CENWW-OD-DL HOLDREN
January 2023

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

FOR Chief, Operations Division
ATTN: Christopher Peery

SUBJECT: Submission of 2022 Juvenile Fish Collection and Bypass Report, Lower Granite Dam Juvenile Fish Facility.

1. Enclosed find the 2022 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

2022 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 Anchor QEA

January 2023

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

TRANSPORT OPERATIONS - LOWER GRANITE DAM

Introduction

Lower Granite Dam (LWG) 2022 collection season was characterized by average flow, above average spill, below average water temperatures, low descaling rates and higher than average non-salmonid fish collection. Steelhead overshoot spill occurred from March 1-March 30 and again 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 the season except for March and October. 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 14. Extended Length Submersible Bar Screens (ESBSs) were installed in Unit 1 and Units 3-6 from March 21-23. ESBSs were installed in Unit 2 March 29. Juvenile fish facility (JFF) operation was changed 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 19 until collection for truck transport began at 0700 hours August 1.

Research fish were transported by barge April 14 and April 21 as part of the ongoing study to compare in-river verses transported Smolt-to-Adult Return Ratios (SARs). Research fish were bypassed April 5 and April 6 as part of the National Marine Fisheries Service (NMFS) in river survival study. Two agencies conducted five research projects and handled a total of 328,649 smolts at the Lower Granite juvenile collection facility this season in addition to the Smolt Monitoring Program (SMP), gas bubble trauma (GBT) sampling, and kelt collection for Nez Perce Tribe reconditioning program. There were also 2 juvenile lamprey research projects in 2022.

Collection for barge transport occurred from 0700 hours April 23 through 0700 hours June 19. Fish collection resumed for truck transport at 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 2,556,321 during the 2022 season compared to 771,088 in 2021. Distribution of the 2022 total collection excluding mortalities was 348,139 bypassed, 2,159,088 barged, and 47,071 trucked.

Pacific States Marine Fisheries Commission (PSMFC) technicians handled 1,167 and examined 1,073 juvenile salmonids for GBT between April 7 and June 16. Smolts examined were bypassed or sent to the raceway depending on transport operations. One fish was observed with symptoms of GBT during the 2022 season.

The passive integrated transponder (PIT) tag system detected 71,676 PIT-tagged fish at the JFF during the 2022 season. Facility PIT-tagged fish distribution was 25,996 diverted to the river, 43,986 diverted to raceways for transport, 1,536 diverted to sample holding tank, and 158 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. Another 193,437 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 Leads Ray Cooper and Ryan Bonivert, Lead Biological Technician Steven Lee; Biological Technicians: David Riley, Kenneth McIntyre, Kenneth Millar, Cetia Dawson, Kalli Parauka, Erin Fickle, Jon Melnichenko, and Lesley Twiner; and Maintenance personnel/truck transport drivers: Ryan Bonivert, Jeff Kuhn, Ken Wickstrom, and Bradley Gallardo. Anchor QEA was represented by Biologists Shawn Rapp and Environmental Assessment Services was represented by Mark Morasch, Matt Paulsen and Lauren Thielman. Pacific States Marine Fisheries Commission (PSMFC) was represented by Biologists Paul Burke and Darrin Hathaway. PSMFC technicians conducting fish sampling, quality control, data collection, and GBT sampling included Carole Jones, Lauren Thielman and Praxy McIntyre. 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 2022 fish collection season:

1. Installed barge load line PIT tag detection array.
2. Completed front void structural support repairs in barge 8105.
3. Replaced aerators biological balls on barge 8105.
4. Installed electronic controls for raceway supply valves.
5. Completed hydraulic system for the barge loading boom.
6. Continued replacing old mesh on raceway supply headbox screens to prevent fry and juvenile lamprey passage.
7. Continued to install anodes on barge fish hold supply pump to prevent electrolysis corrosion.
8. Continue installing anodes on ESBSs.
9. Continued rebuilding ESBSs and replacing VBS mesh as time permits.
10. Installed electronic operators for all raceway supply knife gate valves.
11. Permanently close the collection channel 5A research weir that is becoming a safety concern.
12. Replace PDW emergency bypass exit hatch.
13. Rebuild raceway tailscreens to reduce weight for personnel safety.
14. Installed PIT detection array on the barge load line.
15. Installed a new hoist for the upstream raceway crowder.

