January
CENWW-ODE HOLDREN 2024

MEMORANDUM THRU:
Rob Lustig, Operations Project Manager, Lower Granite Dam

FOR Chief, Operations Division
ATTN: Christopher Peery

SUBJECT: Submission of 2023 Juvenile Fish Collection and Bypass Report, Lower Granite Dam Juvenile Fish Facility.

1. Enclosed find the 2023 Juvenile Fish Collection and Bypass Report for Lower Granite Dam as requested.

2. If you have any questions contact Elizabeth Holdren at Lower Granite Dam, (509) 843-2263.

ELIZABETH A. HOLDREN
Supervisory Fisheries Biologist, Lower Granite Dam

Enclosure

2023 Juvenile Fish Collection and Bypass Report
Lower Granite Dam Juvenile Fish Facility

Prepared by

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U.S. Army Corps of Engineers

Edited by David Miller

U.S. Army Corps of Engineers

and

Shawn Rapp Environmental Assessment Services

January 2024

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Introduction

Lower Granite Dam (LWG) 2023 collection season was characterized by below average flow, above average spill, above average water temperatures, low descaling rates and higher than average non-salmonid fish collection. Steelhead overshoot spill occurred from March 1-March 30 and from September 1-November 15. Spring spill was based on the total dissolved gas (TDG) cap of 125% saturation for 16 hours and performance standard spill for 8 hours split into two blocks over a 24-hour day. Summer spill volume requirements remained at the historical level of 18 kcfs. Water temperatures were below average during April and May but higher than average for the remainder of the season. Involuntary spill occurred when flows exceeded spill operation requirements and powerhouse hydraulic capacity, and/or hydropower demands.

The juvenile collection channel was watered up in primary bypass March 15. Extended Length Submersible Bar Screens (ESBSs) were installed from March 20-23. Juvenile fish facility (JFF) operation was changed to secondary bypass for 24 hours collection of condition samples at 0700 hours March 25 until collection for transport began at 0700 hours April 23. The collection facility was returned to secondary bypass for condition sampling from 0700 hours June 16 until collection for truck transport began at 0700 hours August 1. Fish were not transported from June 15-19 as scheduled, due to a hydraulic pump failure for the barge loading boom. Fish collected for transport from 0700 hours June 15 to 0700 hours June 16 were bypassed back to the river through the barge loading boom prior to taking it out of service.

Research fish were transported by barge April 20 as part of the ongoing study to compare in-river verses transported Smolt-to-Adult Return Ratios (SARs). Research fish were bypassed April 11-12 and April 19-20 as part of the NMFS in-river survival study. Three agencies conducted six research projects and handled a total of 288,607 smolts at the Lower Granite juvenile collection facility this season in addition to the Smolt Monitoring Program (SMP), gas bubble trauma (GBT) sampling, kelt collection for Nez Perce Tribe reconditioning program, Pacific Northwest National Laboratory (PNNL) juvenile lamprey survival and passage route study, and Columbia River Inter-Tribal Fish Commission lamprey genetics sampling.

Fish collection for barge transport occurred from 0700 hours April 23 through 0700 hours June 15. Fish collection for truck transport occurred from 0700 hours August 1 through 0700 hours November 1. The facility was operated in primary bypass November 1 through December 19. Facility smolt collection totaled 3,438,684 during the 2023 season compared to 2,556,321 in 2022. Distribution of the 2023 total fish collection was 374,976 bypassed, 3,041,835 barged, and 20,083 trucked, excluding mortalities.

Pacific States Marine Fisheries Commission (PSMFC) technicians handled 914 and examined 829 juvenile salmonids for GBT between April 6 and June 15. Smolts examined were bypassed or sent to the raceway depending on transport operations. Three fish were observed with symptoms of GBT during the 2023 season.

The passive integrated transponder (PIT) tag system detected 86,197 PIT-tagged fish at the JFF

during the 2023 season. Facility PIT tagged fish distribution was 31,739 diverted to the river, 53,062 diverted to raceways for transport, 1,269 diverted to sample holding tank, and 127 failed to be detected in secondary bypass, raceways, or the sample systems. These numbers are estimates based on the last PIT-tag detection in the facility. An additional 155,993 PIT-tagged fish were detected at the RSW PIT-tag detectors from March 25-November 1 (PTAGIS) and remained in the river past LWG dam.

Historically, Snake River Basin hatchery salmonids were distinguished from wild salmonids by clipped adipose fins (occasionally pectoral or ventral fins). Before 1998, Idaho Fish and Game (IDFG) was the only agency that released sizeable numbers of unclipped hatchery fish. Starting in 1998, increasing numbers of unclipped hatchery fish were released by state, federal, tribal, or other agencies. Salmonids collected, sampled, bypassed, and transported from Lower Granite facilities are designated as clipped or unclipped not hatchery or wild. Snake River Basin Coho salmon were reintroduced by the tribes and are all of hatchery origin.

Corps of Engineers personnel included: Lead Project Supervisory Fisheries Biologist Elizabeth Holdren, Supervisory Fisheries Biologist David Miller, Maintenance Lead Ryan Bonivert, Lead Biological Technician Steven Lee; Biological Technicians: David Riley, Kenneth McIntyre, Jon Melnichenko, Colby Bunce, Ian Montgomery, Sophia Bonnewit, and Tyler Phillips; and Maintenance personnel/truck transport drivers: Ken Wickstrom, and Bradley Gallardo. Environmental Assessment Services was represented by Biologists Shawn Rapp and Lauren Thielman, Pacific States Marine Fisheries Commission (PSMFC) was represented by Biologists Paul Burke and Darin Hathaway. PSMFC technicians conducting fish sampling, quality control, data collection, and GBT sampling included Carole Jones, Alyson Atondo and Dylan Carpenter. Washington Department of Fish and Wildlife (WDF&W) was represented by Biologist Charles Morrill.

Facility Modifications

The following modifications were made to the JFF prior to or during the 2023 fish collection season:

1. Completed dissolved oxygen and total dissolved gas monitoring systems on 2000 series barges.
2. Completed upgrades to the total dissolved gas monitoring systems on the 4000 and 8000 series barges to include solar powered GPS and data logging.
3. Completed VBS replacement in gatewell slots 3A, 3B, 3C, 5A and 6A.
4. Repainted the deck and above deck structures on barges 8105 and 8106.
5. Replace forward bits on barge 4382.
6. Installed Vaki Pipeline Counter into the sample PVC line to test its suitability for replacing the current outdated counter system. Initiated testing.
7. Coordinated to repaint the separator in 2024.
8. Installed concrete pad and storage case for compressed gas cylinders.
9. Replaced workshop air conditioning system.
10. Installed new air conditioning system into the PIT computer system room.
11. Installed additional lighting for the separator A and B exit dewatering inspection.
12. Installed new perforated dewatering screens at separator A and B exits.

13. Replaced the 10" flex hose section of the barge loading boom.
14. Improvements to the secondary bypass gate to simplify emergency power outage procedures.

River Conditions

Average daily river flows exceeded 100 kcfs for 34 days during the 2023 collection season (March 26-November 1) with an average total river flow of 53.00 kcfs. The highest daily average flow was 180.82 kcfs on May 23, while the lowest daily average flow was 14.9 kcfs on October 22. Spill for juvenile fish passage occurred for 152 days from April 3 to August 31. LWG spilled up to the 125% gas cap for 16 hours a day and performance standard spill (20 kcfs) for up to 8 hours per day during the spring spill season (April 3-June 20). Summer spill of 18 kcfs began at 0001 hours on June 21 and ended at 2400 hours August 15. RSW only operation started August 16 and ended August 31. Spill was distributed according to the Fish Passage Plan (FPP) Table LWG-7 and LWG-8. Average season flow through spillways was 34.5 kcfs with a maximum daily average of 80.8 kcfs on May 23 and a minimum daily average of 4.5 kcfs on August 21. Adult steelhead overshoot spill through the RSW occurred from 0500-0900 hours on Sundays, Tuesdays, and Thursdays from March 1 to March 30 and from September 1 to November 15. River temperatures, collected as part of the daily condition sample, averaged 59.2° F for the season and ranged from 43.0° F on March 30 and April 1 to 68.0° F on July 4 and July 5. Daily powerhouse outflow and spill is shown in Figure 1. Average monthly flow and spill for the 2019-2023 collection seasons are provided in Table 1.

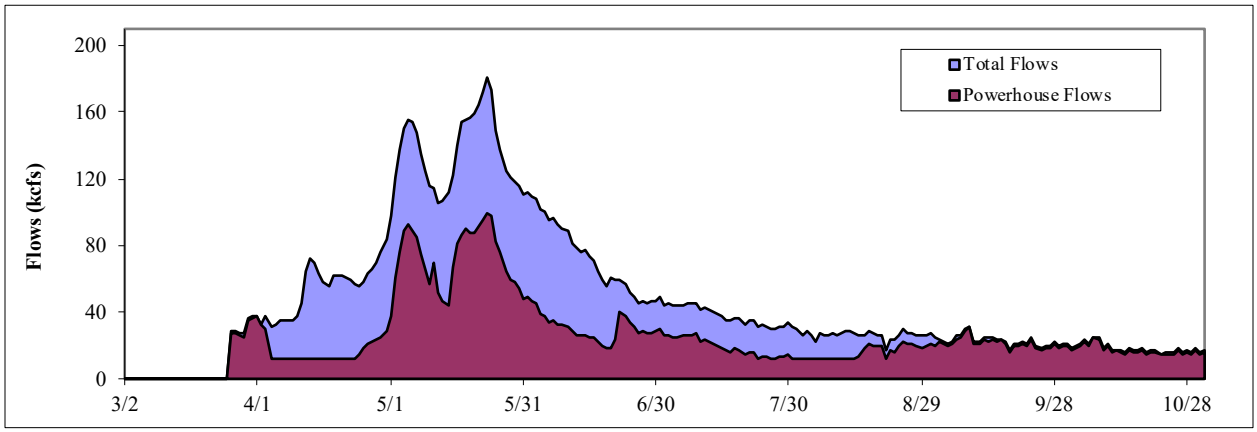

Figure 1. Daily average total flow and powerhouse flow at LWG, 2023.

Table 1. Comparison of average monthly river flow (kcfs) and spill (kcfs) at LWG, 2019-2023.

