27, resulting in only 9 Chinook being sampled. Under this protocol, all entry into the trap is volitional, which could affect how the sample represents the run. Fall Chinook sample sizes between weeks 35-39 were similarly adversely affected by trap restrictions due to temperatures above 21.1C combined with high salmonid abundance (primarily Chinook and Coho) resulting in all four picket leads being raised (Figure 6). Details on picket lead protocols which reduce sampling effort can be found in Appendix B.

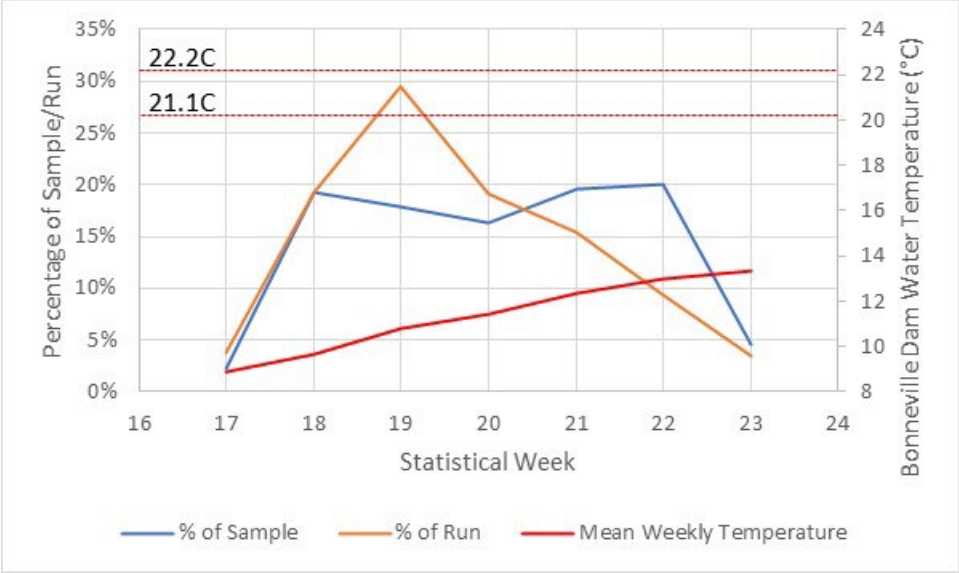


Figure 4. The weekly spring Chinook sample and run as a percentage of the total sample and run size at Bonneville Dam in 2022.

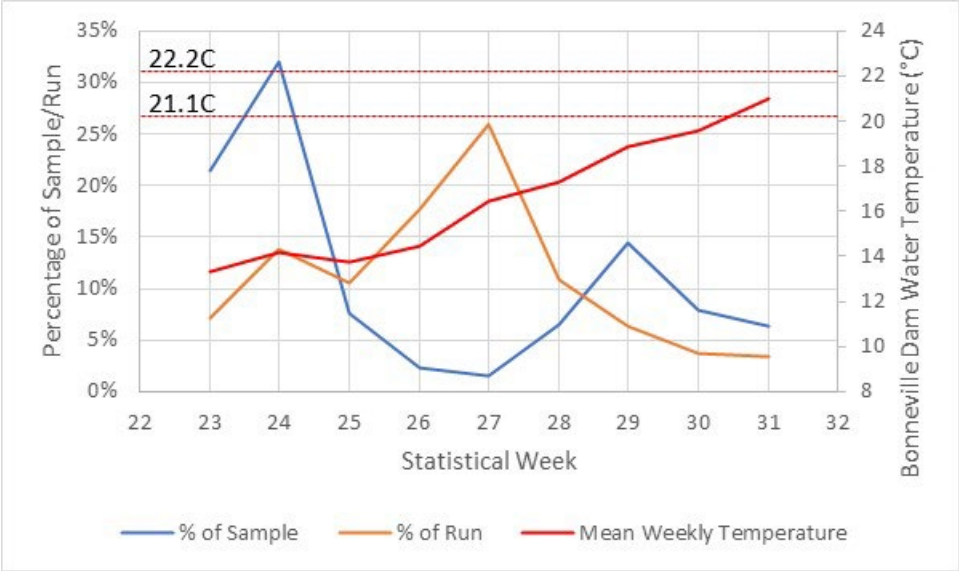


Figure 5. The weekly summer Chinook sample and run as a percentage of the total sample and run size at Bonneville Dam in 2022. AFF regulations require reduced sampling when the temperature at Bonneville Dam reaches 21.1°C with sampling halted at 22.2°C.

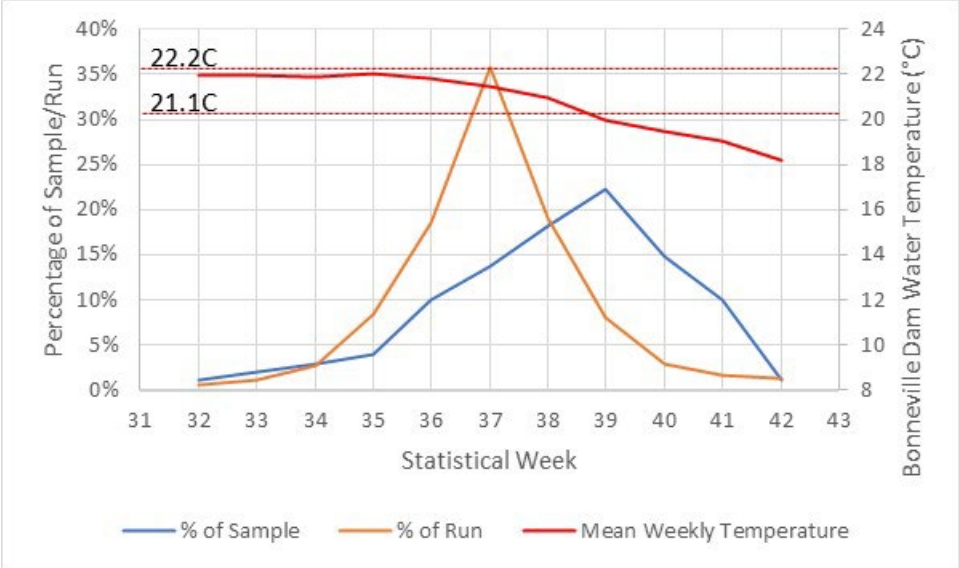


Figure 6. The weekly fall Chinook sample and run as a percentage of the total sample and run size at Bonneville Dam in 2022. AFF regulations require reduced sampling when the temperature at Bonneville Dam reaches 21.1°C with sampling halted at 22.2°C.

Detection Numbers

The tracking of 1,102 spring Chinook generated 85,715 weir detections, which were grouped into 7,885 site detections at 122 sites. The 530 summer Chinook generated 43,911 weir detections grouped into 3,990 site detections at 96 sites, and the 1,472 fall Chinook generated 54,827 weir detections grouped into 6,493 site detections at 44 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 for each race (spring, summer, fall) 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 2022) 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 in terminal areas upstream of Priest Rapids Dam (Table 4, Figure 8). The majority of fall Chinook were last detected downstream of McNary Dam and at fall Chinook

[4] Also tracked were 101 Tules which generated 1777 detections at 12 sites and 1 minijack which generated 80 detections at 8 sites.

spawning areas between McNary and Ice Harbor/Priest Rapids dams (Table 4, Figure 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 22 (Figure 10, Table 5). Beginning in early June, summer Chinook bound for above Priest Rapids dam predominated with the percentage peaking in Week 30 then declining and the percentage of Snake River increased peaking in Week 33. Fall Chinook were mostly last detected downstream of McNary Dam between weeks 34 and 40 with Hanford Reach fall Chinook being the dominant component in weeks 41-42 (Figure 10).

Table 4. Percentage of spring, summer, and fall Chinook Salmon tracked from Bonneville Dam estimated to pass upstream Columbia and Snake River dams in 2022.

	Spring Chinook		Summer Chinook		Fall Chinook	
Dam	Percentage	SE	Percentage	SE	Percentage	SE
The Dalles	76.9	1.3	84.2	3.7	56.4	1.7
John Day	68.9	1.5	78.1	3.8	41.3	1.6
McNary	63.6	1.5	76.0	3.8	36.6	1.6
Priest Rapids	17.7	1.2	57.4	4.8	5.7	0.8
Rock Island	17.6	1.2	53.6	4.8	2.5	0.5
Rocky Reach	6.4	0.8	45.4	5.1	1.6	0.4
Wells	5.4	0.7	28.2	5.0	0.7	0.2
Ice Harbor	39.7	1.6	12.0	1.8	13.8	1.1
Lower Monumental	38.6	1.5	11.6	1.8	13.4	1.1
Little Goose	37.9	1.5	11.6	1.8	12.2	1.1
Lower Granite	37.2	1.5	11.4	1.8	11.8	1.1

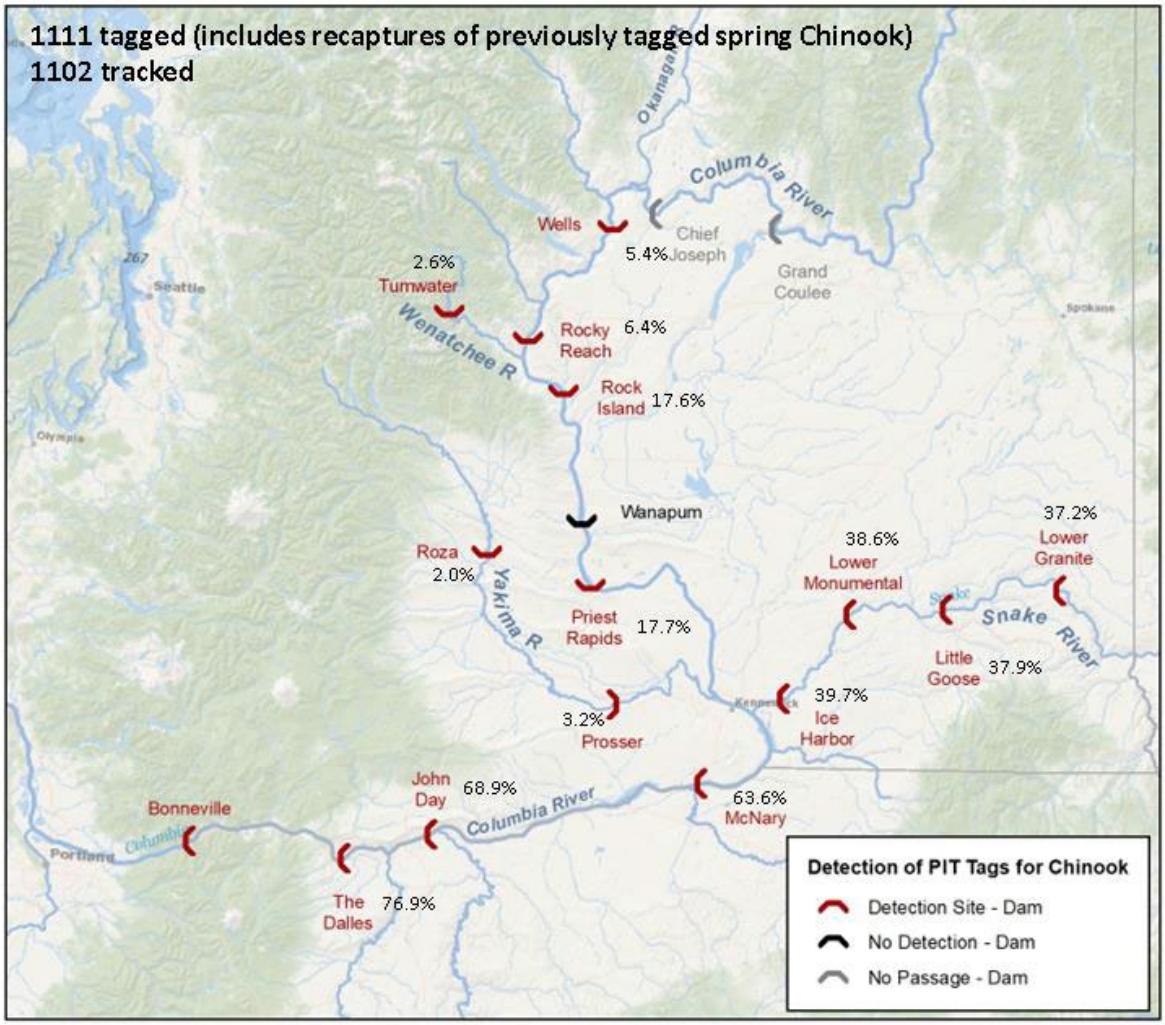


Figure 7. Map of the Columbia River Basin from Bonneville to Wells and Lower Granite dams showing the number of spring Chinook Salmon PIT tagged at Bonneville Dam, and the percentage of the run estimated to pass upstream dams in 2022.

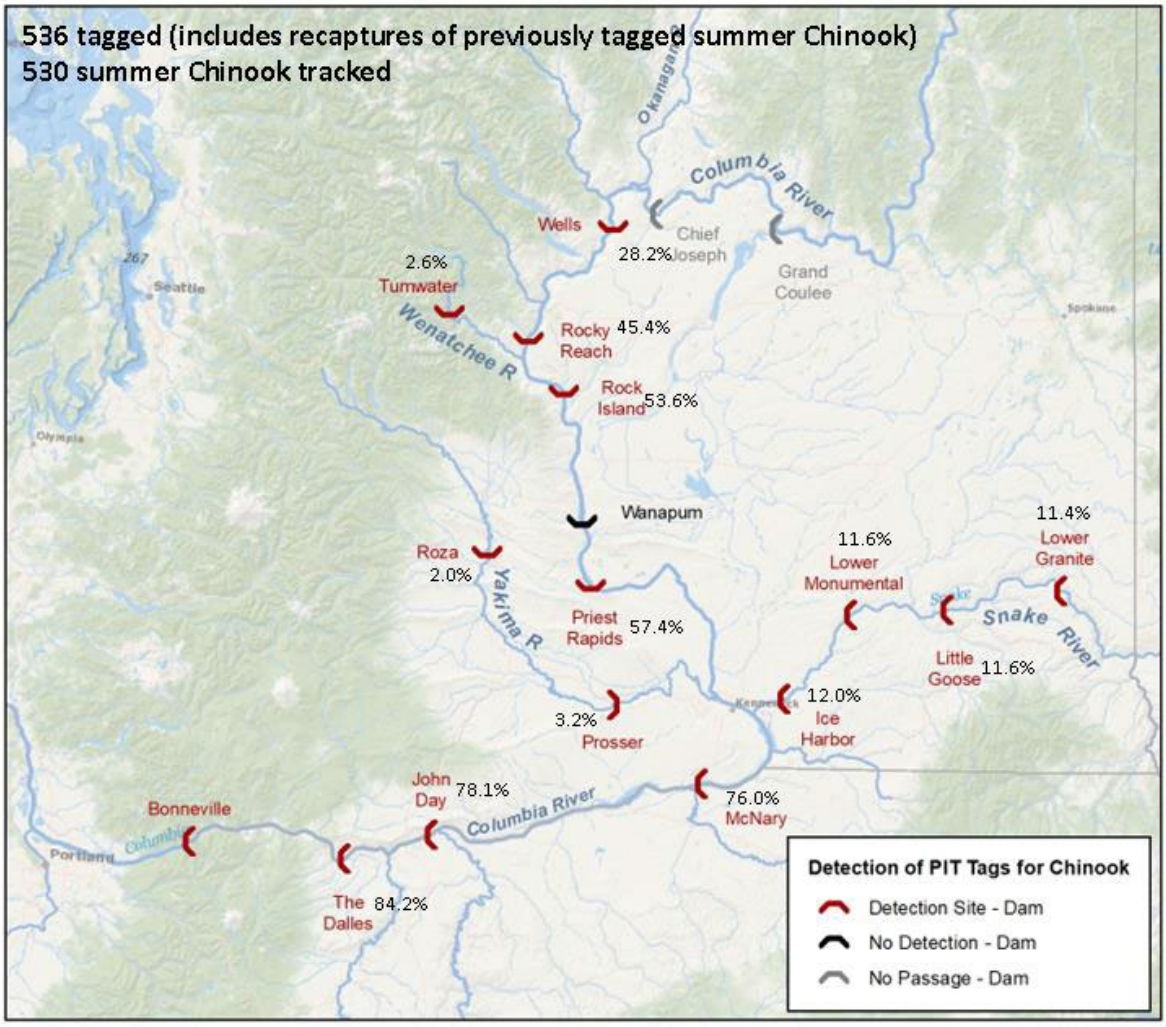


Figure 8. Map of the Columbia River Basin from Bonneville to Wells and Lower Granite dams showing the number of summer Chinook Salmon PIT tagged at Bonneville Dam, and the percentage of the run estimated to pass upstream dams in 2022.

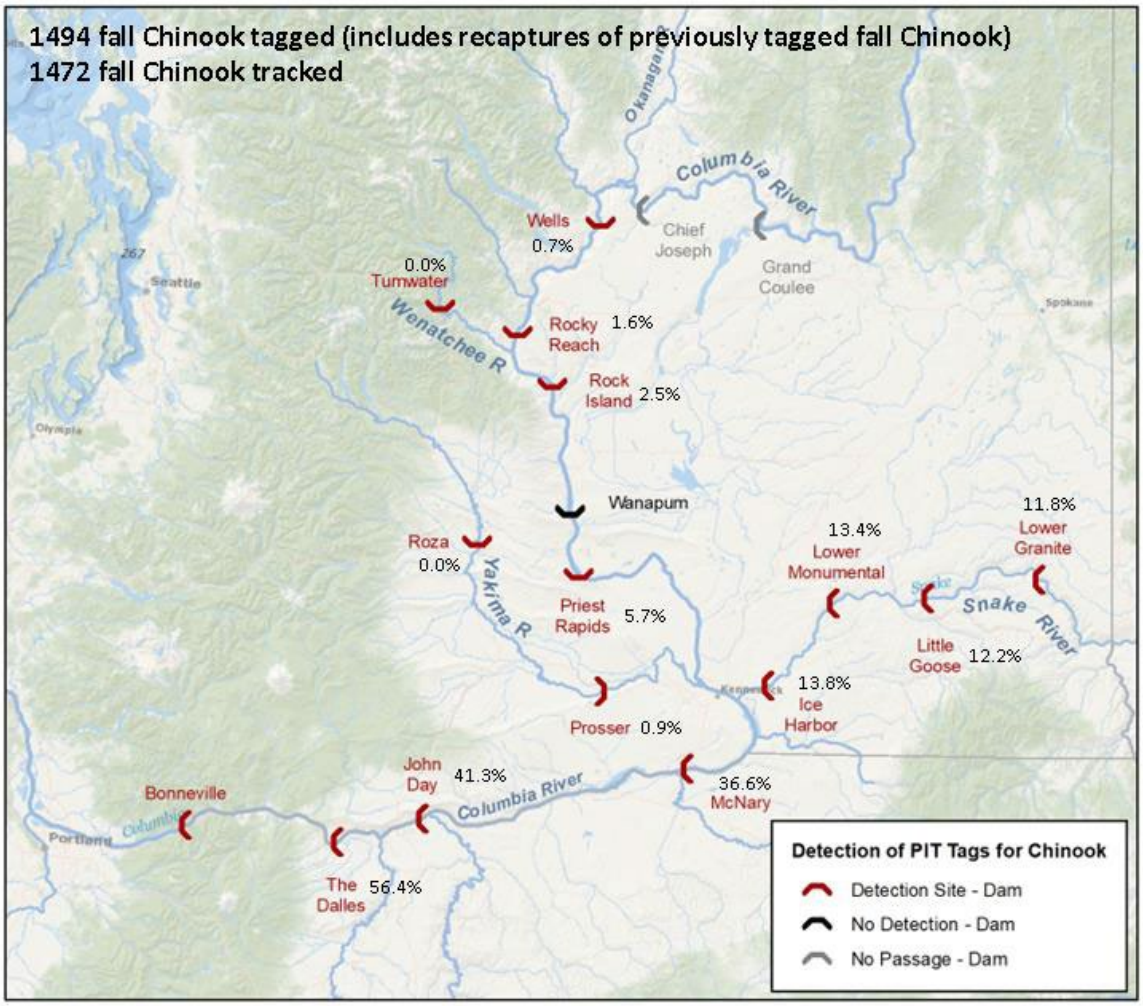


Figure 9. Map of the Columbia River Basin from Bonneville to Wells and Lower Granite dams showing the number of fall Chinook Salmon PIT tagged at Bonneville Dam, and the percentage of the run estimated to pass upstream dams in 2022.

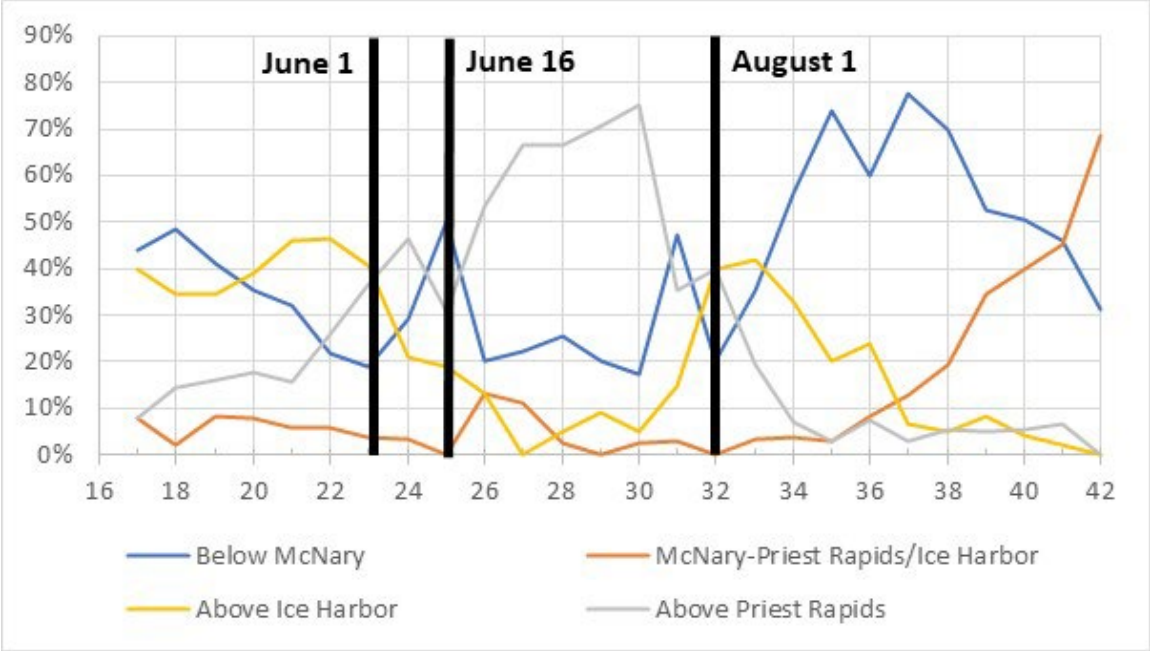


Figure 10. Distribution of final detection areas of the Columbia Basin by statistical week for Chinook Salmon PIT tagged at Bonneville Dam in 2022. Dates used to differentiate spring, summer, and fall Chinook are shown; both June 1 and June 16 are used to differentiate spring and summer Chinook.

The mean percentage of PIT-tagged Chinook Salmon passing mainstem Columbia and Snake River dams without detection, was 0.7% for spring Chinook, 0.8% for summer Chinook and 0.3% for fall Chinook (Table 6). 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 Wells Dam at 16.7% (though this comprised only 1 fall Chinook out of 6 passing), summer and fall Chinook at Ice Harbor at 4.9% and 1.3% respectively.

The mean deviation between total Chinook escapement estimates based on PIT tags and those estimated by visual counts was 2.3%; 0.3% for spring Chinook, -16.2% for summer Chinook, and 15.6% for fall Chinook (Table 7). However, total differences between visual and PIT tag estimates at individual dams varied by up to 46.3% for fall Chinook at Lower Monumental to -61.6% for summer Chinook at Ice Harbor. Likely affecting visual counts at dams was that spring Chinook tagged at Bonneville Dam were often detected at upstream dams as summer Chinook (and in one case, a fall Chinook); other mismatches of race at Bonneville compared to race at upstream dams also occurred (Table 8).

Table 5. Distribution of final detection areas of the Columbia Basin by statistical week for Chinook Salmon PIT tagged at Bonneville Dam in 2022.

	Last Detection Site			
Statistical Week	% Below McNary	% McNary-Priest Rapids/Ice Harbor	% Above Ice Harbor	% Above Priest Rapids
17	41.7	8.3	41.7	8.3
18	48.3	2.4	34.9	14.4
19	41.1	8.1	34.5	16.2
20	35.4	7.7	39.2	17.7
21	31.8	6.1	46.3	15.9
22	22.0	5.7	46.3	26.0
23	17.9	3.7	41.4	37.0
24	28.7	3.6	21.0	46.7
25	50.0	0.0	19.0	31.0
26	20.0	13.3	13.3	53.3
27	12.5	12.5	0.0	75.0
28	25.6	2.6	5.1	66.7
29	20.0	0.0	9.3	70.7
30	17.5	0.0	10.0	72.5
31	43.8	3.1	15.6	37.5
32	20.0	0.0	40.0	40.0
33	33.3	3.3	43.3	20.0
34	46.7	4.4	40.0	8.9
35	72.1	3.3	21.3	3.3
36	51.0	10.2	29.9	8.8
37	72.0	15.9	8.2	3.9
38	69.7	19.7	4.9	5.7
39	52.1	34.7	8.3	4.9
40	50.0	40.3	4.2	5.6
41	45.2	45.9	2.1	6.8
42	26.7	73.3	0.0	0.0
Mean	**53.0**	**13.7**	**18.4**	**14.9**
Spring Chinook	**36.4**	**6.2**	**39.7**	**17.7**
Summer Chinook	**24.0**	**6.6**	**12.0**	**57.4**
Fall Chinook	**63.4**	**17.1**	**13.8**	**5.7**

Table 6. Percentage of Chinook Salmon detected upstream that missed detection at mainstem dams in 2022.

Dam	Spring	Summer	Fall
Bonneville	0.1	0.0	0.0
The Dalles	0.2	1.4	0.1
John Day	1.2	2.1	0.9
McNary	0.7	1.0	0.0
Priest Rapids	0.0	0.0	0.0
Rock Island	0.0	0.0	0.0
Rocky Reach	2.7	0.0	0.0
Wells	0.0	0.0	16.7
Ice Harbor	3.0	4.9	1.3
Lower Monumental	1.1	0.0	0.7
Little Goose	0.0	0.0	0.8
Lower Granite	0.5	0.0	NA
Mean (weighted by number of detections)	**0.7**	**0.8**	**0.3**

Table 7. Spring, summer, fall, and total Chinook Salmon escapement at Columbia Basin mainstem dams upstream of Bonneville Dam in 2022. Estimates are from both PIT tag recoveries and dam counts (FPC 2022).

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	128,869	128,196	-0.5	116,495	98,101	-15.8
John Day	116,306	114,902	-1.2	89,571	91,038	1.6
McNary	105,848	106,057	0.2	82,342	88,559	7.6
Priest Rapids	24,420	29,600	21.2	76,726	66,830	-12.9
Rock Island	25,996	29,326	12.8	62,812	62,489	-0.5
Rocky Reach	7,900	10,592	34.1	67,003	52,869	-21.1
Wells	7,150	9,010	26.0	57,364	32,878	-42.7
Ice Harbor	69,173	66,232	-4.3	36,427	13,993	-61.6
L. Monumental	67,090	64,298	-4.2	16,932	13,560	-19.9
Little Goose	62,694	63,266	0.9	21,400	13,486	-37.0
Lower Granite	66,241	62,068	-6.3	25,414	13,261	-47.8
Mean (weighted)			**0.3**			**-16.2**
	Fall Chinook Salmon			**Total Chinook Salmon**		
The Dalles	328,719	332,264	1.1	574,083	558,562	-2.7
John Day	205,047	243,737	18.9	410,924	449,678	9.4
McNary	184,929	215,853	16.7	373,119	410,469	10.0
Priest Rapids	35,529	33,736	-5.0	136,675	130,166	-4.8
Rock Island	12,594	14,607	16.0	101,402	106,423	5.0
Rocky Reach	11,497	9,343	-18.7	86,400	72,804	-15.7
Wells	4,457	4,206	-5.6	68,971	46,094	-33.2
Ice Harbor	55,789	81,381	45.9	161,389	161,605	0.1
L. Monumental	53,851	78,758	46.3	137,873	156,616	13.6
Little Goose	51,994	71,972	38.4	136,088	148,725	9.3
Lower Granite	54,952	69,776	27.0	146,607	145,105	-1.0
Mean (weighted)			**15.6**			**2.3**

Table 8. 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 2022.

Last Date Spring Run	First Date Fall Run	Race at Bonneville / Race at Dam Listed Below	Spring / Summer	Spring / Falls	Summer / Spring	Summer / Fall	Fall / Summer
June 3	August 4	The Dalles	2.4	0.0	3.8	0.9	0.0
June 5	August 6	John Day	3.0	0.0	4.5	0.8	0.6
June 8	August 9	McNary	4.6	0.0	4.9	0.3	0.8
June 13	August 14	Priest Rapids	21.6	0.0	0.4	0.0	3.4
June 17	August 18	Rock Island	20.7	0.0	0.8	0.0	7.3
June 19	August 20	Rocky Reach	45.3	0.0	0.4	0.0	10.3
June 28	August 29	Wells	28.1	1.6	4.1	3.4	30.8
June 11	August 12	Ice Harbor	5.0	0.0	4.0	3.0	0.6
June 13	August 14	L. Monumental	11.0	0.0	5.8	1.9	0.6
June 15	August 16	Little Goose	23.4	0.0	1.0	2.0	0.7
June 17	August 18	Lower Granite	25.0	0.0	1.0	2.0	0.7

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 9) with comparisons showing deviations up to 11.9. Chinook that ultimately passed any of these three dams primarily passed Bonneville Dam in the spring and, to a lesser extent, in the fall (Figure 11).

Table 9. Chinook Salmon escapement, as estimated using PIT tag detections, to Tumwater, Prosser, and Roza dams in 2022.

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	55	5925	4997	639	9.2
Prosser Dam, Yakima River	55	8665	4658	1058	-11.9
Roza Dam, Yakima River	28	5206	3375	436	2.8

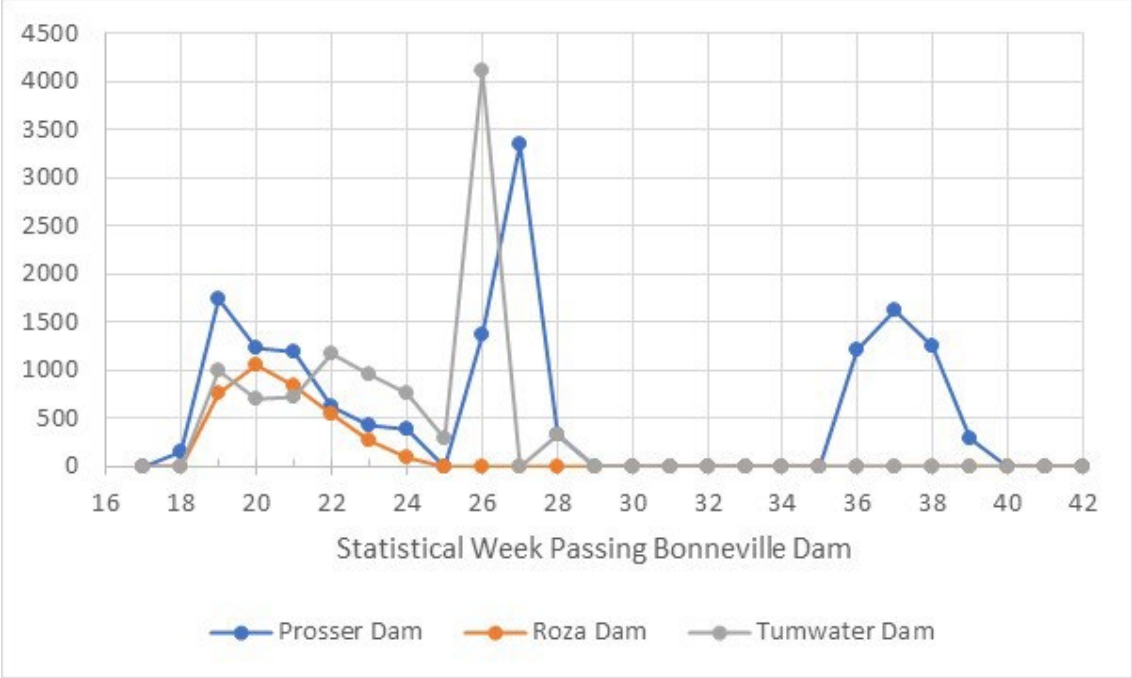


Figure 11. Percentage of Chinook Salmon by statistical week tagged at Bonneville Dam in 2022 destined for the Tumwater Dam (Wenatchee River), Prosser Dam (Yakima River) and Roza Dam (Yakima River) based on upstream PIT tag detections.

Migration Rates and Passage Time

Chinook migration rates between mainstem dams in Table 10 in 2022 ranged between 17.6 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.

Among the mainstem and tributary dams in Table 11, 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 and summer Chinook and Lower Granite Dam for 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 10. Chinook Salmon migration rates between Columbia Basin dams estimated using PIT tag data in 2022.

		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	36.1	21.5	38.1
Bonneville-Lower Granite	461	27.2	22.9	32.8
Priest Rapids-Wells	191	21.3	24.0	17.6
McNary-Ice Harbor	68	31.2	18.6	46.2
Ice Harbor-Lower Granite	157	19.8	29.8	31.0
To and Between Tributary Sites				
Rock Island - Tumwater	68	2.1	3.5	NA
McNary - Prosser	145	18.2	3.2	7.0
Prosser - Roza	130	6.8	7.3	NA

Table 11. 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 2022.

	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	74.4	77.4	66.2	5.0	4.2	5.2
The Dalles	0.2	0.1	0.1	2.0	2.1	5.4
John Day	0.2	0.1	0.1	2.9	3.9	2.8
McNary	103.4	98.0	83.2	5.1	1.5	3.2
Priest Rapids	4.5	5.7	5.1	3.5	6.4	2.0
Rock Island	62.3	46.1	92.4	12.9	6.9	5.9
Rocky Reach	12.2	8.3	9.2	8.6	10.0	1.4
Wells	237.3	110.0	77.8	31.3	23.4	1.6
Ice Harbor	3.6	2.6	1.9	6.8	1.1	0.9
Lower Monumental	2.1	0.2	0.2	8.0	1.1	2.3
Little Goose	0.1	0.1	0.1	11.1	1.6	3.9
Lower Granite	192.4	175.6	218.6	22.9	3.8	10.9
Prosser	0.1	0.1	18.9	0.0	2.9	2.9
Roza	1.1	16.2	NA	12.0	4.0	0.0
Tumwater	1326.1	851.3	NA	52.9	32.4	0.0

Bonneville Dam Chinook Salmon Age Composition

Age 1.2 was the dominant age group for spring Chinook in all weeks and overall comprised 87.3 of the run with Age 1.1 comprising 10.1 of the run and Age 1.3, 2.3 (Table 12, Figure 12). The female population was comprised of 95.2 Age 1.2 and 4.1 Age 1.3, while male population was comprised of 76.6 Age 1.2, 21.6 Age 1.1, and 1.7 Age 1.1. The difference in the percentage of the males and females that were of age 1.1, 1.2, and 1.3 were statistically significant at $\alpha=0.05$ for $n \geq 10$.

Table 12. Weekly and total age composition of spring Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2022.

Week	of Run	Number Ageable	Female	Brood Year and Age Class				
				2019	2018		2017	
				1.1	0.3	1.2	0.4	1.3
17	2.6	21	64.0	0.0	0.0	100.0	0.0	0.0
18	19.3	165	55.2	0.0	0.0	98.2	0.0	1.8
19	29.5	160	57.1	4.4	0.0	94.4	0.0	1.3
20	19.1	163	54.9	11.7	0.0	87.7	0.0	0.6
21	15.4	185	43.7	29.7	0.0	69.2	0.0	1.1
22	9.3	195	41.1	20.0	1.0	72.3	0.0	6.7
23	3.5	45	58.7	4.4	0.0	71.1	4.4	20.0
Composite	**98.7**	**934**	**53.0**	**10.1**	**0.1**	**87.3**	**0.2**	**2.3**
SE			**0.9**	**0.1**	**1.0**	**0.1**	**0.5**	**0.9**
		Female	**Mean**	**0.0**	**0.2**	**95.2**	**0.4**	**4.1**
			SE	**—**	**0.1**	**0.5**	**0.2**	**0.5**
		Male	**Mean**	**21.6**	**0.1**	**76.6**	**0.0**	**1.8**
			SE	**1.7**	**0.1**	**1.8**	**0.4**	**0.7**
Total Sample Size				**122**	**2**	**770**	**2**	**29**
T-Statistic for test of differences				**15.26**	**0.03**	**12.63**	**0.92**	**2.41**
p-value				**<0.01**	**0.49**	**<0.01**	**0.23**	**0.01**

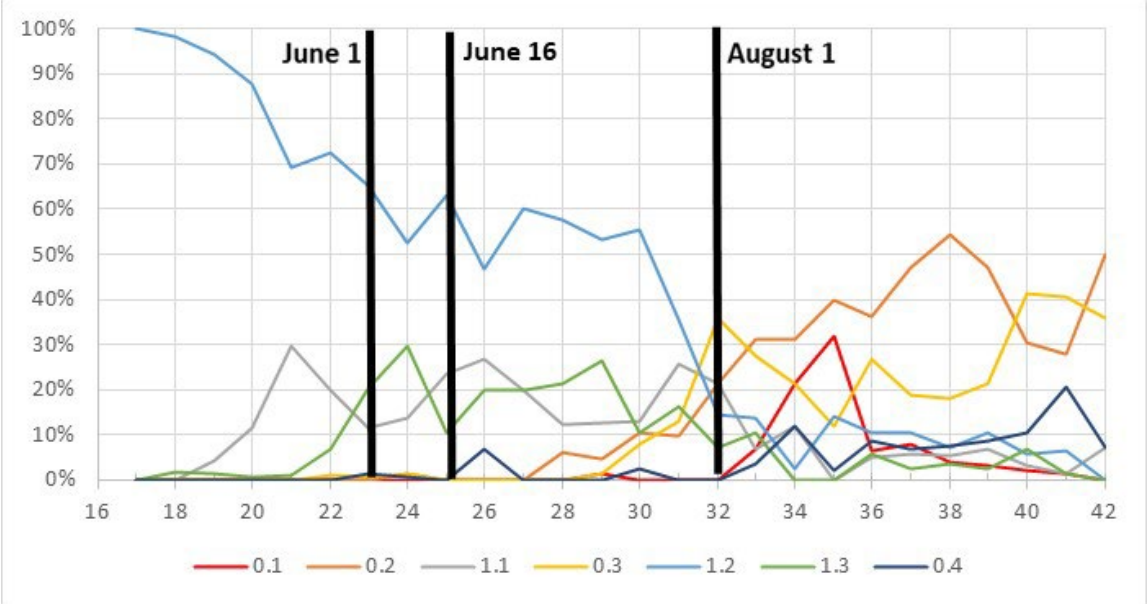


Figure 12. Weekly age composition of Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2022 with weekly percentage of run. Dates used to differentiate spring, summer, and fall Chinook are shown; both June 1 and June 16 are used to differentiate spring and summer Chinook.

The predominant age class for summer Chinook was also 1.2, comprising an estimated 55.0 of the population (Table 13, Figure 12) followed by Age 1.3 at 22.1 and Age 1.1 at 15.6. The dominant age class for female summer Chinook was Age 1.2 at 52.4 followed by Age 1.3 at 42.5. The predominant age for male

summer Chinook was Age 1.2 at 56.0, followed by Age 1.1 at 30.7 and Age 1.3 at 7.6. The differences in age composition were significant at $\alpha=0.05$ for Age 0.2, 1.1, and 1.3. for $n \geq 10$

The predominant age class for fall Chinook was 0.2 at 44.4% of the run (Table 14, Figure 12) followed by Age 0.3 at 21.2%, Age 1.2 at 9.7%, and Age 0.1 at 8.6%. Females were primarily Age 0.2 (38.7%) with lesser percentages of 0.3 (30.8%), 0.4 (12.2%), and 1.2 (11.3%). Among males, Age 0.2 also predominated at 47.9%, followed by 14.8% at Age 0.1, 14.5% at Age 0.3, and 8.6% at Age 1.2. The differences in age composition between the sexes were significant at $\alpha=0.05$ for age classes 0.1, 0.2,1,1, 0.3, and 0.4 for $n \geq 10$.

The percentage of yearling freshwater (Age 1.x) Chinook was at or near 100 through Week 23 (Figure 13), then began to decline through the rest of the year, with the percentage of subyearling freshwater Chinook (0.x) showing the opposite trend. The first week that Age 0.x Chinook predominated was Week 32 at 57.1 of the run.

Table 13. Weekly and total age composition of summer Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2022. 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							
				2020	2019		2018		2017		2016
				0.1	0.2	1.1	0.3	1.2	0.4	1.3	1.4
23	7.2	104	41.1	0.0	0.0	14.4	1.0	62.5	0.0	20.2	1.9
24	13.8	139	39.6	0.0	1.4	13.7	1.4	52.5	0.7	29.5	0.7
25	10.6	38	31.0	0.0	0.0	23.7	0.0	63.2	0.0	10.5	2.6
26	17.7	15	40.0	0.0	0.0	26.7	0.0	46.7	6.7	20.0	0.0
27	25.9	5	55.6	0.0	0.0	20.0	0.0	60.0	0.0	20.0	0.0
28	10.9	33	34.3	0.0	6.1	12.1	0.0	57.6	0.0	21.2	3.0
29	6.4	64	37.3	1.6	4.7	12.5	1.6	53.1	0.0	26.6	0.0
30	3.7	38	43.9	0.0	10.5	13.2	7.9	55.3	2.6	10.5	0.0
31	3.4	31	28.1	0.0	9.7	25.8	12.9	35.5	0.0	16.1	0.0
Composite	**99.6**	**843**	**42.0**	**0.2**	**3.0**	**15.6**	**2.4**	**55.0**	**0.6**	**22.1**	**1.1**
SE			**5.1**	**0.1**	**0.6**	**3.8**	**0.3**	**4.5**	**1.3**	**3.6**	**0.6**
Female	**Mean**			**0.0**	**0.5**	**0.0**	**0.6**	**52.4**	**3.0**	**42.5**	**1.0**
	SE			**-**	**0.3**	**-**	**0.3**	**12.7**	**2.6**	**12.8**	**0.8**
Male	**Mean**			**0.2**	**3.1**	**30.7**	**1.5**	**56.0**	**0.2**	**7.6**	**0.8**
	SE			**0.1**	**0.8**	**9.9**	**0.4**	**9.9**	**0.2**	**1.0**	**0.4**
Total Sample Size				**1**	**14**	**72**	**11**	**252**	**3**	**100**	**5**
T-Statistic for test of differences				**1.23**	**3.22**	**3.10**	**1.74**	**0.22**	**1.11**	**2.72**	**0.20**
p-value				**0.22**	**<0.01**	**<0.01**	**0.055**	**0.41**	**0.17**	**<0.01**	**0.42**

Table 14. Weekly and total age composition of fall Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2022. Composite age composition estimates are weighted by the percentage of the run passing Bonneville Dam in each week.