River Conditions

Average daily river flows exceeded 100 kcfs 34 days during the 2022 season with an average total river flow of 53.20 kcfs. The highest daily average flow for the March 26-November 1 collection season was 208.72 kcfs June 14. This is the latest peak flow recorded at LWG since at least 1985. Lowest daily average flow for the season was 14.0 kcfs October 17. Spill for juvenile fish passage occurred for 152 days from April 3 through midnight on 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 31. RSW only operation began after average total outflow dropped below 30 kcfs (August 16-31). Spill was distributed according to the Fish Passage Plan (FPP) Table LWG-7 and LWG-8. Average season flow through spillways was 32.9 kcfs with a maximum daily average of 102.5 kcfs June 14 and a minimum daily average of 9.3 kcfs August 30. Adult steelhead overshoot spill through the RSW occurred from 0500-0900 hours on Sundays, Tuesdays, and Thursdays March 1 to March 30 and from September 1 to November 15. This operation was modified to 2-hour blocks 6 days per week September 22 to October 12 in response TDG exceeding 110%. River temperatures collected as part of the daily condition sample averaged 57.4° F for the season and ranged from 43.2° F April 20 to 66.7° F July 21. Daily powerhouse outflow and spill is shown in Figure 1. Average monthly flow and spill for the 2018-2022 collection seasons are provided in Table 1.

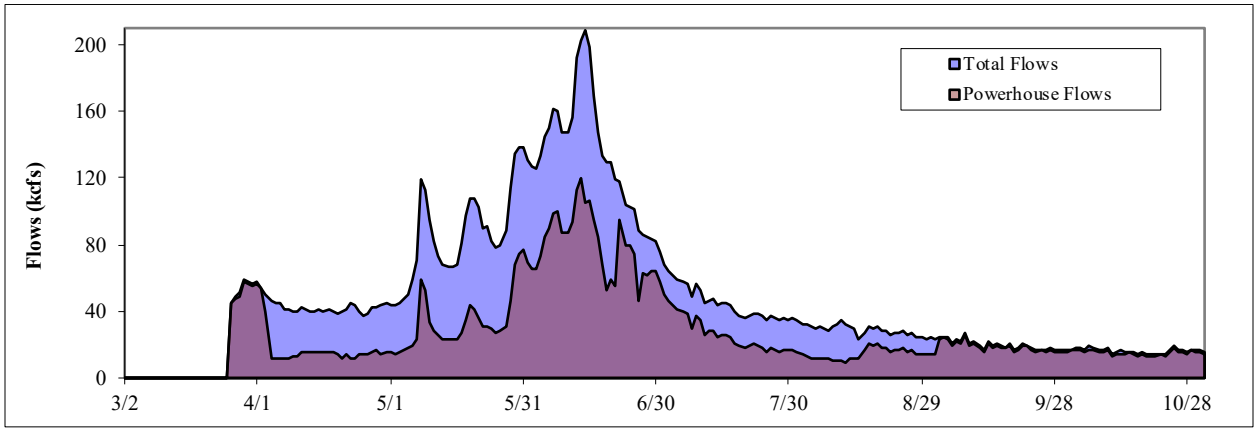

Figure 1. Daily average total flow (kcfs) and powerhouse flow at Lower Granite Dam, 2022.

Table 1. Comparison of average monthly river flow (kcfs) and spill (kcfs) at LWG, 2018-2022.