Flow (kcfs)	2019	2020	2021	2022	2023	2019–22 Ave.
March	76.68	33.82	41.43	53.08	30.94	42.17
April	121.47	54.67	49.91	42.66	53.82	67.18
May	122.06	106.17	70.51	85.29	136.63	96.01
June	92.71	98.06	54.10	135.44	73.37	95.08
July	38.54	50.77	25.13	46.17	37.84	40.15
August	28.92	28.63	22.28	28.87	26.43	27.18
September	25.75	24.01	19.50	20.12	22.76	22.34
October	22.13	20.95	16.80	16.27	18.16	19.04

Table 1. (Continued)

Spill (kcfs)						
March	0.02	0.00	0.51	0.54	0.79	0.26
April	46.18	32.40	28.99	24.68	36.94	33.06
May	42.73	62.02	45.48	51.20	63.08	50.36
June	35.66	53.73	32.29	54.90	42.24	44.15
July	18.62	19.87	10.02	18.14	18.17	16.66
August	16.18	12.37	10.17	13.86	10.18	13.15
September	0.29	0.16	0.16	0.94	0.83	0.39
October	0.00	0.49	0.75	0.73	0.67	0.49

Fish Collection

Migration and Collection

Daily collection for condition sampling in secondary bypass mode occurred from 0700 hours March 25 through 0700 hours April 23 and from 0700 hours June 15 through 0700 hours August 1. Collection for barge transport occurred from 0700 hours April 23 through 0700 hours June 15. One research barge departed LWG April 20 as part of National Marine Fisheries Service (NMFS) seasonal effects transportation study. Truck transport occurred from 0700 hours August 1 through 0700 hours November 1. An estimated 3,438,684 juvenile salmonids were collected during the 2023 season compared to 2,556,321 juvenile salmonids in 2022 (Table 2). The percent of total collection for each species was: 38.4% clipped and 8.7% unclipped yearling Chinook salmon *Oncorhynchus tschawytscha*, 3.6% clipped and 7.9% unclipped subyearling fall Chinook salmon, 26.0% clipped and 11.9% unclipped steelhead *O. mykiss*, 0.5% clipped and 0.1% unclipped Sockeye/Kokanee salmon *O. nerka*, and 2.8% Coho salmon *O. kisutch*. Daily collection and bypass numbers are provided in Appendix Table 1.

By the end of May, 94.6% of the total season collection had occurred. The percent of total collection arriving by the end of June and the end of July was 97.4% and 99.4%, respectively. The remaining 0.6% of juvenile salmonids were collected August through November 1. Daily collection of all species combined versus total flow is shown in Figure 2. Total daily collection in 2023 peaked at 428,800 fish on May 4. This was the highest peak collection day and tied for the second latest peak collection day in the last 5 years. The peak daily collection total and date for each species group for 2019-2023 are listed in Table 3.

Table 2. Annual collection, bypass, transportation, and mortality at LWG, 2019-2023.

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
Collection										
2019	1,470,467	396,127	176,608	263,341	2,190,548	540,061	44,450	5,207	77,396	5,164,205
2020	449,966	133,693	100,061	185,432	439,343	120,302	16,890	1,021	49,232	1,495,940
2021	141,518	32,735	76,606	222,821	229,147	45,926	2,722	1,757	17,856	771,088
2022	914,982	224,009	152,095	307,473	633,227	203,224	41,440	2,282	77,589	2,556,321
2023	1,322,081	298,975	123,175	270,364	894,740	408,639	18,900	4,310	97,500	3,438,684
Bypass										
2019	453,214	153,562	3,285	41,108	1,160,105	210,169	9	154	20,630	2,042,236
2020	61,015	28,661	29,125	66,140	126,779	16,408	0	20	963	329,111
2021	21,753	12,441	17,635	57,070	153,371	18,123	40	52	784	281,269
2022	47,180	40,497	39,303	83,559	107,860	26,088	9	381	3,262	348,139
2023	77,992	37,019	30,644	90,858	96,732	38,284	6	25	3,416	374,976
Truck										
2019	4	258	1,906	17,377	3	2	0	28	8	19,586
2020	1	73	580	19,788	1	3	0	550	13	21,009
2021	2	180	13,271	108,192	217	104	0	22	368	122,356
2022	0	3	921	45,981	9	38	0	50	69	47,071
2023	1	40	886	19,043	3	2	0	33	75	20,083
Barge										
2019	1,016,004	242,036	171,023	204,217	1,030,304	329,833	44,341	5,005	56,679	3,099,442
2020	388,550	104,847	70,172	99,141	312,488	103,871	16,834	414	48,228	1,144,545
2021	119,594	20,087	45,588	57,172	75,517	27,687	2,666	1,662	16,681	366,654
2022	867,076	183,270	111,680	177,375	525,248	177,072	41,377	1,821	74,169	2,159,088
2023	1,243,399	261,754	91,415	159,965	797,924	370,328	18,855	4,226	93,969	3,041,835
Total Transport										
2019	1,016,008	242,294	172,929	221,594	1,030,307	329,835	44,341	5,033	56,687	3,119,028
2020	388,551	104,920	70,752	118,929	312,489	103,874	16,834	964	48,241	1,165,554
2021	119,596	20,267	58,859	165,364	75,734	27,791	2,666	1,684	17,049	489,010
2022	867,076	183,273	112,601	223,356	525,257	177,110	41,377	1,871	74,238	2,206,159
2023	1,243,400	261,794	92,301	179,008	797,927	370,330	18,855	4,259	94,044	3,061,918
2023 Mortalities										
Facility	689	162	230	498	81	25	39	26	40	1,790
NMFS	135	30	70	79	27	6	6	5	5	363
Res/Sac	0	63	0	11	5	4	0	0	0	83

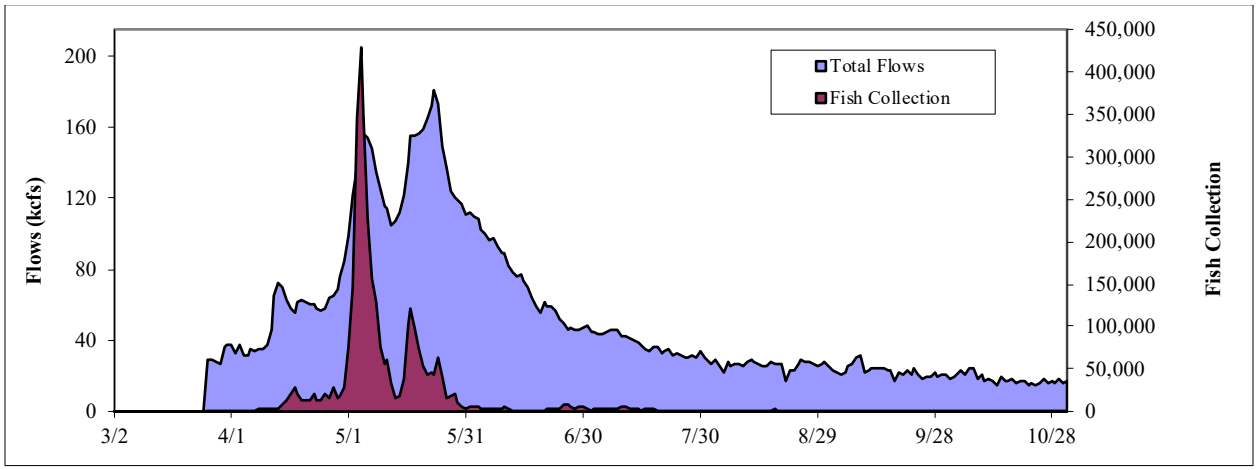

Figure 2. Fish collection and daily average flows at LWG, 2023.

Table 3. Annual peak collection days at LWG, 2019-2023.

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2019	30-Apr	30-Apr	5-Jun	5-Jun	10-Apr	27-Apr	18-May	18-May	12-Apr	10-Apr
	76,200	17,600	16,650	18,250	159,600	31,400	13,000	1,000	8,000	245,802
2020	5-May	14-May	31-May	31-May	4-May	4-May	14-May	15-May	22-May	4-May
	37,600	8,129	8,934	13,012	47,400	16,000	8,290	200	4,800	92,200
2021	6-May	6-May	6-Jun	25-Jun	17-Apr	6-May	9-May	3-May	7-May	17-Apr
	14,950	2,200	6,869	13,172	34,900	4,400	850	400	1,800	38,400
2022	8-May	8-May	8-Jun	10-May	10-May	10-May	14-May	9-May	8-May	8-May
	202,800	29,000	10,450	13,200	97,600	31,400	13,800	400	14,600	346,200
2023	4-May	4-May	18-May	24-May	4-May	4-May	15-May	23-May	17-May	4-May
	187,800	40,800	11,800	21,400	131,400	60,400	5,600	700	7,400	428,800

Adult Fallbacks

A total of 2,607 adult salmonids fell back through the juvenile collection facility and were bypassed directly back to the river from the separator between March 25 and November 1. The total number of each species of adult fallbacks are listed in Table 4. Steelhead kelts are included in the total though they are not technically fallbacks. Fallbacks were routed directly back to the river during primary bypass operation prior to March 25 and after November 1. Daily adult fallbacks and fallback mortalities are in Appendix Table 4.

Table 4. Annual totals of adult salmonids released from the separator at LWG, 2019-2023.

	Adult Chinook Salmon		Jack Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Totals
2019	222	293	147	142	814	713	0	7	19	2,357
2020	161	227	458	307	567	567	6	56	44	2,393
2021	185	271	634	243	310	303	10	11	103	2,070
2022	371	367	201	143	741	538	17	1	70	2,449
2023	400	345	208	102	708	649	36	8	151	2,607
19-22 Avg.	235	289	360	209	608	530	8	19	59	2,317

Steelhead were the most common adult salmonid species removed from the separator in 2023 (Table 5). March through May accounted for 52.3% of adult steelhead removed from the separator. The remaining 47.7% of steelhead fallbacks were removed from the separator June through November 1. The total number of steelhead fallbacks removed from the separator include out migrating kelts. Most of the Chinook salmon adults (78.5%) were removed from the separator during September and October (fall Chinook salmon). There were 36 clipped and 8 unclipped Sockeye/Kokanee salmon fallbacks released back to the river July through October. There were 151 Coho salmon fallbacks released to the river from the separator with 125 (82.8%)

removed in October.