				Brood Year and Age Class									
				2020	2019		2018		2017			2016	
Week	of Run	Number Ageable	Females	0.1	0.2	1.1	0.3	1.2	0.4	1.3	2.2	0.5	1.4
32	0.5	14	46.7	0.0	21.4	21.4	35.7	14.3	0.0	7.1	0.0	0.0	0.0
33	1.1	29	33.3	6.9	31.0	6.9	27.6	13.8	3.4	10.3	0.0	0.0	0.0
34	2.7	42	25.0	21.4	31.0	11.9	21.4	2.4	11.9	0.0	0.0	0.0	0.0
35	8.4	50	19.7	32.0	40.0	0.0	12.0	14.0	2.0	0.0	0.0	0.0	0.0
36	18.6	141	40.4	6.4	36.2	5.0	27.0	10.6	8.5	5.7	0.0	0.0	0.7
37	35.9	161	44.8	8.1	47.2	5.6	18.6	10.6	6.8	2.5	0.6	0.0	0.0
38	19.1	171	45.4	4.1	54.4	5.3	18.1	7.0	7.6	3.5	0.0	0.0	0.0
39	8.0	278	40.5	3.2	46.8	6.8	21.2	10.4	8.6	2.5	0.0	0.4	0.0
40	2.9	192	49.5	2.1	30.7	3.1	41.1	5.7	10.4	6.8	0.0	0.0	0.0
41	1.7	136	49.0	1.5	27.2	1.5	41.2	6.6	20.6	1.5	0.0	0.0	0.0
42	0.8	15	31.3	0.0	53.3	6.7	33.3	0.0	6.7	0.0	0.0	0.0	0.0
Composite	**99.6**	**1229**	**41.1**	**8.6**	**44.4**	**5.2**	**21.2**	**9.7**	**7.4**	**3.2**	**0.2**	**0.0**	**0.1**
SE			**1.6**	**1.1**	**1.9**	**0.8**	**1.5**	**1.2**	**1.0**	**0.6**	**0.2**	**0.0**	**0.1**
Female	**Mean**			**0.0**	**38.7**	**1.4**	**30.8**	**11.3**	**12.2**	**4.7**	**0.5**	**0.1**	**0.3**
	SE			**0.0**	**2.8**	**0.8**	**2.5**	**2.0**	**1.8**	**1.2**	**0.1**	**0.3**	**0.5**
Male	**Mean**			**14.8**	**47.9**	**7.8**	**14.5**	**8.6**	**4.1**	**2.2**	**0.0**	**0.0**	**0.0**
	SE			**1.8**	**2.6**	**1.5**	**1.9**	**1.4**	**1.1**	**0.8**	**0.8**	**0.8**	**0.8**
Total Sample Size				**71**	**496**	**62**	**325**	**106**	**114**	**44**	**1**	**1**	**1**
T-Statistic for test of differences				**8.38**	**2.42**	**3.87**	**5.13**	**1.10**	**3.78**	**1.75**	**0.52**	**10.73**	**1.50**
p-value				**<0.01**	**0.01**	**<0.01**	**<0.01**	**0.14**	**<0.01**	**0.04**	**0.35**	**0.03**	**0.19**

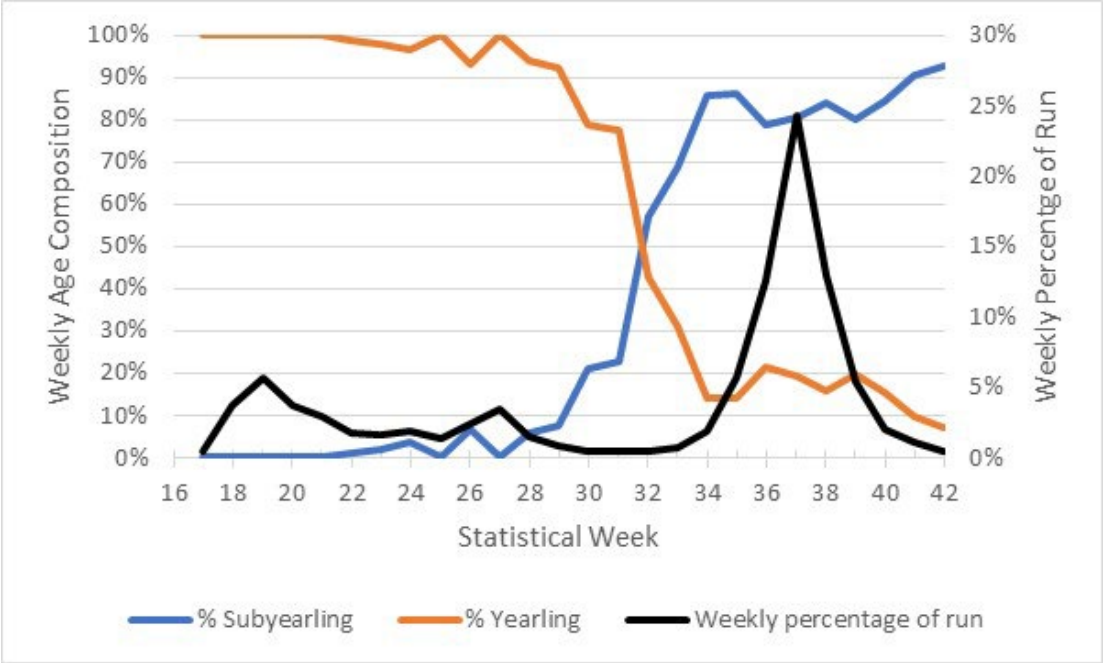


Figure 13. Weekly age composition of Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2022 with weekly percentage of run.

Upstream Age and Length-at-Age Composition

Age 1.2 was the dominant age class for spring Chinook at all dams (Table 15, Figure 15). Among summer Chinook, age 1.2 was the most abundant age component at all dams except for Wells Dam where 1.3 was most abundant (Table 15, Figure 16). Among fall Chinook age 0.2 was the most abundant age component at all dams except for Wells Dam where Age 1.1 was most abundant (Table 15, Figure 17). Length-at-age composition estimates at mainstem dam sites are summarized in Tables 16-18.

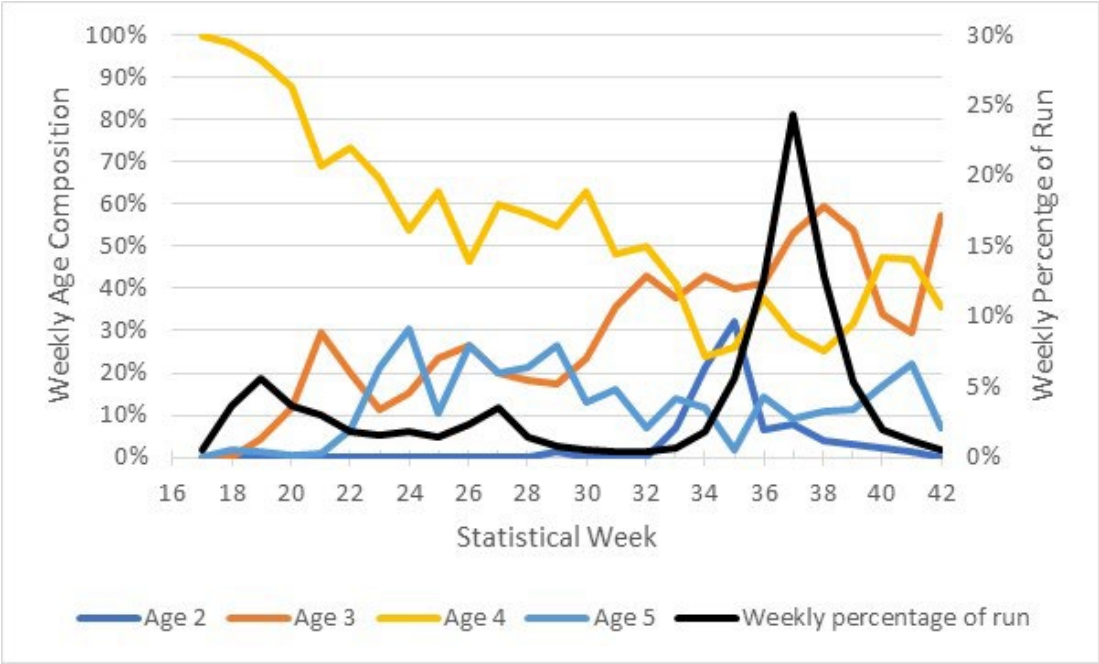


Figure 14. Weekly total age composition of Chinook Salmon at Bonneville Dam as estimated from scale patterns in 2022 with weekly percentage of run.

Table 15. 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 2022[5].

		Brood Year and Age Class									
Run and Site	**Ageable**	**2020**	**2019**		**2018**		**2017**			**2016**	
Spring	**N**	**0.1**	**0.2**	**1.1**	**0.3**	**1.2**	**0.4**	**1.3**	**2.2**	**0.5**	**1.4**
Bonneville	920	0.0	0.0	13.0	0.2	83.3	0.2	3.3	0.0	0.0	0.0
The Dalles	755	0.0	0.0	14.7	0.3	81.5	0.3	3.3	0.0	0.0	0.0
John Day	681	0.0	0.0	14.8	0.3	81.4	0.3	3.2	0.0	0.0	0.0
McNary	634	0.0	0.0	14.0	0.3	82.0	0.3	3.3	0.0	0.0	0.0
Priest Rapids	183	0.0	0.0	18.0	0.5	71.6	1.1	8.7	0.0	0.0	0.0
Rock Island	182	0.0	0.0	18.1	0.5	72.0	1.1	8.2	0.0	0.0	0.0
Rocky Reach	66	0.0	0.0	25.8	1.5	47.0	3.0	22.7	0.0	0.0	0.0
Wells	56	0.0	0.0	30.4	1.8	50.0	3.6	14.3	0.0	0.0	0.0
Ice Harbor	395	0.0	0.0	11.9	0.0	86.8	0.0	1.3	0.0	0.0	0.0
Low. Mon.	388	0.0	0.0	12.1	0.0	86.6	0.0	1.3	0.0	0.0	0.0
Little Goose	383	0.0	0.0	12.3	0.0	86.4	0.0	1.3	0.0	0.0	0.0
Lower Granite	375	0.0	0.0	12.3	0.0	86.4	0.0	1.3	0.0	0.0	0.0
Summer	**N**	**0.1**	**0.2**	**1.1**	**0.3**	**1.2**	**0.4**	**1.3**	**2.2**	**0.5**	**1.4**
Bonneville	461	0.2	3.0	15.6	2.4	54.9	0.7	22.3	0.0	0.0	0.9
The Dalles	401	0.2	3.0	17.7	2.2	52.6	0.5	22.7	0.0	0.0	1.0
John Day	356	0.3	2.8	18.3	2.2	51.7	0.6	23.0	0.0	0.0	1.1
McNary	340	0.3	2.9	17.6	2.1	51.5	0.6	23.8	0.0	0.0	1.2
Priest Rapids	232	0.4	3.9	11.2	0.9	48.3	0.9	33.2	0.0	0.0	1.3
Rock Island	222	0.5	4.1	10.8	0.9	47.7	0.9	33.8	0.0	0.0	1.4
Rocky Reach	191	0.0	4.7	9.4	1.0	45.5	1.0	36.6	0.0	0.0	1.6
Wells	123	0.0	4.1	8.9	0.8	38.2	1.6	45.5	0.0	0.0	0.8
Ice Harbor	96	1.0	0.0	30.2	3.1	61.5	0.0	3.1	0.0	0.0	1.0
Low. Mon.	94	1.1	0.0	29.8	3.2	61.7	0.0	3.2	0.0	0.0	1.1
Little Goose	94	1.1	0.0	29.8	3.2	61.7	0.0	3.2	0.0	0.0	1.1
Lower Granite	92	1.1	0.0	29.3	3.3	62.0	0.0	3.3	0.0	0.0	1.1
Fall	**N**	**0.1**	**0.2**	**1.1**	**0.3**	**1.2**	**0.4**	**1.3**	**2.2**	**0.5**	**2.2**
Bonneville	1209	5.5	40.9	5.2	26.6	8.9	9.1	3.6	0.1	0.1	0.1
The Dalles	804	4.1	42.9	6.6	26.7	8.7	8.1	2.6	0.1	0.1	0.0
John Day	628	3.5	44.3	7.2	26.1	8.0	8.1	2.9	0.0	0.0	0.0
McNary	580	3.6	43.8	7.6	25.9	7.9	8.3	2.9	0.0	0.0	0.0
Priest Rapids	87	5.7	41.4	14.9	20.7	9.2	1.1	6.9	0.0	0.0	0.0
Rock Island	41	0.0	34.1	24.4	14.6	14.6	2.4	9.8	0.0	0.0	0.0
Rocky Reach	29	0.0	34.5	27.6	20.7	6.9	3.4	6.9	0.0	0.0	0.0
Wells	15	0.0	26.7	40.0	20.0	6.7	0.0	6.7	0.0	0.0	0.0
Ice Harbor	144	4.2	52.1	8.3	19.4	9.0	6.3	0.7	0.0	0.0	0.0
Low. Mon.	138	4.3	53.6	8.7	18.1	8.7	5.8	0.7	0.0	0.0	0.0
Little Goose	127	4.7	53.5	9.4	17.3	8.7	6.3	0.0	0.0	0.0	0.0
Lower Granite	123	4.9	52.8	9.8	17.1	8.9	6.5	0.0	0.0	0.0	0.0

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

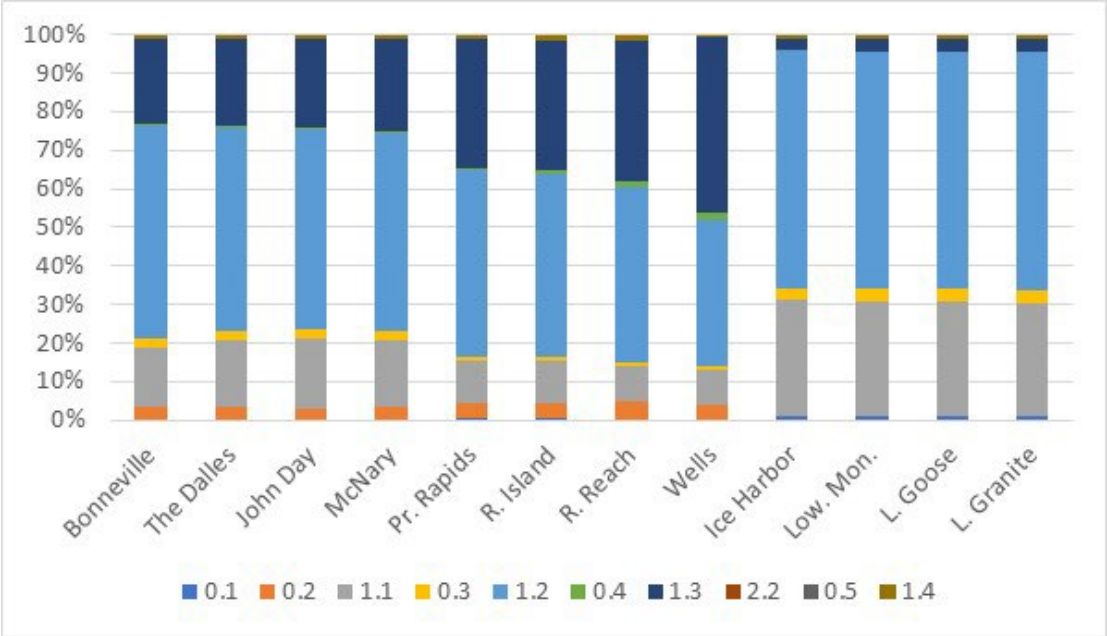


Figure 15. Spring Chinook age composition at Columbia and Snake River dams estimated using PIT-tagged Chinook tracked by this project. Spring Chinook are defined as passing Bonneville Dam prior to June 1, 2022.

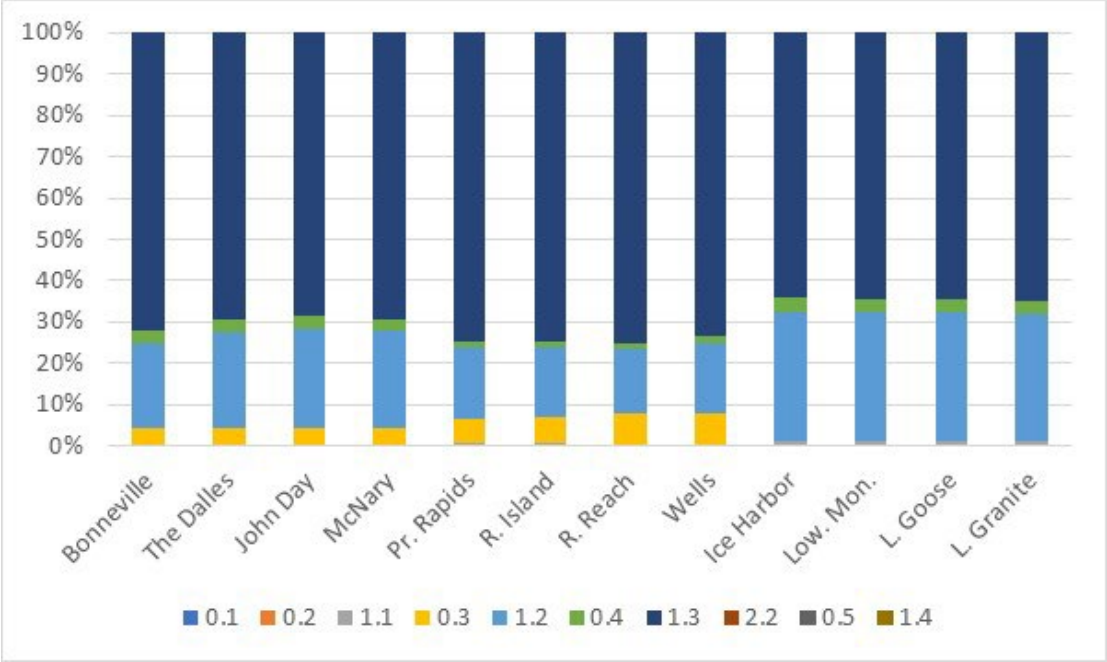


Figure 16. Summer Chinook age composition at Columbia and Snake River dams estimated using PIT-tagged Chinook tracked by this project. Summer Chinook are defined as passing Bonneville Dam between June 1 and July 31, 2022.

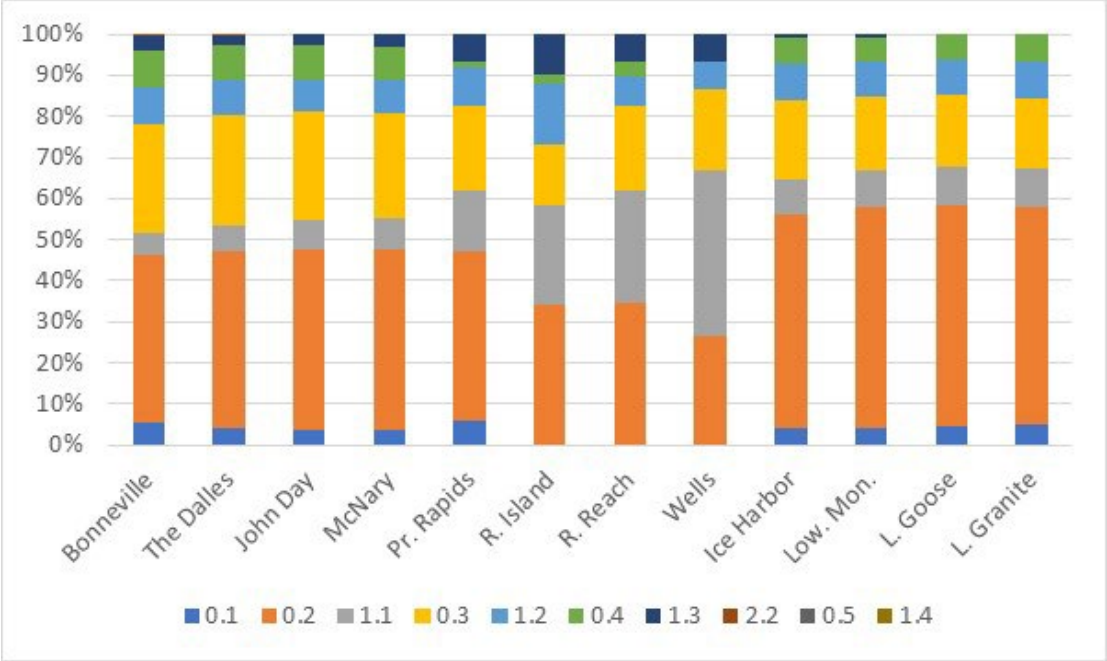


Figure 17. Fall Chinook age composition at Columbia and Snake River dams estimated using PIT-tagged Chinook tracked by this project. Fall Chinook are defined as passing Bonneville Dam on or after August 1, 2022.

Table 16. 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 2022.

Dam	Statistic	Brood Year and Age Class				
		2019	2018		2017	
		1.1	0.3	1.2	0.4	1.3
Bonneville	μ	487	743	720	860	826
	s	35	4	52	14	65
	n	120	2	766	2	30
The Dalles	μ	485	743	718	860	821
	s	34	4	54	14	68
	n	111	2	615	2	25
John Day	μ	484	743	718	860	825
	s	34	4	55	14	60
	n	101	2	554	2	22
McNary	μ	483	743	718	860	828
	s	34	4	56	14	60
	n	89	2	520	2	21
Priest Rapids	μ	482	740	738	860	832
	s	32	-	57	14	52
	n	33	1	131	2	16
Rock Island	μ	482	740	738	860	830
	s	32	-	57	14	54
	n	33	1	131	2	15
Rocky Reach	μ	476	740	705	860	830
	s	38	-	63	14	54
	n	17	1	31	2	15
Wells	μ	476	740	705	860	817
	s	38	-	60	14	61
	n	17	1	28	2	8
Ice Harbor	μ	483		713		818
	s	37		52		85
	n	47		343		5
Lower Monumental	μ	483		713		818
	s	37		52		85
	n	47		336		5
Little Goose	μ	483		712		818
	s	37		52		85
	n	47		331		5
Lower Granite	μ	483		712		818
	s	38		52		85
	n	46		324		5

Table 17. 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 2022.

		Brood Year and Age Class							
		2020	2019		2018		2017		2016
Dam	Statistic	0.1	0.2	1.1	0.3	1.2	0.4	1.3	1.4
Bonneville	μ	365	609	531	773	715	885	808	816
	s	-	54	56	71	67	64	62	237
	n	1	14	72	11	253	3	103	4
The Dalles	μ	365	620	530	754	709	893	809	816
	s	-	47	56	64	68	88	64	237
	n	1	12	71	9	211	2	91	4
John Day	μ	365	608	527	759	705	893	809	816
	s	-	40	56	67	69	88	65	237
	n	1	10	65	8	184	2	82	4
McNary	μ	365	608	528	770	702	893	810	816
	s	-	40	55	64	68	88	64	237
	n	1	10	60	7	175	2	81	4
Priest Rapids	μ	365	617	536	768	691	893	811	760
	s	-	29	65	25	71	88	66	256
	N	1	9	26	2	112	2	77	3
Rock Island	μ	365	617	534	768	691	893	811	760
	s	-	29	67	25	73	88	67	256
	N	1	9	24	2	106	2	75	3
Rocky Reach	μ		617	542	768	682	893	811	760
	s		29	74	25	67	88	66	256
	n		9	18	2	87	2	70	3
Wells	μ		616	526	785	681	893	813	1025
	s		30	83	-	82	88	69	-
	n		5	11	1	47	2	56	1
Ice Harbor	μ	365		518	777	724	800	985	665
	s	-		48	65	59	26	-	121
	n	1		29	3	59	3	1	96
Lower Monumental	μ	365		517	777	724	800	985	665
	s	-		48	65	59	26	-	122
	n	1		28	3	58	3	1	94
Little Goose	μ	365		517	777	724	800	985	665
	s	-		48	65	59	26	-	122
	n	1		28	3	58	3	1	94
Lower Granite	μ	365		519	777	723	800	985	666
	s	-		47	65	59	26	-	120
	n	1		27	3	57	3	1	92

Table 18. 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 2022.

Dam	Statistic	Brood Year and Age Class									
		2020	2019		2018		2017			2016	
		0.1	0.2	1.1	0.3	1.2	0.4	1.3	2.2	0.5	1.4
Bonneville	μ	492	636	575	738	712	803	797	735	765	785
	s	53	58	58	50	65	60	57	-	-	-
	n	67	494	63	322	107	110	43	1	1	1
The Dalles	μ	457	624	570	736	698	807	796	735	765	
	s	44	54	60	50	67	64	64	-	-	
	n	33	345	53	215	70	65	21	1	1	
John Day	μ	463	624	568	737	699	805	803			
	s	36	49	60	51	63	62	63			
	n	22	278	45	164	50	51	18			
McNary	μ	459	623	569	733	697	805	802			
	s	32	48	61	50	65	64	65			
	n	21	254	44	150	46	48	17			
Priest Rapids	μ	444	615	554	721	705	740	819			
	s	11	39	78	55	64	-	47			
	n	5	36	13	18	8	1	6			
Rock Island	μ		597	539	746	683	740	795			
	s		27	82	46	57	-	25			
	n		14	10	6	6	1	4			
Rocky Reach	μ		598	533	746	635	740	775			
	s		29	89	46	64	-	7			
	n		10	8	6	2	1	2			
Wells	μ		578	524	753	590		770			
	s		22	95	68	-		-			
	n		4	6	3	1		1			
Ice Harbor	μ	473	616	558	730	680	765	715			
	s	26	52	53	54	72	59	-			
	n	6	75	12	28	13	9	1			
Lower Monumental	μ	473	616	558	730	667	768	715			
	s	26	52	53	57	58	62	-			
	n	6	74	12	25	12	8	1			
Little Goose	μ	473	615	558	734	675	768				
	s	26	52	53	50	53	62				
	n	6	68	12	22	11	8				
Lower Granite	μ	473	616	558	733	675	768				
	s	26	53	53	51	53	62				
	n	6	65	12	21	11	8				

Fallback

Estimated fallback rates, based on Chinook Salmon reascending fish ladders, or being detected downstream after ascending a fish ladder, ranged from 0.0 for spring Chinook at Priest Rapids and Rock Island dams to 22.8 for fall Chinook at Lower Granite Dam (Table 19). 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.

Table 19. Estimated minimum Chinook Salmon fallback rates by race at Columbia Basin dams with PIT tag detection in 2022 as estimated by PIT tags[6].

Dam	Spring Chinook	Summer Chinook	Fall Chinook
Bonneville	0.3	2.1	1.3
The Dalles	0.8	0.4	6.3
John Day	1.2	1.0	1.3
McNary	1.7	0.5	1.9
Priest Rapids	0.0	0.7	21.7
Rock Island	0.0	1.9	6.8
Rocky Reach	1.3	4.4	3.1
Wells	6.3	12.4	5.9
Ice Harbor	1.1	0.0	1.9
L. Monumental	0.9	0.0	1.9
Little Goose	1.6	2.0	12.1
Lower Granite	3.5	1.0	22.8
Weighted Mean	**1.2**	**2.0**	**4.1**

A total of 204 Chinook (excluding minijacks and Tules) generated 301 fallback events at mainstem dams with adult PIT tag detection (Table 20). A total of 69 Chinook had more than one fallback event with two Chinook falling back 6 times. Figures showing the movement of some of these Chinook are in the Appendix C (Figures C27 – C29).

Table 20. Frequency of fallback events for spring, summer, and fall Chinook Salmon tagged by this project in 2022. (Tules and minijacks excluded).

Frequency of Fallback Events per Chinook	Total Number of Chinook
1	135
2	54
3	7
4	5
5	1
6	2
Number of Chinook falling back at least once	**204**
Percentage of Chinook with at least one fallback event	**6.6**
Total fallback events	**301**
Number of Chinook (excluding minijacks and Tules) in study	**3104**
Fallback events per Chinook	**0.97**

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

Night Passage

Night passage (2000-0400 Pacific Standard Time) of tagged Chinook Salmon was under 10 at all mainstem dams except for fall Chinook at Rock Island, Rocky Reach, and Wells dams (Table 21). Higher percentages of night passage were estimated at Yakima River dams, but sample sizes were relatively small, ranging from 3 to 25 fish (Table 21).

Table 21. Chinook Salmon night passage (2000-0400) in 2022 at Columbia Basin dams as estimated by PIT tag detections.

Site	Spring Chinook	Summer Chinook	Fall Chinook
Bonneville	0.1	0.4	0.2
The Dalles	1.2	2.2	1.5
John Day	0.1	0.5	1.1
McNary	1.1	2.0	2.5
Priest Rapids	1.0	2.2	5.4
Rock Island	1.5	1.9	13.6
Rocky Reach	4.0	2.2	12.5
Wells	3.1	2.8	11.8
Ice Harbor	1.4	5.0	0.6
Lower Monumental	0.7	1.0	0.6
Little Goose	0.7	4.9	0.7
Lower Granite	1.7	2.0	2.2
Prosser	0.0	44.4	33.3
Roza	16.0	33.3	NA
Tumwater	5.9	4.8	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 67.1% for Hells Canyon stock to 8.3% for Yakima stock. (Table 22) The overall stray rate was 31.6%.

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 71.8% for Dworshak Hatchery to a low of 0.0% for Deschutes, Clearwater, Lookingglass, and Entiat Hatcheries (Table 23). The overall stray rate estimated using GSI was 16.6%.

Table 22. Table showing final-PIT-fate categories for Chinook by hatchery in 2022 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.

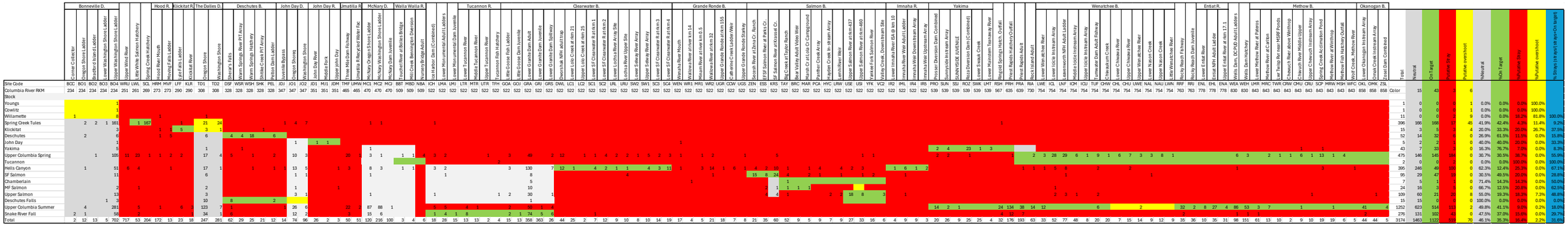
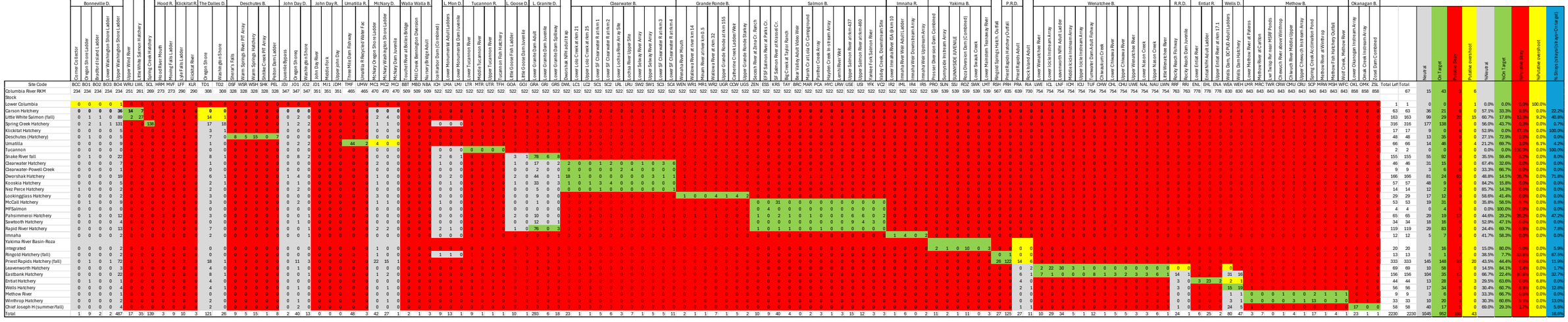


Table 23. Table showing final-PIT-fate categories for Chinook by hatchery in 2022 using Genetic Stock Identification (GSI). Fate categories are categorized by color. Grey is neutral (meaning last detected on route to expected destinations), green is on target (meaning last detected at their expected 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.



RESULTS-STEELHEAD

Sample Size

A total of 867 steelhead were sampled at Bonneville Dam in 2022 of which 843 were PIT tagged (Table 24). After adding previously tagged fish (24) which were sampled and therefore identified for the tracking study and included in our sample), and removing the three steelhead not detected upstream, 862 were tracked upstream (Table 24).

Table 24. Number of steelhead PIT tagged at Bonneville Dam and tracked past Bonneville by date and statistical week in 2022.

Sampling Dates	Week	Percentage of Run	Sampled	PIT Tagged	Previously Tagged	Not Detected After Release or only at BO2/BO3	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.							
4/21-4/22	17	0.1	1	1	0	0	1	0	0	0
4/25-4/29	18	0.1	0	0	0	0	0	0	0	0
5/3-5/6	19	0.1	2	2	0	0	2	0	0	0
5/9-5/13	20	0.1	1	1	0	0	1	0	0	0
5/16-5/20	21	0.1	2	1	1	1	1	0	0	0
5/23-5/27	22	0.2	5	5	0	0	5	0	0	0
5/31, 6/1-3	23	0.2	4	4	0	0	4	0	0	0
6/6-6/10	24	0.5	3	3	0	0	3	0	5	0
6/13. 6/15-17	25	0.6	1	1	0	0	1	0	5	0
6/21-6/23	26	1.2	3	3	0	0	3	0	3	0
6/27,28-6/30	27	3.0	0	0	0	0	0	0	4	0
7/5-7/8	28	5.0	37	37	0	0	37	0	3	0
7/11-7/15	29	7.8	57	55	2	1	56	0	3	0
7/18-7/22	30	7.0	49	49	0	1	48	0	0	0
7/26-7/29	31	9.2	60	57	3	0	60	2	0	0
8/2,5	32	5.9	24	22	2	0	24	2	0	3
8/8,11,12	**33**	5.9	61	58	3	0	61	3	0	2
8/15-18	34	10.3	122	115	7	1	121	4	0	1
8/23,24	35	2.7	23	23	0	0	23	2	0	3
8/29-31	36	9.0	50	48	2	1	49	3	0	2
9/6-9/9	37	7.0	5	5	0	0	5	4	0	0
9/12-9/16	38	10.1	21	21	0	0	21	4	0	1
9/19-9/23	39	5.8	138	135	3	0	138	0	5	0
9/26-30	40	3.1	112	111	1	0	112	0	1	0
10/3-10/7	41	1.5	68	68	0	0	68	0	0	0
10/11-13	42	0.7	18	18	0	0	18	0	0	0
No Sampling	>42	1.3	No Sampling after Oct. 12 due to insufficient target salmonids passing Bonneville.							
Total			**867**	**843**	**24**	**5**	**862**	**24**	**29**	**12**

Distribution of Sample

During weeks 37-38, a period in which visual counts estimate 17.1 of the steelhead run passed Bonneville Dam, we only sampled 26 steelhead which comprised only 3.0 of our total sample (Figure 18). This was due to the trap being operated for 7 of the 8 days those weeks with all four picket leads raised. As mentioned earlier, under this protocol for Chinook, all entry into the trap is volitional which could affect how representative our sample is relative to the run. In addition, the trap was closed one day each week, for Week 37 due to Labor Day and for Week 38 due to water temperatures above 21.1C. Details on picket lead protocols which reduce sampling effort can be found in Appendix B.

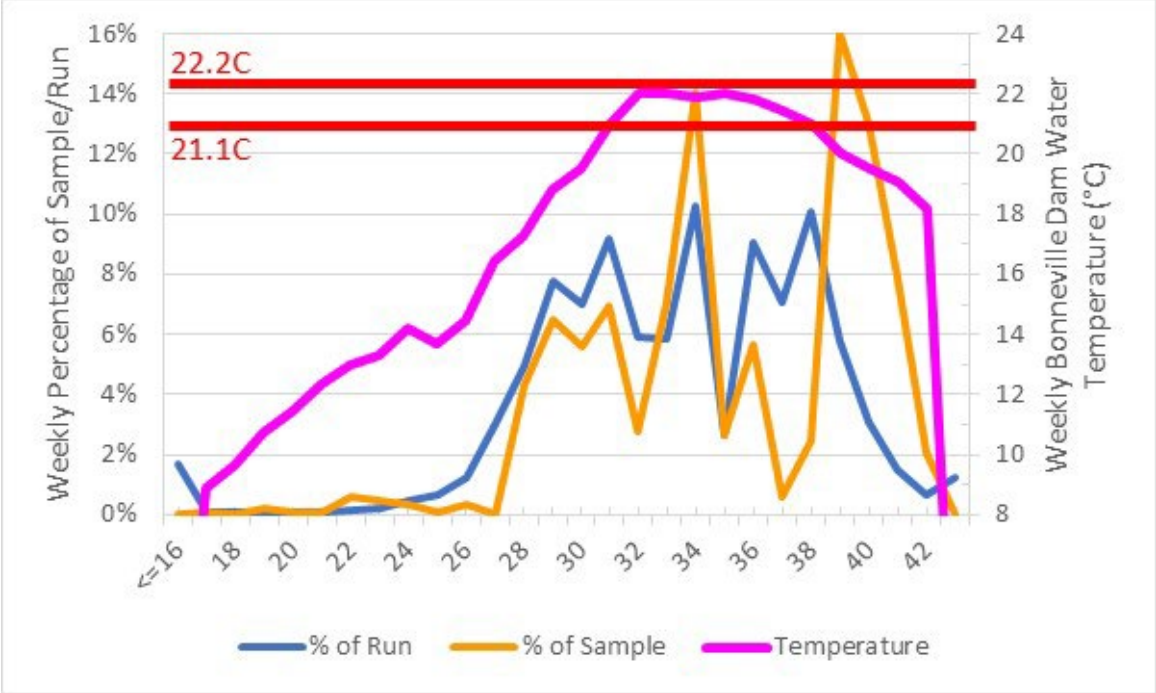


Figure 18. The weekly steelhead sample and run as a percentage of the total sample and run size at Bonneville Dam in 2022. Sampling was reduced at 21.1°C and halted at 22.2°C.

Detection Numbers

The 862 steelhead tracked in 2022 through December 31, 2023, generated 78,861 weir detections and 6,537 site detections at 158 sites. A table of sites (Table C1 and Figures C1, C18-C22) and maps that show the categorical ranges of detection numbers at the sites throughout the Columbia Basin can be found in Appendix C.

Bonneville Dam Steelhead Age Composition

The predominant age for 2022 steelhead was 1.2, comprising an estimated

50.7% of the run (Figure 19, Table 25) while Age r.2[7] comprised 18.0%, Age 2.2 was 12.2% and Age 1.1 was 9.1%. Only 604 steelhead (out of 867 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 incorrectly on the scale card or that the scale card may have been mislabeled.

[7] Age r.x indicates that the freshwater age is not readable due to scale regeneration but the saltwater age can be determined. Age r indicates neither the freshwater or saltwater age could be determined.