Flow (kcfs)	2018	2019	2020	2021	2022	2018–21 Avg.
March	58.80	76.68	33.82	41.43	53.08	42.64
April	94.33	121.47	54.67	49.91	42.66	80.09
May	139.11	122.06	106.17	70.51	85.29	109.46
June	82.92	92.71	98.06	54.10	135.44	81.95
July	38.22	38.54	50.77	25.13	46.17	38.17
August	29.48	28.92	28.63	22.28	28.87	27.33
September	22.97	25.75	24.01	19.50	20.12	23.06
October	18.70	22.13	20.95	16.80	16.27	19.65
Spill (kcfs)						
March	6.85	0.02	0.00	0.51	0.54	0.78
April	40.61	46.18	32.40	28.99	24.68	37.04
May	42.76	42.73	62.02	45.48	51.20	48.25
June	30.94	35.66	53.73	32.29	54.90	38.15
July	17.48	18.62	19.87	10.02	18.14	16.50
August	16.12	16.18	12.37	10.17	13.86	13.71
September	0.42	0.29	0.16	0.16	0.94	0.26
October	0.00	0.00	0.49	0.75	0.73	0.31

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 again from 0700 hours June 19 through 0700 hours August 1. Collection for barge transport occurred from 0700 hours April 23 through 0700 hours June 19. Two research barges departed LWG April 14 and 21 as part of NMFS seasonal effects transportation study. Truck transport occurred from 0700 hours August 1 through 0700 hours November 1. An estimated 2,556,321 juvenile salmonids were collected during the 2022 season compared to 771,088 in 2021 (Table 2). The percent of the total collection for each species was: 35.8% clipped and 8.8% unclipped yearling Chinook salmon *Oncorhynchus tschawytscha*, 5.9% clipped and 12.0% unclipped subyearling Chinook salmon, 24.8% clipped and 7.9% unclipped Steelhead trout *O. mykiss*, 1.6% clipped and 0.1% unclipped Sockeye/Kokanee salmon *O. nerka*, and 3.0% Coho salmon *O. kisutch*. Daily collection and bypass numbers are provided in Appendix Table 1.

Table 2. Annual collection, bypass, transportation and mortality at LWG, 2018-2022.

	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										
2018	2,342,198	698,954	208,584	329,159	1,877,057	645,906	165,786	22,959	182,829	6,473,432
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
Bypass										
2018	353,084	257,945	1,075	13,690	599,397	112,054	12	4,483	3,543	1,345,283
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
Truck										
2018	0	7	665	12,387	0	2	0	40	9	13,110
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
Barge										
2018	1,988,387	440,782	206,504	302,296	1,277,515	533,803	165,687	18,378	179,217	5,112,569
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
Total Transport										
2018	1,988,387	440,789	207,169	314,683	1,277,515	533,805	165,687	18,418	179,226	5,125,679
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
2022 Mortalities										
Facility	726	239	191	558	110	26	54	30	89	2,023
NMFS	130	36	45	116	36	3	9	27	14	416
Res/Sac	0	30	0	0	21	1	0	0	0	52

By the end of May, 80.9% of the total season collection had occurred. The percent of total collection arriving by the end of June and the end of July was 95.7% and 98.1%, respectively. The remaining 1.9% 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 2022 peaked at 346,200 (May 8). This was the second highest peak collection day and the second latest peak collection day in the last 5 years. The peak daily collection total and date for each species group for 2018-2022 are listed in Table 3.