Table 5. Monthly totals of adult salmonids released from the separator at LWG, 2023.

	Adult Chinook Salmon		Jack Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Totals
March	0	0	0	0	31	11	0	0	0	42
April	0	0	0	0	42	26	0	0	0	68
May	14	3	2	1	226	374	0	0	0	620
June	41	17	2	5	5	38	0	0	0	108
July	22	9	14	5	6	1	21	1	0	79
August	24	30	5	13	18	27	13	4	0	134
September	147	166	67	46	229	114	2	1	26	798
October	152	120	118	32	151	58	0	2	125	758
Totals	400	345	208	102	708	649	36	8	151	2,607

Adult salmonid condition was classified as good, fair, poor, or dead prior to being released from the separator (Table 6). Overall, 95.1% of fallback condition was classified as good to fair. Condition ratings of adult salmonids examined were as follows: 83.7% good, 11.4% fair, 4.1% poor, and 0.8% mortalities. Adult salmonid mortalities included 3 clipped yearling Chinook salmon, 1 clipped steelhead non-kelt, 11 clipped steelhead kelts, and 7 unclipped steelhead kelts. Sockeye and Coho salmon had the highest percent of good/fair fish (100.0%) followed by Jack Chinook salmon (99.7%), adult Chinook salmon (98.7%), and steelhead (91.4%). There were 235 adult lamprey (*Entosphenus tridentatus*) collected at the juvenile facility which included 233 released at Offield Landing boat ramp (4 separator, 23 raceways, 8 sample collection tank and 198 sample holding tank) and, 2 sample tank mortalities.

Table 6. Condition of adult salmonids released from the separator at LWG, 2023.

	Adult Chinook Salmon		Jack Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Totals
Good	352	315	203	100	534	501	27	6	143	2,181
Fair	40	28	4	2	104	101	9	2	8	298
Poor	5	2	1	0	58	40	0	0	0	106
Dead	3	0	0	0	12	7	0	0	0	22
Total	400	345	208	102	708	649	36	8	151	2,607

Sampling

Consistent with the 2023 Fish Operations Plan (FOP), Appendix E of the 2023 FPP, and guidance provided by the Regional Implementation Oversight Group (RIOG) through the Technical Management Team (TMT), the juvenile fish transportation program allows for variable start and end dates based on fish survival, adult returns, current in-river conditions, and water supply forecasts data. All fish collected that are not needed for research are bypassed to the river prior to the start of collection for transportation. This year TMT requested collection for

transport at Lower Granite, Little Goose, and Lower Monumental to begin at 0700 hours April 23. Lower Granite collection for fish sampling began at 0700 hours March 25 and ended at 0700 hours November 1. Sampling at Lower Granite Dam is diverting and segregating groups of fish in a consistent fashion so that data collected from those segregated groups will accurately represent the sum of fish being collected in real time and is not the act of evaluating those groups. A total of 221 daily samples were processed this season. The sample rate was set at 10% March 25 and fluctuated from a minimum of 0.5% to a maximum of 100% based on daily fish numbers.

During March and April, unclipped Sockeye/Kokanee salmon without CWT or PIT tags are classified as Kokanee salmon (likely from Dworshak reservoir) and recorded as incidental fish. Smolt monitoring personnel sampled 63 unclipped Sockeye/Kokanee salmon from March 26 to May 8, compared to 340 from March 2 to April 30 in 2022. Genetic samples were taken from 138 unclipped Sockeye/Kokanee salmon in 2021 and results showed that these fish were Kokanee salmon from Dworshak Reservoir and not unclipped Sockeye salmon from the Stanley Basin. Smolt monitoring staff sampled 59,707 smolts or 1.7% of the total facility collection in 2023 compared to 70,811 smolts or 2.8% of the total facility collection in 2022 (Table 7).

Table 7. Annual percentage of smolts sampled at LWG, 2019-2023

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2019	0.6	0.9	4.7	9.1	0.7	0.7	0.6	1.6	1.2	1.3
2020	1.9	2.8	6.8	15.9	2.4	2.3	1.3	59.1	1.9	4.3
2021	4.3	6.1	7.9	10.0	4.1	5.9	3.8	6.7	5.7	6.5
2022	1.4	2.4	4.3	9.9	1.8	1.5	0.6	4.1	1.4	2.8
2023	1.0	1.5	4.2	8.8	1.0	0.9	1.3	2.3	1.0	1.7
19–22 Ave.	1.2	1.1	4.9	10.2	1.0	1.0	0.6	3.4	1.2	1.8

The percent of the total smolts sampled in 2023 by species included: 21.2% clipped and 7.6% unclipped yearling Chinook salmon, 8.6% clipped and 39.9% unclipped subyearling Chinook salmon, 14.7% clipped and 5.8% unclipped steelhead, 0.4% clipped and 0.2% unclipped Sockeye/Kokanee salmon, and 1.7% Coho salmon (Table 8).

Transportation

An estimated 3,061,918 juvenile salmonids were transported from Lower Granite Dam in 2023 by barge and truck combined. This is the second highest number of fish transported in the last 5 years and the highest percent of the collection transported since 2010. The percentage of fish transported was 89.0% of the total facility collection. The percentage of the total collection transported for each species group included 94.0% clipped and 87.6% unclipped yearling Chinook salmon, 74.9% clipped and 66.2% unclipped subyearling Chinook salmon, 89.2% clipped and 90.6% unclipped steelhead, 99.8% clipped and 98.8% unclipped Sockeye/Kokanee salmon, and 96.5% Coho salmon. Daily barge transportation numbers are provided in Appendix Table 2.

Table 8. Weekly sample totals at LWG, 2023.

Week	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
Ending	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2-Mar	0	0	0	0	0	0	0	0	0	0
9-Mar	0	0	0	0	0	0	0	0	0	0
16-Mar	0	0	0	0	0	0	0	0	0	0
23-Mar	0	0	0	0	0	0	0	0	0	0
30-Mar	176	104	0	9	2	19	0	0	4	314
6-Apr	863	616	0	11	152	84	0	0	1	1727
13-Apr	2007	1173	0	14	556	57	0	0	1	3808
20-Apr	1454	578	0	111	1105	442	0	0	43	3733
27-Apr	690	302	0	13	1735	219	0	0	35	2994
4-May	2991	574	0	29	2072	701	0	0	67	6434
11-May	2599	511	14	43	1326	687	8	0	100	5288
18-May	1404	347	203	219	575	369	239	4	151	3511
25-May	386	176	233	586	635	449	2	24	287	2778
1-Jun	69	37	353	629	266	230	0	18	83	1685
8-Jun	12	30	566	615	211	144	0	14	37	1629
15-Jun	6	12	730	530	67	52	0	0	38	1435
22-Jun	5	10	596	827	31	17	0	0	67	1553
29-Jun	1	1	920	1360	15	6	0	0	20	2323
6-Jul	1	2	458	894	5	4	0	0	8	1372
13-Jul	1	0	249	1104	1	0	0	0	0	1355
20-Jul	0	1	85	1219	1	0	0	1	1	1308
27-Jul	2	0	52	1530	1	1	0	0	0	1586
3-Aug	0	1	41	1299	0	1	0	0	0	1342
10-Aug	1	0	98	2944	1	0	0	0	5	3049
17-Aug	0	2	131	2963	0	0	0	0	2	3098
24-Aug	0	0	71	1906	0	0	0	0	8	1985
31-Aug	0	0	30	695	0	1	0	0	2	728
7-Sep	0	0	27	350	0	2	0	1	4	384
14-Sep	0	3	32	523	0	0	0	4	8	570
21-Sep	0	1	20	239	1	1	0	0	3	265
28-Sep	0	0	5	111	0	1	0	6	9	132
5-Oct	0	1	5	35	0	1	0	5	5	52
12-Oct	0	2	64	522	0	2	0	13	3	606
19-Oct	0	3	77	1095	0	1	0	3	4	1183
26-Oct	0	13	43	888	0	0	0	4	0	948
1-Nov	0	15	23	486	0	0	0	4	4	532
Totals	12,668	4,515	5,126	23,799	8,758	3,491	249	101	1,000	59,707

Fish collected April 11 and April 12 were bypassed as part of the reach survival study. Fish collected for NMFS transport study April 18 and April 19 were transported April 20. Collection for every other day general barge transport occurred 0700 hours April 23 through 0700 hours June 15 from Lower Granite. Unlike previous years, everyday barging operations did not occur in 2023. Due to the barge loading boom hydraulic failure, fish were not transported from LWG on June 17 and June 19 but were still barged from LGS and LMN. Fish collected in raceways for the June 17 trip from 0700 hours June 15 to 0700 hours June 16 were bypassed from the juvenile fish facility raceways directly to the river. An estimated 3,041,835 juvenile salmonids were transported by barge from Lower Granite Dam in 2023. The percent of fish transported by barge was 88.5% of the total facility collection, and for each species group included 94.0% clipped and 87.6% unclipped yearling Chinook salmon, 74.2% clipped and 59.2% unclipped subyearling Chinook salmon, 89.2% clipped and 90.6% unclipped steelhead, 99.8% clipped and

98.1% unclipped Sockeye/Kokanee salmon, and 96.4% Coho salmon. A total of 6,244,024 smolts were transported by barge from Lower Granite, Little Goose (LGO), and Lower Monumental (LMN) by Lower Granite staff as part of the Walla Walla District trap and transport program.

Barge oxygen levels are monitored with Point Four systems on all barges. YSI portable oxygen monitoring units are used as backup systems for all barges. Temperature and oxygen data are recorded every two hours during loading and then every four hours until fish are released. Total dissolved gas (TDG) monitoring systems were installed in the sea chest and a barge hold in 2021. Improvements to this system in 2023 include data logging capability and GPS location (8000 series barges only).