Table 25. Weekly and total age composition of steelhead at Bonneville Dam as estimated from scale patterns in 2022. 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
			2020	2019		2018			2017	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	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
18	0.1	0	--	--	--	--	--	--	--	--	--	--	--	--
19	0.0	2	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	50.0	0.0	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	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
22	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
23	0.1	4	0.0	50.0	0.0	25.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.1	3	0.0	33.3	0.0	0.0	33.3	0.0	0.0	0.0	33.3	0.0	0.0	0.0
25	0.2	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
26	0.7	3	0.0	66.7	0.0	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1.4	0	--	--	--	--	--	--	--	--	--	--	--	--
28	2.8	37	0.0	37.8	5.4	0.0	16.2	2.7	0.0	0.0	0.0	32.4	5.4	0.0
29	4.7	57	3.5	49.1	5.3	0.0	24.6	0.0	0.0	1.8	0.0	15.8	0.0	0.0
30	4.7	49	8.2	44.9	4.1	0.0	12.2	0.0	0.0	8.2	0.0	22.4	0.0	0.0
31	4.2	60	10.0	36.7	8.3	0.0	16.7	0.0	0.0	1.7	3.3	23.3	0.0	0.0
32	3.8	24	20.8	25.0	12.5	0.0	8.3	0.0	4.2	4.2	4.2	20.8	0.0	0.0
33	7.9	61	9.8	49.2	4.9	0.0	6.6	0.0	1.6	3.3	8.2	16.4	0.0	0.0
34	4.1	122	5.7	53.3	3.3	0.0	11.5	0.0	0.0	7.4	3.3	13.9	0.8	0.8
35	12.4	23	13.0	39.1	4.3	0.0	17.4	0.0	4.3	8.7	4.3	8.7	0.0	0.0
36	12.4	50	14.0	48.0	6.0	0.0	14.0	0.0	0.0	0.0	2.0	16.0	0.0	0.0
37	11.3	5	20.0	80.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	8.2	21	4.8	61.9	0.0	0.0	9.5	0.0	0.0	0.0	0.0	23.8	0.0	0.0
39	7.4	138	8.7	60.9	1.4	0.7	8.7	0.0	0.0	0.7	3.6	15.2	0.0	0.0
40	4.3	112	7.1	72.3	0.9	0.0	6.3	0.0	0.9	0.9	0.0	10.7	0.0	0.9
41	2.5	68	7.4	66.2	0.0	0.0	5.9	0.0	0.0	1.5	1.5	17.6	0.0	0.0
42	1.4	18	5.6	61.1	0.0	0.0	5.6	0.0	0.0	0.0	5.6	22.2	0.0	0.0
Total		**867**	**9.1**	**50.7**	**4.1**	**0.1**	**12.2**	**0.1**	**0.5**	**2.5**	**2.2**	**18.0**	**0.4**	**0.1**
SE			**1.6**	**2.4**	**0.8**	**0.1**	**1.4**	**0.1**	**0.3**	**0.6**	**0.5**	**1.6**	**0.2**	**0.1**

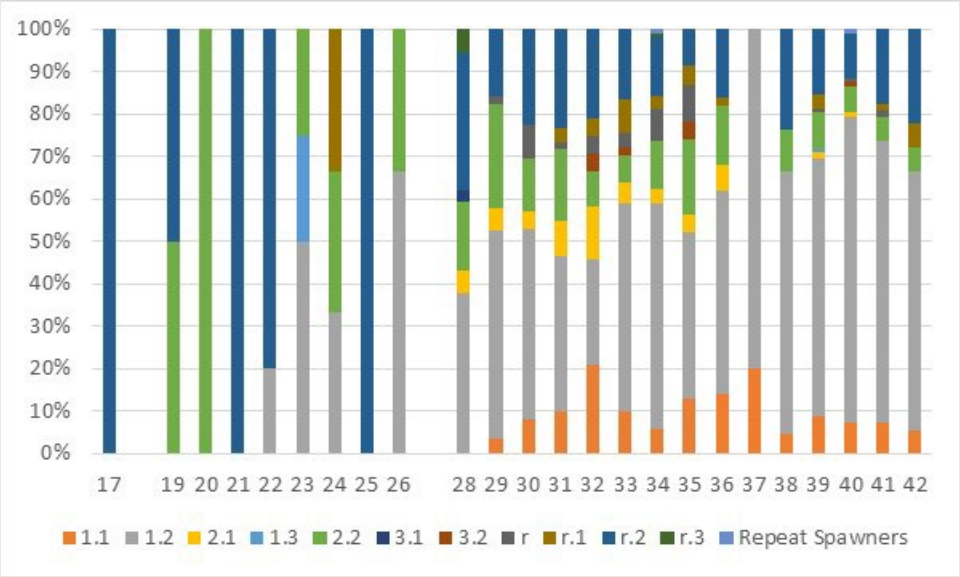


Figure 19. Weekly age composition of steelhead at Bonneville Dam as estimated from scale patterns for age classes in 2022.

Age 1.2 was the dominant age class at over 69 of the run at all dams (Table 26 and Figure 20). Upstream length-at-age estimates at dams are in Table 27.

Table 26. Unweighted age composition of steelhead at mainstem dams in 2022 for principal age groups (excluding those steelhead with freshwater zones where age could not be determined).

Dam	N ageable	Age Classification							Repeat Spawner
		1.1	1.2	2.1	1.3	2.2	3.1	3.2	
Bonneville	667	10.2	69.6	4.3	0.3	14.5	0.1	0.6	0.3
The Dalles	582	10.8	69.9	4.3	0.2	13.7	0.2	0.7	0.2
John Day	540	11.1	70.4	4.3	0.2	13.0	0.2	0.7	0.2
McNary	502	11.6	71.9	3.6	0.2	12.0	0.2	0.6	0.0
Priest Rapids	38	10.5	71.1	7.9	0.0	10.5	0.0	0.0	0.0
Rock Island	37	10.8	73.0	8.1	0.0	8.1	0.0	0.0	0.0
Rocky Reach	32	9.4	84.4	0.0	0.0	6.3	0.0	0.0	0.0
Wells	29	10.3	82.8	0.0	0.0	6.9	0.0	0.0	0.0
Ice Harbor	434	11.1	75.6	1.6	0.2	10.6	0.2	0.7	0.0
Lower Monumental	419	10.5	75.7	1.7	0.2	11.0	0.2	0.7	0.0
Little Goose	404	10.6	75.7	1.2	0.2	11.4	0.0	0.7	0.0
Lower Granite	129	10.8	75.9	1.3	0.3	11.0	0.0	0.8	0.0

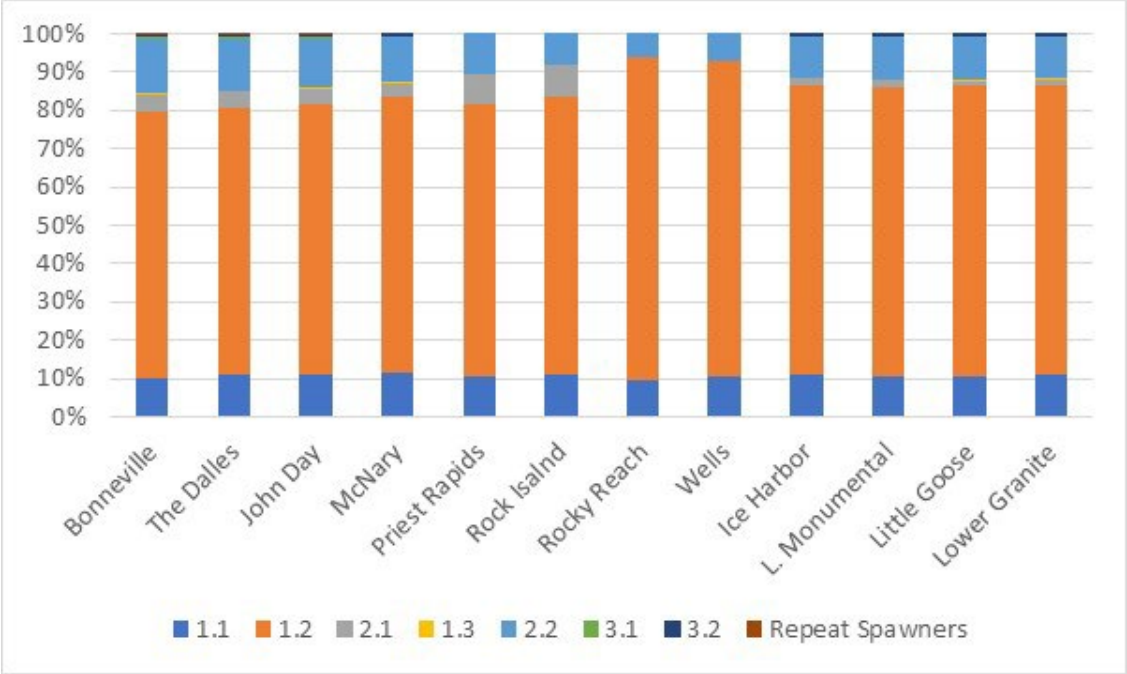


Figure 20. Unweighted age composition of steelhead at mainstem dams in 2022 for principal age groups (excluding those steelhead with freshwater zones where age could not be determined).

Table 27. Steelhead length-at-age composition at mainstem Columbia Basin dams, as estimated by upstream PIT tag detections of steelhead sampled at Bonneville Dam in 2022. (r = unreadable)

		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	568	763	570	820	736	615	803	666	578	738	762
	s	53	86	50	163	68	—	75	89	61	71	96
	n	68	464	29	2	97	1	4	23	21	151	3
The Dalles	μ	567	763	572	935	739	615	803	666	585	744	
	s	53	86	49	—	69	—	75	89	57	73	
	n	63	407	25	1	80	1	4	23	17	111	
John Day	μ	566	764	572	935	746	615	803	664	582	743	
	s	54	85	49	—	69	—	75	90	57	73	
	n	60	380	23	1	70	1	4	22	16	104	
McNary	μ	566	763	572	935	751	615	812	669	578	746	
	s	53	84	49	—	67	—	89	89	62	71	
	n	58	361	18	1	60	1	3	21	13	97	
Priest Rapids	μ	529	734	545		724			640	610	698	
	s	14	41	18		23			62	—	73	
	n	4	27	3		4			4	1	8	
Rock Island	μ	529	734	545		732			640	610	710	
	s	14	41	18		20			62	—	70	
	n	4	27	3		3			4	1	7	
Rocky Reach	μ	528	734			723			640	610	668	
	s	18	41			18			62	—	46	
	n	3	27			2			4	1	4	
Wells	μ	528	734			723			638	610	660	
	s	18	43			18			75	—	53	
	n	3	24			2			3	1	3	
Ice Harbor	μ	570	767	599	935	765	615	812	687	580	753	
	s	56	86	41	—	67	—	89	94	70	71	
	n	48	328	7	1	46	1	3	15	10	85	
Lower Monumental	μ	568	768	599	935	765	615	812	687	580	754	
	s	57	86	41	—	67	—	89	94	70	70	
	n	44	317	7	1	46	1	3	15	10	80	
Little Goose	μ	569	771	599	935	765		812	687	580	755	
	s	57	86	49	—	67		89	94	70	71	
	n	43	306	5	1	46		3	15	10	78	
Lower Granite	μ	569	771	599	935	768		812	687	580	758	
	s	57	85	49	—	66		89	94	70	70	
	n	43	303	5	1	44		3	15	10	76	

Mainstem Dam Recoveries, Mortality, and Escapement Estimates

The mean deviation between total steelhead escapement estimates based on PIT tags and those estimated by visual counts was 2.8 with a range of -6.3 at Lower Granite Dam to 34.1 at Rocky Reach Dam (Table 22). Greater deviations were at or above Priest Rapids Dam with deviations ranging from 12.8 to 34.1. At other dams, with much higher counts of steelhead, the deviation was no greater than 6.3.

Table 28. Steelhead escapement at Columbia Basin mainstem dams upstream of Bonneville Dam in 2022. Estimates are from both PIT tag recoveries and dam counts (FPC 2022).

Dam	Viewing Window Count	PIT Tag Estimate	Percent Difference
The Dalles	128,869	128,196	-0.5
John Day	116,306	114,902	-1.2
McNary	105,848	106,057	0.2
Priest Rapids	24,420	29,600	21.2
Rock Island	25,996	29,326	12.8
Rocky Reach	7,900	10,592	34.1
Wells	7,150	9,010	26.0
Ice Harbor	69,173	66,232	-4.3
L. Monumental	67,090	64,298	-4.2
Little Goose	62,694	63,266	0.9
Lower Granite	66,241	62,068	-6.3
Mean (weighted)			**2.8**

Data on tag detections through December 31, 2023, was downloaded from www.ptagis.org. An estimated 56.0 of the run had its most upstream detection at or above Ice Harbor Dam compared to 8.9 at or above Priest Rapids Dam (Table 29). Steelhead last detected in the Snake River dominated the run after the early portion of the run (Table 29, Figures 21-22).

Table 29. Most upstream detection by Statistical Week and region for steelhead tracked by this study in 2022.

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	1	0.0	100.0	0.0	0.0	0.0
18	0.1	0	--	--	--	--	--
19	0.1	2	100.0	0.0	0.0	0.0	0.0
20	0.1	1	100.0	0.0	0.0	0.0	0.0
21	0.1	2	100.0	0.0	0.0	0.0	0.0
22	0.2	5	60.0	40.0	0.0	0.0	0.0
23	0.2	4	25.0	25.0	0.0	0.0	50.0
24	0.5	3	33.3	33.3	0.0	33.3	0.0
25	0.6	1	0.0	100.0	0.0	0.0	0.0
26	1.2	3	33.3	0.0	33.3	0.0	33.3
27	3.0	0	--	--	--	--	--
28	5.0	37	32.4	8.1	0.0	13.5	45.9
29	7.8	57	15.8	5.3	7.0	19.3	52.6
30	7.0	49	30.6	16.3	8.2	10.2	34.7
31	9.2	60	25.0	8.3	8.3	11.7	46.7
32	5.9	24	37.5	12.5	4.2	20.8	25.0
33	5.9	60	25.0	6.7	6.7	11.7	50.0
34	10.3	121	19.8	4.1	3.3	9.9	62.8
35	2.7	23	34.8	4.3	0.0	4.3	56.5
36	9.0	50	12.0	4.0	2.0	12.0	70.0
37	7.0	5	40.0	0.0	0.0	0.0	60.0
38	10.1	21	23.8	0.0	0.0	0.0	76.2
39	5.8	138	21.0	2.2	2.9	1.4	72.5
40	3.1	112	19.6	1.8	0.9	0.0	77.7
41	1.5	68	7.4	1.5	2.9	0.0	88.2
42	0.7	18	5.6	11.1	5.6	0.0	77.8
>=43	1.3	--	--	--	--	--	--
Weeks 17-18 20-31 33-42		**865**	**24.7**	**6.4**	**4.0**	**8.9**	**56.0**

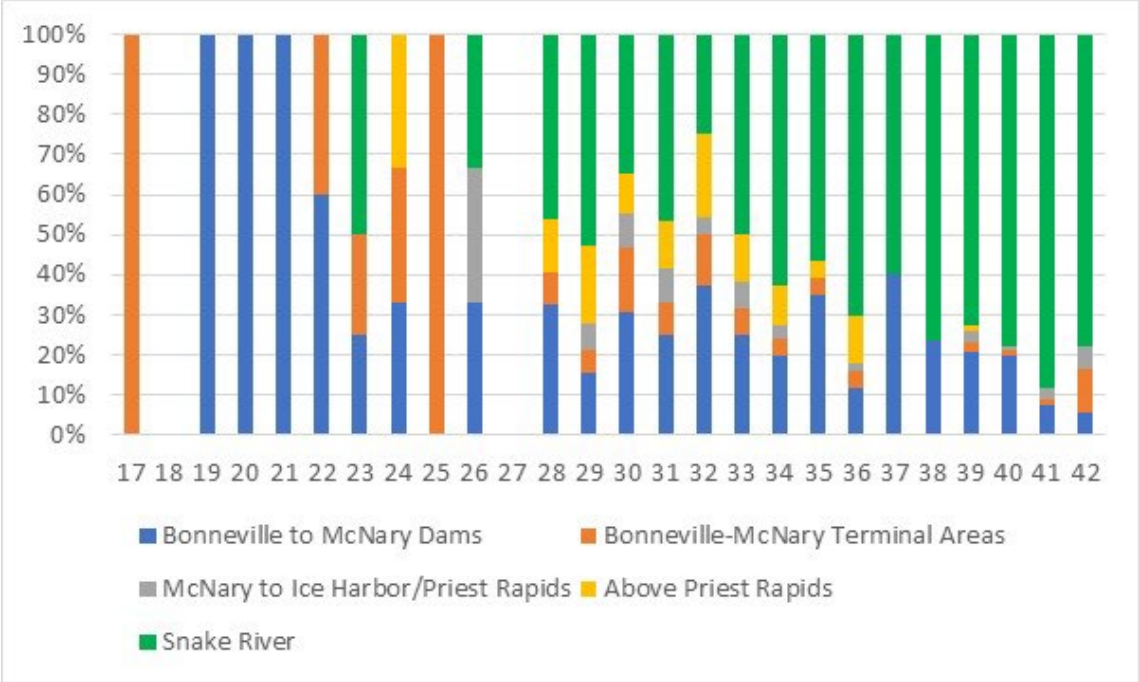


Figure 21. Most upstream detection by Statistical Week and region for steelhead tracked by this study in 2022 as a percentage of the weekly run.

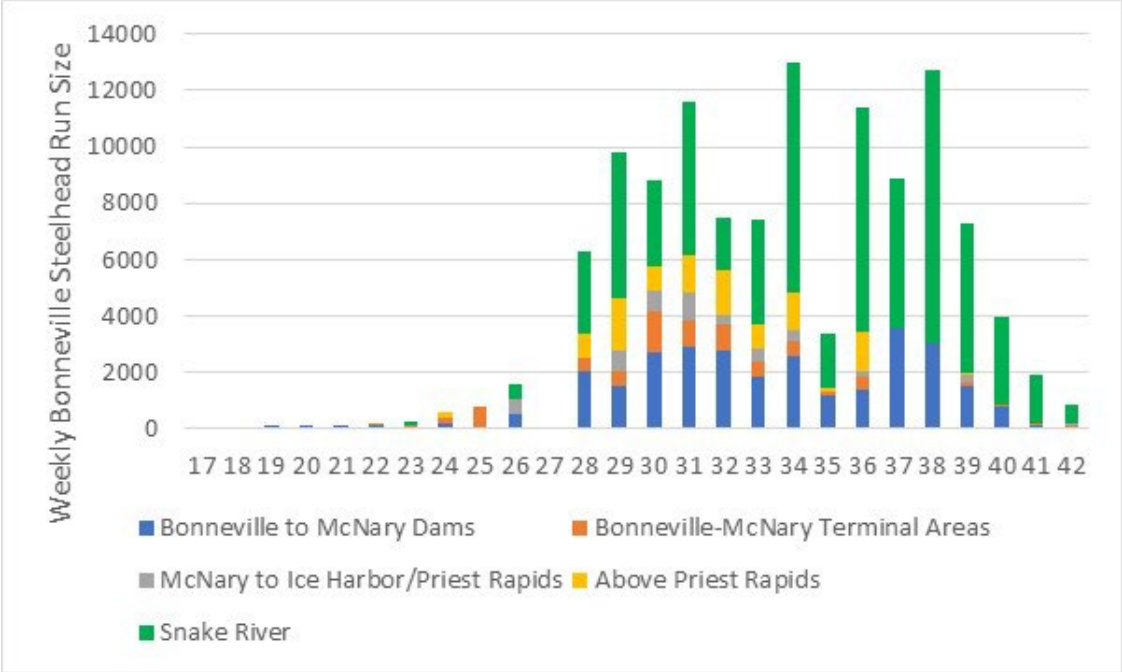


Figure 22. Most upstream detection by Statistical Week and region for steelhead tracked by this study in 2022 as estimated by numbers of fish passing Bonneville Dam by week.

The percentage of PIT-tagged steelhead passing a dam without detection ranged from 0.0 at McNary, Priest Rapids, Rock Island, and Rocky Reach dams to 0.9 at Little Goose Dam (Table 30).

Table 30. Percentages of steelhead passing a dam undetected that were subsequently detected upstream in 2022.

Dam	Percent not Detected
Bonneville	0.4
The Dalles	0.8
John Day	0.8
McNary	0.0
Priest Rapids	0.0
Rock Island	0.0
Rocky Reach	0.0
Wells	0.4
Ice Harbor	0.6
Lower Monumental	0.4
Little Goose	0.9
Lower Granite	0.4
Mean (weighted by number passing each dam)	**0.5**

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 (41.7 km/day), while the slowest was 7.6 km/day between Bonneville and John Day dams (Table 31).

Table 31. Steelhead migration rate between Columbia Basin dams as estimated by PIT tag detections in 2022.

Dam Pair	Distance (km)	Median Migration Rate (km/day)
Bonneville-The Dalles	74	12.3
The Dalles-John Day	39	25.3
John Day-McNary	123	41.7
Bonneville-John Day	113	7.6
Bonneville - McNary	231	11.9
McNary - Priest Rapids	167	25.2
Priest Rapids - Rock Island	89	25.6
Rock Island - Rocky Reach	33	18.6
Rocky Reach - Wells	65	24.9
Rock Island - Tumwater	68	4.7
Bonneville – Rock Island	487	14.8
Bonneville - Wells	585	14.6
McNary - Ice Harbor	67	32.6
Ice Harbor - Lower Granite	156	24.0
Bonneville-Lower Granite	461	14.1

Lower Granite, Wells, McNary, Bonneville, and Rock Island dams had the greatest median passage time from first to last PIT tag detection at a dam among mainstem Columbia Basin dams (Table 32). 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 32. 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 2022.

Dam	Median Passage Time (minutes)	Percentage with more than 12 hours between first detection and last detection at a dam
Bonneville	58.8	6.7
The Dalles	0.1	2.9
John Day	1.1	2.8
McNary	91.3	4.1
Priest Rapids	4.1	0.0
Rock Island	40.9	4.1
Rocky Reach	6.2	7.3
Wells	95.8	2.8
Ice Harbor	2.9	4.4
Lower Monumental	0.7	7.5
Little Goose	0.0	3.0
Lower Granite	207.9	27.2

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 2022 (Table 33). 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 after December 31, 2022, to avoid including downstream movements of kelt as fallbacks. Steelhead were detected falling back up to nine times over dams (Table 34). Figures showing examples of the movements of a steelhead with high rates of fallbacks are in Appendix C (Figures C30 - 31).

Table 33. Estimated minimum steelhead fallback at mainstem Columbia Basin dams in 2022 as estimated by PIT tag[8] 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 34. Frequency of fallback events for steelhead tagged by this project in 2022.

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 1.3 at Bonneville Dam to 14.8 at Lower Monumental Dam (Table 35). 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 58.8 minutes (Table 30), steelhead tagged by this project would be expected to pass during daytime hours.

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

Table 35. Estimated steelhead night passage (2000-0400 PST) at Columbia Basin dams in 2022.

Site	Percentage Night Passage
Bonneville	1.3
The Dalles	7.1
John Day	8.9
McNary	8.0
Priest Rapids	7.8
Rock Island	14.3
Rocky Reach	2.4
Wells	2.8
Ice Harbor	8.1
Lower Monumental	14.8
Little Goose	10.3
Lower Granite	5.4

B-Run Analyses

A total of 136 B-run steelhead were sampled in 2022 (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 38 at 71.4% (Figure 23, Table 36). 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 9,076 fish while the A-run steelhead peaked in Week 31 at 11,605 fish (Table 36). Among steelhead sampled at Bonneville Dam 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), 95.2% of steelhead with fork lengths 78.0 cm and greater were destined for the Snake Basin (Table 36), all of which passed Bonneville on or after Week 28 (Figure 24). Of the 55 B-Run steelhead in terminal areas, 38 (69.1%) had the most upstream detection in the Clearwater Basin. Among the B-run steelhead sampled at Bonneville Dam where ocean age could be estimated, two-ocean steelhead made up 99.3% of the B-run while another 0.7% were three-ocean fish compared to A-run steelhead which were 22.1% one-ocean, 77.4% two-ocean, and 0.6% three-ocean (Table 37).

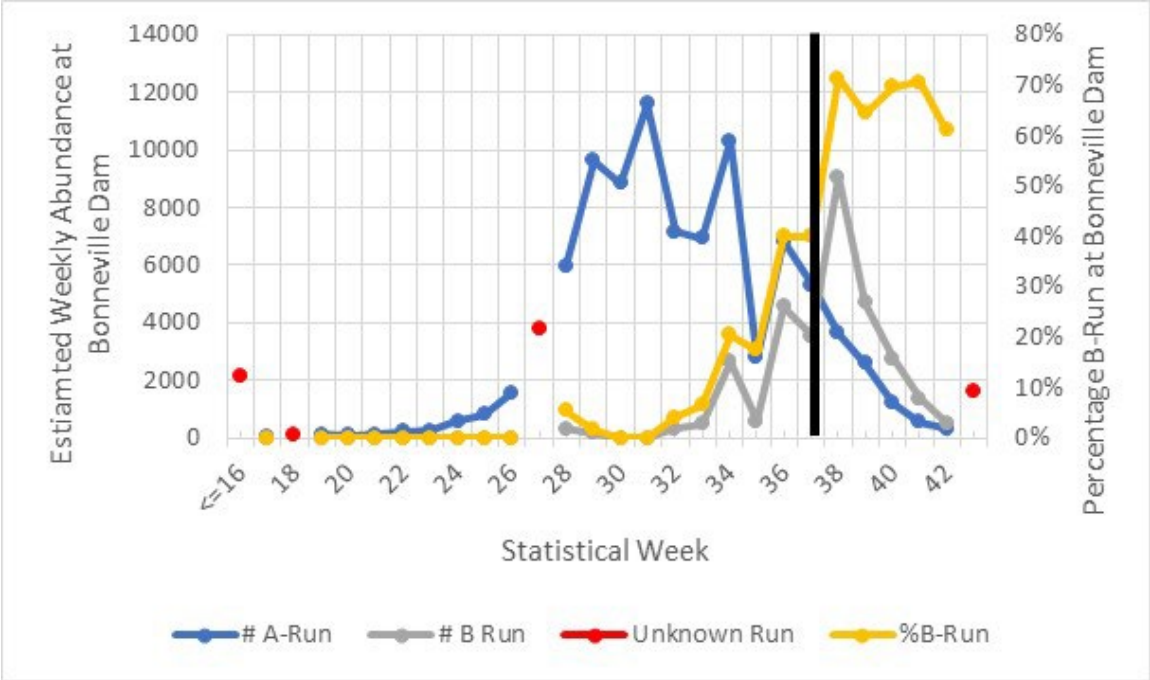


Figure 23. Percentage of B-run steelhead and estimated A- and B-run escapement at Bonneville Dam by statistical week in 2022. The vertical line shows approximately August 25, which is considered the date that separates A- and B-run steelhead. Steelhead are classified as "Unknown Run" if they passed during weeks that no steelhead were sampled (weeks prior to 17, weeks 18 and 27, and after week 42).

Table 36. Percentage and number of A- and B-run steelhead estimated at Bonneville Dam by Statistical Week in 2022.

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	--	--	--	--	--	100.0	--	--	2167	--
17	0.1	1	1		100.0	0.0		77	0		
18	0.1	--	--	--	--	--	100.0	--	--	93	--
19	0.1	2	2		100.0	0.0		138	0		
20	0.1	1	1		100.0	0.0		102	0		
21	0.1	2	2		100.0	0.0		136	0		
22	0.2	5	5		100.0	0.0		218	0		
23	0.2	4	4		100.0	0.0		253	0		
24	0.5	3	3		100.0	0.0		582	0		
25	0.6	1	1		100.0	0.0		808	0		
26	1.2	3	3		100.0	0.0		1566	0		
27	3.0	--	--	--	--	--	100.0	--	--	3815	--
28	5.0	37	35	2	94.6	5.4		5947	340		100.0
29	7.8	57	56	1	98.2	1.8		9632	172		0.0
30	7.0	49	49		100.0	0.0		8846	0		
31	9.2	60	60		100.0	0.0		11605	0		
32	5.9	24	23	1	95.8	4.2		7171	312		
33	5.9	61	57	4	93.4	6.6		6942	487		100.0
34	10.3	122	97	25	79.5	20.5		10319	2659		84.2
35	2.7	23	19	4	82.6	17.4		2798	589		100.0
36	9.0	50	30	20	60.0	40.0		6842	4561		88.2
37	7.0	5	3	2	60.0	40.0		5336	3558		100.0
38	10.1	21	6	15	28.6	71.4		3630	9076		100.0
39	5.8	138	49	89	35.5	64.5		2585	4694		100.0
40	3.1	112	34	78	30.4	69.6		1198	2747		98.4
41	1.5	68	20	48	29.4	70.6		568	1364		97.8
42	0.7	18	7	11	38.9	61.1		327	515		90.0
>42	1.3	--	--	--	--	--	100.0	--	--	1592	--
Total		**867**	**576**	**300**	**69.3**	**24.6**	**6.1**	**54763**	**10822**	**7667**	**95.2**

Table 37. Ocean age composition of A- (<78 cm fork length) and B-run (≥78 cm fork length) steelhead sampled at Bonneville Dam in 2022.

Run	N (ageable)	One-Ocean % (x.1)	Two-Ocean % (x.2)	Three Ocean % (x.3)
A-Run	544	22.1	77.4	0.6
B-Run	298	0.0	99.3	0.7
All Steelhead	**842**	**14.3**	**85.2**	**0.7**

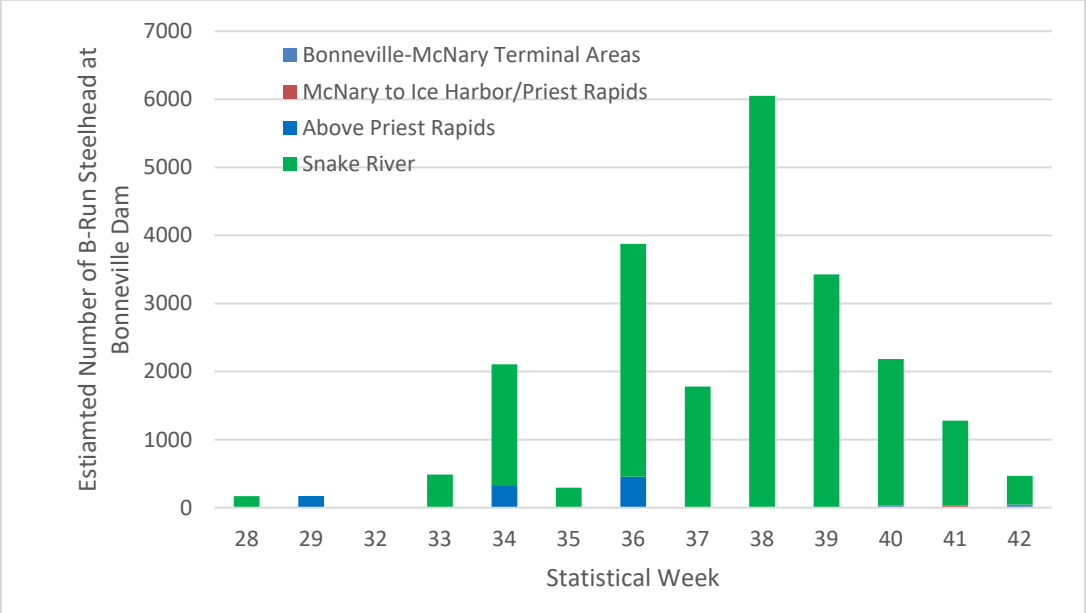


Figure 24. Most upstream detection site for B-run steelhead (≥78 cm fork length) by Statistical Week sampled at Bonneville Dam in 2022.

Kelt Analyses

A total of 75 steelhead PIT tagged in 2022 were detected migrating downstream in the Columbia Basin in late winter, spring, and summer of 2023, 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 38 and C2). For 2022 steelhead we looked for kelt/repeat spawner behavior to December 31, 2023. 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 detection sites have been added 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 where they are assumed to spawn. 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 2022, two steelhead were moving downriver after spawning before April 1st (Tables 38 and C3) so identified as kelts for a total of 77 analyzed. The highest percentage of kelt passing Bonneville for weeks where 10 or more steelhead were sampled was in

Week 32 at 25.0 (Table 39). The greatest number of kelt was also estimated to be in Week 32 at 1,871 steelhead (Figures 25 and 26, Table 39)[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 38. Some biological and detection information on the steelhead moving in the Columbia Basin system in 2022 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.

						Most Upstream Site		Last Site Detected				
PIT Tag	Date Encountered at AFF	Sex	Fin Clip	Age	Fork Length	Basin and Site	Date	Basin and Site	Date	Moving Downstream at Last Detection	Upstream in Summer/ Fall 2022	In Kelt Program
3DD.003D3414C3	9/26/22	Male	AD	1.2	865	Clearwater (SC1)	1/15/2023	Clearwater (SC2)	5/6/2023	X		
3DD.003D368600	8/29/22	Female	AD	r.1	610	Methow (TWR)	4/24/2023	Columbia (RRJ)	4/24/2023	X		
3DD.003D459000	7/15/22	Female		1.2	720	Tucannon (JPT)	4/1/2023	Walla Walla (WWB)	4/1/2023	X		
3DD.003D4FF241	8/5/22	Female		1.1	530	Okanogan(OKL)	9/24/2022	Columbia (RRJ)	5/4/2023	X		
3DD.003DEA9C11	9/23/22	Female		2.2	760	Columbia (MC2)	9/30/2022	Columbia (BCC)	5/2/2023	X		
3DD.003DEA9C2F	9/23/22	Female		2.2	750	Wenatchee (NAL)	4/24/2023	Columbia (BCC)	5/20/2023	X		
3DD.003DEA9C5B	8/30/22	Female		2.2	830	Clearwater (LRU)	3/15/2023	Snake (GRS)	5/15/2023	X		
3DD.003DEA9C92	8/29/22	Female		2.1	610	Snake (GRA)	10/2/2022	Snake (LMJ)	6/7/2023	X		
3DD.003DEA9D19	8/23/22	Female	AD	1.2	830	Snake (GRA)	10/4/2022	Snake (GRS)	4/10/2023	X		
3DD.003DEA9D21	8/30/22	Female		2.2	790	Snake (GRA)	9/22/2022	Snake (GRS)	5/18/2023	X		
3DD.003DEA9DE6	9/16/22	Female		1.2	705	Snake (GRA)	10/3/2022	Snake (GRS)	5/4/2023	X		
3DD.003DEA9E47	9/23/22	Female		2.2	820	Clearwater (LRU)	3/29/2023	Columbia (BCC)	6/16/2023	X		
3DD.003DEAA08F	10/3/22	Female	AD	1.2	860	Snake (GRA)	10/23/2022	Snake (GRS)	4/7/2023	X		
3DD.003DEAA0D1	10/7/22	Female	AD	1.2	800	Snake (GRA)	10/24/2022	Snake (GRJ)	5/11/2023	X		
3DD.003DEAA0E7	10/6/22	Female		r.2	800	Snake (GRA)	11/1/2022	Snake (GRS)	4/10/2023	X		
3DD.003DEAA0F7	10/7/22	Female		r.2	710	Tucannon (MTR)	3/20/2023	Tucannon (MTR)	3/20/2023	X		
3DD.003DEAA125	9/27/22	Female	AD	1.2	830	Clearwater (SC2)	4/22/2023	Snake (GRS)	4/26/2023	X		
3DD.003DEAA14A	9/28/22	Female		2.2	765	Clearwater (LRU)	3/22/2023	Snake (GRS)	5/23/2023	X		
3DD.003DEAA168	9/28/22	Female		2.2	760	Snake (GRA)	11/6/2022	Columbia (B2J)	5/23/2023	X		
3DD.003DEAA1AE	9/29/22	Female		2.2	800	Clearwater (LRU)	4/9/2023	Snake (GRS)	6/4/2023	X		
3DD.003DEAA1B1	10/3/22	Female	AD	1.2	835	Snake (GRA)	4/20/2023	Snake (GRS)	5/1/2023	X		
3DD.003DEAAA36	9/19/22	Female	AD	1.1	635	Umatilla (UMW)	3/23/2023	Columbia (TWX)	5/31/2023	X		
3DD.003DEAAA9B	9/21/22	Male		1.1	670	Clearwater (SC1)	3/12/2023	Snake (GRJ)	5/9/2023	X		
3DD.003DEAAAAD	9/20/22	Female		1.2	655	Grande Ronde (UGR)	4/22/2023	Snake (GRJ)	5/16/2023	X		X

						Most Upstream Site		Last Site Detected				
PIT Tag	Date Encountered at AFF	Sex	Fin Clip	Age	Fork Length	Basin and Site	Date	Basin and Site	Date	Moving Downstream at Last Detection	Upstream in Summer/ Fall 2022	In Kelt Program
3DD.003DEAAB01	9/21/22	Female	AD	1.2	830	Snake (GRA)	10/20/2022	Snake (GRS)	4/4/2023	X		
3DD.003DEAAB2A	9/21/22	Female	AD	1.2	855	Clearwater (SC2)	4/24/2023	Clearwater (SC2)	4/24/2023	X		
3DD.003DEAAB37	8/8/22	Female	AD	1.2	710	Yakima (SWC)	1/19/2023	Columbia (BCC)	4/8/2023	X		
3DD.003DEAAB41	8/12/22	Female	AD	r	670	Grande Ronde (JOC)	4/9/2023	Grande Ronde (JOC)	4/9/2023	X		
3DD.003DEAAB44	8/5/22	Male		2.1	540	Wenatchee (MCL)	5/23/2023	Wenatchee (MCL)	5/23/2023	X		
3DD.003DEAAB45	8/11/22	Female	AD	1.2	645	Snake (GRA)	10/1/2022	Walla Wallla (HST)	4/11/2023	X		
3DD.003DEAAB47	8/11/22	Female	AD	1.2	640	Snake (GRA)	10/11/2022	Snake (GOJ)	5/23/2023	X		
3DD.003DEAAB4E	8/5/22	Male	AD	1.1	570	Columbia (MC1)	9/27/2022	Umatilla (TMF)	5/27/2023	X		
3DD.003DEAAB5E	8/5/22	Female		r	560	Columbia (WEA)	9/18/2022	Columbia (RRJ)	6/2/2023	X		
3DD.003DEAAB6B	8/12/22	Female	AD	1.2	750	Okanogan (ZSL)	4/25/2023	Okanogan (TON)	4/24/2023	X		
3DD.003DEAAB90	8/11/22	Female		2.2	660	Imnana (IR1)	5/20/2023	Snake (LMJ)	5/29/2023	X		
3DD.003DEAAB94	8/11/22	Female		1.2	750	John Day (JDM)	4/18/2023	Columbia (BCC)	5/5/2023	X		
3DD.003DEAACAF	7/26/22	Male		r.1	565	Walla Walla (NBA)	3/13/2023	Columbia (PD5)	5/26/2023	X		
3DD.003DEAAD05	9/27/22	Female		1.2	840	Clearwater (SC2)	4/24/2023	Clearwater (SC2)	4/24/2023	X		
3DD.003DEAAD3C	8/16/22	Male	AD	r	520	Snake (GRA)	9/21/2022	Snake (GRS)	5/17/2023	X		
3DD.003DEAAD55	8/18/22	Female	AD	1.2	665	Grande Ronde (WR2)	4/9/2023	Snake (GOJ)	5/7/2023	X		
3DD.003DEAAD72	8/18/22	Female		2.1	560	Columbia (MC1)	10/22/2022	Columbia (JDJ)	5/15/2023	X		
3DD.003DEAAD73	8/18/22	Female		2.2	710	Yakima (SUN)	4/9/2023	Columbia (BCC)	5/30/2023	X		
3DD.003DEAAD95	8/16/22	Female		2.2	835	Clearwater (LRU)	3/23/2023	Snake (GRS)	5/24/2023	X		
3DD.003DEAADC1	8/15/22	Female	AD	1.2	675	Snake (GRA)	10/4/2022	Snake (GOJ)	4/28/2023	X		
3DD.003DEAADC8	8/12/22	Female		2.2	780	Salmon (ESS)	5/1/2023	Columbia (BCC)	6/10/2023	X		
3DD.003DEAADE8	8/16/22	Female	AD	r.2	690	Grande Ronde (WR1)	3/12/2023	Snake (GOJ)	4/27/2023	X		
3DD.003DEAADEA	8/15/22	Female		2.2	825	Clearwater (SW2)	3/22/2023	Snake (GRS)	5/10/2023	X		
3DD.003DEAADFB	7/29/22	Female		2.2	750	Grande Ronde (JOC)	5/15/2023	Snake (GRS)	5/18/2023	X		

						Most Upstream Site		Last Site Detected				
PIT Tag	Date Encountered at AFF	Sex	Fin Clip	Age	Fork Length	Basin and Site	Date	Basin and Site	Date	Moving Downstream at Last Detection	Upstream in Summer/ Fall 2022	In Kelt Program
3DD.003DEAADFD	7/29/22	Male	AD	1.1	535	Snake (GRA)	10/7/2022	Columbia (BCC)	5/26/2023	X		
3DD.003DEAADFF	7/29/22	Female		r.2	670	Yakima (LMT)	4/28/2023	Yakima (LMT)	4/28/2023	X		
3DD.003DEAAE1B	8/5/22	Female		r.2	715	Umatilla (UMW)	3/16/2023	Umatilla (UMW)	3/16/2023	X		
3DD.003DEAAE2C	8/5/22	Female	AD	1.2	615	Snake (GRA)	9/8/2022	Columbia (BCC)	5/1/2023	X		
3DD.003DEAAE8D	10/13/22	Female		1.2	845	Clearwater (SC2)	3/12/2023	Snake (GRS)	4/27/2023	X		
3DD.003DEAAE9A	10/12/22	Female		2.2	750	Clearwater (LRU)	4/23/2023	Snake (GRJ)	5/25/2023	X		
3DD.003DEAAEA9	10/13/22	Female	AD	1.2	720	Tucannon (JPT)	4/19/2023	Walla Walla (HST)	4/19/2023	X		
3DD.003DEAAEFB	7/28/22	Female		2.1	625	Snake (GRA)	10/5/2022	Snake (GRS)	5/6/2023	X		
3DD.003DEAB01A	7/20/22	Female	AD	1.2	700	Tucannon (JPT)	3/20/2023	Columbia (MCJ)	4/17/2023	X		
3DD.003DEAB021	7/21/22	Female		r.2	695	Deschutes (WSH)	4/28/2023	Deschutes (WSH)	4/28/2023	X		
3DD.003DEAB041	7/21/22	Female		r.2	710	Snake (GRA)	8/18/2022	Snake (GRS)	6/5/2023	X		
3DD.003DEAB071	7/15/22	Female		r.2	735	Snake (GRA)	10/22/2022	Snake (GRS)	5/22/2023	X		
3DD.003DEAB088	7/14/22	Female		2.2	715	Columbia (JO1)	1/7/2023	Columbia (BCC)	5/31/2023	X		
3DD.003DEAB08B	7/14/22	Female		2.2	660	Grande Ronde (WR1)	3/13/2023	Snake (GRS)	4/10/2023	X		
3DD.003DEAB09F	7/15/22	Female		2.2	695	Yakima (AH1)	4/23/2023	Yakima (SSJ)	4/24/2023	X		
3DD.003DEAB0D1	7/7/22	#N/A		r.2	705	Snake (GRA)	7/25/2022	Columbia (BCC)	5/9/2023	X		
3DD.003DEAB0DC	7/7/22	#N/A		1.2	705	Methow (MRC)	4/10/2023	Columbia (RRJ)	5/3/2023	X		
3DD.003DEAB10C	7/7/22	#N/A		r.2	715	Wind River (MIN)	2/20/2023	Columbia (BCC)	4/7/2023	X		
3DD.003DEAB252	7/13/22	Female		2.2	640	Walla Walla (COP)	4/1/2023	Walla Walla (WWB)	4/16/2023	X		
3DD.003DEAB254	7/13/22	Female		2.1	550	Columbia (MC1)	9/26/2022	Columbia (PD6)	5/14/2023	X		
3DD.003DEAB308	7/7/22	#N/A		2.2	770	Snake (GRA)	10/2/2022	Snake (GRS)	5/4/2023	X		
3DD.003DEAB531	6/8/22	#N/A		2.2	690	Yakima (PRO)	10/9/2023	Yakima (PRO)	7/19/2023	X	X	
3DD.003DEAB6AE	7/19/22	Male		r	750	Grande Ronde (WEN)	3/12/2023	Grande Ronde (WEN)	4/6/2023	X		
3DD.003DEAB6CE	7/19/22	Female		2.2	700	Columbia (MC1)	10/1/2022	Columbia (BCC)	5/31/2023	X		
3DD.003DEAB6D7	7/15/22	Female	AD	1.2	710	Methow (LMR)	4/2/2023	Columbia (RRJ)	4/25/2023	X		

						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	Sex	Fin Clip	Age	Fork Length	Basin and Site	Date	Basin and Site	Date			
3DD.0077D827A1	9/6/22	Female	AD	1.2	845	Clearwater (SC2)	4/3/2023	Clearwater (SC2)	4/3/2023	X		
3DD.003DEAB09C	7/15/22	Female	AD	1.2	780	Columbia (WEA)	11/7/2022	Columbia (RRJ)	5/3/2023	X		
3DD.003DEAADBB	8/16/22	Male	AD	1.1	575	Snake (GRA)	10/25/2022	Snake (GRS)	3/19/2023	X		
3DD.003DEAB698	7/18/22	Female	AD	1.2	665	Snake (GRA)	9/21/2022	Snake (GRS)	3/1/2023	X		

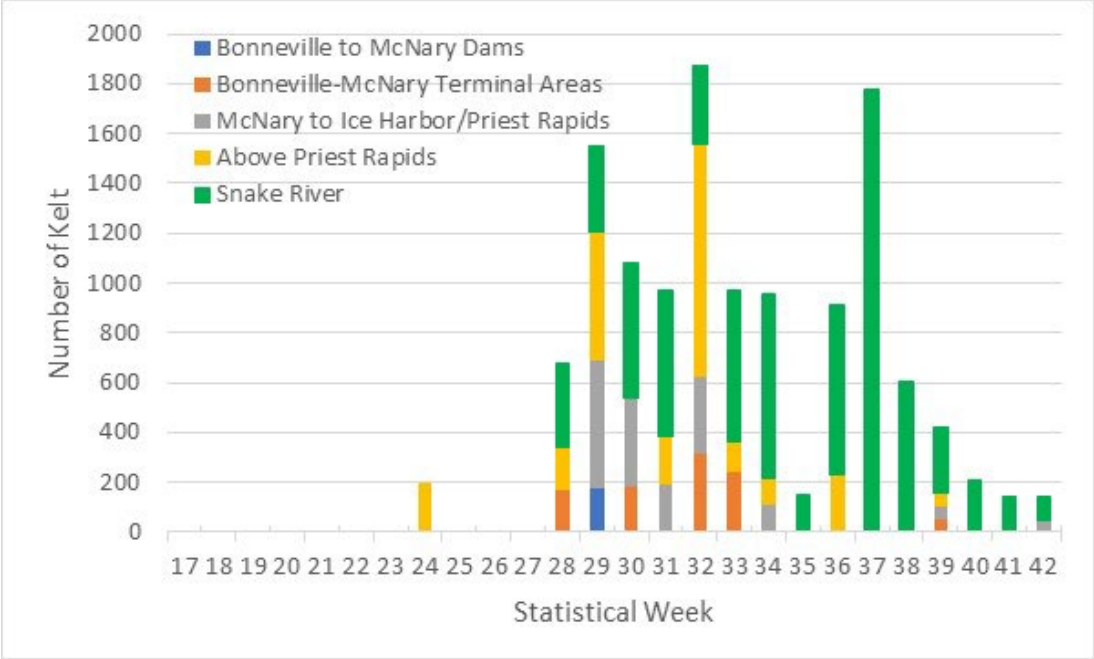


Figure 25. Estimated population designated as kelt by week sampled in 2022 at Bonneville Dam by upstream detection area.