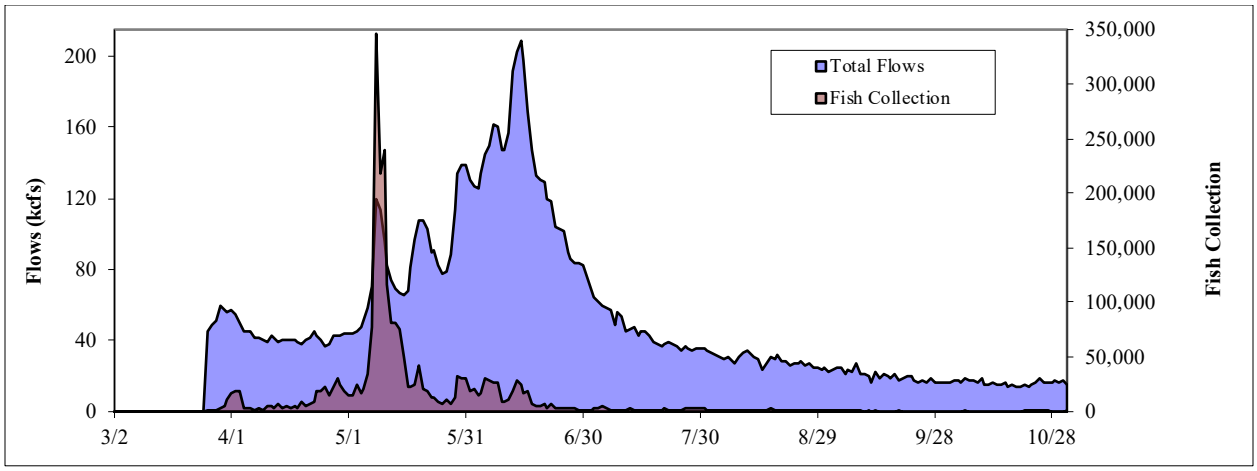

Figure 2. Fish collection and daily average flows at LWG, 2022.

Table 3. Annual peak collection days at LWG, 2018-2022.

	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
2018	9-May	1-May	29-May	27-May	14-Apr	10-May	17-May	17-May	10-May	10-May
	196,200	33,600	19,400	26,800	93,403	49,400	40,800	1,600	18,800	383,600
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

Adult Fallbacks

A total of 2,449 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 through 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, 2018-2022.

	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
2018	297	350	124	252	762	616	4	3	17	2,425
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
18–21 Ave.	216	285	341	236	613	550	5	20	45	2,311

Steelhead were the most common adult salmonid species removed from the separator in 2022 (Table 5). March through May accounted for 28.6% of adult steelhead removed from the separator. The remaining 71.4% 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 (72.0%) were removed from the separator during September and October (fall Chinook salmon). There were 17 clipped and 1 unclipped Sockeye/Kokanee salmon fallbacks released back to the river July through September. A total of 70 Coho salmon fallbacks were released to the river from the separator with 63 (90.0%) removed in October.

Table 5. Monthly totals of adult salmonids released from the separator at LWG, 2022.

	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	20	18	0	0	0	38
April	0	0	0	0	51	32	0	0	0	83
May	34	8	6	0	125	120	0	0	0	293
June	49	38	9	3	45	163	1	0	0	308
July	30	16	11	3	6	3	11	1	0	81
August	14	18	6	5	55	40	2	0	0	140
September	145	183	70	62	242	105	3	0	7	817
October	99	104	99	70	197	57	0	0	63	689
Totals	371	367	201	143	741	538	17	1	70	2,449

Adult salmonid condition was classified as good, fair, poor, or dead prior to being released from the separator (Table 6). Overall, 95.6% of fallback condition was classified as good to fair. Condition ratings of adult salmonids examined were as follows: 84.6% good, 10.9% fair, 4.3% poor, and 0.1% mortalities. Adult salmonid mortalities included 1 clipped and 1 unclipped steelhead kelts. Jack Chinook salmon had the highest percent of good/fair fish (99.4%) followed by adult Chinook salmon (97.7%) and steelhead (93.4%). There were 155 adult Pacific lamprey (*Entosphenus tridentatus*) collected at the juvenile facility and released at Offield Landing boat ramp. Of the 155 lamprey released, there were 103 removed from the sample tank, 49 from the raceways, 2 from the separator and a single fish removed from the flume.

Table 6. Condition of adult salmonids released from the separator at LWG, 2022.