Lower Granite transported 20,083 smolts by truck which is 0.6% of the total juvenile collection. Fish were trucked in a 300-gallon tank mounted on a pickup, and a 1000-gallon tank mounted on a flatbed, August 3 through November 1. Fish were not transported in the 3500-gallon semi-truck trailer in 2023. There were 46 truck trips this season with 6 using the flatbed and 40 using the pickup. Lower Granite did not transport fish collected at LGO by truck in 2023. The number of smolts trucked from LWG by species included: 1 clipped and 40 unclipped yearling Chinook salmon, 886 clipped and 19,043 unclipped subyearling Chinook salmon, 3 clipped and 2 unclipped steelhead, 33 unclipped Sockeye/Kokanee salmon, and 75 Coho salmon. Water temperatures and oxygen levels were monitored to ensure acceptable levels in transport tanks. River water at the release site or river water ice is added to temper truck transport tanks when needed to ensure temperature are within 1-2ºF of Bonneville tailrace.

Bypass

Lower Granite juvenile system was watered up in primary bypass March 15 with fish being returned directly to the river through the outfall pipe. Collection for condition sampling began at 0700 hours March 25. The facility was operated in secondary bypass mode for condition sampling March 25 through April 23 and from June 16 to August 1. An estimated 374,976 juvenile salmonids, 10.9% of the total collection, were bypassed directly back to the river from the juvenile collection facility during the 2023 season. The number of bypassed fish was estimated based on the 0700-0700 daily sample. There were 173,537 juvenile salmonids bypassed from March 25 to April 23, 5.0% of total collection. Another 118,460 juvenile salmonids were bypassed from June 15 to August 1, 3.4% of total collection. During collection for transport season, 82,532 juvenile salmonids (2.4%) were bypassed from the collection facility. The percent total collection of each species bypassed included 5.9% clipped and 12.4% unclipped yearling Chinook salmon, 24.9% clipped and 33.6% unclipped subyearling Chinook salmon, 10.8% clipped and 9.4% unclipped steelhead, <0.1% clipped and 0.6% unclipped Sockeye/Kokanee salmon, and 3.5% Coho salmon. Facility bypass estimates include all fish bypassed to the tailrace during secondary bypass operation when collection for transport did not occur. Bypassed fish include GBT-sampled fish prior to April 24, fish collected and provided for research needs, and steelhead during late season trucking operations. There were 83 research mortalities reported during 2023 included in the bypass total. East raceway mortalities were included in Lower Granite facility mortality when raceways were used for standard transport collection and for NMFS studies. There were 363 mortalities removed from the east raceways

that held NMFS transport research fish. Bypassed fish estimates do not include fish bypassed by the PIT tag diversion system. Juvenile salmonids were bypassed rather than transported for the following purposes this season. The facility was operated in primary bypass mode November 1-December 19.

1. The facility was operated in primary bypass from 0700 hours November 1 until the juvenile bypass system was dewatered for winter maintenance December 19. ESBSs were installed March 20-23. ESBSs for unit 1-6 were removed November 13-15 to support transformer gasket replacement on phase T1.
2. Secondary bypass occurred from March 25 through April 23 and from June 16 to August 1. Daily condition sampling occurred during secondary bypass operations. Fish sampled during secondary bypass are included in the facility bypass total.
3. There were 267 fish sampled for GBT and bypassed between April 7 and April 21. Bypassed fish included 135 clipped and 69 unclipped yearling Chinook salmon, 46 clipped and 17 unclipped steelhead.
4. There were 47,272 fish collected and bypassed as part of research projects this season (See; Research Section).
5. There were 31,739 PIT-tagged fish of different species bypassed through the juvenile facility PIT tag system (PTAGIS database). These fish are not included in the facility bypass total.
6. Fish collected for the June 17 barge trip were bypassed from the fish facility due to the barge loading boom hydraulic failure.

According to the PTAGIS database, 86,197 PIT-tagged fish were detected in the LWG juvenile collection facility in 2023. Of the detected fish, 36.8% were bypassed to the LWG tailrace through the PIT-tag diversion system, 61.6% were diverted to the raceways to be transported, 1.5% were diverted to the sample tank, and 0.1% were not detected at an exit monitor and their disposition was unknown. The above PIT-tag numbers are estimates based on the last PIT-tag monitor where the fish were detected. There were also 155,993 PIT-tagged fish detected passing over the RSW PIT-tag detectors. All PIT-tagged fish were bypassed to the river from March 25 through April 23 and June 15 to August 1, except for fish collected on April 18, April 19, for the NMFS transportation study.

Incidental Species

Non-target fish species that were too large to pass through the separator bars were recorded and bypassed through the adult release flume at the separator. Incidental fish small enough to pass through the separator bars were either sampled and bypassed back to the river or held in raceways and transported with juvenile salmonids. The number of incidental species counted in the daily sample were expanded based on the sample rate to calculate collection. Incidental fish recorded at the separator were added to the expanded collection from the sample to estimate the total collection for each incidental species. An estimated 747,319 incidental species were collected at the fish facility during the March 25 to November 1 passage period compared to 1,117,288 in 2022 (Table 9). This is the third highest collection of incidental species since at least 1999. Regardless, the prevailing trend has been a decrease in the number of incidental fish collected in the last 3 years after incidental fish collection increased significantly from 2018

(126,848) to 2021 (1,281,744). The 1999 to 2016 average number of incidentals collected during the smolt monitoring season is 43,478, compared to 627,681 incidentals for the 2018 to 2023 average. The 2017 season data is excluded due to the facility dewatering on August 2 to facilitate the completion of the juvenile bypass system. Siberian prawn collection has increased significantly since they were first observed at LWG in 2004, but has decreased significantly since peaking in 2021. Siberian prawn collection was 477,814 this season compared to 668,377 in 2022, 1,179,365 in 2021, 145,030 in 2020, and 71,565 in 2019. All Siberian prawns in the sample were euthanized (per Washington Department of Fish and Wildlife permit requirements) and disposed of in landfills.

Table 9. Estimated collection of incidental fish species at LWG, 2023.

Common Name	*Scientific Name*	Separator	Expanded Sample	Total Collection[1]
American Shad (Adult)	*Alosa sapidissima*	82	30	112
American Shad (Juvenile)	*A. sapidissima*	0	3,855	3,855
Banded Killifish	*Fundulus diaphanus*	0	6	6
Bass, Largemouth	*Micropterus salmoides*	0	20	20
Bass, Smallmouth	*M. dolomieui*	14	3,164	3,178
Bullhead (misc.)	*Amierus sp.*	0	726	726
Catfish, Channel	*Ictalurus punctatus*	36	4,812	4,848
Catfish, Flathead	*Pylodictis olivaris*	0	0	0
Chiselmouth	*Acrocheilus alutaceus*	1	66	67
Common Carp	*Cyprinus carpio*	14	47	61
Crappie (misc)	*Pomoxis sp.*	48	16,727	16,775
Dace, Longnose	*Rhinichthys cataractae*	0	22	22
Dace, Speckled	*R. osculus*	0	0	0
Kokanee[2]	*Oncorhynchus nerka*	0	236	236
Northern Pikeminnow	*Ptychocheilus oregonensis*	10	43	53
Pacific Lamprey (Adult)	*Entosphenus tridentatus*	1	310	311
Pacific Lamprey (Ammocoete)	*E. tridentatus*	0	62,902	62,902
Pacific Lamprey (Macrophthalmia)	*E. tridentatus*	0	130,559	130,559
Peamouth	*Mylocheilus caurinus*	16	18,843	18,859
Redside Shiner	*Richardsonius balteatus*	0	0	0
Sand Roller	*Percopsis transmontana*	0	1,030	1,030
Sculpin	*Cottus sp.*	0	287	287
Siberian Prawn	*Exopalaemon modestus*	0	477,814	477,814
Sucker (misc.)	*Catostomus sp.*	356	17,207	17,563
Sunfish (misc.)	*Lepomis sp.*	2	2,965	2,967
Trout, Bull	*Salvelinus Malma*	1	0	1
Trout, Cutthroat	*Oncorhynchus clarkii*	0	0	0
Trout, Rainbow	*O. mykiss*	573	1	574
Walleye	*Stizostedion vitreum*	22	15	37
Warmouth	*Lepomis gulosis*	0	1	1
White Sturgeon	*Acipenser transmontanus*	3	0	3
Whitefish	*Prosopium sp.*	19	4,425	4,444
Yellow Perch	*Perca flavescens*	4	4	8
Total		1,202	746,117	747,319

[1]Separator count plus expanded sample count equals estimated total facility collection.
[2]Unclipped *Oncorhynchus nerka* not CWT or PIT-tagged and >200mm, and those sampled from March 2 to May 1.

The following incidental species had the highest collection observed at LWG since 1999. The channel catfish collection was 4,848 this season, compared to 514 for the 1999 to 2022 average. The crappie collection was 16,775 this season, compared to 2,662 for the 1999 to 2022 average. The adult lamprey collection was 311 this season, compared to 36 for the 1999 to 2022 average.

The peamouth collection was 18,859 this season, compared to 4,785 for the 1999 to 2022 average. The sucker collection was 17,563 this season, compared to 3,324 for the 1999 to 2022 average. The juvenile shad collection was 3,855 this season, compared to 875 for the 1999 to 2022 average. The walleye collection was 37 this season, compared to 31 in 2022, 14 in 2021, 5 in 2020, 13 in 2019, 5 in 2018, 1 in 2017, 3 in 2016 and 1 in 2015.

Fish Condition

Descaling

The standard descaling criteria is classified as a fish with scale loss of 20% or greater on one side of the body. Scale loss less than 20% on one side of the body is not considered descaled. PSMFC and EAS smolt monitoring personnel collected descaling data from the full sample rather than the portion of the sample used for condition monitoring.

The descaling rate for all fish sampled in 2023 was 0.8% compared to 0.7% in 2022 and 1.1% for the 2019 to 2022 average (Table 10). This is the second lowest descaling rate observed at LWG since at least 1995. The four years with the lowest descaling rates have occurred since 2018 when the new above ground flume was constructed with 14-inch orifices. The annual descaling rate by species group was 1.1% clipped and 0.8% unclipped yearling Chinook salmon, 0.5% clipped and 0.5% unclipped subyearling Chinook salmon, 1.6% clipped and 1.3% unclipped steelhead, 1.2% clipped and 2.0% unclipped Sockeye/Kokanee salmon and 0.8% Coho salmon.

Table 10. Annual full-sample descaling rates (>20%) by species at LWG, 2019-2023.