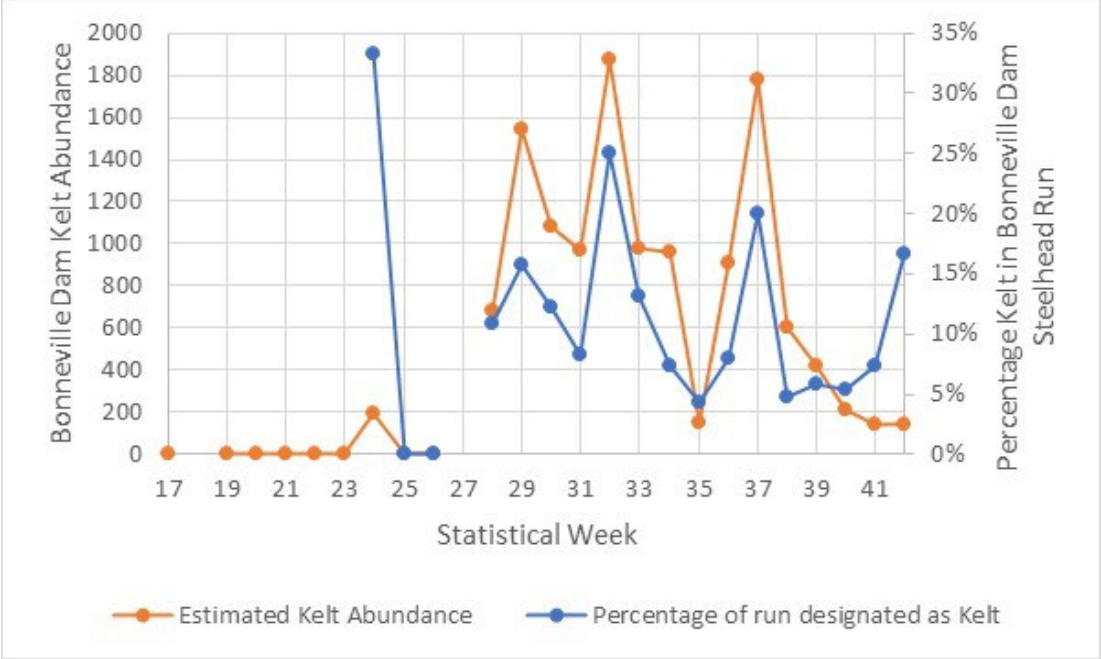


Figure 26. Percentage and number of kelt estimated to be passing Bonneville Dam by Statistical Week as estimated by this project in 2022.

Table 39. Weekly number and percentage of kelt and last detection site for steelhead sampled by this project at Bonneville Dam in 2022.

Week	Sample Size	Kelt	Estimated # Kelt	Most Upstream Detection Among Steelhead Designated as Kelt				
				Bonneville to McNary Dams	Bonneville-McNary Terminal Areas	McNary to Ice Harbor/Priest Rapids	Above Priest Rapids	Snake River
17	1	0.0	0.0	--	--	--	--	--
18	0	--	--	--	--	--	--	--
19	2	0.0	0.0	--	--	--	--	--
20	1	0.0	0.0	--	--	--	--	--
21	2	0.0	0.0	--	--	--	--	--
22	5	0.0	0.0	--	--	--	--	--
23	4	0.0	0.0	--	--	--	--	--
24	3	33.3	194	0.0	0.0	0.0	100.0	0.0
25	1	0.0	0.0	--	--	--	--	--
26	3	0.0	0.0	--	--	--	--	--
27	0	--	--	--	--	--	--	--
28	37	10.8	680	0.0	25.0	0.0	25.0	50.0
29	57	15.8	1,548	11.1	0.0	33.3	33.3	22.2
30	49	12.2	1,083	0.0	16.7	33.3	0.0	50.0
31	60	8.3	967	0.0	0.0	20.0	20.0	60.0
32	24	25.0	1,871	0.0	16.7	16.7	50.0	16.7
33	61	13.1	974	0.0	25.0	0.0	12.5	62.5
34	122	7.4	957	0.0	0.0	11.1	11.1	77.8
35	23	4.3	147	0.0	0.0	0.0	0.0	100.0
36	50	8.0	912	0.0	0.0	0.0	25.0	75.0
37	5	20.0	1,779	0.0	0.0	0.0	0.0	100.0
38	21	4.8	605	0.0	0.0	0.0	0.0	100.0
39	138	5.8	422	0.0	12.5	12.5	12.5	62.5
40	112	5.4	211	0.0	0.0	0.0	0.0	100.0
41	68	7.4	142	0.0	0.0	0.0	0.0	100.0
42	18	16.7	140	0.0	0.0	33.3	0.0	66.7
Total	**867**	**10.6**	**12,633**	**0.9**	**6.1**	**10.8**	**15.3**	**66.9**

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 2022 tagged fish, systems at the following dams detected smolts: Bonneville (1), John Day (1), McNary (1), Little Goose (4), Lower Granite (5), and Rocky Reach (4) (Table 37 and C2). Another major exit location for kelts is the Bonneville Dam Corner Collector, where 13 steelhead tagged by this study were last detected migrating downstream in spring and summer 2023. In addition, an antenna at a Lower Granite Dam spillway (GRS) detected a total of 23 steelhead assigned as kelts as they were detected at the spillway. Of the 73 identified kelts, 47 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. One steelhead tagged and tracked in 2022 (3DD.003DEAB531) was detected at Prosser Dam October 27, 2023, then detected migrating downstream through the Bonneville Corner Connector (BCC) on May 13, 2023, then detected migrating upstream through Bonneville Dam on

July 19, 2023, followed by The Dalles, John Day, and McNary Dams before being detected Prosser Dam (PRO) October 9, 2023.

We have also updated information on kelts/repeat spawners from several past annual reports with data from 2019 through 2021 movements (Table 40). 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 2021 (three records) and 2020 (one record). No new information on movement for steelhead tagged in 2019 was detected during 2022/23 analysis years.

Table 40. 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 2009-2022. Data is categorized by last detection site.

	Tag Year													
Last site	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**
Bonneville Corner Collector	13	14	33	24	17	14	32	25	38	30	25	10	23	61
Bonneville Juvenile Bypass	1	1	1	6	2	6	1	5	3	6	5	1	4	7
Bonneville Dam Bradford Island Ladders heading downstream	0	0	0	1	0	0	0	2	1	3	2	0	0	0
Bonneville Dam ladders heading downstream	0	0	0	1	1	1	0	0	0	0	0	0	0	0
Estuary Trawl or Pile Dikes (TWX or PD5, PD6, or PD7)	3	0	1	0	2	1	1	0	0	2	2	0	0	1
Ice Harbor Juvenile Bypass	0	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	0	1	0	NA	NA	NA
John Day Juvenile Bypass	1	0	2	3	3	3	20	6	2	8	6	3	11	3
Little Goose Juvenile Bypass	4	3	1	5	7	5	11	5	2	9	5	11	13	6
Lower Granite Juvenile Bypass	4	6	1	5	11	7	5	0	3	4	3	4	10	3
Lower Monumental Juvenile Bypass	2	0	0	5	5	5	4	0	2	7	1	12	9	4
Lower Granite Dam adult ladders moving downstream	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Lower Granite Spillway (new in 2019)	23	17	34	24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington Shore McNary Dam ladder downstream	0	0	0	0	3	1	3	0	1	0	0	0	2	1
McNary Dam Juvenile Bypass	1	0	2	1	2	3	4	1	1	4	4	3	2	4
Rocky Reach Juvenile Bypass	6	7	9	3	9	5	1	2	10	1	0	4	6	7
Migrating downstream in tributaries	19	22	70	35	22	9	2	6	NA	4	3	0	0	0
Repeat spawners, at Bonneville Dam or above migrating upstream	1	3	3	3	0	4	4	4	5	12	1	NA	NA	NA
Trapped by CRITFC Kelt Program														
Snake Basin	1	6	0	3	10	6	7	5	4	11	NA	NA	NA	NA
Yakima Basin	0	1	7	6	4	0	1	1	6	6	1	NA	NA	NA
Total[10]	**77**	**73**	**158**	**121**	**85**	**64**	**98**	**63**	**77**	**108**	**58**	**49**	**86**	**97**
Estimated kelt as percentage of run	**8.9**	**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	**--**	**8**	**2**	**2**	**9**	**7**	**0**	**0**	**2**	**5**	**13**	**3**	**9**	**5**
Minimum number of kelts	**77**	**80**	**160**	**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, or counted as moving back upstream, 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 (17.8 vs. 13.9) and lower percentage of two ocean fish (82.2 vs. 85.4) (Table 41). The mean length of non-kelt was 72.8 cm compared to 71.6 cm for kelt.

Table 41. Ocean age composition of steelhead designated as kelt or non-kelt sampled at Bonneville Dam in 2022.

Run	Number Ageable for Ocean Age	One-Ocean (x.1)	Two-Ocean (x.2)	Three-Ocean (x.3)
Kelt	77	17.8	82.2	0.0
Non-Kelt	790	13.9	85.4	0.7

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 42). For those fish for which PBT was not available, stock classifications were made using Genetic Stock Identification (GSI) (Table 43). The estimated Steelhead stray rate using PBT for those stocks with more than 10 fish that were designated as either putative strays or on-target ranged from 34.6% for Wallowa Hatchery to 0.0% for Oxbow Hatchery. The stray rate for GSI ranged from 67.2% for the combined MGICLS stock to 0.0% for the upper Clearwater stock. The overall stray rate was 43.7% for GSI classified steelhead and 15.2% for PBT classified steelhead.

Table 42. Showing final-PIT-fate categories by stock as determined using PBT for steelhead tagged in 2022. 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 D.				Klickitat R.		The Dalles D.		Deschutes B.			John Day D		Umatilla B.		McNary D.		Walla Walla B.								
	Oregon Shore Ladder	Lower Washington Shore Ladder	Bonneville Dam, WA Shore Ladder	Hood River Mouth	Lyle Falls Ladder	Swale Creek Array	Oregon Shore	Washington Shore	Sherar's Falls	Warm Springs River	Pelton Dam Ladder	Oregon Shoreq	Washington Shore	Three Mile Dam Fishway	Umatilla R Recycled Water Fac	McNary Oregon Shore Ladder	McNary Washington Shore Ladder	Pattit Creek Instream Site	Touchet River at Harvey Shaw	Touchet River-Bolles Bridge	Juvenile Pond Touchet	Ice Harbor Dam (Combined)	Tucannon at Panjab Creek	Lower Monumental Adult Ladders	Little Goose Fish Ladder	Lower Granite Dam Adult
Columbia RKM	234	234	234	273	290	290	308	308	328	328	328	347	347	465	465	470	470	509	509	509	509	522	522	522	522	522
Site Code	BO1	BO3	BO4	HRM	LFF	SWC	TD1	TD2	DSF	WSR	PEL	JO1	JO2	TMF	UMW	MC1	MC2	PAT	HST	BBT	JPT	ICH	TPJ	LMA	GOA	GRA
Stock																										
Dworshak	0	0	2	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	5
Lyons Ferry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	2	0	1	1	0	8
MGILCS	0	0	3	0	0	0	3	0	5	0	2	0	0	0	0	0	0	0	0	0	0	2	0	1	0	3
Oxbow	0	0	4	0	0	0	2	0	0	0	0	2	0	0	0	1	0	0	0	0	0	1	0	0	0	31
Pahsimmeroi	0	0	6	0	0	0	4	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	56
Parkdale-Hood 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
Sawtooth	0	0	3	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	19
Skamania	0	1	16	1	6	1	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	1	1	1	0	0	0	0	0	0	0	0	0	0
Upper Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wallowa	1	0	6	0	0	0	0	0	0	1	0	3	0	0	0	0	1	0	1	1	4	2	0	4	2	56
Wells	0	0	1	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Winthrop	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
Total	1	1	41	1	6	1	15	0	6	1	2	9	1	1	2	2	2	1	1	1	6	10	1	6	2	178

	Clearwater B.				Grande Ronde B.				Salmon B.										Methow B.		Okanogan B.													
	Dworshak NFH adult trap	Upper Lolo Creek at rkm 25	Lower SF Clearwater R at rkm 1	Lower SF Clearwater R at rkm 2	Joseph Creek	Wallowa River at rkm 4	Wallowa River at rkm 32	Upper Grande Ronde at rkm 155	Upper Salmon River at rkm 437	Yankee Fork Salmon River	Redfish Lake Creek	Little Sheep Creek	Lower Wenatchee River	Rocky Reach Fishway	East Bank Hatchery Outfall	Wells Dam, DCPUD Adult Ladders	Wells Dam Hatchery	Lower Methow River at Pateros	Methow River at Carlton	Lower Okanogan Instream Array	Zosel Dam Combined	Foster Creek	Total	Neutral	On Target	Putative Stray	Putative overshoot	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target))
Columbia RKM	522	522	522	522	522	522	522	522	522	522	522	522	754	763	764	830	830	843	843	858	858	868										
Site Code	DWL	LC2	SC1	SC2	JOC	WR1	WR2	UGR	USE	YFK	RFL	LSC	LWE	RRF	EBO	WEA	WEH	LMR	MRC	OKL	ZSL	FST	Color	15	43	3	6					
Stock																																
Dworshak	0	0	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	11	9	1	0	52.4%	42.9%	4.8%	0.0%	10.0%
Lyons Ferry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	2	0	5	8	13.3%	0.0%	33.3%	53.3%	100.0%
MGILCS	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	19	12	7	0	0	63.2%	36.8%	0.0%	0.0%	0.0%
Oxbow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	10	31	0	0	24.4%	75.6%	0.0%	0.0%	0.0%
Pahsimmeroi	0	0	0	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	1	0	0	1	78	13	64	1	0	16.7%	82.1%	1.3%	0.0%	1.5%
Parkdale-Hood 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	NA	NA	NA	NA	
Sawtooth	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	1	0	30	26	3	1	0	86.7%	10.0%	3.3%	0.0%	25.0%
Skamania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	16	0	7	0	69.6%	0.0%	30.4%	0.0%	100.0%
Umatilla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	2	0	0	33.3%	66.7%	0.0%	0.0%	0.0%
Upper Columbia	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0.0%	100.0%	0.0%	0.0%	0.0%
Upper Salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	
Wallowa	0	0	0	0	1	7	9	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	100	74	17	9	0	74.0%	17.0%	9.0%	0.0%	34.6%
Wells	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	14	2	2	0	2	2	1	28	23	4	1	0	82.1%	14.3%	3.6%	0.0%	20.0%
Winthrop	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%	0.0%
Total	1	0	3	6	1	7	9	0	7	3	1	4	1	1	1	15	3	2	1	2	3	2	360	189	138	25	8	52.5%	38.3%	6.9%	2.2%	15.3%

Table 43. Showing final-PIT-fate categories by stock as determined using GSI for steelhead tagged in 2022. 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 D.					Klickitat B.				The Dalles D.		Deschutes B.					John Day D.			John Day R.			Umatilla B.		McNary D.		Walla Walla B.						
	Oregon Shore Ladder	Lower Washington Shore Ladder	Upper Washington Shore Ladder	Mine Reach, Wind River	Hood River Mouth	Lyle Falls Ladder	Swale Creek Array	Lower White Creek	Fifteen Mile Creek	Oregon Shore	Washington Shore	Sherar's Falls	Warm Springs River	Warm Springs Hatchery	Trout Creek	Pelton Dam Ladder	John Day Dam Juvenile	Oregon Shoreq	Washington Shore	John Day River, McDonald Ferry	SF John Day (Mid)	Upper John Day	Three Mile Dam Fishway	Umatilla R Recycled Water Fac	McNary Oregon Shore Ladder	McNary Washington Shore Ladder	Touchet River at Harvey Shaw	Touchet River-Bolles Bridge	Lower Coppei Instream Array	Juvenile Pond Touchet	Pattit Creek Instream Site	Mill Creek Dam	Nursery Bridge Adult
Site Code	BO1	BO3	BO4	MIN	HRM	LFF	SWC	WHC	158	TD1	TD2	DSF	WSR	WSH	TR2	PEL	JDJ	JO1	JO2	JD1	SJ1	JDM	TMF	UMW	MC1	MC2	HST	BBT	COP	JPT	PAT	MBD	NBA
Stock																																	
Lower Columbia	0	0	3	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
Skamania	0	1	20	0	1	6	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
Klickitat	0	1	5	0	0	4	0	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MGICLS	1	0	32	0	0	0	0	1	1	17	0	6	1	1	2	2	0	14	2	2	2	1	4	6	12	4	1	1	1	6	1	0	1
Yakima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Upper Columbia	0	0	1	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
SF Clearwater	0	1	36	0	0	0	0	0	0	12	1	2	0	0	0	0	0	8	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Upper Clearwater	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SF Salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF Salmon	0	0	1	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
Upper Salmon	0	0	11	0	0	0	0	0	0	4	1	0	0	0	0	0	0	4	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Total	1	3	111	1	1	10	1	3	1	33	3	8	1	2	2	2	1	29	7	2	2	1	4	6	15	5	1	1	1	6	1	1	1

						Clearwater B.									Grande Ronde B.						Salmon B.				
	Ice Harbor Dam (Combined)	Lower Monumental Adult Ladders	Middle Tucannon River	Little Goose Fish Ladder	Lower Granite Dam Adult	Dworshak NFH adult trap	Lower Lolo Creek at rkm 21	Upper Lolo Creek at rkm 25	Lower SF Clearwater R at rkm 1	Lower SF Clearwater R at rkm 2	Lower Lochsa River Array Site	Lochsa River Upper Site	Upper Selway River Array	Upper Selway River Array	Joseph Creek	Wenaha River Mouth	Wallowa River at rkm 4	Wallowa River at rkm 4	Wallowa River at rkm 32	Upper Grande Ronde at rkm 155	EFSF Salmon River at Parks Cr.	SF Salmon River at Krassel Cr.	Upper Salmon River at rkm 437	Yankee Fork Salmon River	Redfish Lake Creek
Site Code	ICH	LMA	MTR	GOA	GRA	DWL	LC1	LC2	SC1	SC2	LRL	LRU	SW2	SW2	JOC	WEN	WR1	WR1	WR2	UGR	ESS	KRS	USE	YFK	RFL
Stock																									
Lower Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Skamania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Klickitat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MGICLS	5	6	2	2	102	0	0	0	0	1	0	0	0	0	2	1	8	8	9	2	1	1	2	0	0
Yakima	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SF Clearwater	8	1	0	3	183	7	1	1	11	34	0	1	0	0	0	0	0	0	0	1	0	0	1	4	0
Upper Clearwater	1	0	0	1	3	0	0	0	0	0	1	15	1	1	0	0	0	0	0	0	0	0	0	0	0
SF Salmon	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
MF Salmon	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Salmon	3	1	0	0	78	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	4	0	1
Total	17	9	2	6	372	7	1	1	11	35	1	16	1	1	3	1	8	8	10	3	2	1	7	4	1

	Imnaha B.						Yakima B.							Wenatchee B.									Methow B.			Okanogan B.		
	Lower Imnaha River ISA @ km 7	Lower Imnaha River ISA @ km 10	Little Sheep Creek	Big Sheep Creek	Upper Imnaha River ISA @ km 41	Grouse Creek Mouth	Prosser Diversion Dam Combined	Toppenish Creek at Simcoe Ck	Ahtanum at Lasalle HS	Roza Diversion Dam	Lower Mainstem Teanaway River	Ringold Springs Hatchery	Priest Rapids Adult	Lower Wenatchee River	Lower Mission Creek Instream	Lower Icicle Instream Array	Lower Nason Creek	Upper Nason Creek	Rocky Reach Fishway	East Bank Hatchery	Wells Dam Hatchery	Wells Dam, DCPUD Adult Ladders	Lower Methow River at Pateros	Methow River at Carlton	Lwr Twisp Rvr near MSRF Ponds	Lower Okanogan Instream Array	Zosel Dam	Foster Creek
Site Code	IR1	IR2	LSC	BSC	IR3	GCM	PRO	TP2	AH1	ROZ	LMT	RSH	PRA	LWE	MCL	ICL	NAL	NAU	RRF	EBO	WEH	WEA	LMR	MRC	TWR	OKL	ZSL	FST
Stock																												
Lower Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Skamania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Klickitat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MGICLS	1	1	5	1	0	1	2	1	1	1	1	3	1	1	1	1	1	1	1	1	2	14	1	1	2	4	1	2
Yakima	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
Upper Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	1	0	0	1	1	0
SF Clearwater	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
Upper Clearwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SF Salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF Salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Salmon	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	1	0	0	1	0
Total	1	1	5	1	1	1	2	1	1	1	1	3	1	1	1	2	1	1	1	1	3	20	1	2	2	5	1	2

	Total	Neutral	On Target	Putative Stray	Putative overshoot	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target))
Site Code	N	15	43	3	6					
Stock										
Lower Columbia	4	0	0	1	3	0.0%	0.0%	25.0%	75.0%	100.0%
Skamania	28	20	8	0	0	71.4%	28.6%	0.0%	0.0%	0.0%
Klickitat	13	5	6	2	0	38.5%	46.2%	15.4%	0.0%	25.0%
MGICLS	324	94	42	86	102	29.0%	13.0%	26.5%	31.5%	67.2%
Yakima	6	3	1	2	0	50.0%	16.7%	33.3%	0.0%	66.7%
Upper Columbia	8	2	6	0	0	25.0%	75.0%	0.0%	0.0%	0.0%
SF Clearwater	320	256	55	9	0	80.0%	17.2%	2.8%	0.0%	14.1%
Upper Clearwater	27	9	18	0	0	33.3%	66.7%	0.0%	0.0%	0.0%
SF Salmon	2	1	1	0	0	50.0%	50.0%	0.0%	0.0%	0.0%
MF Salmon	6	6	0	0	0	100.0%	0.0%	0.0%	0.0%	0.0%
Upper Salmon	119	104	5	10	0	87.4%	4.2%	8.4%	0.0%	66.7%
Total	857	500	142	110	105	58.3%	16.6%	12.8%	12.3%	43.7%

RESULTS-SOCKEYE[11]

Sample Size

In 2022, a total of 1375 Sockeye were sampled, and 1364 Sockeye tagged by this project (Table 44). A total of 4 Sockeye were previously tagged, 3 by other agencies as juveniles on their downstream migration and 1 by CRITFC. The previously tagged CRITFC Sockeye and 1 of the 3 previously tagged by other agencies were mistakenly given a second tag by CRITFC samplers. These fish were excluded from further analysis due to the small number, difficulties in analysis presented by double tagged fish, and possible differential detection rates at upstream detection sites. A total of 10 Sockeye were not detected after tagging and 3 were last detected at antennas BO2 and BO3 leaving a total of 1354 tagged Sockeye detected at the upper most antennas BO1 or BO4 or upstream of Bonneville Dam.

Distribution of Sample

The sampling rate was similar to the run proportion (Figure 27) with the major exception being Week 27 when 43.2 of the Sockeye run passed Bonneville Dam. As was previously mentioned in the case of Chinook sampling during this week, the high Sockeye abundance combined with shad abundance resulted a sampling protocol where no picket leads were dropped, meaning that the sample was totally volitional resulting in a decreased sample size (and an increased likelihood of a biased sample). In 2022, sampling restrictions were in place for 33 days over the 11 weeks. Reduced sampling occurred on 18 days due to shad abundance and 12 days due to high temperatures during the last 3 weeks that we sampled Sockeye Salmon. There were 3 days of no sampling due to high water temperatures.

[11] The information presented in this section of the report is a summary of Fryer et al. 2024.

Table 44. Number of Sockeye Salmon sampled, and PIT tagged at Bonneville Dam and tracked upstream by date and statistical week in 2022.

Dates Sockeye Salmon Sampled	Statistical Week	Percentage of Run	Sampled (N)	Tagged	Excluded Due to Bad/Missing Data	Previously Tagged		Double Tagged	Mortalities	Last Detected at Bonneville downstream of exit antennas	Not Detected After Tagging	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
6/1,3	23	0.1	5	5	0	0	0	0	0	1	0	4	0	0	0
6/7-10	24	1.1	66	63	0	0	1	0	0	0	2	62	0	0	0
6/13-17	25	4.2	165	164	0	0	0	0	0	1	2	161	0	5	0
6/21-23	26	25.5	259	259	0	0	0	0	0	0	1	258	0	4	0
6/27-30	27	43.2	193	191	0	0	1	1	0	1	0	191	0	4	0
7/5-8	28	14.8	277	273	0	1	0	1	0	0	1	272	0	4	0
7/11,13-15	29	6.4	132	132	0	0	0	0	0	0	2	130	0	0	0
7/18-22	30	3.3	135	135	0	0	0	0	0	0	1	134	0	0	0
7/25-29	31	1.2	105	105	0	0	0	0	0	0	0	105	4	0	1
8/2,5	32	0.2	30	29	0	0	1	0	0	0	1	29	4	0	1
8/8,11	33	0.1	8	8	0	0	0	0	0	0	0	8	4	0	1
Total			**1375**	**1364**	**0**	**1**	**3**	**2**	**0**	**3**	**10**	**1354**	**12**	**17**	**3**

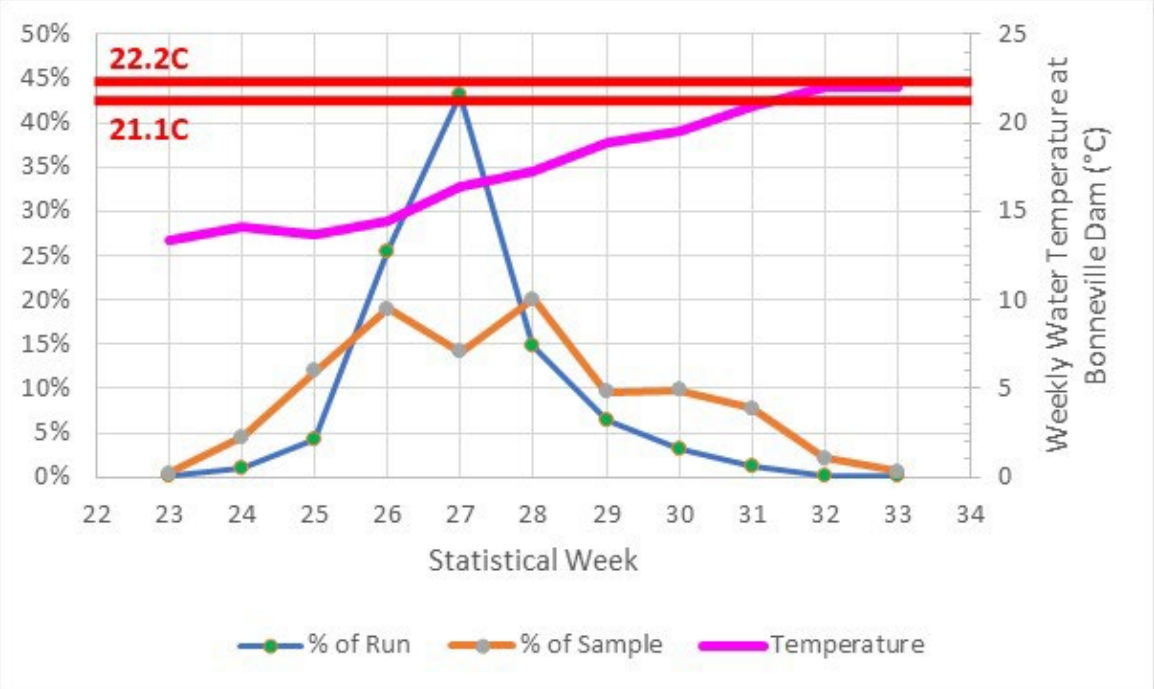


Figure 27. The weekly Sockeye sample and run as a percentage of the total sample and run size at Bonneville Dam in 2022. AFF regulations require reduced sampling when the temperature at Bonneville Dam reaches 21.1°C with sampling halted at 22.2°C.

Detection Numbers

The tracking of 1,352 Sockeye generated 58,128 weir detections, which were grouped into 10,737 site detections at 47 sites. Maps and table of sites found in the Appendix C (Table C1 and Figures C1, C23-26) show the sites and the categorical ranges of detection numbers at the sites throughout the Columbia 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 45).

In the Okanagan Basin, both Zosel and Skaha dams had high rates of PIT-tagged Sockeye Salmon missing detection in 2022 due to high river flows allowing Sockeye Salmon to avoid detection by migrating through the unmonitored spillway rather than through fish ladders where PIT tag antennas were located.

Table 45. Percentage of Bonneville Dam PIT-tagged Sockeye Salmon not detected at upstream dams and in-stream PIT tag arrays on their migration route for 2006-2022.

		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**	**2022**	**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	1.6	1.1
The Dalles	A	--	--	--	--	--	--	--	1.6	0.3	0.6	0.4	2.1	0.9	0.5	1.4	0.8	1.8	1.0
John Day	A	--	--	--	--	--	--	--	--	--	--	--	--	2.8	3.3	4.5	2.8	3.6	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	4.8	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	0.0	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	0.0	7.9
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	0.1	1.0
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	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	0.0	2.5
Lower Monumental	A	--	--	--	--	--	--	--	--	--	0.0	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	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	0.0	0.2
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	70.9	46.2
Lower Wenatchee (LWE)	D	--	--	--	--	--	--	--	--	48.0	17.9	54.7	49.6	68.4	33.3	78.4	32.6	21.4	44.9
Upper Wenatchee (UWE)	D	--	--	--	--	--	--	--	--	52.7	24.6	9.7	9.3	9.9	3.2	11.3	49.4	32.3	22.5
Lower Okanagan (OKL)	D	--	--	--	--	--	--	--	--	68.9	13.8	59.4	47.4	50.1	66.7	40.4	83.7	77.7	56.4
Okanagan Channel (OKC)	D	--	--	--	--	--	--	--	--	--	--	16.9	--	7.7	5.3	5.7	0.0	5.9	6.9
Skaha (SKA)	C	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0	41.5	0.0	40.0	20.4

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.**

Bonneville Dam Age Composition

The predominant age group in 2022 was Age 1.2 comprising 94.8 of the run in 2022 (Tables 46 and 47) with 54.1 the run estimated to be female. No other age group comprised more than 2.1 of the run in 2022.

Table 46. Weekly and total age composition of Sockeye Salmon at Bonneville Dam as estimated from scale patterns in 2022. (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	60.0	5	0.0	100.0	0.0	0.0	0.0
24	1.1	47.7	46	4.3	93.5	0.0	2.2	0.0
25	4.2	36.8	164	1.8	94.5	1.8	0.6	1.2
26	25.5	48.6	254	2.0	93.7	0.4	3.9	0.0
27	43.1	55.7	186	1.6	95.7	0.5	1.6	0.5
28	14.8	57.8	269	2.2	95.2	1.1	1.5	0.0
29	6.4	59.9	171	3.5	93.6	0.6	1.2	1.2
30	3.3	67.4	134	2.2	94.0	0.7	1.5	1.5
31	1.2	59.6	104	1.9	93.3	0.0	3.8	1.0
32	0.2	75.9	30	0.0	100.0	0.0	0.0	0.0
33	0.1	75.0	8	0.0	87.5	0.0	12.5	0.0
Composite	**100.0**	**54.1**	**1416**	**2.0**	**94.8**	**0.6**	**2.1**	**0.4**
Standard Error		**1.8**		**1.0**	**1.6**	**0.6**	**0.6**	**0.5**
F statistic for linear regression between age and stat. week				**1.00**	**1.42**	**0.472**	**2.96**	**0.184**
P value				**0.344**	**0.263**	**0.562**	**0.120**	**0.678**
Females				**0.8**	**96.8**	**0.2**	**1.5**	**0.6**
Standard Error				**0.3**	**0.8**	**0.1**	**0.6**	**0.4**
Males				**3.3**	**92.6**	**1.1**	**2.8**	**0.1**
Standard Error				**1.0**	**1.4**	**0.6**	**0.9**	**0.1**
T-test p value for males vs females by age				**0.016**	**0.011**	**0.132**	**0.221**	**0.290**

The age composition of females in 2022 was 96.8 Age 1.2, 1.5 Age 1.3 and 0.8 Age 1.1 compared to males at 92.6 Age 1.2, 2.8 Age 1.3, and 3.3 Age 1.1. The difference in the percentage of Age 1.1 and 1.2 Sockeye by sex was significant (α=0.05) in 2022 (Table 46).

There was not a significant linear relationship between any age group and statistical week in 2022 (Table 46, Figure 28) for any of the age classes.

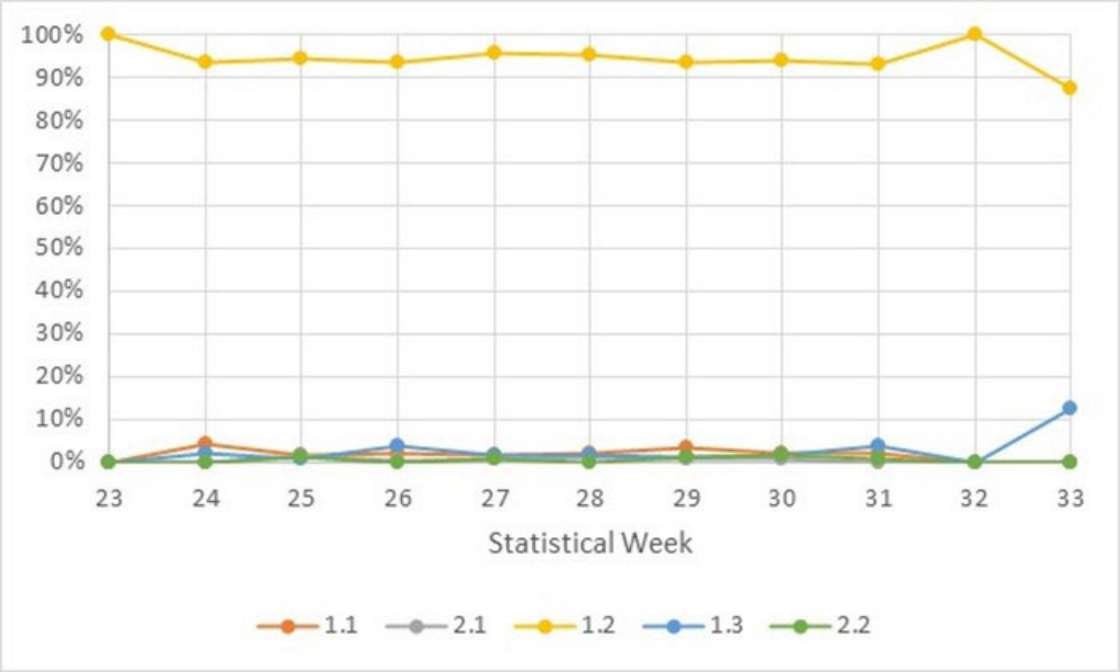


Figure 28. Weekly age composition estimates by statistical week for Sockeye Salmon sampled at Bonneville Dam in 2022.

Mainstem Dam Recoveries, Mortality, and Escapement Estimates

The percentage of Sockeye Salmon passing Bonneville Dam that were estimated to pass upstream sites (Figure 29) was higher than the 2006-2022 mean at all mainstem sites through Wells Dam in addition to Tumwater Dam (Table 47)[12].

[12] 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.

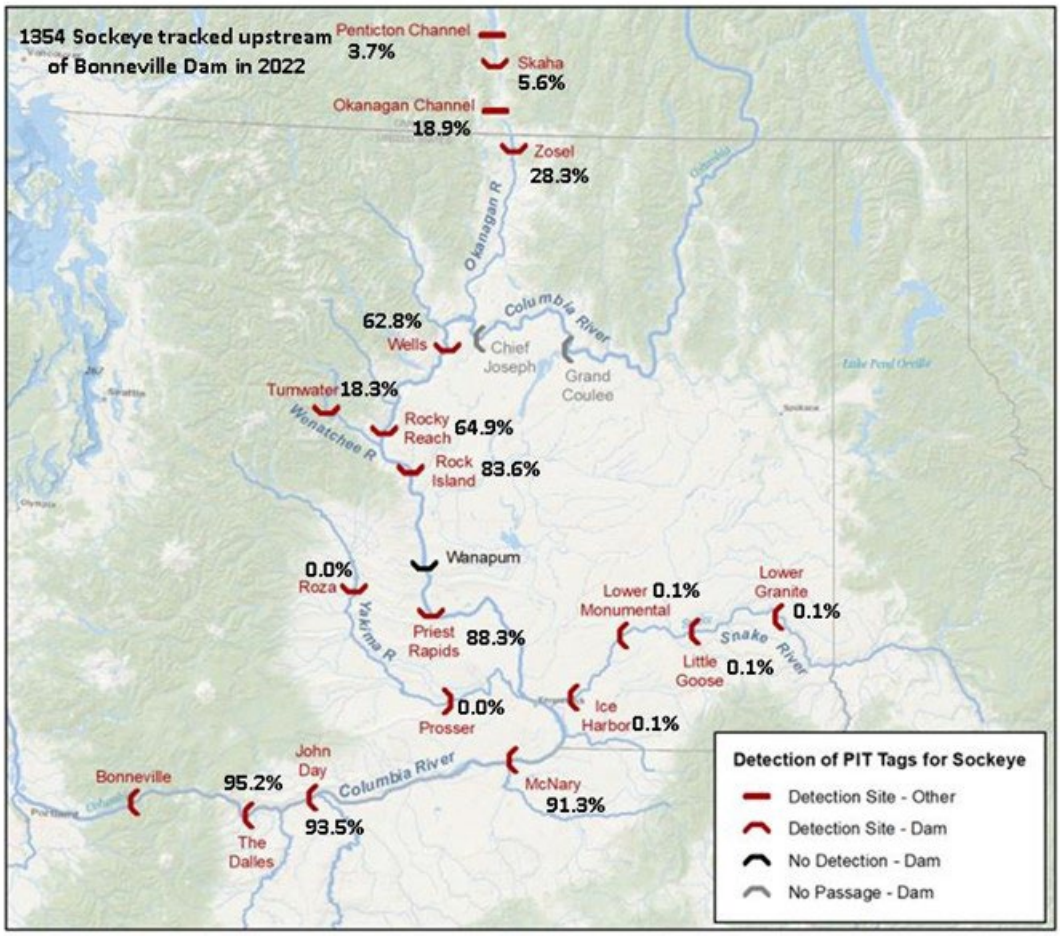


Figure 29. Map of the Columbia River Basin showing the number of fish PIT tagged at Bonneville Dam, and the percentage of the run estimated to pass upstream dams in 2022.

Table 47. Estimated percentage of Sockeye Salmon PIT tagged at Bonneville Dam passing upstream dams and OKC in years 2006-2022.