	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	327	334	184	129	585	440	11	1	62	2,073
Fair	32	28	16	13	105	65	3	0	6	268
Poor	12	5	1	1	50	32	3	0	2	106
Dead	0	0	0	0	1	1	0	0	1	2
Total	371	367	201	143	741	538	17	1	70	2,449

Sampling

Consistent with the 2022 Fish Operations Plan (FOP), Appendix E of the 2022 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. All fish sampled prior to transport were bypassed to the river. 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 50% March 25 and fluctuated from a minimum of 0.5% to a maximum of 100% based on daily fish numbers and when accommodating for approved research needs. Due to the large numbers of unclipped Sockeye/Kokanee salmon, likely being from Dworshak reservoir, observed in the daily sample during March and April, the sampling protocol was changed in 2021. During March and April unclipped Sockeye/Kokanee salmon without CWT or PIT tags are classified as Kokanee salmon and recorded as an incidental fish. Smolt monitoring personnel sampled 340 unclipped Sockeye/Kokanee salmon from March 2 to April 30, compared to 5,744 in 2021, and 11 in 2020. 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/Kokanee salmon from the Stanley Basin. The smolt monitoring staff sampled 70,811 smolts or 2.8% of the total facility collection compared to 49,737 smolts or 6.5% of the total facility collection in 2021 (Table 7).

Table 7. Annual percentage of smolts sampled at LWG, 2018-2022.

	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
2018	0.6	0.7	3.1	7.9	0.6	0.6	0.5	1.1	0.6	1.1
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
18–21 Avg.	0.8	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 2022 by species included: 17.7% clipped and 7.5% unclipped yearling Chinook salmon, 9.2% clipped and 43.2% unclipped subyearling Chinook salmon, 16.1% clipped and 4.3% unclipped steelhead, 0.4% clipped and 0.1% unclipped Sockeye/Kokanee salmon, and 1.6% Coho salmon (Table 8).

Table 8. Weekly sample totals at LWG, 2022.

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
3-Mar	0	0	0	0	0	0	0	0	0	0
10-Mar	0	0	0	0	0	0	0	0	0	0
17-Mar	0	0	0	0	0	0	0	0	0	0
24-Mar	0	0	0	0	0	0	0	0	0	0
31-Mar	917	1496	0	20	537	91	0	0	14	3075
7-Apr	454	381	0	8	1154	291	0	0	4	2292
14-Apr	627	436	0	12	667	116	0	0	3	1861
21-Apr	1417	541	0	4	688	68	0	0	1	2719
28-Apr	1195	280	0	6	2051	86	0	0	3	3621
5-May	1661	185	0	10	721	113	0	0	29	2719
12-May	3361	494	11	149	1666	517	12	3	248	6461
19-May	1093	340	48	115	699	321	242	4	65	2927
26-May	776	326	85	166	574	378	4	6	78	2393
2-Jun	823	519	610	941	673	403	0	1	228	4198
9-Jun	84	99	968	976	523	278	0	1	138	3067
16-Jun	65	126	1283	1564	575	198	1	11	104	3927
23-Jun	19	35	632	1031	424	104	1	11	40	2297
30-Jun	14	34	299	746	355	57	0	13	91	1609
7-Jul	1	4	651	1178	45	9	0	3	29	1920
14-Jul	1	1	630	1188	13	2	0	2	6	1843
21-Jul	0	0	561	1536	2	0	0	1	3	2103
28-Jul	0	0	347	2526	1	0	0	0	5	2879
4-Aug	0	0	85	1464	0	0	0	1	2	1552
11-Aug	0	0	44	1317	0	0	0	0	0	1361
18-Aug	0	0	50	2203	0	0	0	1	2	2256
25-Aug	0	0	17	1164	0	1	0	0	1	1183
1-Sep	0	0	22	1104	0	1	0	0	2	1129
8-Sep	0	0	15	1038	0	0	0	2	3	1058
15-Sep	0	0	25	1357	2	7	0	1	3	1395
22-Sep	0	1	13	1435	0	1	0	3	8	1461
29-Sep	0	0	8	685	1	4	0	3	4	705
6-Oct	0	0	32	845	3	2	0	6	1	889
13-Oct	0	0	12	628	0	2	0	4	1	647
20-Oct	0	0	14	1104	1	1	0	3	0	1123
27-Oct	0	1	38	2971	3	1	0	10	1	3025
1-Nov	0	1	9	1095	0	5	0	3	3	1116
Totals	12,508	5,300	6,509	30,586	11,378	3,057	260	93	1,120	70,811