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2019	1.2	0.7	0.6	0.7	1.6	1.8	1.2	6.0	1.1	1.0
2020	1.4	0.9	0.5	0.5	2.2	2.5	0.0	4.4	1.1	1.1
2021	1.5	1.6	1.0	0.7	2.8	2.8	9.9	7.3	2.0	1.5
2022	0.6	0.6	0.3	0.4	1.7	1.5	1.2	4.6	1.3	0.7
2023	1.1	0.8	0.5	0.5	1.6	1.3	1.2	2.0	0.8	0.8
2019–2022 Avg.	1.1	0.8	0.6	0.6	2.0	2.1	1.9	4.9	1.4	1.1

The highest weekly descaling rate for all species combined was 3.0% for the week ending October 12 (Table 11). Typically, the highest weekly descaling rates are observed in late August, September, and October when temperatures increase, flows decrease, and the sample size decreases. Descaling increased slightly in September and increased again in October when debris levels increased, and fish collection decreased. The lowest descaling rates are generally during June and July when small subyearling Chinook salmon dominate the collection. This season the lowest weekly descaling rates were observed from the last two weeks of June through September. Clipped Sockeye/Kokanee salmon collected at the juvenile fish facility in late May and early June exhibited high rates of caudal fin rot, and fungus but their decaling rate was low compared to previous years. IDFG determined these maladies were due to rearing and release

conditions related to differences in water hardness levels between the hatchery and release locations, and not Lower Granite operation. Daily descaling rates are provided in Appendix, Table 3.

Table 11. Weekly descaling rates in percent for fish sampled at LWG, 2023.

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
Week Ending	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
3-Mar										
10-Mar										
17-Mar										
24-Mar										
30-Mar	1.14%	0.97%	--	--	0.00%	0.00%	--	--	0.00%	0.99%
6-Apr	1.63%	1.47%	--	--	0.00%	2.38%	--	--	0.00%	1.46%
13-Apr	1.00%	0.26%	--	--	1.08%	1.75%	--	--	0.00%	0.80%
20-Apr	0.55%	0.52%	--	--	1.18%	0.68%	--	--	0.00%	0.75%
27-Apr	1.59%	0.00%	--	--	0.69%	0.46%	--	--	0.00%	0.81%
4-May	1.11%	1.05%	--	--	1.59%	1.43%	--	--	0.00%	1.28%
11-May	1.04%	1.58%	0.00%	0.00%	1.66%	2.04%	0.00%	--	1.00%	1.37%
18-May	0.86%	0.00%	0.00%	0.00%	2.09%	0.81%	1.26%	0.00%	0.00%	0.86%
25-May	1.04%	0.00%	0.00%	0.62%	3.16%	0.45%	0.00%	0.00%	0.70%	1.16%
1-Jun	1.47%	2.70%	0.29%	0.00%	4.53%	3.07%	--	0.00%	4.82%	1.66%
8-Jun	8.33%	0.00%	0.18%	0.18%	1.91%	0.00%	--	0.00%	0.00%	0.45%
15-Jun	0.00%	0.00%	0.42%	0.20%	0.00%	3.85%	--	--	0.00%	0.43%
22-Jun	0.00%	0.00%	0.34%	0.42%	3.23%	0.00%	--	--	0.00%	0.42%
29-Jun	0.00%	0.00%	0.22%	0.24%	6.67%	0.00%	--	--	0.00%	0.27%
6-Jul	0.00%	0.00%	0.44%	0.11%	0.00%	0.00%	--	--	0.00%	0.22%
13-Jul	0.00%	--	0.41%	0.18%	0.00%	--	--	--	--	0.22%
20-Jul	--	0.00%	0.00%	0.16%	0.00%	--	--	0.00%	0.00%	0.15%
27-Jul	0.00%	--	0.00%	0.07%	0.00%	0.00%	--	--	--	0.06%
3-Aug	--	0.00%	0.00%	0.08%	--	0.00%	--	--	--	0.07%
10-Aug	0.00%	--	0.00%	0.27%	0.00%	--	--	--	0.00%	0.26%
17-Aug	--	0.00%	0.00%	0.51%	--	--	--	--	0.00%	0.49%
24-Aug	--	--	0.00%	0.42%	--	--	--	--	0.00%	0.40%
31-Aug	--	--	0.00%	0.58%	--	0.00%	--	--	0.00%	0.55%
7-Sep	--	--	0.00%	0.29%	--	0.00%	--	0.00%	0.00%	0.27%
14-Sep	--	0.00%	0.00%	1.15%	--	--	--	0.00%	0.00%	1.06%
21-Sep	--	0.00%	10.00%	0.00%	0.00%	0.00%	--	--	0.00%	0.76%
28-Sep	--	--	0.00%	1.80%	--	0.00%	--	0.00%	0.00%	1.53%
5-Oct	--	0.00%	0.00%	2.94%	--	0.00%	--	0.00%	0.00%	1.96%
12-Oct	--	0.00%	9.84%	1.96%	--	0.00%	--	7.69%	33.33%	3.04%
19-Oct	--	33.33%	2.60%	1.84%	--	0.00%	--	0.00%	0.00%	1.96%
26-Oct	--	15.38%	4.65%	1.24%	--	--	--	0.00%	--	1.59%
1-Nov	--	0.00%	0.00%	1.44%	--	--	--	25.00%	0.00%	1.51%
# Descaled	133	34	24	111	136	45	3	2	8	496
# Sampled	12,625	4,484	5,077	22,924	8,747	3,488	249	101	997	58,692
% Descaled	1.05%	0.76%	0.47%	0.48%	1.55%	1.29%	1.20%	1.98%	0.80%	0.85%

Injuries and Disease

Injury and disease data gathered from a subsample of 100 fish of the dominant species and not more than 100 each of the non-dominant species. There were 26,621 fish examined for injury and disease and 3,284 fish (12.3%) were afflicted with an injury or disease symptom in 2023. The body injuries possibly associated with dam passage included a generic body injury category and a generic fin injury category. Head injuries that were associated with dam passage include generic head injuries, eye injuries, operculum injuries and "pop" or bulging eye. Fish were also examined for external symptoms of fungus, Columnaris, bacterial kidney disease, and parasites.

Body injuries were observed on 8.1% of the smolts examined in the detailed subsample. Blood pooling is defined as the vasodilatation of the capillaries in fins (also referred to as fin pinkness). It may be a symptom of anesthetic use during higher water temperatures and is mostly found on subyearling Chinook salmon. Fin hemorrhaging is the discharge of blood outside the body and is a sign of trauma. Of the smolts examined from the sample that had body injuries, the most common symptom observed in 2023 was general fin injury (42.8%), followed by pink fin (25.3%), fin discoloration (23.4%), body injuries (5.1%), and deformities (3.4%). Unclipped subyearling fall Chinook salmon had the highest incidence of body injuries (10.1%), followed by clipped subyearling fall Chinook salmon (7.8%), clipped steelhead (7.8%), and clipped Sockeye salmon (7.2%).

Head injuries were recorded on 0.6% of the smolts examined in the detailed subsample. Clipped yearling Chinook salmon had the highest incidence of head injury (1.1%), followed by clipped steelhead (1.0%), unclipped yearling Chinook salmon (0.9%) and unclipped steelhead (0.7%). Operculum injuries (40.9%) were the most frequently observed type of head injury, followed by eye hemorrhages (33.1%), eye injuries (11.0%), general head injuries (10.4%), and "pop" eye (4.5%).

Injuries associated with predators include wounds inflicted by other fish, birds, and lamprey. Predator wounds were observed on 0.6% of the smolts examined. Predator marks caused by birds, characterized by a distinct V-shaped descaling pattern on both sides of a fish were the most common predator mark at 56.8% compared to 41.4% caused by fish and 1.8% caused by lamprey. Predator marks were highest on unclipped steelhead (1.1%), followed by clipped steelhead (1.0%), coho salmon (0.9%), and clipped yearling Chinook salmon (0.8%). Injuries caused by lamprey were observed on 0.01% of all condition sampled smolts in 2022 and 2023 compared to 0.53% in 2021 and 0.02% in 2020.

External symptoms of disease were observed on 4.0% of the smolts examined in the detailed subsample compared to 3.0% in 2022, 4.5% in 2021, 4.7 in 2020, and 6.5% in 2019. Unclipped subyearling fall Chinook salmon (6.2%) had the highest incidence of disease symptoms, followed by clipped subyearling fall Chinook salmon (5.1%), and clipped Sockeye salmon (2.6%). Of the fish afflicted, fin hemorrhages comprised the majority of disease symptoms (79.6%), followed by parasites (9.0%), fungus (6.2%), Columnaris (4.0%), and bacterial kidney disease (1.1%).

Fin hemorrhage was found on 3.2% of all species and rearing types examined. Fin hemorrhage was the primary disease afflicting subyearling Chinook salmon and was observed on 5.7% of

unclipped and 4.7% of clipped subyearling Chinook salmon examined this season.

Columnaris is caused by the bacterium *Flavobacterium columnare* that becomes more virulent as water temperatures increase. Summer and subyearling migrants are more susceptible to infection as water temperatures increase during their outmigration. Columnaris can be recognized by the presence of yellowish lesions on the belly, damage to the gills, pelvic fins, snout, and caudal fins. SMP at Lower Granite only classify fish as being infected with Columnaris if there is some tissue loss on the snout or body (fish with only red mouth edges are not classified as infected). Columnaris was identified at Lower Granite in 1996 and symptoms observed on all sample fish have been recorded since 1999. Typically, the first incidence of Columnaris is observed in July after the majority of subyearling Chinook salmon have passed the Project. The first symptoms of Columnaris this season were observed July 25. The 2023 Columnaris infection rate for subyearling Chinook salmon was 0.15% (43 of 28,001), which was the highest columnaris infection rate in the last 3 years but the third lowest rate since recording began in 1999. Columnaris infection rates have generally been much lower in recent years since Dworshak Reservoir has been used to keep the LWG forebay below 68.0°F.

Mortality

Facility mortality includes fish removed from the barges or trucks before departure, sample mortalities, recovery tank mortalities, separator mortalities, and raceway mortalities, not including the east raceways when used to hold only NMFS research fish. Mortalities removed from east raceways when used exclusively for NMFS studies are included in bypassed fish and are considered research mortalities not facility mortalities. Annual facility mortality for all groups combined was 0.05% in 2023 and totaled 1,790 fish (Table 12). Within each species group the number of facility mortalities were 689 clipped and 162 unclipped yearling Chinook salmon, 230 clipped and 498 unclipped subyearling Chinook salmon, 81 clipped and 25 unclipped steelhead, 39 clipped and 26 unclipped Sockeye/Kokanee salmon, and 40 Coho salmon.