	Percentage by Year																	
Dam or Site	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Mean**
The Dalles	--	--	--	--	--	--	--	89.5	93.1	82.8	94.0	89.3	93.3	94.6	95.0	89.6	95.2	91.6
John Day	--	--	--	--	--	--	--	--	--	--	--	--	90.9	92.7	92.1	84.0	93.5	90.7
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	91.3	82.9
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	88.3	78.0
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	83.6	74.3
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	64.9	59.7
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	62.8	57.9
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	18.3	13.8
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	18.9	28.7

In 2022, the number of Sockeye Salmon counted at John Day was greater than that of The Dalles, and the counts at Priest Rapids and Rock Island dams were greater than the three downriver dams (The Dalles, John Day, and McNary) compared to PIT tag estimates of escapement which follow the expected decline as the run moves upstream (Table 48, Figure 30). The difference between PIT tag estimates and Columbia River dam visual counts ranged from -23.5 at Rocky Reach Dam to 8.8 at The Dalles Dam.

Table 48. 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 2022.

Dam	Visual Dam Count	Escapement Estimate Using Bonneville PIT-Tagged Sockeye Salmon	Difference Between Bonneville PIT Tag and Visual Estimates
Bonneville	663,253	663,253	--
The Dalles	580,582	631,572	8.8
John Day	630,888	620,143	-1.7
McNary	595,712	605,374	1.6
Priest Rapids	654,407	585,695	-10.5
Rock Island	659,933	554,519	-16.0
Rocky Reach	562,721	430,559	-23.5
Wells	478,418	416,766	-12.9
Tumwater	110,693	121,534	9.8
Ice Harbor	1,850	946	-48.9
L. Monumental	1,953	543	-72.2
Little Goose	2,099	408	-80.6
Lower Granite	2,087	408	-80.5
Prosser	157	0	-100.0
Roza	510	175	-65.7

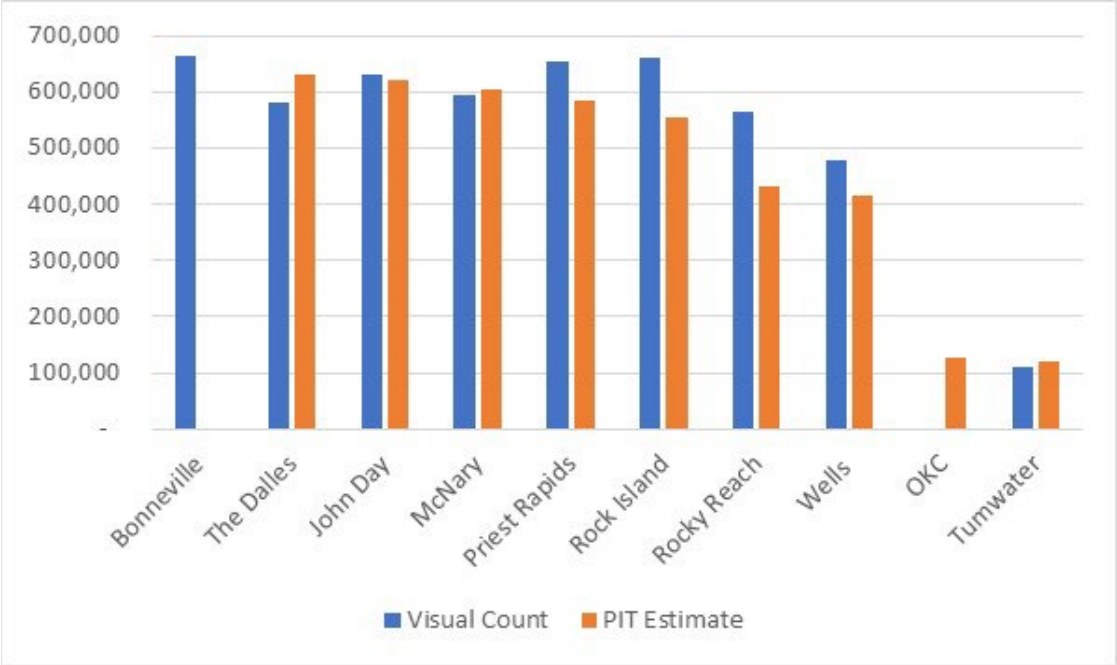


Figure 30. Estimated PIT tag and visual count estimates of escapement at Columbia River dams and Tumwater Dam in 2022.

Survival of Bonneville-tagged Sockeye Salmon to upstream points declined as the run progressed, however there was only a significant linear relationship (α=0.05) between statistical week and survival to The Dalles Dam.

Table 49. Sockeye Salmon survival through selected reaches by statistical week as estimated by PIT tag detections in 2022 and the p-value for a linear regression between weekly reach survival and statistical week.

Statistical Week at Bonneville Dam	Number Tracked	Survival from Bonneville to:				
		The Dalles	John Day	McNary	Priest Rapids	Rock Island
23	4	100.0	100.0	100.0	100.0	100.0
24	62	96.8	95.2	95.2	90.3	82.3
25	161	95.7	92.5	89.4	84.5	73.3
26	258	93.0	90.3	89.5	85.3	80.6
27	191	97.4	96.3	94.2	93.2	88.0
28	272	97.1	96.0	93.4	90.1	87.1
29	130	90.8	89.2	87.7	86.9	85.4
30	134	88.1	85.8	79.1	70.9	67.2
31	105	87.6	81.0	64.8	36.2	33.3
32	29	62.1	55.2	10.3	3.4	3.4
33	8	87.5	75.0	50.0	12.5	12.5
Composite[13]	**1354**	**95.2**	**93.5**	**91.3**	**88.3**	**83.6**
p-value		**0.036**	**0.156**	**0.182**	**0.123**	**0.109**

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

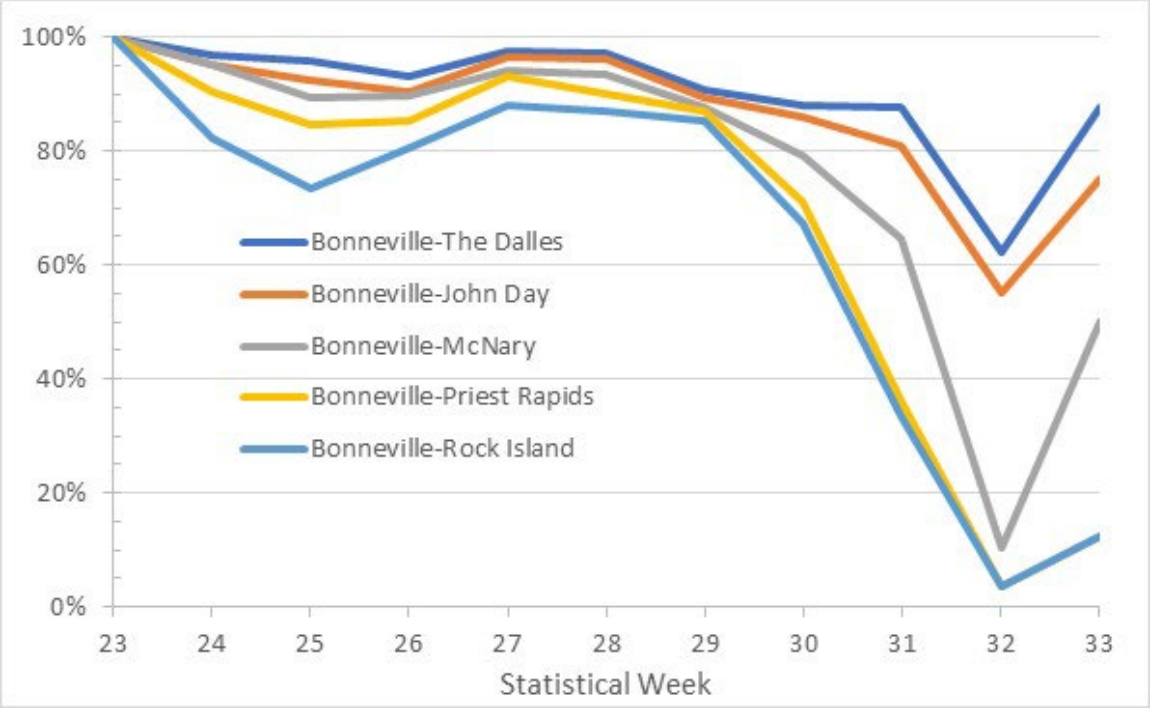


Figure 31. Survival of Sockeye Salmon PIT tagged at Bonneville Dam to The Dalles, John Day, McNary, Priest Rapids, and Rock Island dams by statistical week in 2022.

Migration Rates and Passage Time

The fastest median migration rate between mainstem Columbia River dam pairs listed in Table 50 was Bonneville-McNary Dam at 45.8 km/day while the slowest was John Day-McNary Dam at 28.5 km/day.

Table 50. Median Sockeye Salmon migration rates and travel time between dams as estimated by PIT tag detections in 2022.

		Adults Tagged at Bonneville Dam	
Dam Pair	Distance (km)	Median Travel Time (days)	Median Migration Rate (km/day)
Bonneville-The Dalles	74	1.8	40.4
The Dalles-John Day	39	1.0	41.0
John Day-McNary	63	2.2	28.5
McNary-Priest Rapids	167	4.3	38.9
Priest Rapids-Rock Island	89	2.9	31.2
Rock Island-Rocky Reach	33	1.0	33.5
Rocky Reach-Wells	65	2.0	32.5
Rock Island-Tumwater	73	9.1	8.0
Bonneville-John Day	113	2.8	39.9
Bonneville-McNary	231	5.0	45.8
Bonneville-Priest Rapids	329	9.8	33.7
Bonneville-Rock Island	487	12.6	38.6
Bonneville-Tumwater	560	21.4	26.1
Bonneville-Wells	585	15.7	37.2

There was a significant linear relationship (α=0.05) between the statistical week passing Bonneville Dam and travel time to all upstream Columbia River

dams (Table 51) except The Dalles and McNary dams. Median travel times between the Okanagan and Wenatchee stocks differed by 0.6 days or less for all dam pairs listed that are in the normal migration corridor for both stocks. The difference between males and females was 0.9 days or less to all mainstem dams; however, the median time for males to travel from Bonneville to Zosel Dam was 8.2 days greater, and Wells to Zosel 6.9 days greater, than females.

Table 51. 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 2022. 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	1.8	3.5	5.7	16.5	21.2	NA	23.9	26.8	NA	NA	NA
24	2.2	4.1	11.7	19.0	22.7	37.4	23.9	26.6	29.8	5.2	18.1
25	2.4	4.7	8.0	14.7	18.1	33.9	19.1	21.9	25.4	4.6	16.5
26	2.0	3.1	5.8	10.7	13.7	29.0	14.7	16.9	23.3	4.5	13.8
27	1.9	2.9	5.0	9.8	12.7	23.0	13.7	15.2	41.9	24.9	10.2
28	1.7	2.7	4.8	8.8	11.1	19.6	12.0	13.9	54.7	40.2	7.7
29	1.7	2.6	4.7	8.5	10.9	17.8	11.8	13.6	42.2	28.8	6.1
30	1.7	2.7	4.7	7.8	10.0	16.2	10.9	13.1	39.7	26.3	7.0
31	1.7	2.6	4.8	8.0	10.9	20.4	11.9	13.5	36.1	23.4	9.1
32	1.9	2.9	5.8	11.1	14.1	NA	15.2	17.8	28.4	10.7	NA
33	2.0	3.0	5.0	9.1	11.6	NA	12.4	14.3	NA	NA	NA
p-value	**0.188**	**0.031**	**0.072**	**0.006**	**0.005**	**0.001**	**0.006**	**0.031**	**0.001**	**0.001**	**0.001**
Stock											
Okanagan	1.9	2.8	5.1	9.8	12.7	NA	13.7	15.8	40.0	24.1	NA
Wenatchee	1.8	2.8	4.9	9.2	12.2	21.4	13.0	15.1	NA	NA	21.4
Males	1.9	2.8	5.1	10.0	12.8	22.0	13.8	16.1	46.1	29.8	2.8
Females	1.8	2.8	4.9	9.6	12.1	21.1	13.0	15.2	37.9	22.9	2.8

Mainstem dams with the greatest median passage times (Table 52) are those with more comprehensive detection networks within ladders (e.g., Bonneville, Priest Rapids, Rock Island, and Lower Granite) or trapping activities which can slow migration (e.g., Bonneville, Priest Rapids, Tumwater, and Lower Granite). At Zosel Dam additional antennas were installed across the tailrace; the additional detections increased passage times as Sockeye were first detected at the tailrace then at the fishway antennas. In previous years, Sockeye were only detected at the fishway antennas.

Table 52. 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 2022.

Dam	N	Median Passage (Minutes)	>12 Hours
Bonneville	1337	12.5	1.2
The Dalles	1240	0.1	1.6
John Day	1190	0.0	3.6
McNary	1122	0.2	1.4
Priest Rapids	1088	9.0	3.0
Rock Island	1025	28.4	1.0
Rocky Reach	832	4.3	3.1
Wells	815	4.9	3.3
Zosel	218	65.8	15.1
Tumwater	184	22.8	4.9
Ice Harbor	1	2.7	0.0
Lower Monumental	1	0.1	0.0
Little Goose	1	0.1	0.0
Lower Granite	1	501.7	100.0
Weighted Mean (by detection number)		**9.1**	**2.6**

Fallback

Fallback rates at mainstem Columbia River dams for adults tagged at Bonneville Dam in 2022 ranged from 0.4 at McNary Dam to 3.0 at John Day Dam Higher rates were estimated for returning juveniles passing Ice Harbor and Lower Granite dams.

Table 53. Estimated minimum fallback rates for Sockeye Salmon in this study at upstream dams in 2022[14].

Dam - Mainstem	Fallback Rate	Dam - Tributary	Fallback Rate
Bonneville	0.7	Tumwater	0.5
The Dalles	2.9	Zosel	6.0
John Day	3.0	Skaha	4.9
McNary	0.4		
Priest Rapids	1.9		
Rock Island	2.8		
Rocky Reach	0.5		
Wells	1.0		
Ice Harbor	0.0		
Lower Monumental	0.0		
Little Goose	0.0		
Lower Granite	0.0		

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

Of the 143 Sockeye Salmon tagged as adults by this project in 2022 which fell back over at least one dam, 18 fell back over two dams and 1 fell back over four dams (Table 54).

Table 54. 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 2022.

Fallback Events	Number of Sockeye
1	124
2	18
3	0
4	1
Number of Sockeye Salmon falling back at least once	**143**
Percent of Sockeye Salmon with at least one fallback event	**10.5**
Total fallback events	**164**
Number of Sockeye Salmon detected at or upstream of Bonneville Dam	**1365**
Fallbacks events per Sockeye Salmon	**0.12**

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) in 2022 (Table 55).

Table 55. Estimated Sockeye Salmon night passage (2000-0400) by stock at Columbia River, Zosel, and Tumwater dams in 2022. Dams outside the typical migratory corridor for the stock in question are shaded yellow.

Dam	All Adults	Okanagan	Wenatchee
Bonneville	0.7	0.9	0.0
The Dalles	10.1	10.4	8.6
John Day	5.0	5.1	4.6
McNary	6.8	6.9	6.0
Priest Rapids	2.8	3.2	1.4
Rock Island	4.3	4.5	3.5
Rocky Reach	6.3	6.2	7.1
Wells	11.5	11.4	22.2
Tumwater	2.7	NA	2.7
Zosel	20.6	20.6	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 56). There was high concurrence between PIT tag and GSI stock classifications with 624 out of 625 (99.8) being classified similarly (Table 56). The sole exception was a Sockeye

(3DD.003DEAAE) classified by GSI as Wenatchee stock last detected in the lower Okanagan River at OKL site. This fish was tagged at Bonneville Dam on July 29, passed Wells Dam on August 20, and was last detected moving upstream at OKL on September 1.

Table 56. Comparison of stock composition estimates for individual Sockeye Salmon sampled at Bonneville Dam in 2022. Green shading indicates agreement between the two methods orange indicates disagreement.

Stock Estimated Using PIT Tags	Stock Estimated by Genetics (PBT or GSI)					
	Okanagan	Wenatchee	Snake	Unknown[15]	Yakima	Total
Okanagan	433	1	0	1	**0**	**435**
Wenatchee	0	190	0	0	**0**	**190**
Snake	0	0	1	0	**0**	**1**
Yakima	0	0	0	0	**0**	**0**
Unknown[16]	668	75	3	4	**0**	**750**
Total	**1101**	**266**	**4**	**5**	**0**	**1376**

No Sockeye were classified by PIT or GSI as being of Yakima stock. There were two Sockeye Salmon last detected in the Yakima River, one at Roza Dam (ROZ) and the other at the Sunnyside Diversion (SSJ). However, both fish had last Columbia River detections at the Priest Rapids Dam fish trap, where it is most likely they were trapped and transported to Cle Elum Lake, before migrating downstream to ROZ and SSJ. Both fish were classified by GSI as being of Okanagan stock. No Sockeye Salmon were classified as Deschutes stock in 2022, nor were any Sockeye Salmon last detected in the Deschutes River.

Among the four Sockeye classified by GSI as being Snake River origin (Table 56), one was last detected at Bonneville Dam (BO4), one at McNary Dam (MC1), and one at Lower Granite Dam (GRA) with a fourth not detected after release.

In 2022, of the 199 Sockeye Salmon classified as Wenatchee stock detected at Rock Island Dam, 14 (7.0%) overshot the Wenatchee River and were detected at Rocky Reach Dam and 9 (4.5%) were detected at Wells Dam. Of these overshoots, 6 eventually returned to the Wenatchee River with 5 detected on the spawning grounds (4 at WTL and 1 at LWN), and 1 last detected at

[15] Either no genetics sample is available, the sample did not classify to a particular stock, or GSI data was removed due to a suspected data collection error.
[16] 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 June 23, 2022, where there was a suspected mix up of genetics samples.

Tumwater Dam. One Sockeye classified as Wenatchee stock was last detected at OKL at Okanagan River km 25.

Straying

No Sockeye were classified differently by PBT than using GSI so only GSI results are presented in Table 57. The estimated Sockeye stray rate was 0.8% for the Okanagan stock and 2.5% for the Wenatchee stock for an overall stray rate of 1.5%. Both of the Okanagan stock strays were last detected at Columbia River hatcheries, one each at Ringold and Wells. Of the 4 Wenatchee strays, one was last detected at ENL, located at Entiat river kilometer 2 while the other three were further up Columbia River tributaries in the Entiat, Twisp (Methow) and Okanagan. There were two Sockeye last detected in the Yakima River that were last detected on the Columbia River at the Priest Rapids Dam fish trap and were likely transported to Cle Elum Lake for a reintroduction program. They then migrated downstream where they were last detected at Roza and Sunnyside Dam. Neither Sockeye, nor any other Sockeye, were detected downstream at Prosser Dam at Yakima rkm 76.

Table 57. Showing final-PIT-fate categories by Sockeye stock as determined using Genetics Stock Identification for Sockeye tagged in 2022. 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		McNary Dam				Yakima						Wenatchee						R. Reach		Entiat		Wells D/H			Okanagan											
	Bonneville PH2 Juvenile	BON PH2 Corner Collector	Bonneville Bradford Is. Ladder	Bonneville WA Shore Ladder/AFF	Bonneville WA Ladder Slots	The Dalles East Fish Ladder	The Dalles North Fish Ladder	John Day South Fish Ladder	John Day North Fish Ladder	McNary Oregon Shore Ladder	McNary Washington Shore Ladder	McNary Dam Juvenile	Lower Granite Dam Adult	SUNNYSIDE JUVENILE	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 Basin	Little Wenatchee River	Rocky Reach Fishway	Rocky Reach Dam Juvenile	Lower Entiat River	Upper Entiat River at rkm 17.1	Wells Dam, DCPUD Adult Ladders	Wells Dam Hatchery	Lwr Twisp Rvr near MSRF Ponds	Lower Okanogan Instream Array	Zosel Dam Combined	Okanagan Channel at VDS-3	Vasuex Creek, BC, Canada	McIntyre Dam	Skaha Dam Fish Ladder	Penticton Channel PIT Array	Neutral	On Target	Putative Stray	Putative overshoot	Likely Cte Elum program	%Neutral	%On Target	%Putative Stray	%Putative overshoot	% Strays (strays/(strays+On target)
Tributary RKM													173	167	206				2	41	44	81	90	90			2	17			66	25	132	149	163	166	177	196										
Columbia RKM	234	234	234	234	234	308	308	347	347	470	470	470	522	539	539	567	639	730	754	754	754	754	754	754	763	763	778	778	830	830	843	858	858	858	858	858	858	858										
Site Code	B2J	BCC	BO1	BO3	BO4	TD1	TD2	JO1	JO2	MC1	MC2	MCJ	GRA	SSJ	ROZ	RSH	PRA	RIA	LWE	ICL	TUF	UWE	WTL	LWN	RRF	RRJ	ENL	ENA	WEA	WEH	TWR	OKL	ZSL	OKC	OKV	OKM	SKA	OKP										
Stock																																														
Okanagan	1	1	3	2	68	21	6	33	11	39	22	1		1	1	1	52	7							13	1			368	1		34	146	177	1	14	8	53	830	253	2	1	2	76.3%	23.3%	0.2%	0.1%	0.8%
Snake				1						1			1																										3	0	0	0	0	100.0%	0.0%	0.0%	0.0%	NA
Wenatchee				1	19	5		12	5	8	7						9	1	4	2	16	14	135	19			1	1	4		1	1							103	154	4	4	0	38.9%	58.1%	1.5%	1.5%	2.5%
Total	1	1	3	3	88	26	6	45	16	48	29	1	1	1	1	1	61	8	4	2	16	14	135	19	13	1	1	1	372	1	1	35	146	177	1	14	8	53	936	407	6	5	2	69.0%	30.0%	0.4%	0.4%	1.5%

DISCUSSION

In 2022, this project tracked a total of 3,275 Chinook, 864 steelhead, and 1,221 Sockeye (Table 58) 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 2022 marked the 17th year of Sockeye Salmon PIT tagging, the 16th year of Chinook Salmon PIT tagging and the 14th 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 58. Total number of Chinook and Sockeye salmon and steelhead PIT tags tracked by year (includes recaptures of previously PIT tagged fish) 2009-2022.

	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
2022	3,104	862	1,354	5,365	0.36	0.68	0.20	0.32
Mean	**3,271**	**1,291**	**1,230**	**5,797**	**0.48**	**0.69**	**0.58**	**0.48**
All Years	**45,800**	**18,080**	**17,224**	**81,154**				

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 2022 the percentage of Chinook Salmon at Bonneville Dam, which ultimately passed Ice Harbor Dam, peaked at 46.3 of the run for Statistical weeks 21 and 22, which started May 15 and 22, 2022 respectively (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 16), the percentage that ultimately passed Ice Harbor Dam had declined to under 10 of the run. The percentage detected above Priest Rapids Dam exceeded 50 for those Chinook tagged in Week 28 and remained above 70 for weeks 26-30 (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 21.6 of spring and 0.4 of summer Chinook at Bonneville Dam were classified differently at Priest Rapids Dam (Table 8). This study also found that 5.0 of spring and 7.0 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 difficulty in removing the scales from the fish because of extreme resorption of the outer part of the scales which also makes ageing difficult, if not impossible. Tules are of less interest to fishery managers. However, in 2022, we did sample 101 Tules between weeks 31 and 37. Of these, 45 were last

detected at Bonneville Dam (55 of which were at the upper antennas of Bonneville Dam, 41 were last detected at Spring Creek Hatchery, 10 at The Dalles Dam, 2 at John Day Dam, and 1 at Ringold Springs Hatchery above McNary Dam (Figure C16 in Appendix C). All Tules, except for the first Tule sampled in Week 31 (which was classified as an Eastbank Hatchery summer Chinook) were classified genetically as Tules raised at Spring Creek Hatchery.

REFERENCES

Busby, P.J. T. C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, R. W. Waknitz, and I.V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-27. http://www.nwfsc.noaa.gov/publications/techmemos/tm27.

CBFWA (Columbia Basin Fish and Wildlife Authority PIT Tag Steering Committee). 1999. PIT tag marking procedures manual. CBFWA. Portland. 26p.

FPC (Fish Passage Center). 2022. Adult fish counts online at www.fpc.org.

Fryer, J.K. 2009. Use of PIT tags to determine upstream migratory timing and survival of Columbia Basin Sockeye Salmon in 2008. Columbia River Inter-Tribal Fish Commission Technical Report 09-03. 43p. https://critfc.org/reports/use-of-pit-tags-to-determine-upstream-migratory-timing-and-survival-of-columbia-basin-sockeye-salmon-in-2008/.

Hatch, D. et al. *Multiple Years. Annual Reports on the Kelt Reconditioning and Reproductive Success*. Columbia River Inter-Tribal Fish Commission Technical Report. http://www.critfc.org/fish-and-watersheds/fishery-science/scientific-reports/

Kelsey D., J. Mainord, J. Whiteaker, and J.K. Fryer. 2011. Age and length composition of Columbia Basin Chinook and Sockeye salmon and steelhead at Bonneville Dam in 2009. Columbia River Inter-Tribal Fish Commission Technical Report 11-08 for U.S. Dept. of Energy Bonneville Power Administration Project 2008-518-00. 41p. https://critfc.org/reports/age-and-length-composition-of-columbia-basin-chinook-and-sockeye-salmon-and-steelhead-at-bonneville-dam-in-2009/.

Koo, T.S.Y. 1962. Age designation in salmon. Pages 37-48 *in* T.S.Y. Koo (editor). Studies of Alaska Red Salmon. University of Washington Press, Seattle, Washington.

Whiteaker J., and J.K. Fryer. 2008. Age and length composition of Columbia Basin Chinook and Sockeye salmon and steelhead at Bonneville Dam in 2007. Columbia River Inter-Tribal Fish Commission Technical Report 08-04. 45p. https://critfc.org/reports/age-and-length-composition-of-columbia-basin-chinook-and-sockeye-salmon-and-steelhead-at-bonneville-dam-in-2007-2/.

APPENDIX A

Section on Adult Trap Protocols out of the 2022 Fish Passage Plan for Bonneville Adult Fish Facility. Full document can be found at https://pweb.crohms.org/tmt/documents/fpp/2022/final/FPP22_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 lamprey trapping will be permitted above 72°F for tagging and transport purposes.

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).

1.5.1. 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.

1.5.2. 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.

1.5.3. 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.

1.5.4. 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.

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

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

1.5.7. 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.

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

1.5.9. 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 2022. 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	Trap closed, no sampling	No sampling due to holiday or other reason
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	2	0	0	0	0	0	0	0	0	0	0	0
18	5	0	0	0	0	0	0	0	0	0	0	0
19	4	0	0	0	0	0	0	0	0	0	0	1
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	1	4	0	0	0	0	0	0	0	0	0

25	0	3	2	0	0	0	0	0	0	0	0	0
26	0	0	2	1	0	0	0	0	0	0	0	1
27	0	0	0	0	4	0	0	0	0	0	0	0
28	1	0	3	0	0	0	0	0	0	0	0	1
29	1	4	0	0	0	0	0	0	0	0	0	0
30	5	0	0	0	0	0	0	0	0	0	0	0
31	3	0	0	0	0	2	0	0	0	0	0	0
32	0	0	0	0	0	2	0	0	0	0	3	0
33	0	0	0	0	0	3	0	0	0	0	2	0
34	0	0	0	0	0	4	0	0	0	0	1	0
35	0	2	0	1	0	2	0	0	0	0	3	0
36	0	0	5	0	0	0	1	2	0	0	2	0
37	0	0	0	0	0	0	0	0	4	0	0	1
38	0	0	0	0	0	0	0	1	3	1	0	0
39	0	4	1	0	0	0	0	0	0	0	0	0
40	4	0	1	0	0	0	0	0	0	0	0	0
41	5	0	0	0	0	0	0	0	0	0	0	0
42	2	0	0	0	0	0	0	0	0	0	0	0
Total	**51**	**14**	**18**	**2**	**4**	**13**	**1**	**3**	**7**	**1**	**11**	**4**

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)).

APPENDIX C

Table C1. List of PTAGIS interrogation sites (three letter code, name, and description) to use with maps that follow. Out of 324 active sites, 176 sites detected the fish tagged/tracked in 2022.

Site Code	Site Name	Site Description
158	Fifteenmile Ck at Eighteenmile Ck	The site is located in Fifteenmile Ck at Eighteenmile Ck confluence at rkm 4.
0HR	Henrys Instream Array	This site is 3.2 km below the confluence of Hayden Creek and the Lemhi River on private land near Lemhi Idaho.
AH1	Ahtanum at Lasalle HS	Ahtanum Creek site is located 3 rkm from the mouth of Ahtanum Creek at the lower end of the Lasalle High School property.
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.
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.
CCU	Catherine Creek at Union	This is an in-stream interrogation system located near the town of Union on Catherine Creek, at rkm 25.
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.
CHW	Chiwaukum Creek	This site is located at rkm 0.4 on Chiwaukum Creek (Wenatchee River Basin), located near Tumwater Campground (access through site 51).
CML	Chewuch River Middle Lower	Site is 7 rkm on the Chewuch River.
CMU	Chewuch River Middle Upper	Site is 8 rkm on the Chewuch River.
COP	Lower Coppei Instream Array	Site at RKM 0.8 on Coppei Creek.
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.
DSF	Deschutes Sherars Falls	Site consists of two monitored weirs in the main fishway and two monitored weirs in the high flow fishway; one
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	Located in the East Bank Hatchery outfall channel.
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 at river kilometer 17.1.
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
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
FST	Foster Creek	Located approximately 0.1 km upstream from the confluence with the Columbia River.
GCM	Grouse Creek Mouth	Located in Grouse Creek in the Imnaha River Basin approximately 25m upstream from the confluence with the
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.
HYC	Hayden Creek Instream Array	Lower section of Hayden Creek, in the Lemhi River Basin.
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.
ICU	Upper Icicle Instream Array	Site is a permanent instream PIT tag interrogation site at RKM 10 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
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.
NES	Nespelem River Instream Array	Located 0.86 km upstream from the confluence with the Columbia River. Nespelem River is above Chief Joseph Dam.
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.
OKV	Vaseux Creek, BC, Canada	The site is located 200m upriver from mouth of Vaseux Creek a trib of Okanogan River.
OMF		
OMK	Omak Creek Instream Array	Omak Creek enters the Okanogan River at RKM 51.5, approximately 1 km upstream from the city of Omak, WA. The site is located on Omak Creek, 0.24 rkm from the confluence with the Okanogan River.
PAT	Pattit Creek Instream Site	Site at RKM 1.3 on Pattit Creek a tributary to the Touchet River.
PCA	Panther Creek Array	The array is on Panther Creek approximately 5 rkm from the confluence with Salmon River.
PD5	Columbia River Estuary RKM 62	Located at rkm 62 on the Columbia River.
PD6	Columbia River Estuary RKM 68	Located at rkm 68 on the Columbia River.
PEL	Pelton Dam Ladder - Deschutes	Site in the ladder at PGE's Pelton Dam on the Deschutes River (rkm 328.161).
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.
PWA	Penawawa Creek	Site located at RKM 1.2 on Penawawa Creek, a tributary of the Snake River.
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.
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.
SHK	Shitike Creek PIT Array	Located across the tailout of a pool created by Scale Bridge.
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.
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.
SSJ	Sunnyside Juvenile	Located at Sunnyside Dam in the canal starting about 320 meters below the headgate.
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.
SWC	Swale Creek Array	Located approximately 100 m upstream from the confluence with the Klickitat River.
SWK	Lower Swauk Creek	Located at rkm 1.8 on lower Swauk 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.
TON	Tonasket Creek	Located approximately 0.4 RKM upstream from the confluence of Lake Osoyoos in the town of Oroville, WA.
TOP	Lower Toppenish Creek	The site is located approximately 1700 meters upstream from the confluence of Toppenish Creek with the Yakima River at rkm 130.
TP2	Toppenish Creek at Simcoe Ck	The array is located about 0.75 km upstream from the confluence of Toppenish Creek and Simcoe Creek.
TPJ	Tucannon at Panjab Creek	The site is an instream array at rkm 74.5 on the Tucannon River near the mouth of Panjab Creek.
TR2	Trout/Antelope Cr - Deschutes	Trout and Antelope Creek PIT tag array is located at RKM 20.7 upstream from the confluence with the Deschutes River on privately owned land.
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.
TWX	Estuary Towed Array (Exp.)	The TWX experimental trawl detector is typically deployed in the Columbia River estuary, at and above Jones Beach (rkm 75).

Table C1. Continued.

Site Code	Site Name	Site Description
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	System located on Valley Creek below Stanley, ID., in the Upper Salmon River.
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.
WFC	Wolf Creek, Methow River	The site is located approx. 330m up Wolf Creek, from the confluence with Methow River.
WHC	Lwr White Creek, Klickitat Bsn	Site is in White Creek (Klickitat River Basin) approximately 150 meters upstream from the mouth.
WHS	Wildhorse Spring Creek	The site is located approximately 0.1 rkm upstream from the confluence with the Okanogan River.
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 2022 and labeled later as kelts or repeat spawners when they began migrating downstream (after March 31st) and upstream in spring, summer, or fall of 2023, presumably to and from the ocean.

Tag Year	Tag Number	First Detection After Tagging 2022 in All Seasons	Fall 2022	Winter 2022/23	Spring 2023	Summer 2023	Fall 2023	Comments
2022	3DD.003DEAACAF	The Dalles North Ladder - October 17th	McNary - October 23rd		Middle Walla Walla - March 7th Upper Walla Walla - March 13th Lower Walla Walla - May 15th Columbia Estuary - May 26th			
2022	3DD.003DEAAA36	The Dalles East Ladder - September 21st	John Day - September 22nd		Umatillia - March 23rd to May 26th Columbia Estuary - May 31st			
2022	3DD.003DEAB254	The Dalles East Ladder - July 16th	McNary - September 26th	Lower John Day - February 8th	Columbia Estuary - May 14th			
2022	3DD.003DEAA168	The Dalles East Ladder - October 24th	Lower Granite - November 6th		Bonneville Juvenile - May 23rd			
2022	3DD.003DEA9C11	The Dalles East Ladder - September 25th	McNary - September 30th		Bonneville Corner Collector - May 2nd			
2022	3DD.003DEA9E47	The Dalles East Ladder - September 30th	Lower Granite - October 19th		Lower Lochsa (Clearwater) - March 28th Upper Lochsa (Clearwater) - March 29th	Bonneville Corner Collector - June 16th		
2022	3DD.003DEAADC8	The Dalles East Ladder - September 30th	Lower Granite - October 19th		SF Salmon - April 16th SF Salmon - May 1st	Bonneville Corner Collector - June 10th		
2022	3DD.003DEAAE2C	The Dalles North Ladder - August 7th	Lower Granite Juvenile Bypass - September 25th		John Day Juvenile Bypass - April 28th Bonneville Corner Collector - May 1st			Steelhead fell back over Lower Granite in the early Fall before leaving the system in Spring.
2022	3DD.003DEA9C2F	The Dalles East Ladder - September 25th	Tumwater Dam (Wenatchee) - October 30th		Upper Wenatchee - April 14th Nason Cr (Wenatchee) - April 15th to 24th Bonneville Corner Collector - May 20th			
2022	3DD.003DEAB10C	Upper Wind River - Febuary 8th			Mine Reach Wind River - Febuary 20th Upper Wind River - Febuary 27th Bonneville Corner Collector - April 7th			
2022	3DD.003DEAAD73	The Dalles East Ladder - September 15th	McNary - September 23rd		Prosser Dam (Yakima) - April 9th Sunnyside Dam (Yakima) - April 9th Bonneville Corner Collector - May 30th			
2022	3DD.003DEAAB37	Lower Klickitat - September 18th		Swale Creek (Klickitat) - January 19th	Bonneville Corner Collector - April 8th			
2022	3DD.003DEAAB94	The Dalles East Ladder - September 11th	John Day - November - November 1st		Bonneville Corner Collector - May 5th			
2022	3DD.003DEAADFD	The Dalles East Ladder - September 3rd	Lower Granite - October 7th		Bonneville Corner Collector - May 26th			
2022	3DD.003DEAB088	The Dalles East Ladder - July 15th		John Day - January 7th	Bonneville Corner Collector - May 31st			
2022	3DD.003DEAB0D1	The Dalles East Ladder - July 10th	Lower Granite - July 25th		Bonneville Corner Collector - May 9th			
2022	3DD.003DEAB531	The Dalles East Ladder - June 21st	Prosser Dam (Yakima) - October 27th		Bonneville Corner Collector - May 13th		Prosser Dam (Yakima) - October 9th	Steelhead likely went to the ocean between May (headed downriver) and Oct, 2023 (headed upriver) where it was last detected at Prosser Dam on the Yakima River.
2022	3DD.003DEAB6CE	The Dalles East Ladder - September 25th	McNary - October 1st		Bonneville Corner Collector - May 31st			
2022	3DD.003DEAAD72	The Dalles East Ladder - October 19th	John Day - October 29th		John Day Juvenile Bypass - May 15th			
2022	3DD.003DEAB01A	The Dalles East Ladder - September 6th	Lower Walla Walla River - October 8th	Middle Touchet (Walla Walla) - February 18th	Upper Touchet (Walla Walla) - March 20th Lower Touchet (Walla Walla) - April 3rd McNary Juvenile Bypass - April 17th			
2022	3DD.003DEAAB90	The Dalles East Ladder - September 8th	Lower Granite - September 23rd		Lower Imnaha - April 20th Lower Imnaha - May 20th Lower Granite Spillway - May 26th Lower Monumental Juvenile - May 29th			
2022	3DD.003DEA9C92	The Dalles East Ladder - September 1st	Lower Granite - October 2nd			Lower Granite Spillway - June 3rd Lower Monumental Juvenile - June 6th		
2022	3DD.003DEAAB47	The Dalles East Ladder - September 13th	Lower Granite - October 11th		Little Goose Juvenile Bypass - May 23rd			
2022	3DD.003DEAB08B	The Dalles East Ladder - September 12th	Lower Granite - September 25th		Lower Wallowa (Grande Ronde) - March 13th Little Goose Juvenile Bypass - April 10th			
2022	3DD.003DEAADE8	The Dalles East Ladder - September 12th	Lower Granite - September 23rd	Lower Wallowa (Grande Ronde) - February 21st	Lower Wallowa (Grande Ronde) - March 12th Little Goose Juvenile Bypass - April 27th			
2022	3DD.003DEAADC1	The Dalles East Ladder - September 15th	Lower Granite - October 4th		Lower Granite Spillway - April 25th Little Goose Juvenile Bypass - April 28th			
2022	3DD.003DEAAD55	The Dalles East Ladder - August 21st	Lower Granite - October 25th		Wallowa (Grande Ronde) - April 9th Lower Granite Juvenile Bypass - May 5th Little Goose Juvenile Bypass - May 7th			
2022	3DD.003DEAAE9A	The Dalles East Ladder - October 15th	Lower Granite - November 5th		Lower Lochsa (Clearwater) - April 22nd Upper Lochsa (Clearwater) - April 23rd Lower Granite Juvenile Bypass - May 25th			
2022	3DD.003DEAAA9B	The Dalles East Ladder - September 23rd	Lower Granite - October 7th		Lower SF Clearwater - March 22nd Lower Granite Juvenile Bypass - May 9th			
2022	3DD.003DEAA0D1	The Dalles East Ladder - October 9th	Lower Granite - October 24th		Lower Granite Juvenile Bypass - May 11th			
2022	3DD.003DEAA1AE	The Dalles East Ladder - October 1st	Lower Granite - October 16th		Lower Lochsa (Clearwater) - April 9th Upper Lochsa (Clearwater) - April 9th	Lower Granite Spillway - June 4th		
2022	3DD.003DEAB041	The Dalles East Ladder - August 8th	Lower Granite - August 18th			Lower Granite Spillway - June 5th		
2022	3DD.003DEA9D19	The Dalles North Ladder - September 22nd	Lower Granite - October 4th		Lower Granite Spillway - April 10th			
2022	3DD.003DEAA08F	The Dalles East Ladder - October 6th	Lower Granite - October 23rd		Lower Granite Spillway - April 7th			
2022	3DD.003DEAA0E7	The Dalles East Ladder - October 19th	Lower Granite - November 1st		Lower Granite Spillway - April 10th			
2022	3DD.003DEAAB01	The Dalles East Ladder - October 7th	Lower Granite - October 20th		Lower Granite Spillway - April 4th			
2022	3DD.003DEA9D21	The Dalles East Ladder - September 4th	Lower Granite - September 22nd		Lower Granite Spillway - May 18th			
2022	3DD.003DEAAEFB	The Dalles East Ladder - August 29th	Lower Granite - October 5th		Lower Granite Spillway - May 6th			
2022	3DD.003DEAB071	The Dalles North Ladder - October 11th	Lower Granite - October 22nd		Lower Granite Spillway - May 22nd			
2022	3DD.003DEA9DE6	The Dalles East Ladder - September 18th	Lower Granite - October 3rd		Lower Granite Spillway - May 4th			
2022	3DD.003DEAB308	The Dalles East Ladder - July 10th	Lower Granite - October 2nd		Lower Granite Spillway - May 4th			
2022	3DD.003DEAAD3C	The Dalles East Ladder - September 9th	Lower Granite - September 21st		Lower Granite Spillway - May 17th			

Table C2 (Continued).