Transportation

An estimated 2,206,159 juvenile salmonids were transported from Lower Granite Dam in 2022 by barge and truck combined. This is the third highest number of fish transported and the highest percent of the collection transported in the last 5 years. The number transported was 86.3% of the total facility collection. The percentage of the total collection that was transported of each species group from Lower Granite included: 94.8% clipped and 81.8% unclipped yearling Chinook salmon, 74.0% clipped and 72.6% unclipped subyearling Chinook salmon,

82.9% clipped and 87.2% unclipped steelhead, 99.8% clipped and 82.0% unclipped Sockeye/Kokanee salmon, and 95.7% Coho salmon. Daily barge transportation numbers are provided in Appendix Table 2.

Collection occurred for the NMFS seasonal effects study to compare transport and in-river smolt to adult returns (SARs) and the survival study occurred from April 5 through June 18. Fish were collected April 5 and April 6 were bypassed as part of the reach survival study. Fish collected for NMFS transport study April 12 and April 13 were transported April 14 and fish collected April 19 and April 20 were transported April 21. Collection for general barge transport occurred 0700 hours April 23 through 0700 hours June 19 from Lower Granite. Every other day barging operations occurred April 24 to May 16 and from May 26 to June 19 and everyday barging occurred May 17 through May 24. The June 13 barge trip was cancelled due to high river flows creating unsafe conditions for loading fish. Fish collected for this trip were bypassed from the juvenile fish facility raceways directly to the river. An estimated 2,159,088 juvenile salmonids were transported by barge from Lower Granite Dam in 2022. The percent transported by barge was 84.5% of the total facility collection and for each species group included 94.8% clipped and 81.8% unclipped yearling Chinook salmon, 73.4% clipped and 57.7% unclipped subyearling Chinook salmon, 82.9% clipped and 87.1% unclipped steelhead, 99.8% clipped and 79.8% unclipped Sockeye/Kokanee salmon, and 95.6% Coho salmon. A total of 4,842,407 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 juvenile fish transportation program.

Barge oxygen levels are monitored with a Point Four systems on 4000 and 8000 series barges. YSI portable oxygen monitoring units are used to monitor oxygen on the 2000 series barges and as backup systems on all other barges. Temperature and oxygen data is recorded every two hours during loading and then every four hours until fish are released. TDG monitoring systems were installed in the seachest and a barge hold in 2021. Improvements to this system will include data logging capability and GPS location.

Lower Granite transported 47,071 smolts by truck which is 1.8% 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 2022. There were 46 truck trips this season with 38 using the pickup and 8 using the flatbed. Lower Granite did not transport fish collected at LGO by truck in 2022. The number of smolts trucked from LWG by species included: 3 unclipped yearling Chinook salmon, 921 clipped and 45,981 unclipped subyearling Chinook salmon, 9 clipped and 38 unclipped steelhead, 50 unclipped Sockeye/Kokanee salmon, and 69 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 Dam juvenile system was watered up in primary bypass March 14 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 again from June 20 to August 1. An estimated 348,139