Table 12. Annual facility mortality in percent by species group at LWG, 2019-2023.

	Yearling Chinook salmon		Subyearling Chinook salmon		Steelhead		Sockeye/Kokanee salmon		Coho salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2019	0.08	0.07	0.22	0.24	0.01	0.01	0.22	0.38	0.10	0.06
2020	0.09	0.08	0.18	0.20	0.02	0.02	0.33	3.62	0.06	0.09
2021	0.12	0.08	0.15	0.17	0.02	0.03	0.59	1.20	0.13	0.10
2022	0.08	0.11	0.13	0.18	0.02	0.01	0.13	1.31	0.11	0.08
2023	0.05	0.05	0.19	0.18	0.01	0.01	0.21	0.60	0.04	0.05
19–22 Avg.	0.09	0.08	0.17	0.20	0.010	0.013	0.21	1.05	0.10	0.07

Weekly facility mortality rates were highest during September and October and peaked at 2.81% the week ending on October 12, the same week that descaling rates peaked. Sockeye salmon mortality rates in previous years have been affected by their poor condition at release associated with issues with the water supply at the Springfield Hatchery. IDFG has implemented different

release strategies in recent years that have lowered mortalities at LWG, but these fish still exhibit higher mortality and injury rates than other species. This season clipped and unclipped Sockeye salmon/Kokanee each had their second lowest facility mortality rate in the last 5 years. Weekly facility mortality rates are provided in Table 13.

Table 13. Weekly facility mortality in percent by species group at LWG, 2023.

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
Week Ending	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
3-Mar										
10-Mar										
17-Mar										
24-Mar										
30-Mar	0.00%	0.45%	--	0.00%	0.00%	0.00%	--	--	0.00%	0.17%
6-Apr	0.11%	0.23%	--	4.55%	0.00%	0.00%	--	--	0.00%	0.17%
13-Apr	0.13%	0.32%	--	3.33%	0.03%	0.00%	--	--	0.00%	0.18%
20-Apr	0.01%	0.02%	--	0.22%	0.01%	0.00%	--	--	0.00%	0.02%
27-Apr	0.11%	0.02%	--	0.16%	0.00%	0.00%	--	--	0.00%	0.03%
4-May	0.04%	0.03%	--	0.10%	0.00%	0.00%	--	--	0.00%	0.02%
11-May	0.03%	0.03%	0.04%	0.09%	0.00%	0.00%	0.00%	--	0.02%	0.02%
18-May	0.13%	0.11%	0.37%	0.32%	0.03%	0.01%	0.20%	0.25%	0.06%	0.12%
25-May	0.12%	0.11%	0.10%	0.10%	0.02%	0.01%	2.50%	0.25%	0.03%	0.06%
1-Jun	0.00%	0.00%	0.06%	0.07%	0.00%	0.00%	0.00%	0.31%	0.01%	0.01%
8-Jun	0.43%	0.00%	0.14%	0.16%	0.20%	0.08%	--	0.00%	0.14%	0.15%
15-Jun	0.00%	0.00%	0.24%	0.23%	0.37%	0.17%	--	--	0.48%	0.24%
22-Jun	0.00%	0.00%	0.17%	0.22%	0.00%	0.91%	--	--	0.22%	0.20%
29-Jun	0.00%	0.00%	0.02%	0.02%	0.00%	0.00%	--	--	0.00%	0.02%
6-Jul	0.00%	2.50%	0.03%	0.06%	0.00%	0.00%	--	--	0.00%	0.05%
13-Jul	0.00%	--	0.06%	0.02%	0.00%	--	--	--	--	0.03%
20-Jul	--	0.00%	0.10%	0.04%	0.00%	--	--	0.00%	0.00%	0.04%
27-Jul	0.00%	--	0.38%	0.09%	0.00%	0.00%	--	--	--	0.10%
3-Aug	--	0.00%	0.00%	0.30%	--	0.00%	--	--	--	0.29%
10-Aug	0.00%	--	0.00%	0.62%	0.00%	--	--	--	0.00%	0.59%
17-Aug	--	0.00%	2.29%	0.78%	--	--	--	--	0.00%	0.84%
24-Aug	--	--	0.47%	0.11%	--	--	--	--	0.00%	0.12%
31-Aug	--	--	1.92%	1.31%	--	0.00%	--	--	0.00%	1.33%
7-Sep	--	--	7.41%	2.00%	--	0.00%	--	0.00%	25.00%	2.60%
14-Sep	--	0.00%	3.13%	0.96%	--	--	--	25.00%	0.00%	1.23%
21-Sep	--	0.00%	0.00%	1.67%	0.00%	0.00%	--	--	0.00%	1.51%
28-Sep	--	--	20.00%	0.90%	--	0.00%	--	0.00%	0.00%	1.52%
5-Oct	--	0.00%	0.00%	2.86%	--	0.00%	--	0.00%	0.00%	1.92%
12-Oct	--	0.00%	4.69%	2.30%	--	0.00%	--	15.38%	0.00%	2.81%
19-Oct	--	0.00%	0.00%	0.82%	--	0.00%	--	33.33%	0.00%	0.85%
26-Oct	--	0.00%	0.00%	0.79%	--	--	--	25.00%	--	0.84%
1-Nov	--	0.00%	0.00%	1.03%	--	--	--	50.00%	0.00%	1.32%
# morts	689	162	230	498	81	25	39	26	40	1,790
# collected	1,322,081	298,975	123,175	270,364	894,740	408,639	18,900	4,310	97,500	3,438,684
% mortality	0.05%	0.05%	0.19%	0.18%	0.01%	0.01%	0.21%	0.60%	0.04%	0.05%

Sample mortalities include fish removed from the sample holding tank prior to being handled in the lab and mortalities removed from the sorting trough in the wet lab. Annual sample mortality for all groups combined was 0.53% in 2023 (Table 14) and totaled 314 fish. This is the third lowest sample mortality rate since 1996, and slightly above the 0.51% sample mortality rate observed for the 2019 to 2022 average. The number of sample mortalities and percent mortality by species group included 43 clipped (0.34%) and 31 unclipped (0.69%) yearling Chinook salmon, 49 clipped (0.96%) and 174 (0.73%) unclipped subyearling fall Chinook salmon, 11 clipped (0.13%) and 3 unclipped (0.09%) steelhead, 0 clipped and 0 unclipped Sockeye/Kokanee salmon, and 3 Coho salmon (0.30%). All species groups' sample mortality rates were lower than observed in 2022, except for clipped and unclipped subyearling fall Chinook salmon and Coho salmon. Sample mortality for all groups combined since 2019 has ranged from a high of 0.57% in 2021 to a low of 0.45% in 2019. The last six years have had the six lowest sample mortality rates since 1996 and coincides with putting the above ground flume into operation in 2018.

Table 14. Annual sample mortality by species group in percent at LWG, 2019-2023.

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee salmon		Coho salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2019	0.29	0.49	0.53	0.74	0.12	0.18	0.39	2.35	0.22	0.45
2020	0.31	0.40	0.34	0.57	0.14	0.21	1.35	5.80	0.43	0.47
2021	0.92	0.76	0.45	0.63	0.22	0.18	2.88	6.78	0.79	0.57
2022	0.34	1.34	0.65	0.68	0.18	0.13	0.38	5.38	0.27	0.56
2023	0.34	0.69	0.96	0.73	0.13	0.09	0.00	0.00	0.30%	0.53
19-22 Avg.	0.42	0.82	0.49	0.65	0.16	0.18	0.95	5.56	0.43	0.51

Barge mortalities are salmonids removed from barge holds after the barges depart LWG. The total number of smolts barged in 2023 included: 3,041,835 fish from LWG, 1,573,072 from LGS, and 1,629,520 fish from LMN. The seasonal barge transport program mortality rate was 0.02% (1,017 of 6,244,024) (Table 15). Barge mortalities by species group included: 760 clipped and 72 unclipped yearling Chinook salmon, 41 clipped and 24 unclipped subyearling Chinook salmon, 84 clipped and 18 unclipped steelhead, 14 clipped and 2 unclipped Sockeye/Kokanee salmon, and 2 Coho salmon (Table 15).

Table 15. Total annual transport program barge mortalities 2019-2023.

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	Unknown	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Others	Total
2019	1,345	302	55	48	590	211	21	0	0	0	2,572
2020	220	34	8	4	61	11	20	1	1	0	360
2021	96	14	4	2	82	12	0	1	0	0	211
2022	609	36	31	21	111	10	31	10	9	0	868
2023	760	72	41	24	84	18	14	2	2	0	1,017
19-22 Avg.	567	96	25	19	211	61	18	3	3	0	1,003

Fish truck transport mortality rate in 2023 was 0.24% (49 of 20,083) (Table 16). The 3500-gallon semi-truck was not used for any trips in 2023. The 1000-gallon tank was used for trips on August 7, and August 19 to August 27. The 300-gallon tank was used for all other trips during the trucking season. No trips picked up fish from LGS in 2023. A total of 20,083 fish were collected and transported by truck from LWG. Truck mortality number and percent by species included: 2 clipped (0.23%) and 43 unclipped (0.23%) subyearling fall Chinook salmon, and 4 unclipped sockeye/kokanee salmon (12.1%).

Table 16. Annual percent truck mortality at LWG, 2019-2023.