Tag Year	Tag Number	First Detection After Tagging 2022 in All Seasons	Fall 2022	Winter 2022/23	Spring 2023	Summer 2023	Fall 2023	Comments
2022	3DD.003DEAA1B1	The Dalles East Ladder - October 6th	John Day - November 6th		The Dalles East Ladder - March 26th Lower Granite - April 20th Lower Granite Spillway - May 1st			
2022	3DD.003DEAAE8D	The Dalles East Ladder - October 15th	Lower Granite - October 26th		Lower SF Clearwater - March 12th Lower Granite Spillway - April 27th			
2022	3DD.003DEAADEA	The Dalles East Ladder - September 4th	Lower Granite - September 17th		Upper Selway (Clearwater) - March 22nd Lower Granite Spillway - May 10th			
2022	3DD.003DEAAD95	The Dalles North Ladder - September 6th	Lower Granite - September 26th		Upper Losche (Clearwater) - March 23rd Lower Granite Spillway - May 24th			
2022	3DD.003DEAA14A	The Dalles North Ladder - September 30th	Lower Granite - October 15th		Upper Losche (Clearwater) - March 22nd Lower Granite Spillway - May 23rd			
2022	3DD.003DEA9C5B	The Dalles North Ladder - September 13th	Lower Granite - October 2nd		Upper Losche (Clearwater) - March 15th Lower Granite Spillway - May 15th			
2022	3DD.003DEAA125	The Dalles East Ladder - September 29th	Lower Granite - October 10th		Lower SF Clearwater - March 13th Upper SF Clearwater - March 13th to April 22nd Lower Granite Spillway - April 26th			
2022	3DD.003DEAADFB	The Dalles East Ladder - July 31st	Lower Granite - August 29th		Joseph Creek (Grande Ronde) - April 1st Joseph Creek (Grande Ronde) - May 15th Lower Granite Spillway - May 18th			
2022	3DD.003DEAB6D7	The Dalles East Ladder - July 16th	Wells - October 13th		Lower Methow - April 2nd Rocky Reach Juvenile Bypass - April 25th			
2022	3DD.003DEAAB5E	The Dalles East Ladder - August 27th	Wells - September 18th			Rocky Reach Juvenile Bypass - June 2nd		
2022	3DD.003D4FF241	The Dalles East Ladder - August 9th	Middle Okanagan - September 24th		Omak Creek (Okanagan) - March 23rd to April 29th Rocky Reach Juvenile Bypass - May 4th			
2022	3DD.003D368600	The Dalles East Ladder - August 31st	Lower Methow - October 3rd		Middle Methow - March 20th Twisp (Methow) - April 9th to April 26th Rocky Reach Juvenile Bypass - May 31st			
2022	3DD.003DEAB0DC	The Dalles East Ladder - July 10th	Wells - August 15th		Lower Methow - April 1st Gold Creek (Methow) - April 19th to 25th Rocky Reach Juvenile Bypass - May 3rd			
2022	3DD.003DEAB09C	The Dalles East Ladder - September 6th	Wells - November 7th		Wells Hatchery (volunteer channel) - April 20th to May 2nd Rocky Reach Juvenile Bypass - May 3rd			Steelhead captured at Bonneville on July 15th, 2022, where it was between July and September is unknown.
2022	3DD.003DEAB09F	The Dalles North Ladder - July 18th	McNary- November 8th	Prosser Dam (Yakima) - January 6th	Ahtanum Creek (Yakima) - March 20th to April 23rd Sunnyside Dam Juvenile Bypass (Yakima) - April 24th			
2022	3DD.003DEAADFF	The Dalles East Ladder - September 4th	Prosser Dam (Yakima) - September 11th		Roza Dam (Yakima) - March 17th Lower Teanaway (Yakima) - March 23rd Lower Teanaway (Yakima) - April 28th			
2022	3DD.003DEAAB44	The Dalles East Ladder - September 15th	Lower Wenatchee - September 29th		Mission Creek (Wenatchee) - March 21st Mission Creek (Wenatchee) - May 23rd			
2022	3DD.003DEAAB6B	The Dalles East Ladder - September 4th	Lower Okanagan - September 29th		Zosel Dam (Okanagan) - April 10th Tonasket Creek (Okanagan) - April 14th to 24th Zosel Dam (Okanagan) - April 25th			
2022	3DD.003DEAB021	The Dalles East Ladder - July 23rd	Lower Deschutes - September 20th		Lower Warm Springs - April 3rd Middle Warm Springs - April 22nd to 28th Lower Warm Springs - May 17th			Steelhead may have entered the Deschutes for a few months before heading in the Warm Springs.
2022	3DD.003DEAAB4E	The Dalles East Ladder - September 17th	Threemile Dam (Umatilla) - November 7th		Threemile Dam (Umatilla) - May 27th			
2022	3DD.003DEAAE1B	The Dalles East Ladder - October 16th	John Day - October 20th		Threemile Dam (Umatilla) - March 15th Threemile Dam (Umatilla) - May 11th			
2022	3DD.003DEAB252	The Dalles East Ladder - October 4th	McNary - October 9th		Middle Touchet (Walla Walla) - March 18th Upper Touchet (Walla Walla) - March 20th to April 1st Lower Walla Walla - April 16th			
2022	3DD.003D459000	The Dalles East Ladder - September 6th	Lower Walla Walla River - October 15th	Lower Touchet (Walla Walla) - February 6th Middle Touchet (Walla Walla) - February 20th	Upper Touchet (Walla Walla) - March 30th to April 1st Lower Walla Walla - April 18th			
2022	3DD.003DEAAB45	The Dalles North Ladder - August 13th	Little Goose - October 27th		Middle Touchet (Walla Walla) - March 3rd Upper Touchet (Walla Walla) - March 16th to 21st Lower Touchet (Walla Walla) - April 11th			
2022	3DD.003DEAAEA9	The Dalles North Ladder - October 15th	McNary - October 20th		Lower Touchet (Walla Walla) - March 19th Upper Touchet (Walla Walla) - March 28th to April 19th Lower Touchet (Walla Walla) - April 24th			
2022	3DD.003DEAA0F7	The Dalles East Ladder - October 9th	Lower Monumental - October 24th		Lower Tucannon - March 19th Middle Tucannon - March 20th Lower Tucannon - April 4th			
2022	3DD.003D3414C3	The Dalles East Ladder - September 29th	Lower Granite - October 16th	Lower SF Clearwater - January 15th	Lower SF Clearwater - May 6th			
2022	3DD.0077D827A1	The Dalles East Ladder - September 18th	Lower Granite - October 5th	Lower SF Clearwater - January 12th	Lower SF Clearwater - April 3rd			
2022	3DD.003DEAAD05	The Dalles East Ladder - October 20th	Lower Granite - October 31st		Lower SF Clearwater - March 16th Lower SF Clearwater - April 24th			
2022	3DD.003DEAAB2A	The Dalles East Ladder - September 24th	Lower Granite - November 9th		Lower SF Clearwater - March 8th Lower SF Clearwater - April 24th			

Table C2 (Continued).

Tag Year	Tag Number	First Detection After Tagging 2022 in All Seasons	Fall 2022	Winter 2022/23	Spring 2023	Summer 2023	Fall 2023	Comments
2022	3DD.003DEAB6AE	The Dalles East Ladder - July 22nd	Lower Granite - October 3rd		Middle Wenaha (Grande Ronde) - March 12th Lower Wenaha (Grande Ronde) - April 6th			
2022	3DD.003DEAAB41	The Dalles North Ladder - August 24th	Lower Granite - September 10th		Joseph Creek (Grande Ronde) - April 2nd Joseph Creek (Grande Ronde) - April 9th			
2022	3DD.003DEAAAAD	The Dalles East Ladder - September 23rd	Lower Granite - October 5th		Upper Grande Ronde - April 22nd Lower Granite Juvenile Bypass - May 16th			Steelhead recaptured at Bonneville AFF on September 20th, 2022. Steelhead was recaptured/retained on May 18th, 2022 at Lower Granite 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 2022 and labeled later as kelts or repeat spawners when they began migrating downstream (before April 1st) and upstream in spring, summer, or fall 2023, presumably to and from the ocean.

Tag Year	Tag Number	First Detection After Tagging 2022 in All Seasons	Fall 2022	Winter 2022/23	Spring 2023	Summer 2023	Fall/Winter 2023	Comments
2022	3DD.003DEAB698	The Dalles East Ladder - September 1st	Lower Granite - September 21st		Lower Granite Spillway - March 1st			
2022	3DD.003DEAADBB	The Dalles East Ladder - September 7th	Lower Granite - October 25th		Lower Granite Spillway - March 19th			

Key - - - Upstream | Downstream | Spawning

Table C4. Season by season activities of steelhead tagged in past years 2021, 2020, and 2019 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 the Following Year	Fall	Winter	Spring	Comments
2021	3DD.003D82A75C	The Dalles East Ladder - September 14th, 2021	Lower Monumental - September 24th, 2021	Middle Tucannon - January 20th, 2022	Upper Tucannon - March 7th to 15th, 2022 Lower Monumental Juvenile - March 25th, 2022	Steelhead likely spent several months in the ocean in 2022 before returning to spawn again. New movements.
		Bonneville Ladders - August 23rd, 2022	Lower Monumental - October 3rd, 2022	Middle Tucannon - January 8th, 2023	Upper Tucannon - March 13th to 17th, 2023 Lower Monumental Juvenile - March 25th, 2023	
2021	3DD.003D82A289	Lyle Fish Way (Klickitat) - June 7th, 2021 Lyle Fish Way (Klickitat) - June 5th, 2023			Little Klickitat - March 1st to March 25th, 2022	Steelhead was tagged at Bonneville on June 2nd, 2021. Went to the ocean for a year before returning. New kelt.
2021	3DD.003D829C57	The Dalles East Ladder - September 3rd, 2021	Lower Granite - October 6th, 2021			Steelhead recaptured at Bonneville AFF on September 1st, 2021. Steelhead was recaptured/retained 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. New movements.
		Lower Granite Juvenile Bypass - June 20th, 2022			Big Creek (Salmon) - May 16th, 2022 Big Creek (Salmon) - May 28th, 2023	
2020	3DD.003D53A9D9	The Dalles North Ladder - August 15, 2020	Wells - September 2, 2020		Loup Loup Creek (Okanagan) - April 15, 2021 Loup Loup Creek (Okanagan) - April 25, 2023	Steelhead likely spent a year in the ocean before returning. New kelt. Repeat Spawner.

Key - - - Upstream | Downstream | Spawning

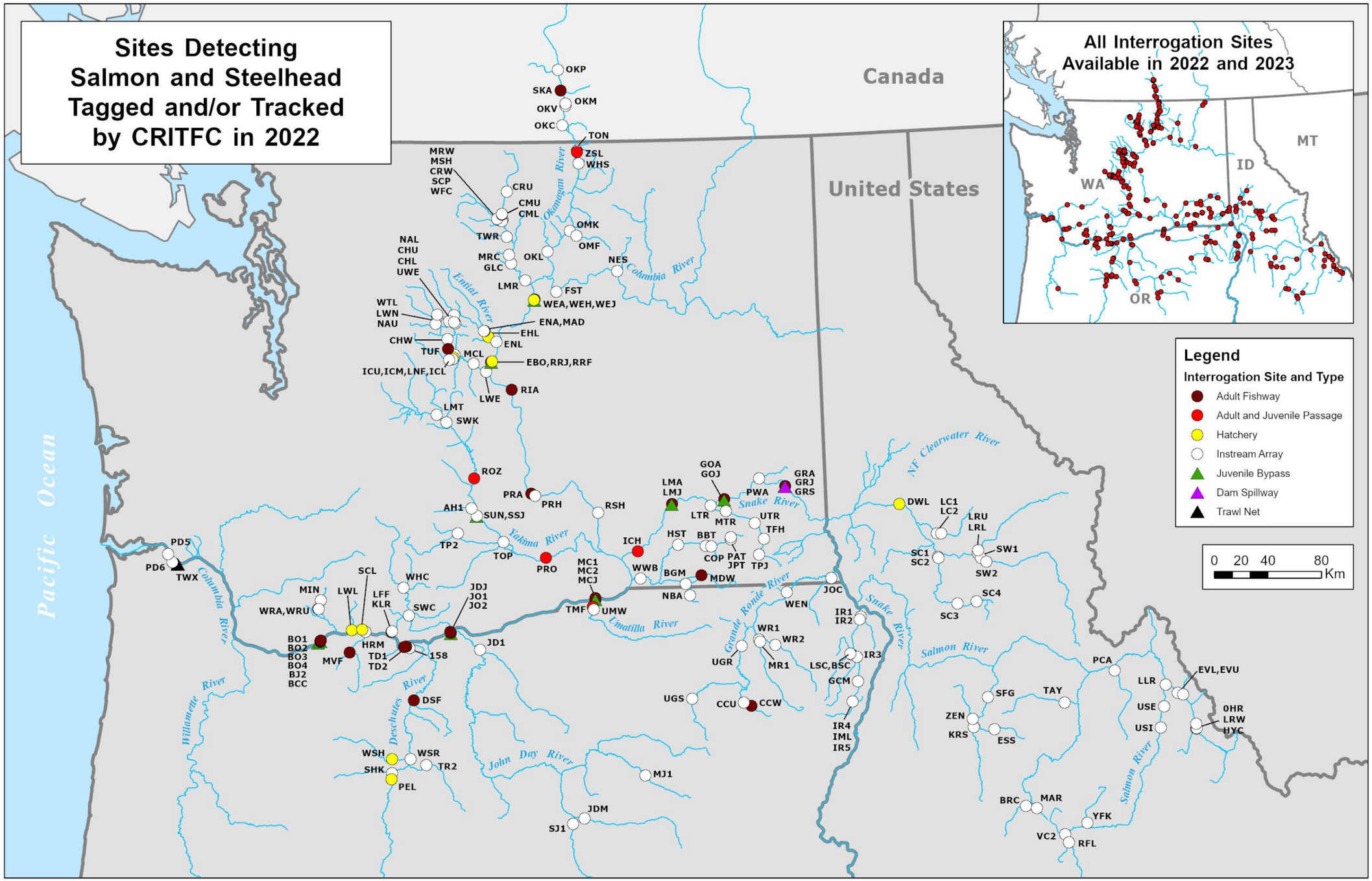


Figure C1. Map of Columbia River interrogation sites that detected Chinook and Sockeye salmon, and steelhead in 2022. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

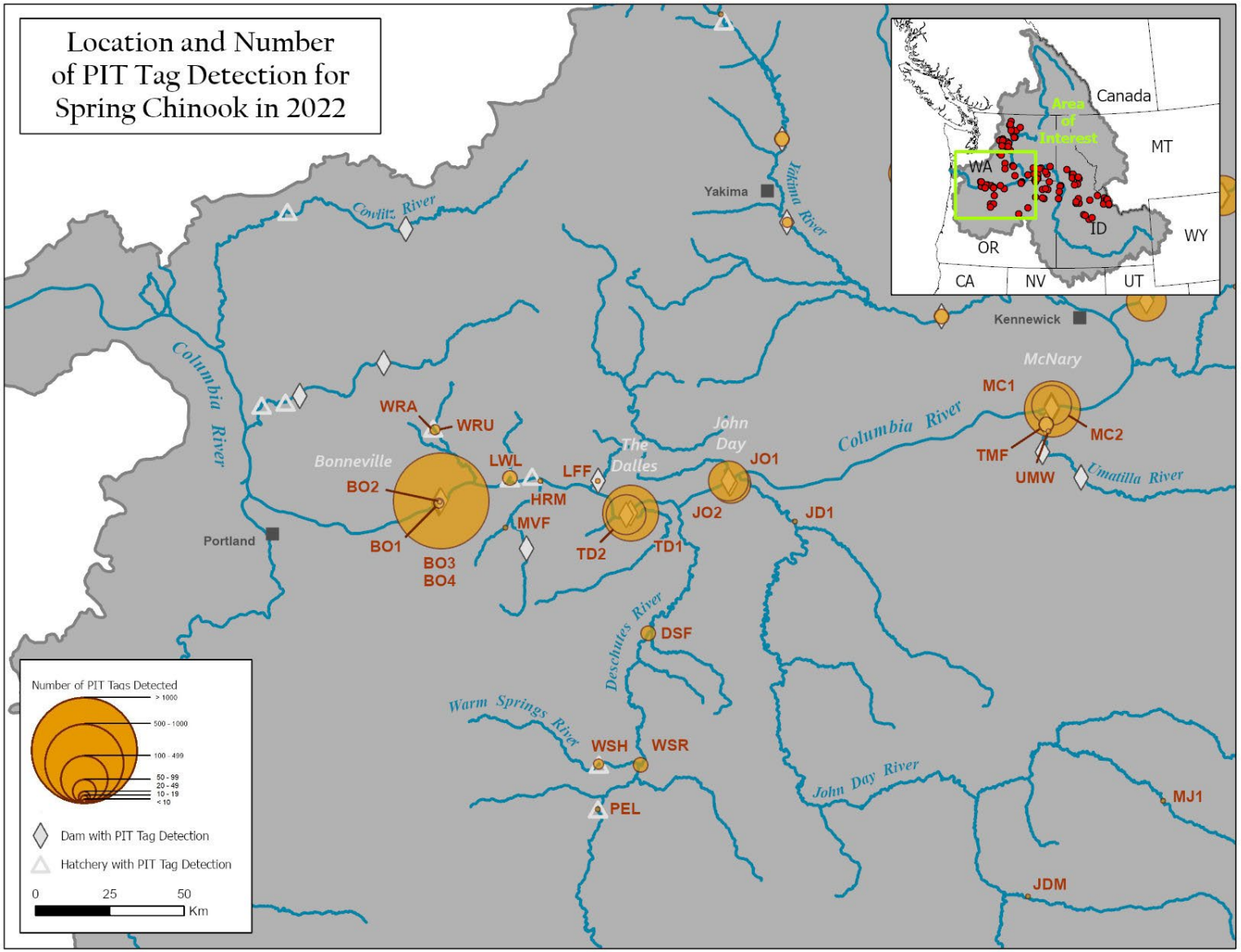


Figure C2. Map of Lower Columbia River detection sites (below Snake River) and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June 1.

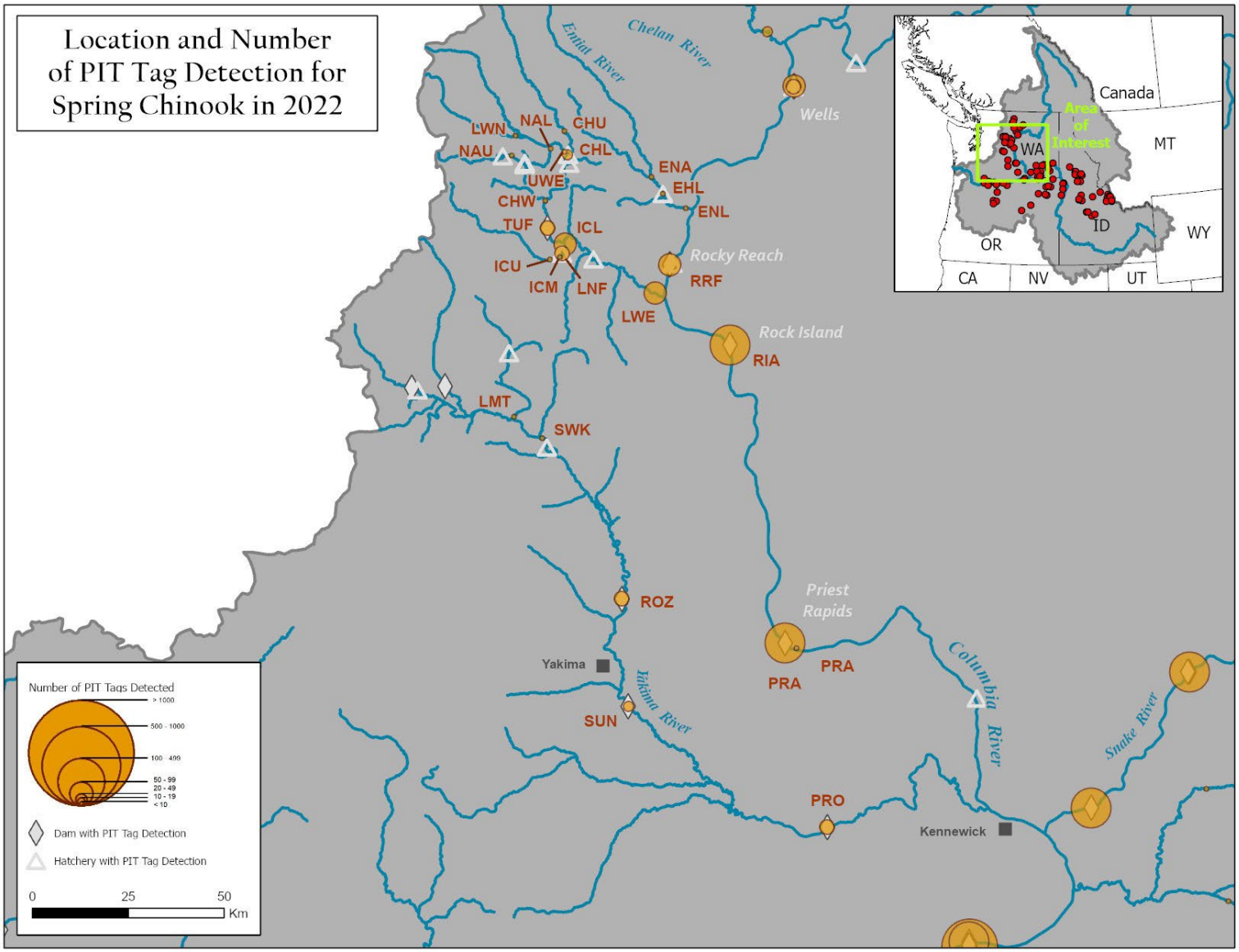


Figure C3. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January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

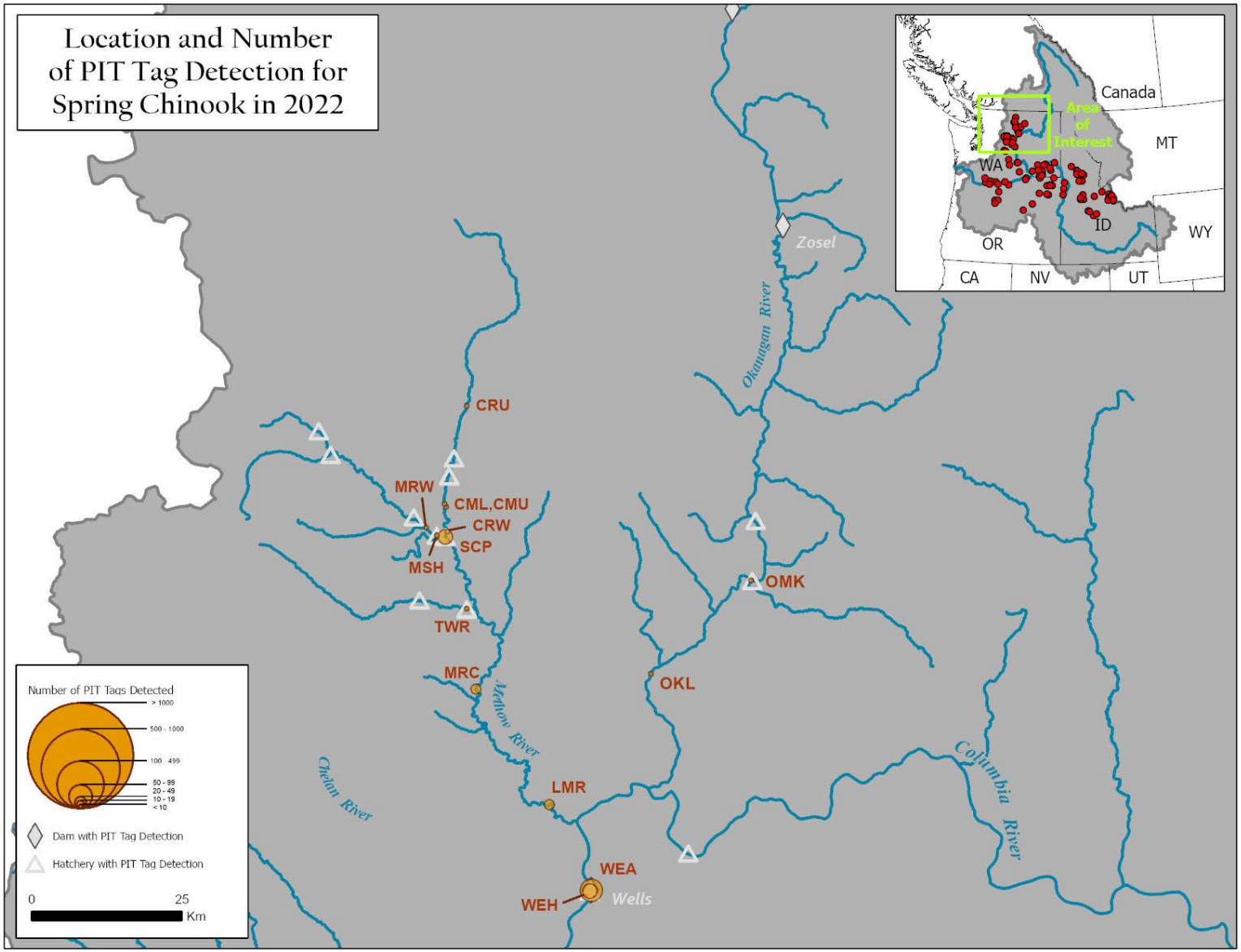


Figure C4. Map of Upper Columbia River (Wells Dam and above) detection sites and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June 1.

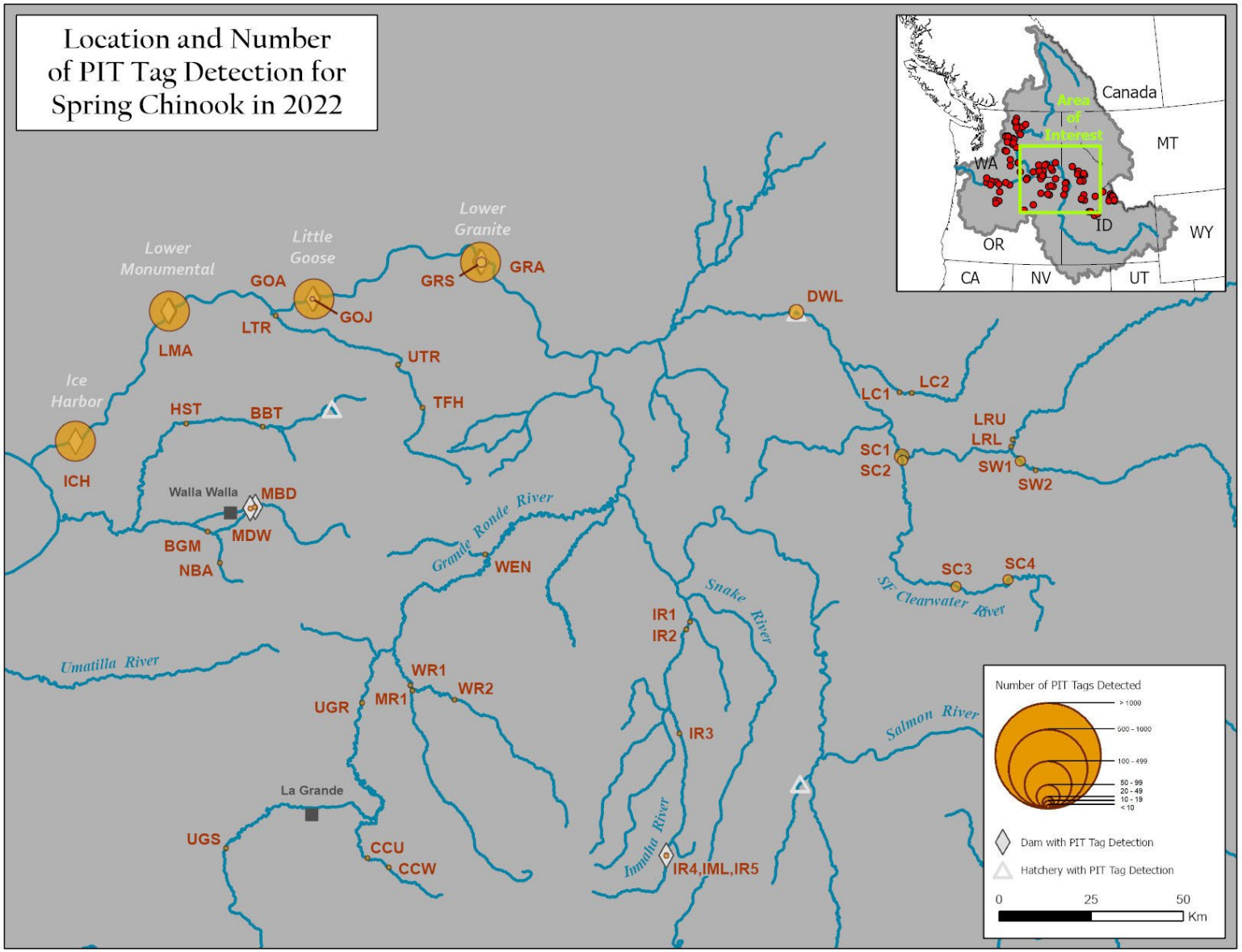


Figure C5. Map of Lower Snake River detection sites (Salmon River not included) and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June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

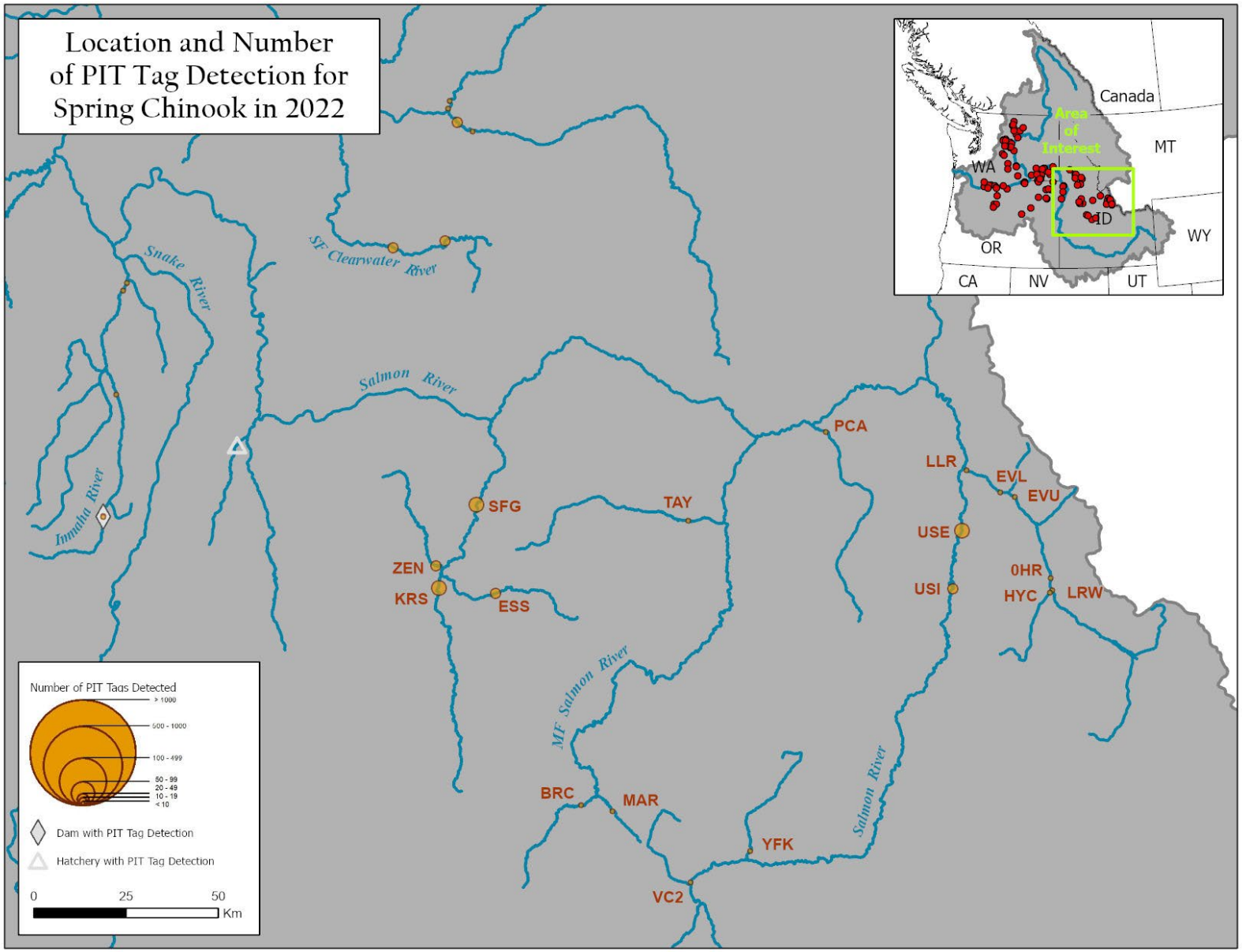


Figure C6. Map of Salmon River detection sites and number of spring Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Spring Chinook is defined as fish passing Bonneville Dam from January 1 to June 1.

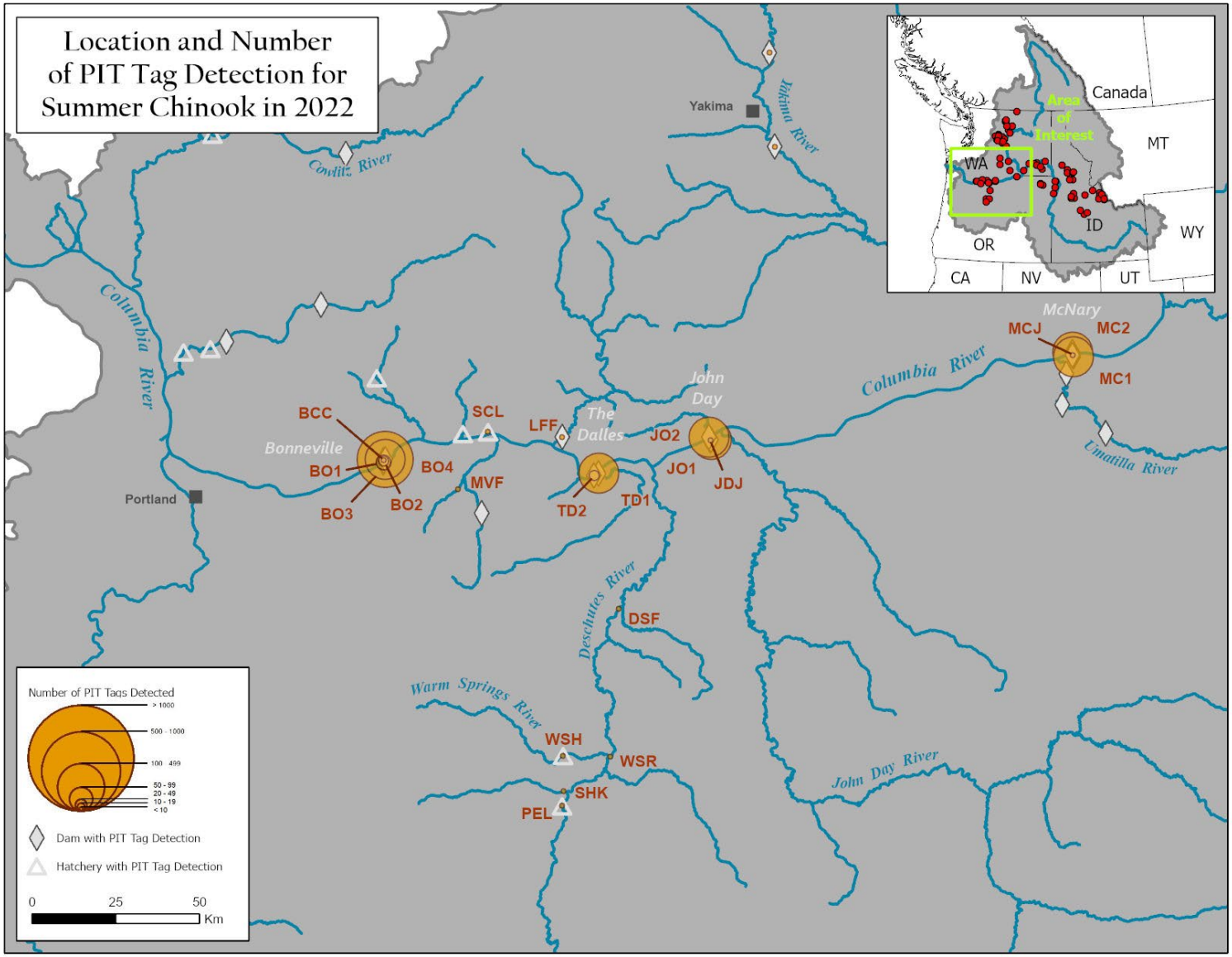


Figure C7. Map of Lower Columbia River detection sites (below Snake River) and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August 1.

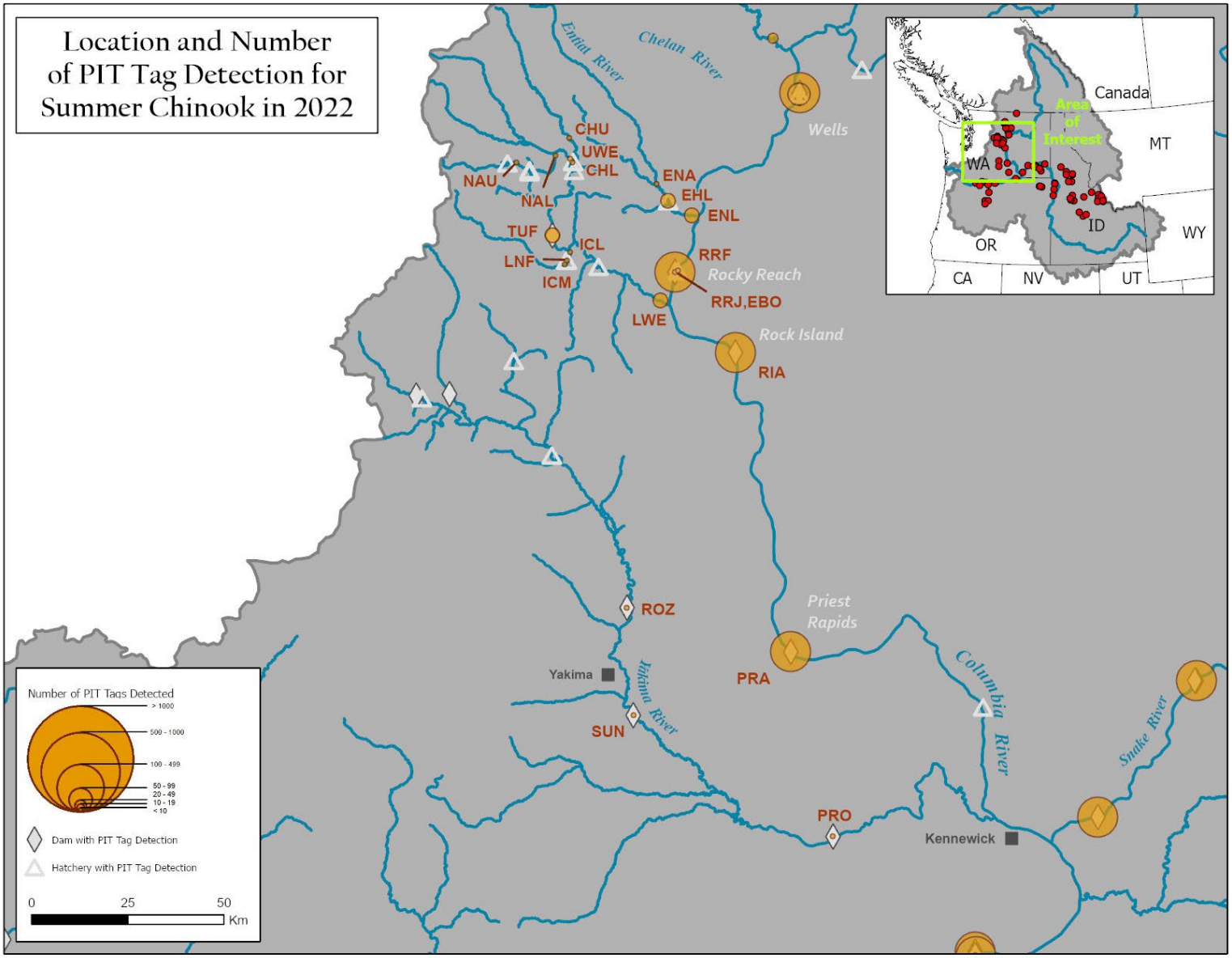


Figure C8. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June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

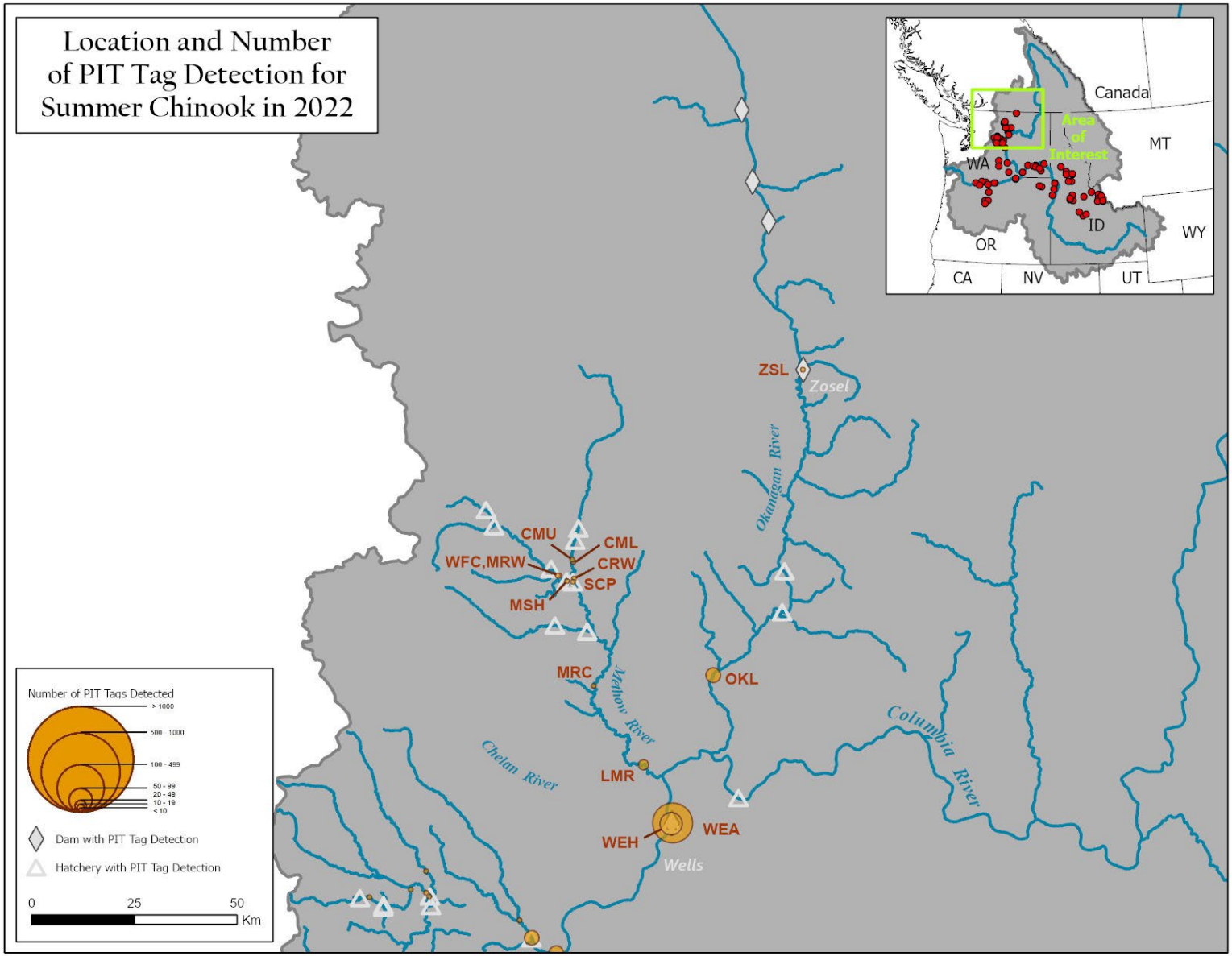


Figure C9. Map of Upper Columbia River (Wells Dam and above) detection sites and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August 1.