	Yearling Chinook Salmon		Subyearling Chinook Salmon		Steelhead Trout		Sockeye/Kokanee Salmon		Coho Salmon	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2019	0.00	1.16	0.19	0.07	0.00	0.00	0.00	3.57	0.00	0.10
2020	0.00	0.00	1.03	0.06	0.00	0.00	--	3.82	7.69	0.19
2021	0.00	0.00	0.11	0.04	0.00	1.92	--	9.09	0.00	0.05
2022	--	0.00	0.54	0.09	0.00	0.00	--	0.00	1.45	0.10
2023	0.00	0.00	0.23	0.23	0.00	0.00	--	12.12	0.00	0.24
19-22 Avg.	0.00	0.58	0.21	0.06	0.00	1.36	--	3.69	0.66	0.09

--no fish trucked

Gas Bubble Trauma Monitoring (PSMFC)

Juvenile salmonids were sampled for GBT from April 6 through June 15 in 2023. PSMFC personnel examined up to 100 clipped and unclipped yearling Chinook salmon and steelhead each week for evidence of bubbles in unpaired fins and in the eyes, as per Fish Passage Center GBT protocols. This season 914 salmonids were netted off the separator and handled by PSMFC technicians. Salmonids examined for GBT symptoms totaled 829 fish and included: 335 clipped and 99 unclipped yearling Chinook salmon and 283 clipped and 112 unclipped steelhead. During GBT sampling, 18 PIT-tagged smolts were handled, not examined, and returned to the separator, including 5 clipped and 5 unclipped yearling Chinook salmon, and 3 clipped and 5 unclipped steelhead. An additional 66 smolts were handled and released to the separator without examination, including 30 clipped and 29 unclipped subyearling fall Chinook salmon, and 7 Coho salmon. Smolts examined for GBT prior to April 23 were put in the sample recovery tank and bypassed after the sample was completed. Smolts examined for GBT after April 23 were returned to the raceways and transported. A total of 267 smolts were bypassed including 135 clipped and 69 unclipped yearling Chinook salmon, and 46 clipped and 17 unclipped steelhead. A total of 647 smolts were transported including: 205 clipped and 35 unclipped yearling Chinook salmon, 30 clipped and 29 unclipped subyearling Chinook salmon, 241 clipped and 100 unclipped steelhead, and 7 Coho salmon. There were 3 fish observed with symptoms of GBT in 2023, compared to 1 in 2022, 2 in 2021, and no fish observed with symptoms in 2020 or 2019.

Research

Corps biological staff supported nine research projects at LWG juvenile fish facility this season. Three agencies participated in six research projects with juvenile salmonids collected at LWG

juvenile facility. Additional support was provided collecting kelts off the separator, collection for two juvenile lamprey studies, and providing fish to support the Ocean and Estuary study. A total of 288,607 smolts (8.4% of the total collection) were handled by research groups during the 2023 season compared to 328,649 smolts (12.9% of total collection) in 2022. The 2019-2022 average number of fish handled as part of LWG research projects was 235,932 smolts. The 288,607 smolts taken from the 2023 collection season included: 100,543 clipped and 15,426 unclipped yearling Chinook salmon, 14,604 clipped and 18,677 unclipped subyearling fall Chinook salmon, 106,870 clipped and 25,063 unclipped steelhead, 2,449 clipped and 433 unclipped Sockeye/Kokanee salmon and 4,542 Coho salmon. Corps biological technicians collected 204 clipped and 366 unclipped adult steelhead kelts from the LWG juvenile separator for the Nez Perce Tribe (NPT) and Columbia River Inter-Tribal Fisheries Commission (CRITFC) this season. Pacific Northwest National Laboratory conducted a juvenile lamprey survival study in which they handled 816 juvenile and 1,348 larval lamprey. CRITFC and FPC conducted a lamprey genetics study in which they handled 1,061 larval and 452 juvenile lamprey.

National Marine Fisheries Service (NMFS)-Study to Compare the Adult Returns of In-river Migrating versus Barged Juvenile Anadromous Salmonids (Transportation Study)

LWG Corps biological technicians collected smolts in the east raceways for NMFS tagging from April 18 to June 15. Raceway flows, fish behavior, and mortalities were monitored by Corps biological staff 24 hours per day. Corps biological technicians collected 239,829 smolts for NMFS that were handled in their marking trailers at LWG fish facility as part of the annual transportation study. Of these, 21,263 smolts were PIT tagged and transported including 1 clipped and 5,835 unclipped yearling Chinook salmon, 5,995 clipped steelhead, and 9,432 unclipped steelhead. There were 218,529 smolts handled that were not selected for tagging. There were 37 smolt mortalities reported by NMFS including 19 clipped and 4 unclipped yearling Chinook salmon, 5 clipped and 3 unclipped subyearling Chinook salmon, 4 clipped steelhead, 1 clipped Sockeye salmon, and 1 Coho salmon. There were an additional 363 mortalities removed by Corps biological staff from the east raceways while being used exclusively for holding NMFS research fish. Unclipped yearling Chinook salmon with fork lengths less than 124 mm were targeted. Unclipped steelhead with fin erosion were not PIT tagged.

National Marine Fisheries Service (NMFS)-Study to Estimate Juvenile Salmonid Reach Survival

Corps biological technicians collected smolts in the east raceways for the continuing in-river survival study from April 11 to June 15 in conjunction with the NMFS Transportation Evaluation study, except fish collected on April 11 and April 12 were only collected for the survival study. NMFS handled 44,912 smolts as part of this study, 40,033 smolts were PIT-tagged and bypassed including 7,166 unclipped yearling Chinook salmon, 18,907 clipped and 13,960 unclipped steelhead. There were 11 pre-tagging mortalities including 8 clipped and 1 unclipped yearling Chinook salmon and 2 clipped steelhead. There were 72 post-tagging mortalities including 63 unclipped yearling Chinook salmon, 5 clipped and 4 unclipped steelhead. Another 4,076 fish were handled but not utilized for the survival study and bypassed including 2,629 clipped and 51 unclipped yearling Chinook salmon, 404 clipped and 360 unclipped subyearling fall Chinook

salmon, 584 clipped and 4 unclipped steelhead and 44 Coho salmon. There were 363 mortalities removed from the east raceways while used exclusively for NMFS as described above.

Idaho Fish and Game (IDFG)-Genetic Stock Identification

The goals of this study are to develop detailed genetic profiles for natural origin salmon and steelhead, develop genetic stock identification (GSI) techniques to estimate stock-specific escapement over LWG, monitor abundance, productivity, distribution of naturally produced adult and juvenile steelhead and salmon, and monitor stock-specific life history characteristics. The objective of the study is to enumerate and characterize the natural production of spring/summer Chinook salmon and steelhead above LWG with regards to age composition and genetic stock identification. Lower Granite biological staff collected 3,019 fish that were sorted by SMP biologists and provided to IDFG for this study from March 27 to June 30. Scale samples and fin clips were taken from 1,377 non-fin eroded unclipped steelhead. Fin clips only were taken from 1,642 non-coded wire tag (CWT), unclipped yearling Chinook salmon. Sampled fish for this study were bypassed prior to transport collection (April 23) and from June 15 to June 30 and included 266 unclipped steelhead without fin erosion and 717 yearling Chinook salmon without CWT.

University of Idaho/Columbia River Intertribal Fisheries Commission (CRITFC)/Nez Perce Tribe (NPT)-Evaluate Reproductive Success of Natural-Origin, Hatchery-Origin, and Kelt Steelhead in the Columbia River Basin

The purpose of this study is to evaluate steelhead kelt physiology and endocrinology as part of rehabilitation. Kelts were collected by Corps biological staff from the Lower Granite juvenile fish separator 24-hours/day March 27-June 30. Collected kelts were diverted to JFF holding tanks that were monitored 24 hours/day for flow, fish behavior, and mortalities. A total of 570 steelhead kelts were collected from the Lower Granite juvenile separator. There were 162 kelt transported to Dworshak National Fish Hatchery and held for acclimation and feeding studies, 377 were sampled for genetics, PIT-tagged, and returned to the tailrace after failing to meet collection criteria, and 27 were released directly back to the tailrace at LWG.

NMFS-Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon

This study is monitoring the migration behavior and survival of wild spring/summer Chinook salmon. The goals of this study are to characterize the migration timing and estimate parr-to-smolt survival to LWG of wild Chinook salmon populations as they migrate from their natal rearing areas and secondarily, to determine migration patterns and what environmental factors influence those patterns. This study was not conducted in 2020 or 2021 due to NMFS COVID restrictions. Fish were PIT-tagged during summer 2022 in natal streams and were diverted to the Separation by Code (SBC) tanks at LWG. PIT-tagged fish were collected in the SBC tanks from April 1 to June 30. A total of 271 fish were handled during this study. For the season, 158 target unclipped yearling Chinook salmon were diverted to the PIT-tag tanks, sampled and bypassed. Another 106 incidental salmonids were handled and bypassed, including 43 clipped and 1 unclipped yearling Chinook salmon, 2 unclipped subyearling fall Chinook salmon, 51 clipped and 9 unclipped steelhead. Another 6 previously PIT-tagged fish for other studies were handled and bypassed, including 2 clipped yearling Chinook salmon, 3 clipped steelhead and 1 clipped

Sockeye salmon and there was 1 clipped steelhead mortality.

WDFW Tucannon Hatchery Chinook Salmon Transport Evaluation

Concerns over Tucannon hatchery spring Chinook salmon survival prompted an interest in evaluating barge transport. A total of 79,456 Chinook salmon were released from three locations. Of these, 38,874 were released from the Tucannon fish hatchery, 20,288 were released at the confluence of the Tucannon and Snake River, and 20,294 were loaded on a LWG research fish transport barge at Lyons Ferry fish hatchery on April 20. These fish were released below Bonneville dam per standard protocol.

NMFS Salmon Ocean Behavior and Distribution in the Columbia River Estuary

Due to the low abundance of smolts being captured in the estuary for an estuary and ocean tracking study, 300 clipped yearling Chinook salmon were taken from the NMFS transportation study on May 8. These fish were held overnight and trucked to Hammond, Oregon. They were acoustic tagged and released into the Columbia River estuary to determine survival, migration routes and timing to marine waters.

CRITFC- Pacific Lamprey Parentage-Based Genetics Monitoring Program

The goal of this study was to collect genetic stock analysis information using parentage analysis of lamprey collected at mainstem dams. Sampling will allow for further refinement of lamprey life history attributes in the Columbia and Snake River basins, including length at age, age at metamorphosis and out-migration, differential growth among natal rearing sites and tributary of origin, and determine relative proportion of translocation offspring among the total abundance of larval and juvenile lamprey passing the juvenile bypass systems at Bonneville, John Day, McNary, and Lower Granite dams. Fin clips and lengths were taken from up to 10 juvenile and 10 larval lamprey collected in the daily sample from March 26 to October 31. The original goal was to sample 500 juvenile and 1000 larval lamprey. The annual goal of 1,000 larval lamprey was reached on August 1 so the goal was increased to 1,250 and sampling continued through October 31. Fin clips and lengths were taken from 452 juvenile and 1,061 larval lamprey this season.