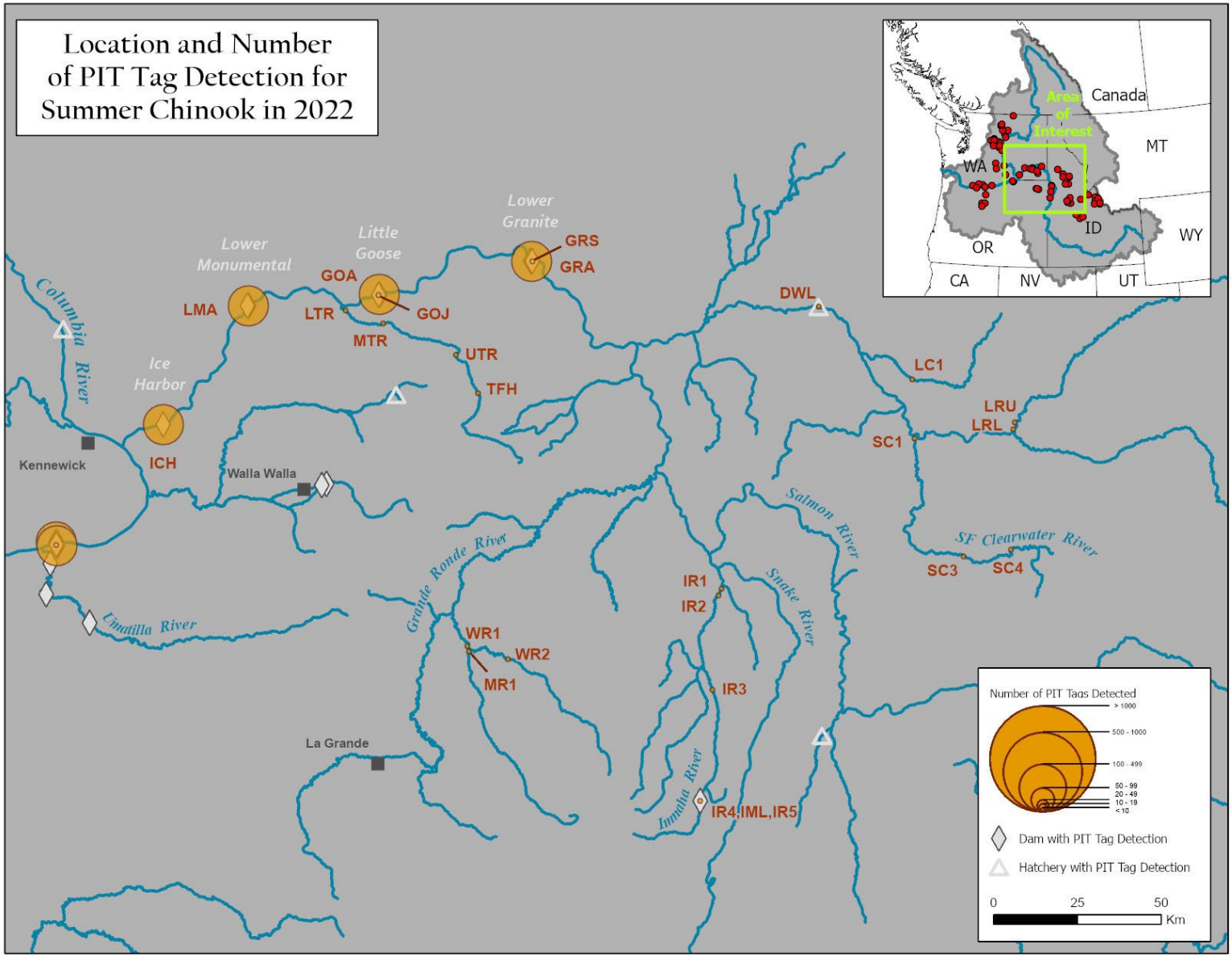


Figure C10. Map of Lower Snake River detection sites (Salmon River not included) and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August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

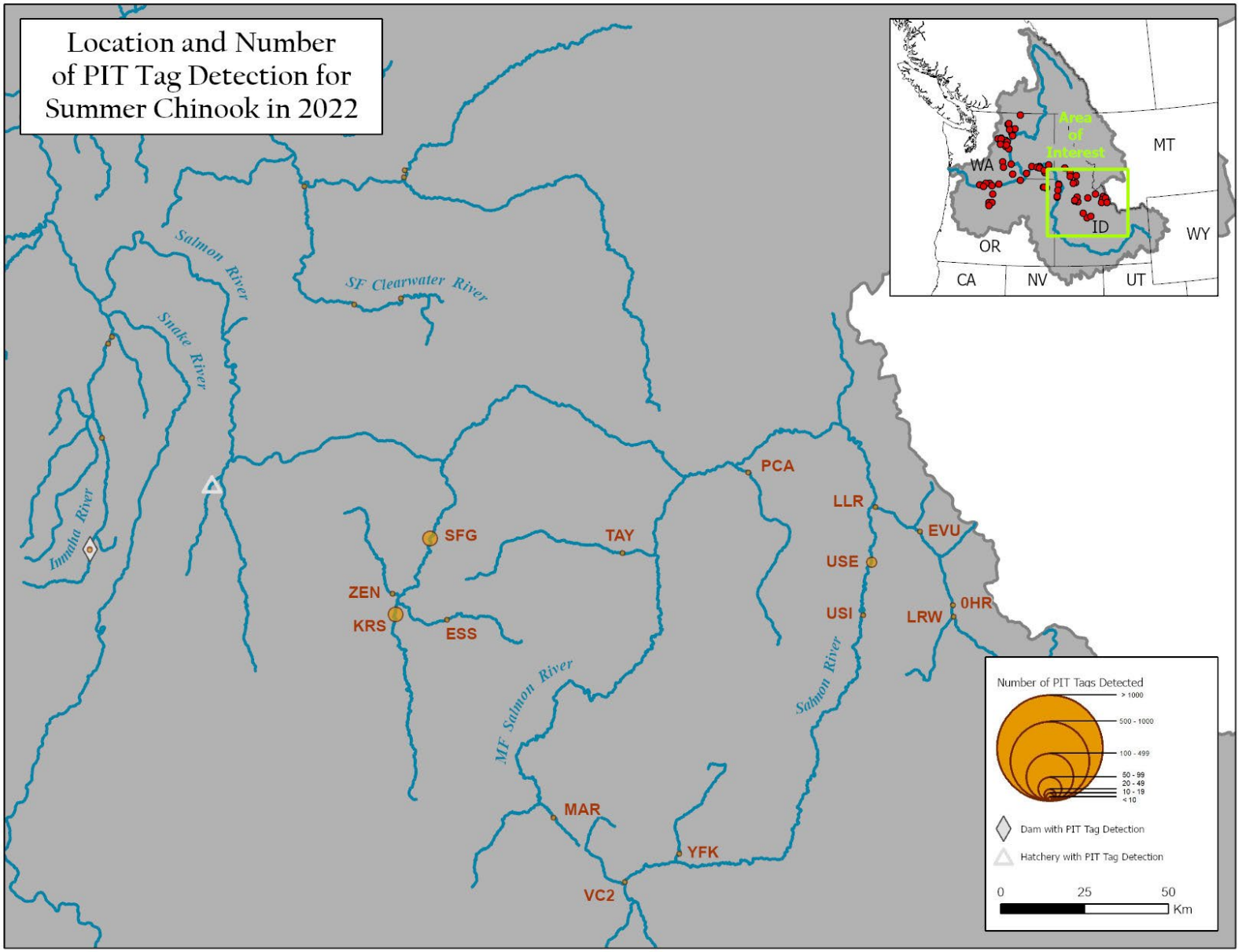


Figure C11. Map of Salmon River detection sites and number of summer Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Summer Chinook is defined as fish passing Bonneville Dam from June 1 to August 1.

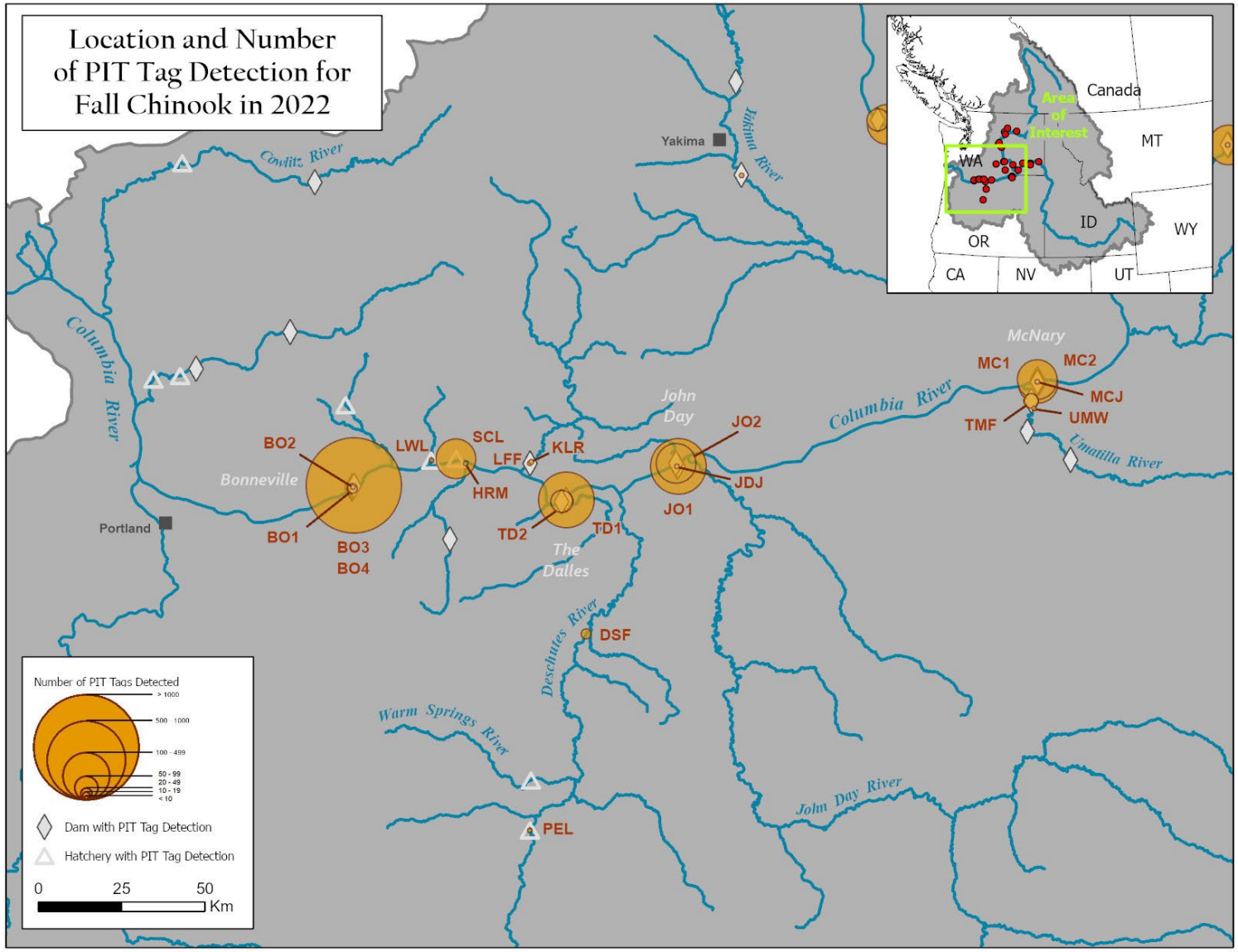


Figure C12. Map of Lower Columbia River detection sites (below Snake River) and number of fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Fall Chinook is defined as fish passing Bonneville Dam from August 1 to end of year.

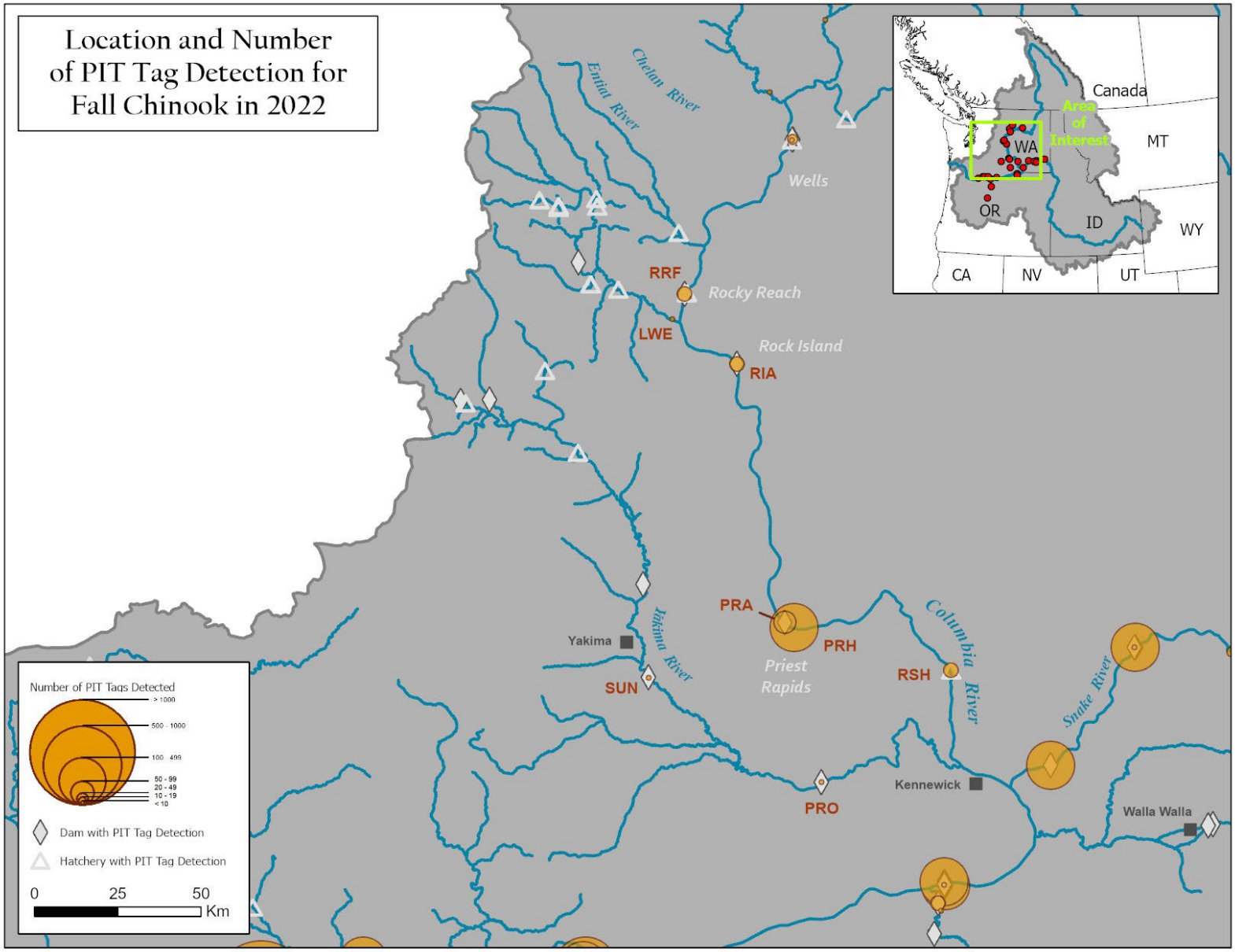


Figure C13. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

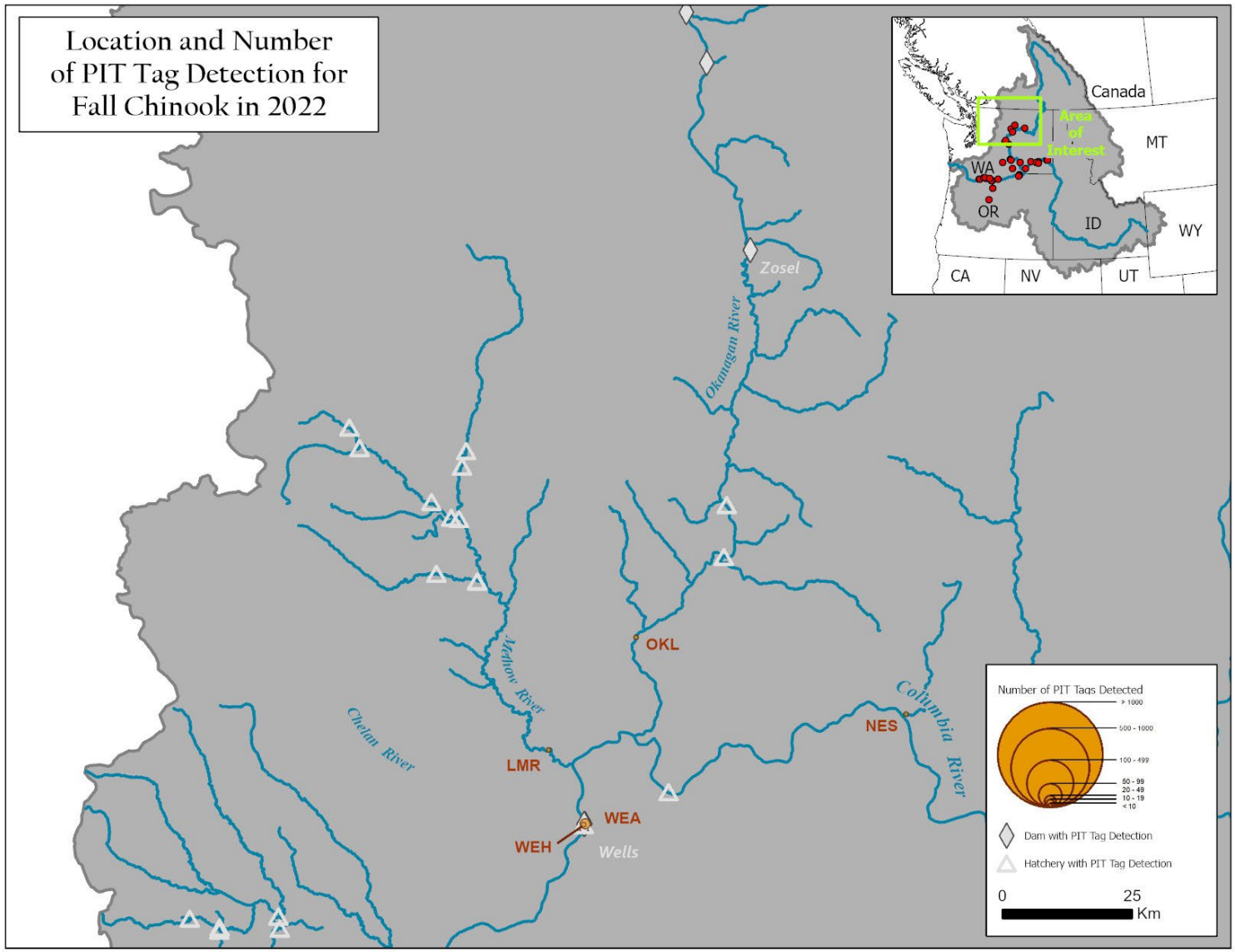


Figure C14. Map of Upper Columbia River detection sites (Wells Dam and above) and number of fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Fall Chinook is defined as fish passing Bonneville Dam from August 1 to end of year.

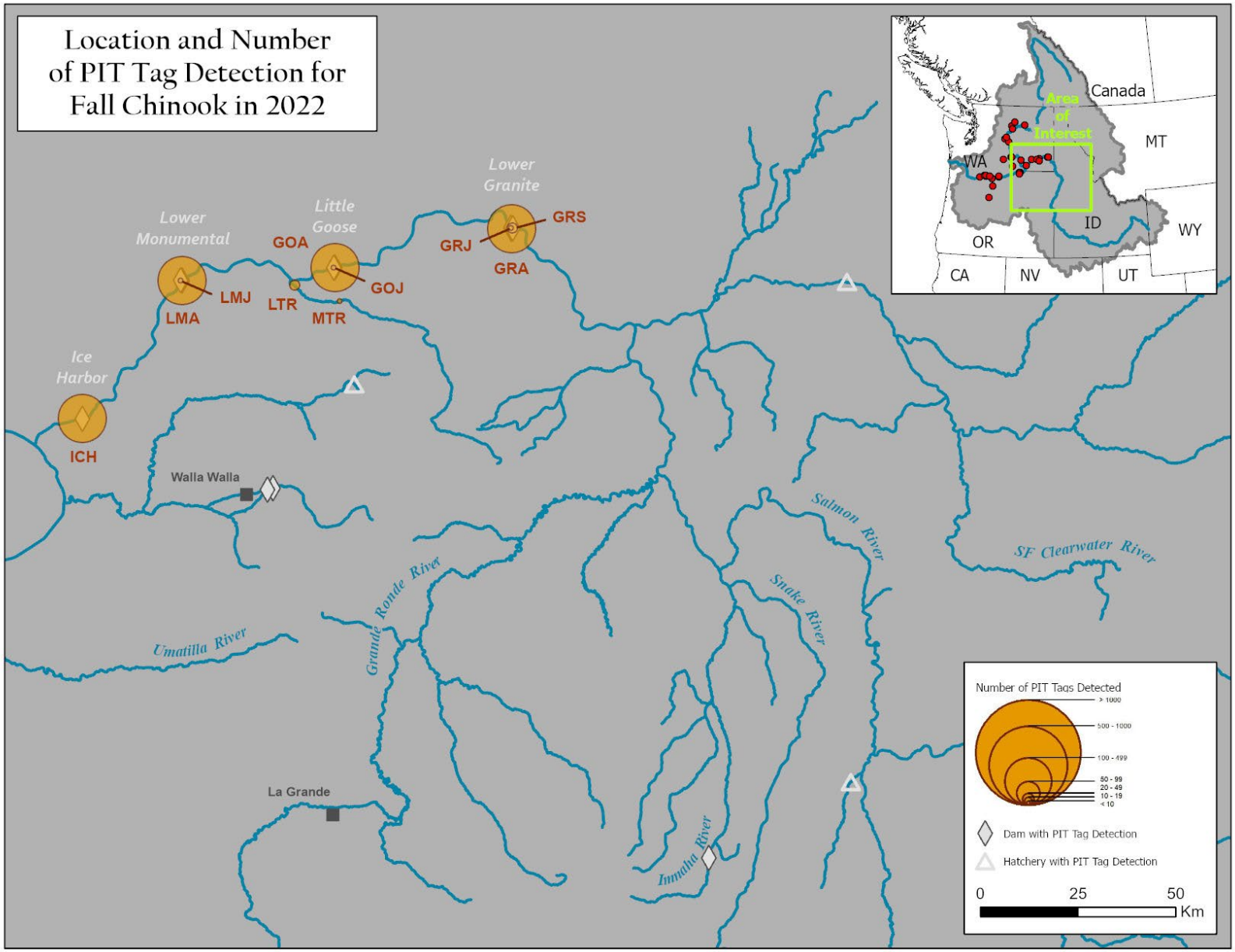


Figure C15. Map of Lower Snake River detection sites and number of fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Fall Chinook is defined as fish passing Bonneville Dam from August 1 to end of year.

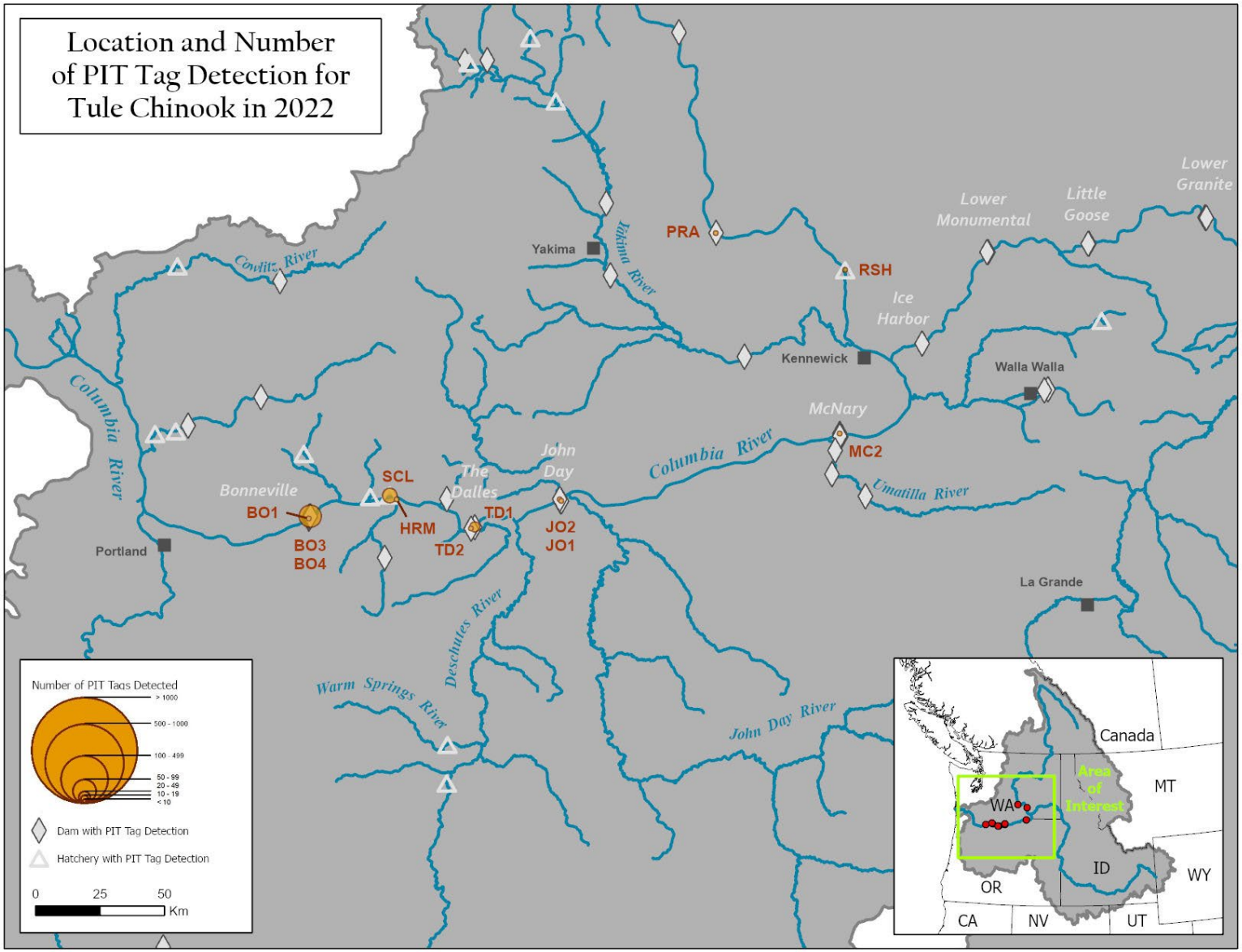


Figure C16. Map of Lower Columbia and Snake rivers detection sites and number of Tule fall Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Tule Chinook are defined as dark spawning mature fish passing Bonneville Dam near the end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

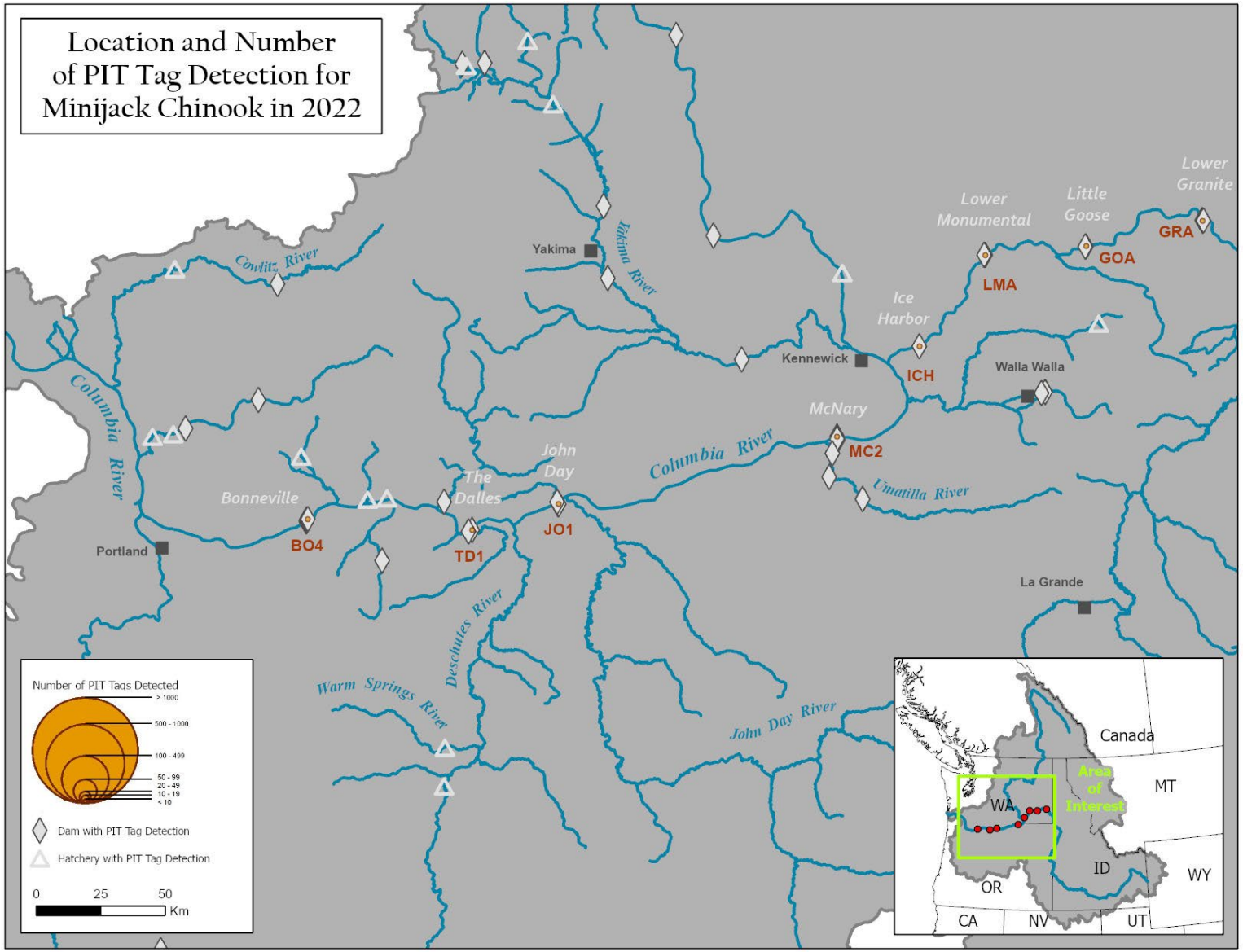


Figure C17. Map of Lower Columbia and Snake rivers detection sites and number of minijack Chinook Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map. Minijack Chinook are defined as early-maturing small chinook that have spent little to no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

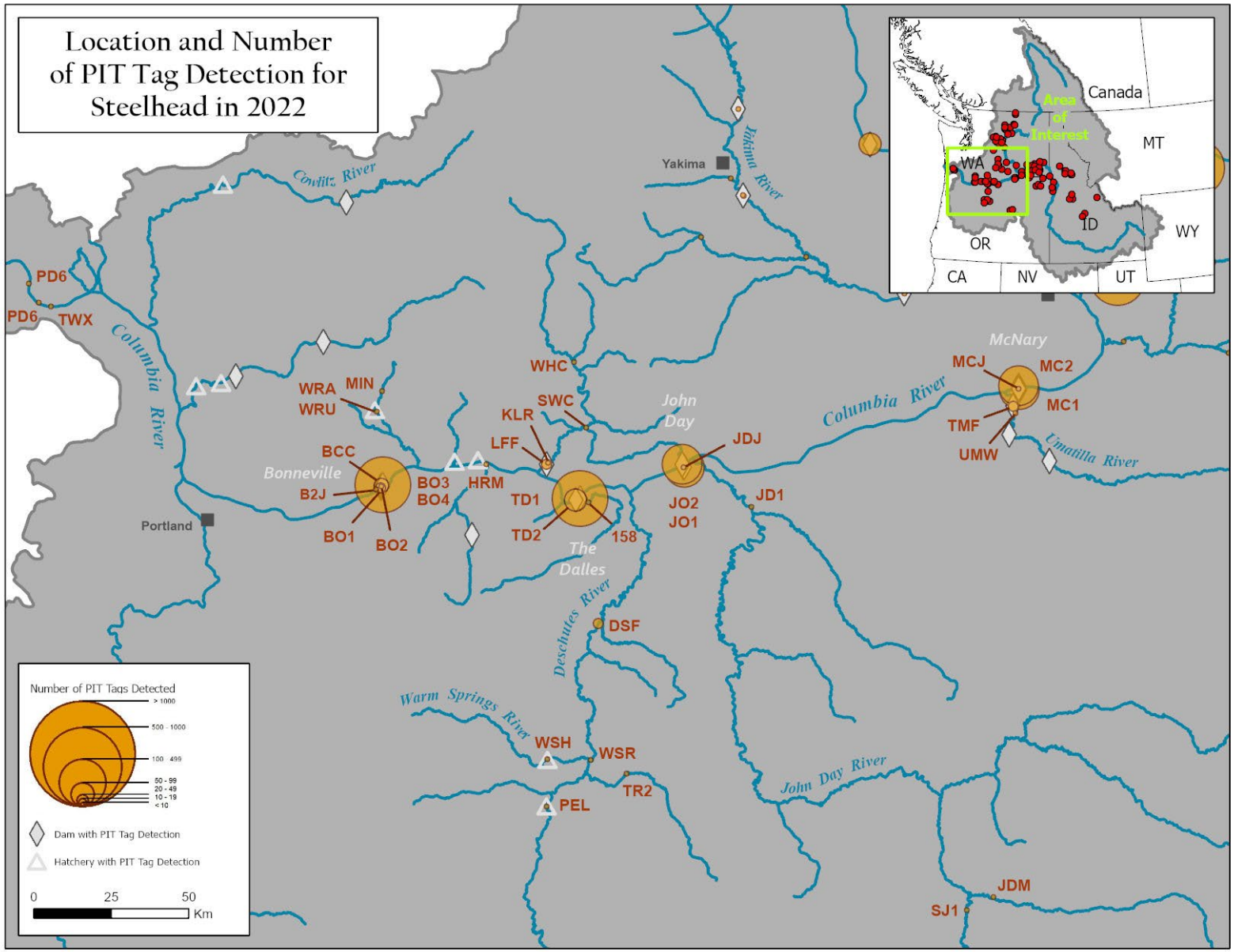


Figure C18. Map of Lower Columbia River detection sites (below Snake River) and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

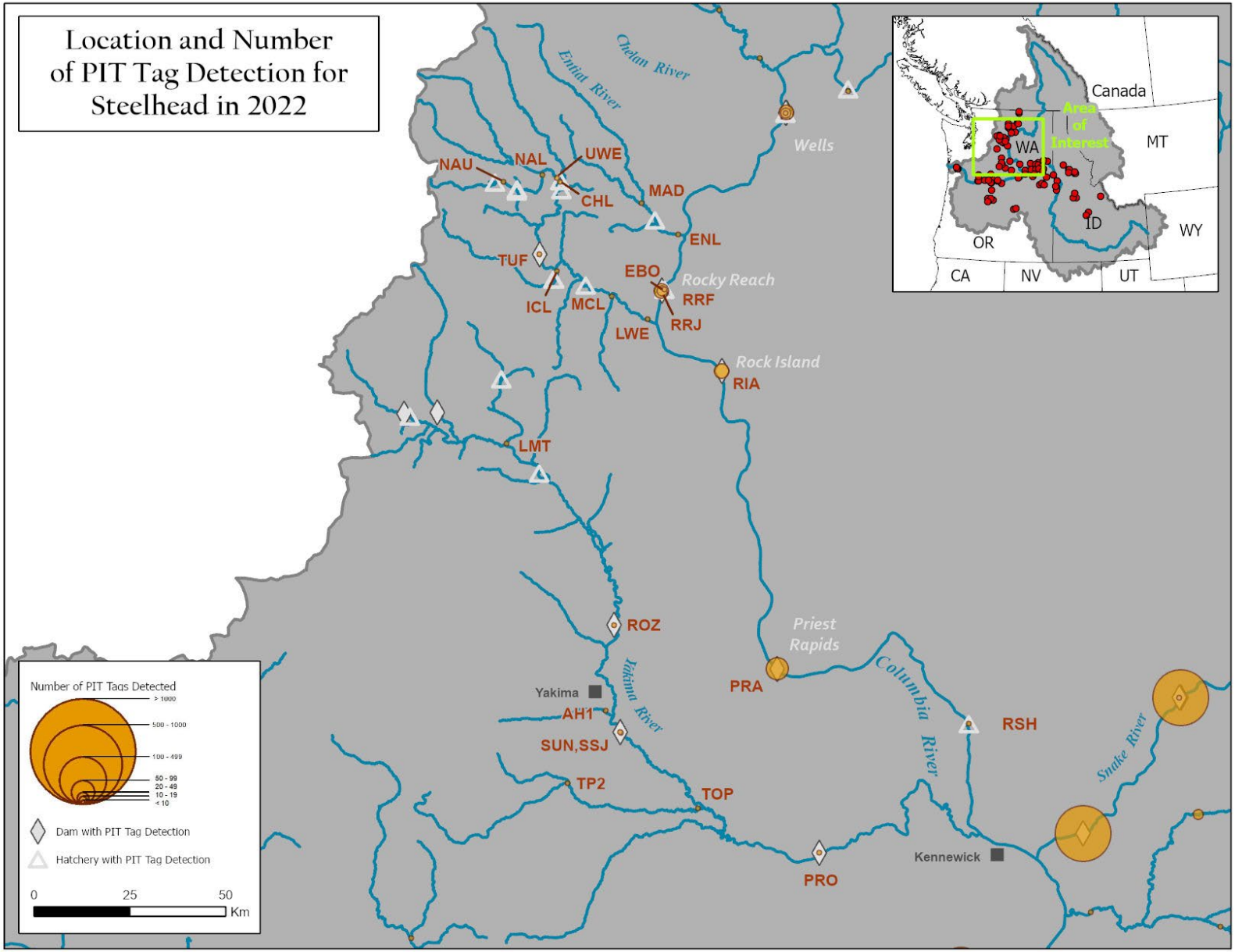


Figure C19. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

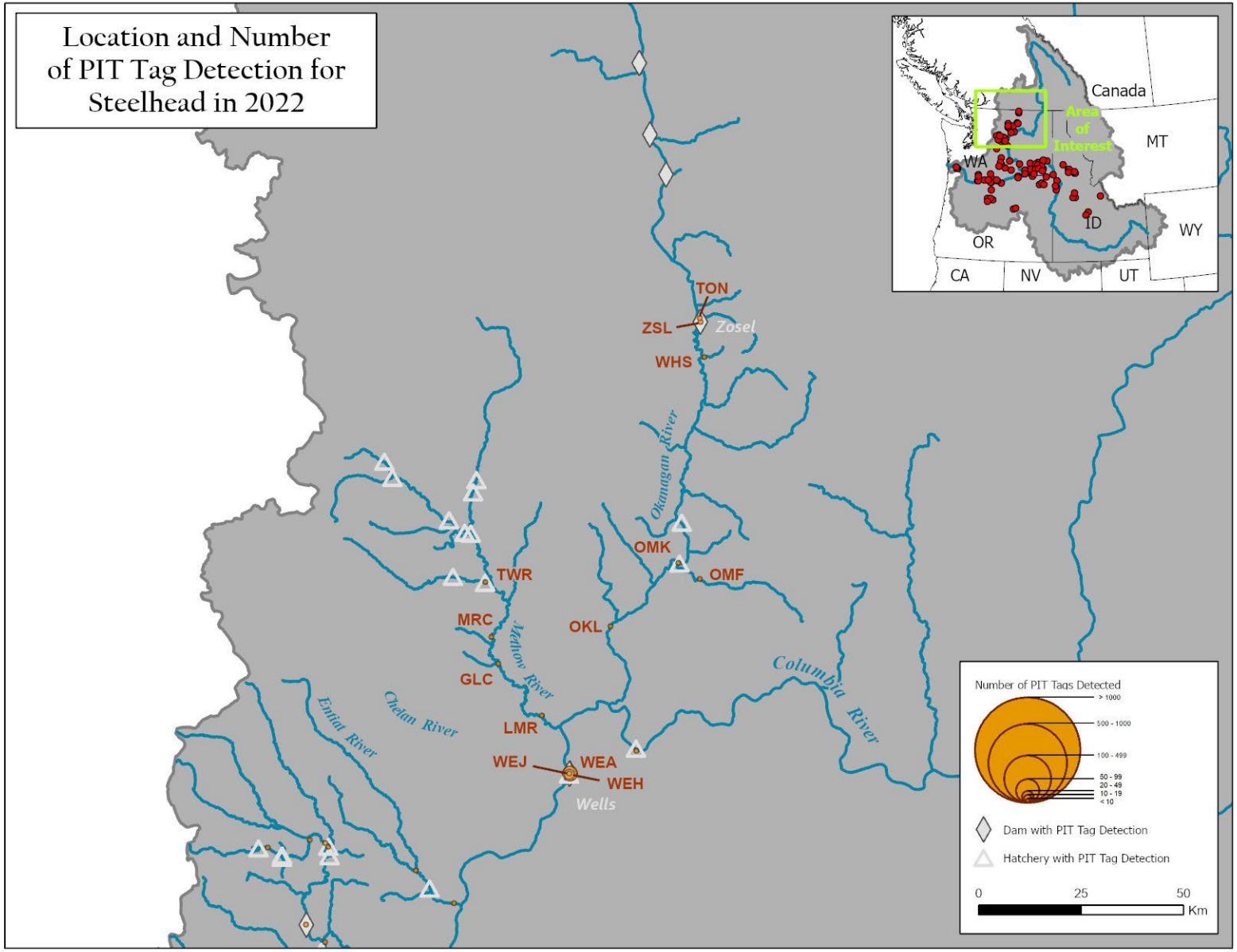


Figure C20. Map of Upper Columbia River (Wells Dam and above) detection sites and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