PNNL- Juvenile Lamprey Survival Study

The primary goal of this study was to estimate survival and passage routes of juvenile lamprey at dams in the Snake and Columbia rivers in 2023. This season larval lamprey were added to the study design. Lamprey were collected at LWG, LGS, LMN fish facilities, the Yakama Nation hatchery, and the Asotin Creek trap and transported to LWG for the study. From all sources, 816 larval and 1,348 juvenile lamprey were collected for this study. Juvenile and larval lamprey were implanted with acoustic or PIT tags and released upstream of LWG at Blyton Landing. Fish were tracked as they re-approached and passed through LWG and the lower Snake River. Excess lamprey not utilized for the study were bypassed at LWG. Juvenile and larval lamprey were collected primarily from the daily sample and raceways at LWG, LGS and LMN fish facilities. LWG provided 731 larval and 226 juvenile lamprey. LGS provided 73 larval and 241

juvenile lamprey. LMN provided 12 larval and 730 juvenile lamprey. The trap at Asotin Creek provided 35 juvenile lamprey. The Yakama Nation hatchery provided 116 juvenile lamprey. Juvenile lamprey were released on 8 dates between March 30 to September 29. A total of 1,116 juvenile and 655 larval lamprey were acoustic-tagged and bypassed at Blyton Landing, 110 larval and 200 juvenile lamprey were not tagged and were bypassed at LWG, 26 larval and 17 juvenile lamprey died before tagging, and 25 larval and 15 juvenile lamprey died after being acoustic-tagged.

USGS- Chinook Salmon Genetic Origin Study

The goal of this study is to determine the origin of unmarked subyearlings in the sample tank at LWG throughout the subyearling out-migration. The U.S. Geological Survey (USGS) developed an approach to estimate the daily abundance of natural origin subyearling fall Chinook salmon passing LWG each year. Fifteen unclipped fish were sampled genetically (fin clipped) every Monday, Wednesday, and Friday from May 15 to October 31 to validate the estimates of origin of unmarked subyearlings in the sample tank and support model abundance estimates. Unmarked hatchery fish were identified by parentage analysis and natural fish were identified as those that are not in the regional hatchery genetic database. During the season, USGS personnel handled 996 unclipped subyearling fall Chinook salmon but only took fin clips from 988 unclipped subyearling fall Chinook salmon, because 7 fish were not sampled and 1 fish died before sampling. Another 12 fish died after sampling and because of this, sampling protocols were changed mid-season and no mortalities occurred after the change. Originally, USGS personnel were sampling fish that had recovered from anesthesia and re-anesthetizing them. After the mortality incident, USGS personnel conducted their sampling concurrent with the SMP effort so the fish were only anesthetized once.

Operation and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within one percent of the peak efficiency from April 1 to October 31. Deviations were infrequent and brief or required by BPA. Table 17 contains unit outages during 2023.

Debris/Trash Racks

Trashracks were raked February 27-March 1. Trashrack raking was not required during the fish passage season.

Extended-length Submersible Bar Screens (ESBSs)

ESBSs were inspected and tested prior to installation on March 20-23. Brush cleaning cycle was set to operate automatically every two hours this season.

Table 17. Lower Granite turbine unit outages, 2023.

Unit	Date OOS	Reason out of service
Units 1-6	Jan 9-19	BPA switchyard modifications
Units 1-6	Feb 27-Mar 1	Trash rack raking
Units 1-6	Mar 20-Mar 23	ESBS Installation
Units 1-6	Feb 6	Doble Testing
Units 1-6	Nov 13-Nov 15	ESBS Removal
Units 1-4	Nov 30, 2023-Feb 8, 2024	T1 Gasket Rehabilitation
Unit 5 & 6	Nov 30-Dec 22	Daily line outage for T1 Gasket Rehabilitation
Unit 1	Apr 23	ESBS/VBS Inspection
	May 22	ESBS/VBS Inspection
	Jun 25	ESBS/VBS Inspection
	Aug 27	ESBS/VBS Inspection
	Oct 23	ESBS/VBS Inspection
	Nov 20, 2023-Feb 8, 2024	Annual Maintenance
Unit 2	Apr 23	ESBS/VBS Inspection
	May 22	ESBS/VBS Inspection
	Jun 25	ESBS/VBS Inspection
	Aug 27	ESBS/VBS Inspection
	Aug 28-Sept 14	Annual Maintenance and VBS Repair
	Oct 22	ESBS/VBS Inspection
Unit 3	Mar 26-Mar 27	Differential Issues
	Apr 23	ESBS/VBS Inspection
	May 22	ESBS/VBS Inspection
	Jun 25	ESBS/VBS Inspection
	Aug 27	ESBS/VBS Inspection
	Oct 2-Oct 18	Annual Maintenance and VBS Replacement
	Oct 22	ESBS/VBS Inspection
Unit 4	Nov 21, 2022-Jan 24, 2023	Thrust Bearing & Bearing Indication Upgrades
	Apr 23	ESBS/VBS Inspection
	May 2	Adjust Wicket Gate Packing
	May 21	ESBS/VBS Inspection
	Jun 26	ESBS/VBS Inspection
	Aug 28	ESBS/VBS Inspection
	Oct 22	ESBS/VBS Inspection
Unit 5	Jan 25	VBS Inspection
	Feb 6-Mar 16	Bearing Indication Upgrade
	Apr 23	ESBS/VBS Inspection
	May 21	ESBS/VBS Inspection
	Jun 26	ESBS/VBS Inspection
	July 10-July 27	Annual Maintenance
	Aug 27	ESBS/VBS Inspection
	Oct 22	ESBS/VBS Inspection
Unit 6	Apr 23	ESBS/VBS Inspection
	May 21	ESBS/VBS Inspection
	Jun 26	ESBS/VBS Inspection
	July 31-Aug 17	Annual Maintenance
	Aug 28	ESBS/VBS Inspection
	Oct 22	ESBS/VBS Inspection

Vertical Barrier Screens (VBSs)

VBSs were video inspected in conjunction with ESBSs during the 2023 fish passage season. Detailed inspections were performed during the June ESBS inspection. VBS screen panel mesh has the potential to deteriorate and become brittle over time. VBS panels for screens that pass underwater camera inspection but showed potential for deterioration continue to be replaced/repaired during unit annual outages or during winter maintenance as time permits.

Gatewells

Gatewells were normally less than 1% covered with debris and did not exceed the 50% debris surface coverage criterion. Turbulence in gatewells with ESBSs causes debris to tumble around and exit through the orifices rather than accumulate on the gatewell surfaces. Surface debris was removed from individual gatewells with a hand dipping basket during initial water-up in late March and continued throughout the season. Occasional oil sheens were dealt with by floating oil absorbent pads in the affected gatewells.

Orifices/Collection Channel

The orifice gallery was watered up on March 15. Orifice operation was determined by collection channel flow and forebay elevation. When the forebay is raised above MOP, 10" orifices in gatewells of non-priority units (typically units 4 & 5) are used to maintain acceptable flow to the PDW. Orifices were inspected as often as every three hours and back-flushed with air as needed to remove debris March 1-May 25. Orifices were inspected and back flushed twice a shift May 25-November 1 when river debris loads were minimal. Orifice operation programming issues continue to be a problem. The facility was operated by two biological technicians to monitor the orifice gallery and the operation of the bypass system during the spring freshet. Orifice lights were checked during daily and nightly inspections.

Primary Dewaterer

The primary bypass system was watered up in bypass mode on March 15. Primary dewaterer floor screen brushes, side screen brushes, and the pneumatic screen cleaners were intermittently operated in auto and manual mode by powerhouse operators and JFF staff due to mechanical and programing issues with the system. Operational changes in response to programming, mechanical, and structural issues with the PDW continue as needed.

Wet Separator/Distribution and Sampling Systems

Water levels in the separator varied with the forebay elevation and PDW operations requiring adjustment in porosity control valves and separator exit gates. Biological technicians adjusted porosity dewatering valves and exit gate positions in response to separator water elevation changes related to PDW weir operation. Separator exit gates were adjusted to improve PIT tag detection efficiencies as coordinated with PSMFC technicians. There were minimal debris obstructions.

Barge Loading Operations

Barge loading operations occurred from April 24 through June 15. The barge loading boom was forced out of service due to a hydraulic pump failure on June 15, shortening the barging season at Lower Granite by two trips. While the loading boom was in service, loading from the raceways went smoothly. Direct loading did not occur.

Truck Loading Operations

Truck transport started as scheduled on August 1 and continued with the last truck departing on November 1.

Recommendations

1. Continue to resolve PDW programming issues.
2. Look into redesigning PDW mechanical screen cleaner.
3. Operate the PDW flume outflow between 35-40 cfs to reduce delays in system.
4. Continue rebuilding motors on the 2000 series barges.
5. Replace barge bumper cable and tire system with bumpers.
6. Paint hulls on 8000 series barges.
7. Install ballast material in barges 4394 and 4382 voids to eliminate use of river water.
8. Improve/modify sample holding tank anesthetic chamber separation door operation.
9. Ensure all researchers working at LGW are accountable for anesthetic waste disposal in compliance with the EPA Clean Water Act.
10. Modify PDW side screen cleaners for reliability and ability to operate system in auto mode.
11. Replace electrical cables, control, and hoist for upstream raceway fish crowder.
12. Construction for roof over upstream raceways.
13. Replace upstream and downstream raceway release manifolds.
14. Replace PVC sample line with a 12-inch flume.
15. Replace sample PIT array with new upgraded flume PIT array.
16. Install inline Vaki Pipeline Counter into the PVC sample line to test system as an alternative method to enumerate fish.
17. Replace PDW floor brushes.

APPENDIX TABLES

Appendix Table 1. Daily collection and bypass numbers and river conditions at Lower Granite Dam, 2023.

Appendix Table 2. Percent descaling and daily facility mortality numbers at Lower Granite Dam, 2023.

Appendix Table 3. Daily number of fish trucked and barged from Lower Granite Dam, 2023.

Appendix Table 4. Daily number of adult fallbacks and fallback mortality at Lower Granite Dam, 2023.