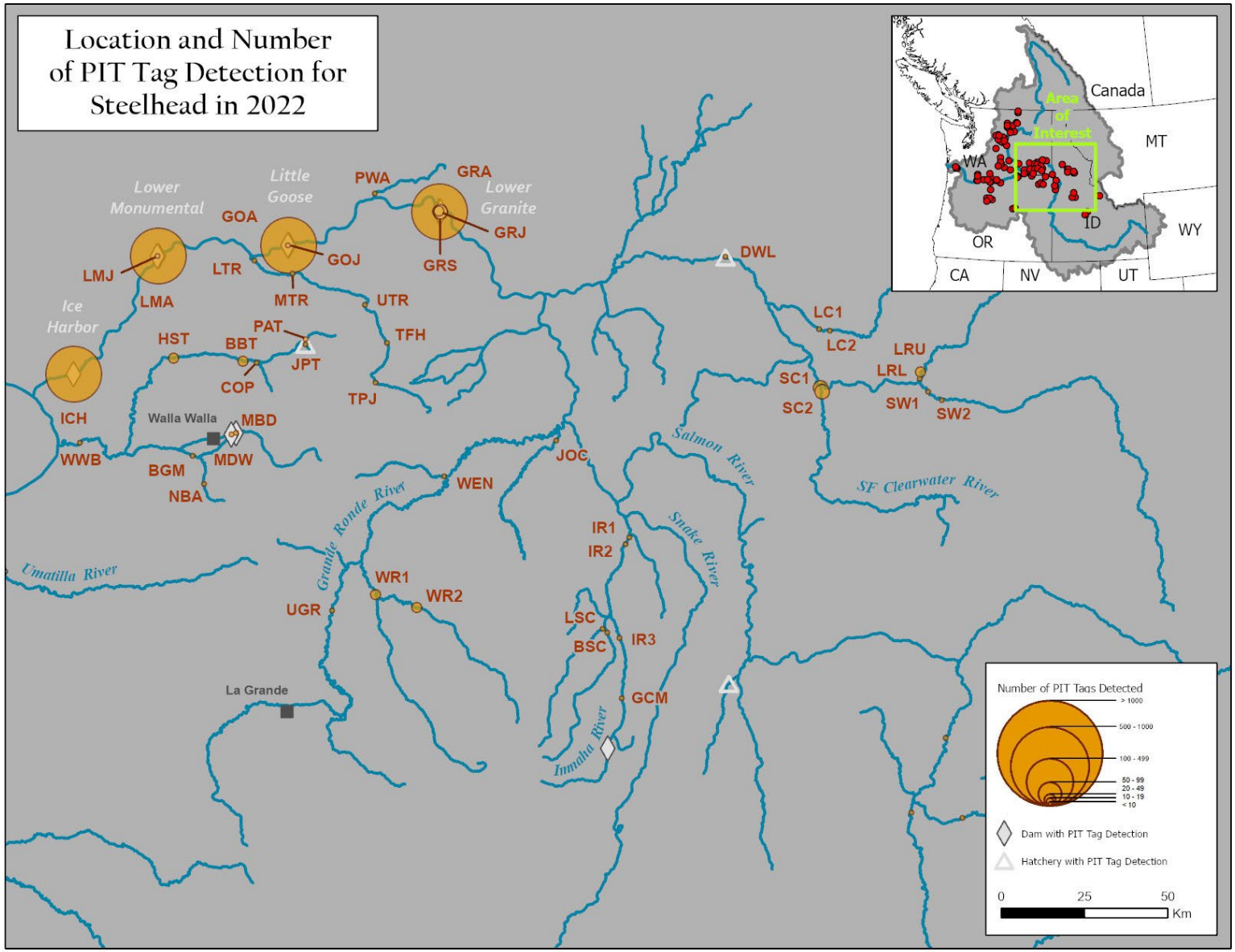


Figure C21. Map of Lower Snake River detection sites (Salmon River not included) and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

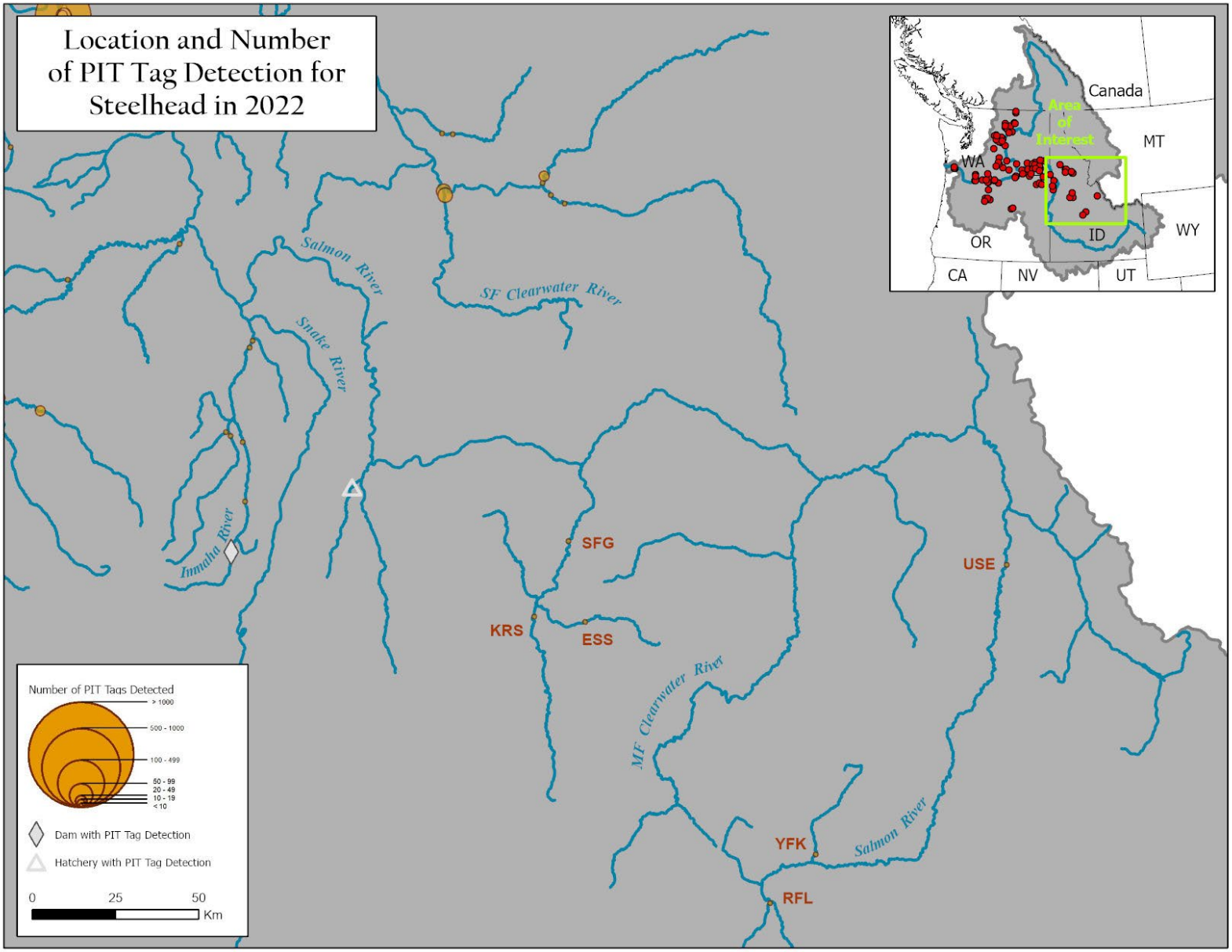


Figure C22. Map of Salmon River detection sites and number of steelhead detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

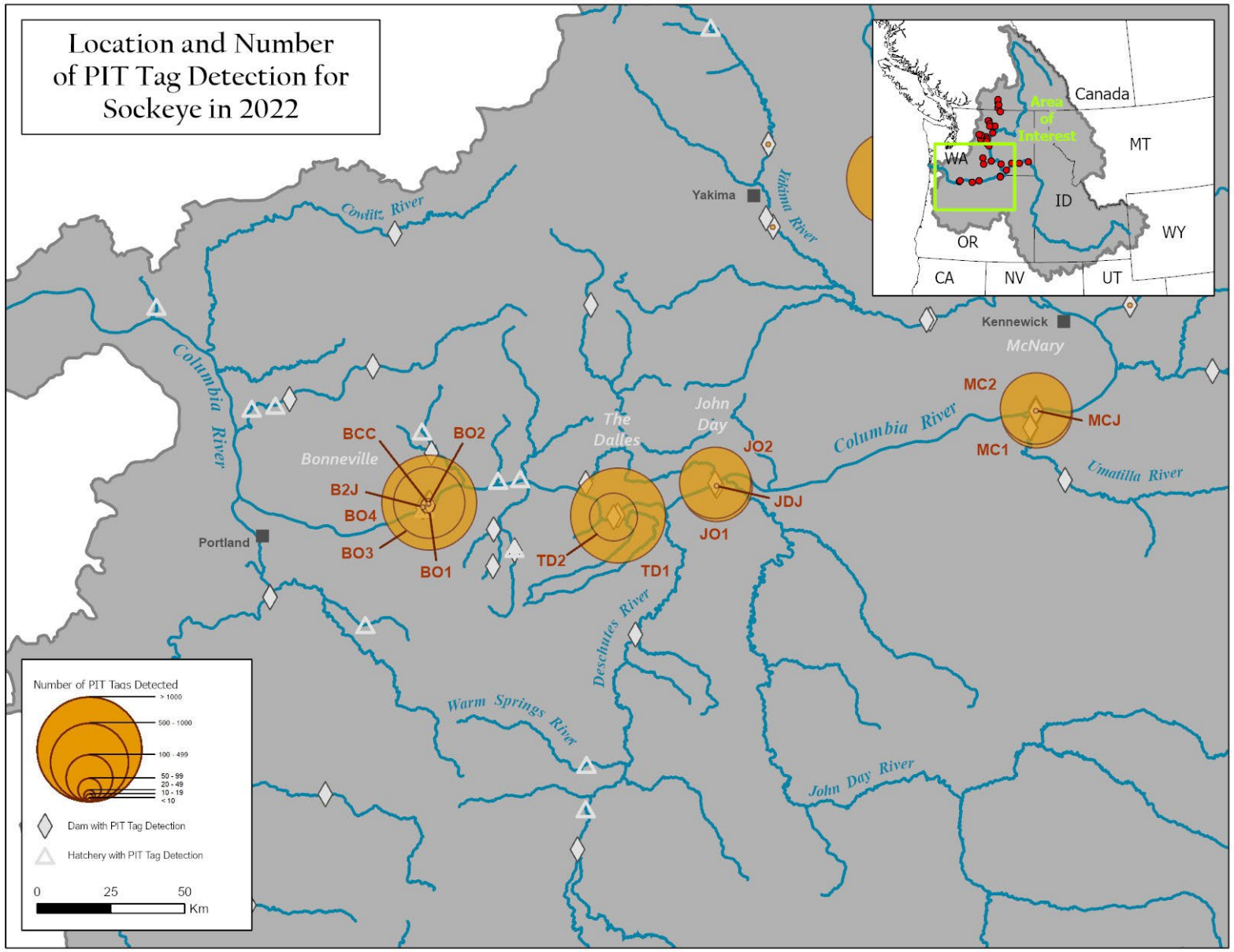


Figure C23. Map of Lower Columbia River detection sites (below Snake River) and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

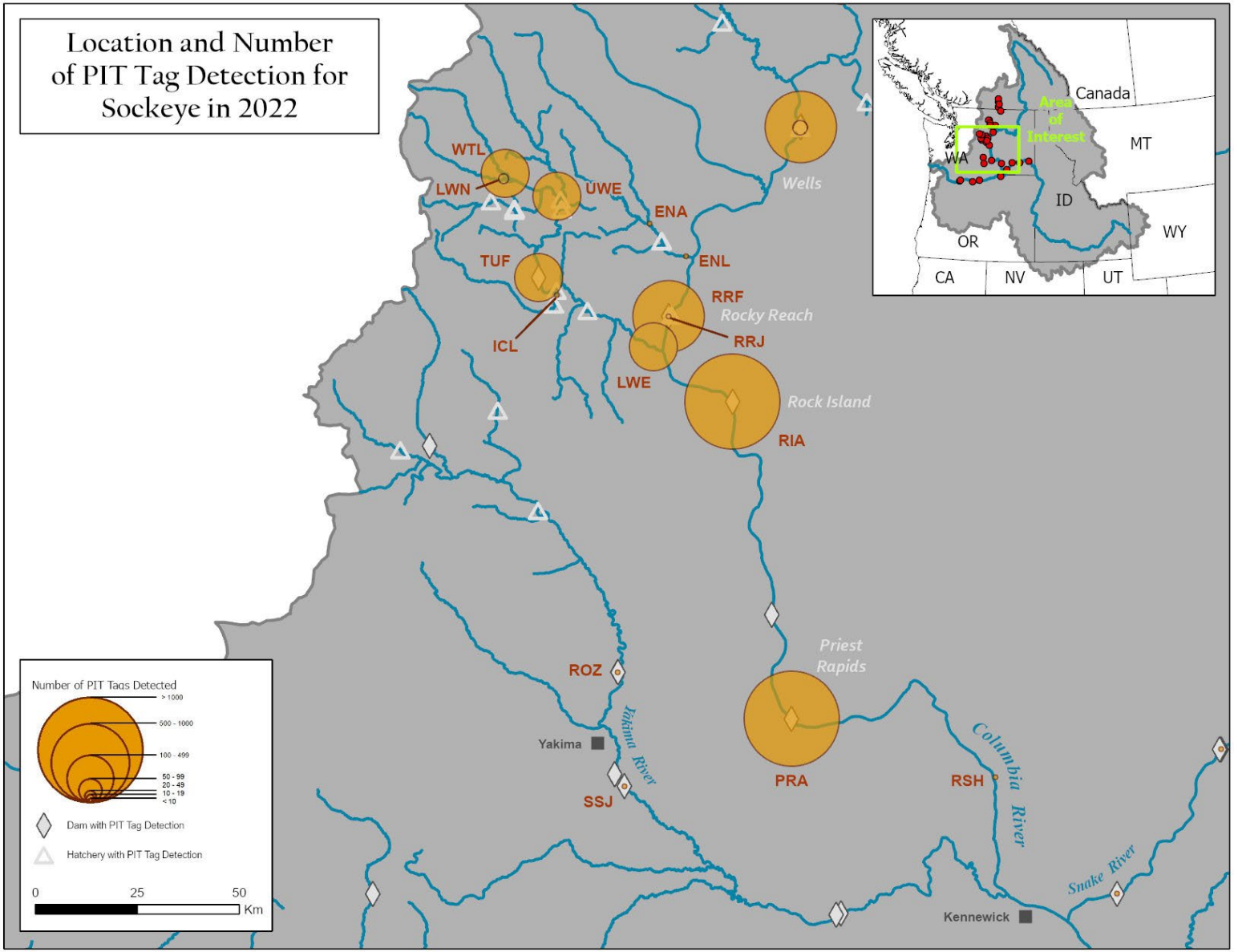


Figure C24. Map of Upper Columbia River (between the Snake River and Wells Dam) detection sites and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

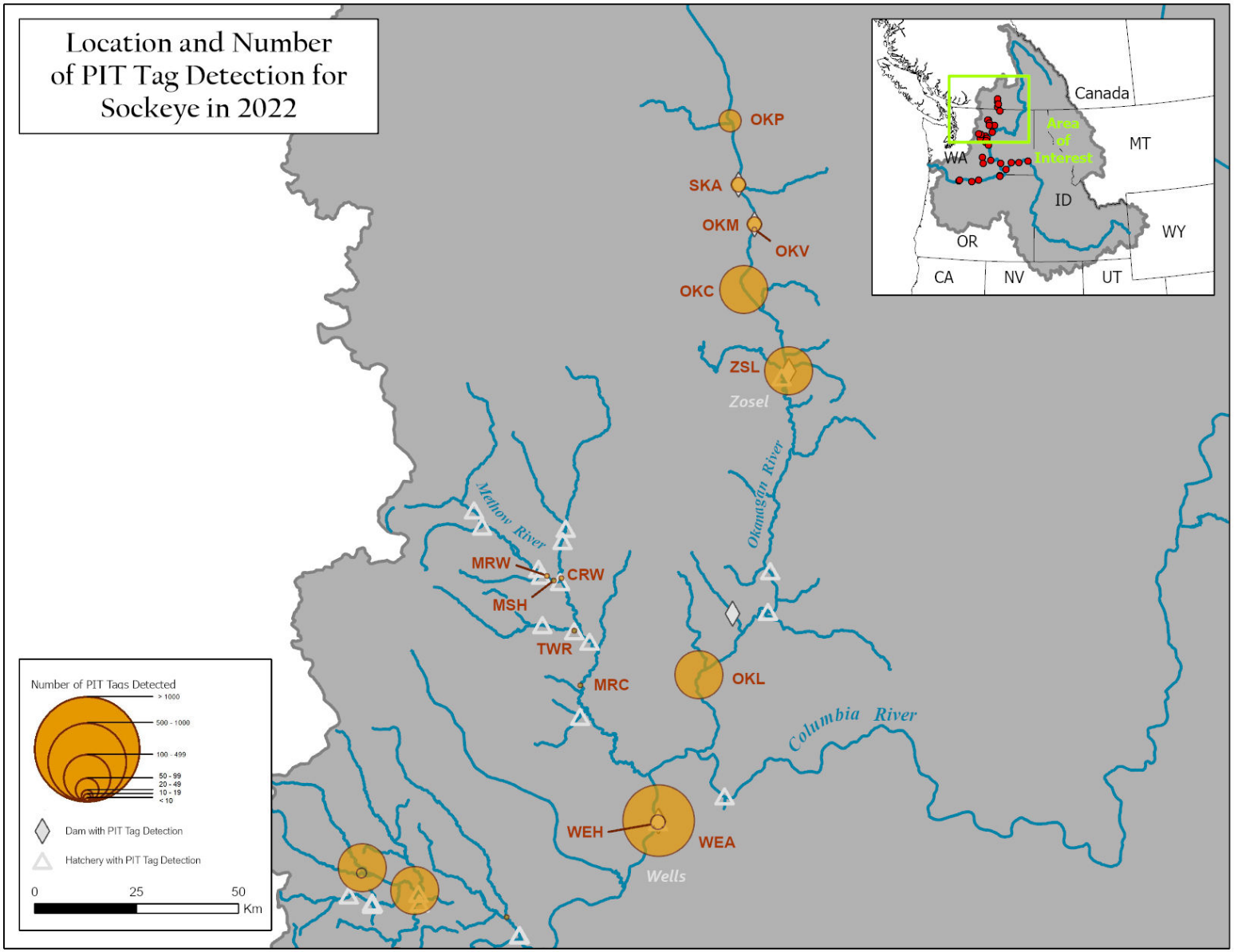


Figure C25. Map of Upper Columbia River (Wells Dam and above) detection sites and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

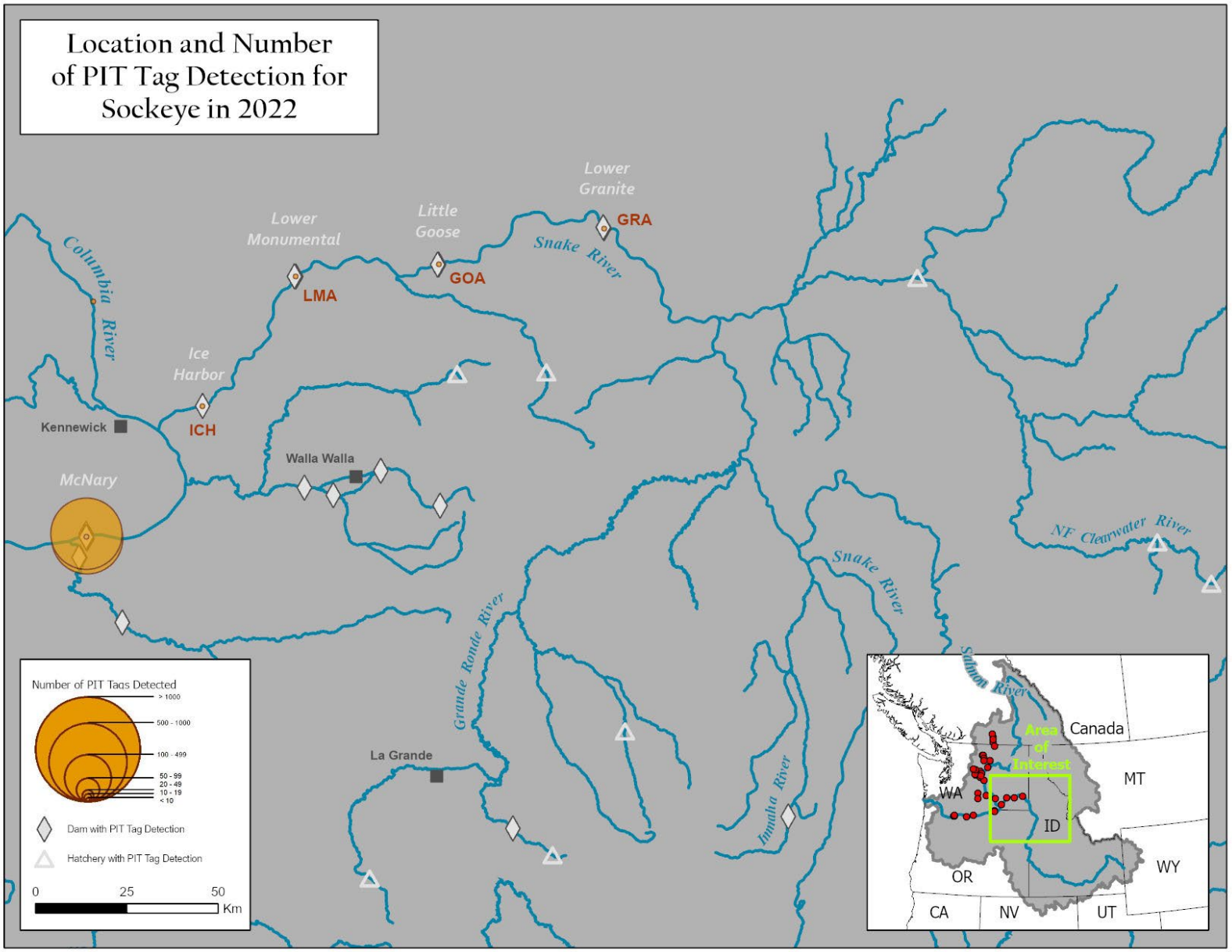


Figure C26. Map of Lower Snake River detection sites (Salmon River not included) and number of Sockeye Salmon detected. Table C1 in Appendix C lists the PTAGIS sites' full name and the three-letter codes on this map.

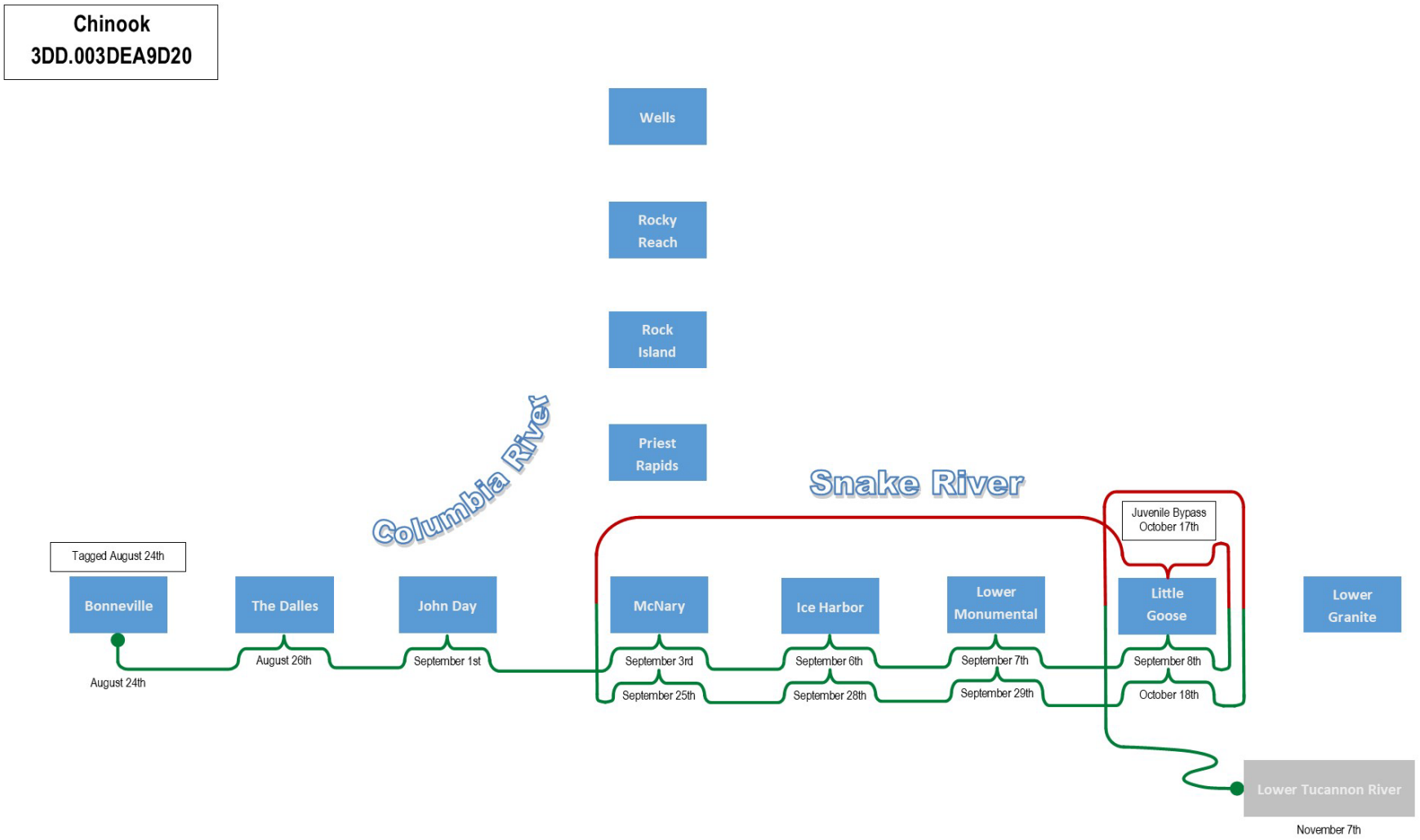


Figure C27. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for Chinook Salmon with PIT tag 3DD.003DEA9D20, tagged and tracked in 2022.

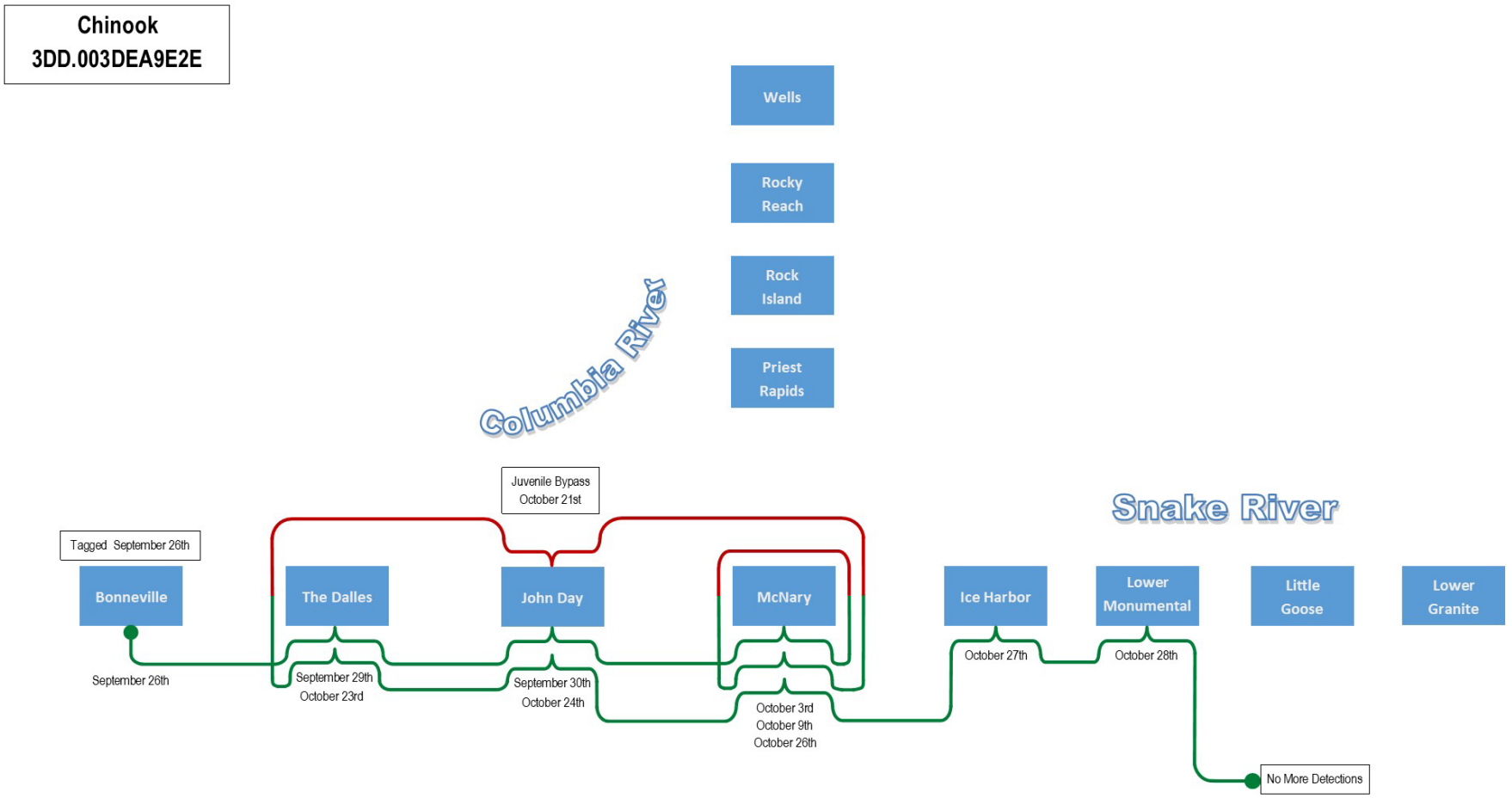


Figure C28. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for Chinook Salmon with PIT tag 3DD.003DEA9E2E, tagged and tracked in 2022.

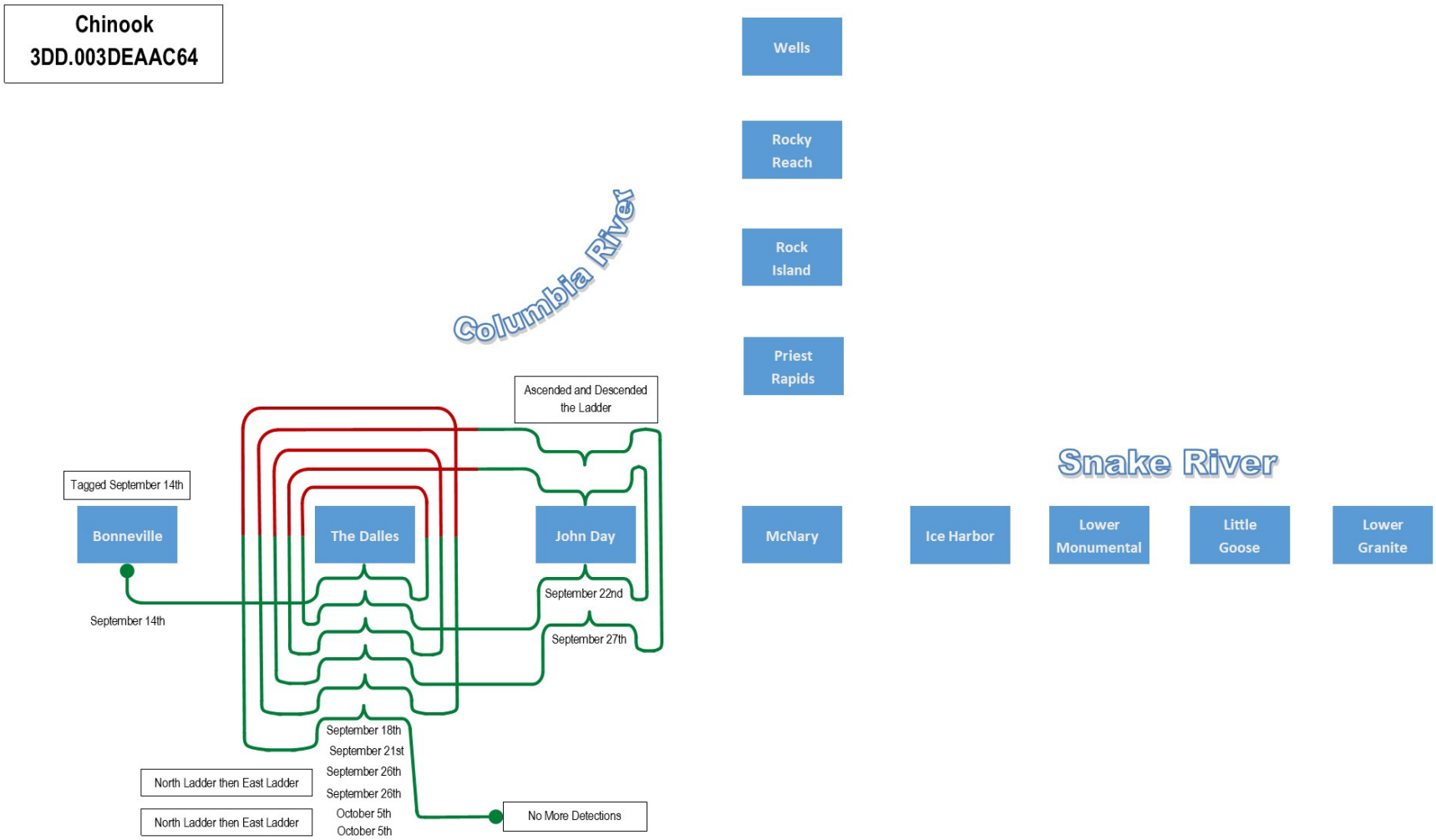


Figure C29. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for Chinook Salmon with PIT tag 3DD.003DEAAC64, tagged and tracked in 2022.

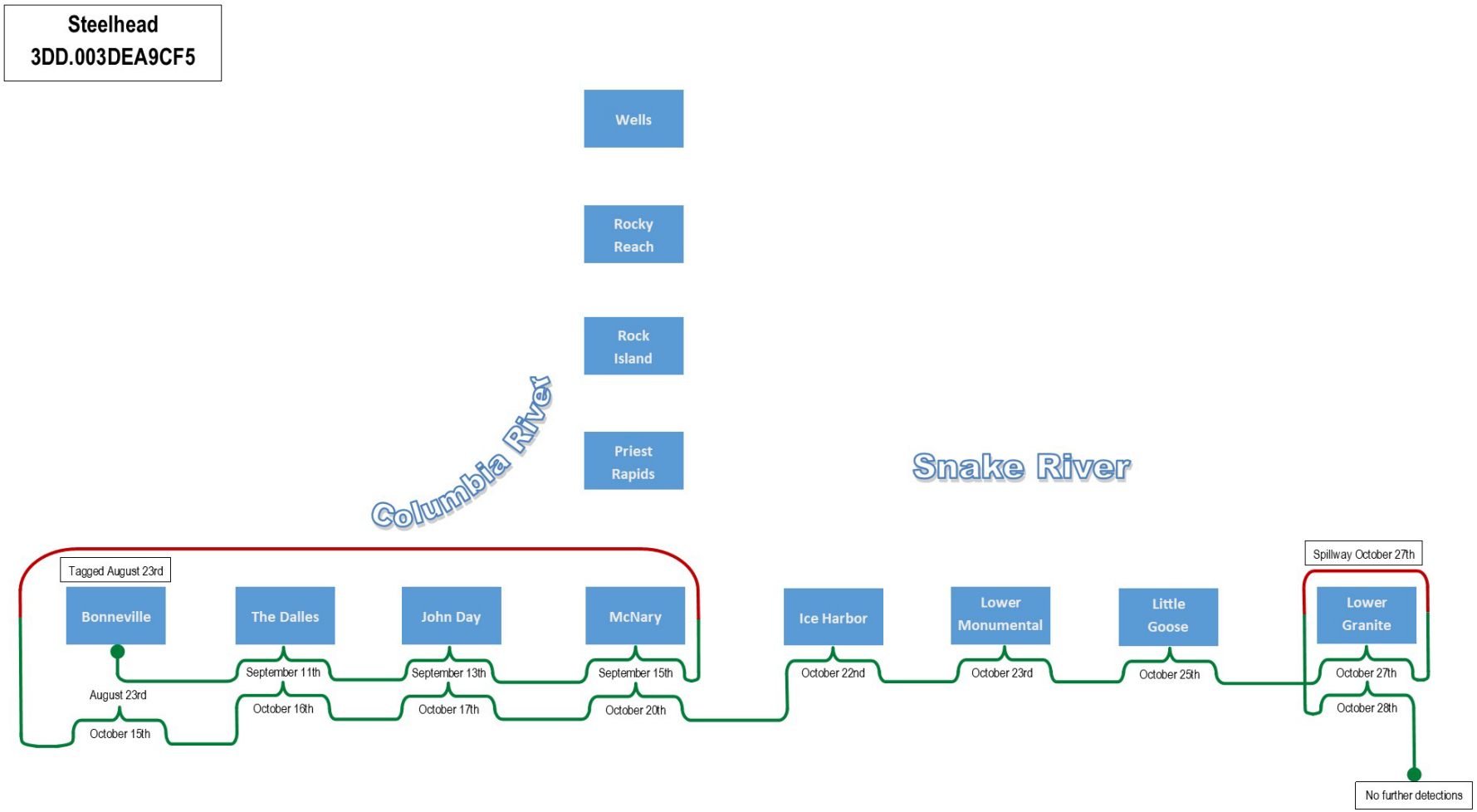


Figure C30. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for steelhead with PIT tag 3DD.003DEA9CF5, tagged and tracked in 2022.

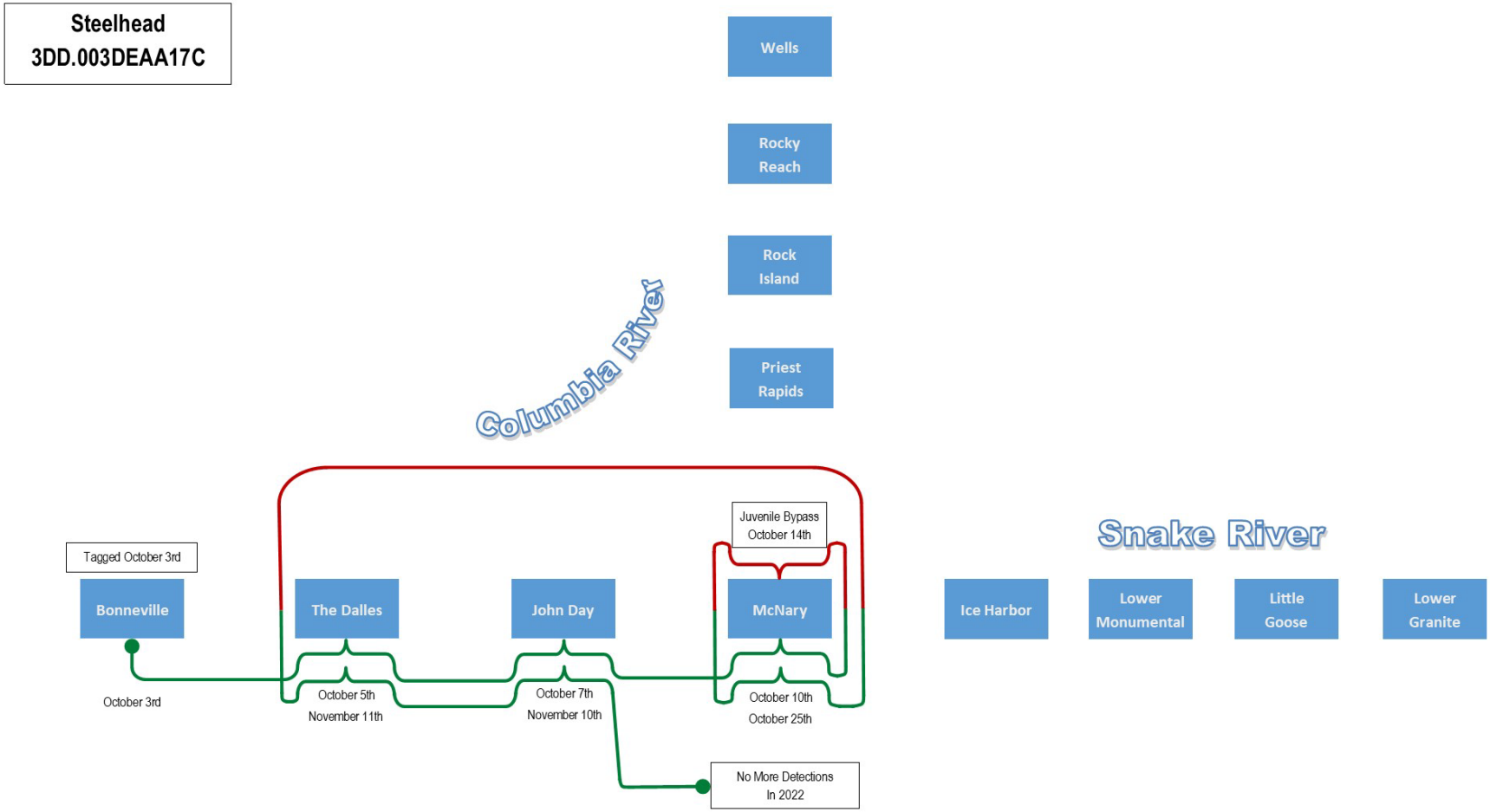


Figure C31. Chart showing the pattern and location of fallback events at mainstem dams on the Columbia and Snake rivers for steelhead with PIT tag 3DD.003DEAA17C, tagged and tracked in 2022.