juvenile salmonids, 13.6% of the total collection, were bypassed directly back to the river from the juvenile collection facility during the 2022 season. The number of bypassed fish was estimated based on the 0700-0700 daily sample. There were 166,353 juvenile salmonids, 6.5% of the total collection, bypassed March 25 to April 23. Another 101,211 juvenile salmonids, 4.0% of the total collection, were bypassed from June 20 to August 1. During collection for transport season 80,575 juvenile (3.2%) salmonids were bypassed from the collection facility. The percent of the total collection of each species bypassed included: 5.2% clipped and 18.1% unclipped yearling Chinook salmon, 25.8% clipped and 27.2% unclipped subyearling Chinook salmon, 17.0% clipped and 12.8% unclipped steelhead, <0.1% clipped and 16.7% unclipped Sockeye/Kokanee salmon, and 4.2% 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 fish prior to April 24, fish collected and provided for research needs, and steelhead during late season trucking operations. Fish provided for research needs are recorded as bypassed including research mortalities. There were 52 research mortalities reported during 2022. There were 416 mortalities removed from the east raceways that held NMFS transport research fish. East raceway mortalities are included in Lower Granite facility mortality when raceways were also used for standard transport collection in addition to NMFS studies. 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 18-24 for Units 1 and 3-6, and March 29 for Unit 2. ESBSs for unit 1-4 and 6 were removed November 14-17 and unit 5 ESBSs were removed November 23 to support transformer gasket replacement on phase T1A.
2. Secondary bypass occurred from March 25 through April 23 and from June 20 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 292 fish sampled for GBT and then bypassed between April 8 and April 22. Bypassed fish included 129 clipped and 60 unclipped yearling Chinook salmon, 98 clipped and 5 unclipped steelhead.
4. There were 40,248 fish collected and bypassed as part of research projects this season (See; Research Section).
5. There were 25,996 PIT-tagged fish juvenile 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 13 barge trip were bypassed from the fish facility due to high river flows creating unsafe barge loading conditions.

According to the PTAGIS database, 71,676 PIT-tagged fish were detected in the LWG juvenile collection facility in 2022. Of the detected fish, 36.3% were bypassed to the LWG tailrace through the PIT tag diversion system, 61.4% were diverted to the raceways to be transported, 2.1% were diverted to the sample tank, and 0.2% 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 193,437 PIT tagged fish detected passing

over the RSW PIT tag detectors and presumably bypassed. All PIT tagged fish were bypassed to the river from March 25 through April 23 and June 20 to August 1, except for fish collected on April 12, April 13, April 19, and April 21 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 1,117,288 incidental species were collected at the fish facility during the March 25 to November 1 passage period compared to 1,281,744 in 2021 (Table 9). This is the second highest collection of incidental species since at least 1999. The 1999 to 2016 average number of incidentals collected during the smolt monitoring season was 42,474 compared to 603,802 for the 2018 to 2022 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 *Exopalaemon modestus* collection has increased significantly since they were first observed at LWG in 2004. Siberian prawn collection was 668,377 this season compared to 1,179,365 in 2021, 145,030 in 2020, 71,565 in 2019, and 43,434 in 2018. All Siberian prawns in the sample were euthanized (per Washington Department of Fish and Wildlife permit requirements) and disposed of in landfills.

The following incidental species had the highest annual collection ever observed at LWG when compared to the 1999 to 2021 average. Smallmouth bass *Micropterus dolomieui* collection was 20,444 compared to 2,342, sunfish *Lepomis* spp. collection was 13,697 compared to 670, crappie *Pomoxis spp.* collection was 11,909 compared to 2,368, adult Pacific lamprey collection was 163 compared to 26, larval Pacific lamprey (ammocoetes) collection was 191,314 compared to 8,262, and juvenile lamprey (macropthalmia) collection was 187,426 compared to 18,475.. Walleye *Stizostedion vitreum* collection was 31 compared to 14 in 2021 and 5 in 2020, 13 in 2019, 5 in 2018, 1 in 2017, 3 in 2016 and 1 in 2015.

Table 9. Estimated collection of incidental fish species at LWG, 2022.

Common Name	*Scientific Name*	Separator	Expanded Sample	Total Collection[1]
American Shad (Adult)	*Alosa sapidissima*	15	14	29
American Shad (Juvenile)	*A. sapidissima*	0	337	337
Banded Killifish	*Fundulus diaphanus*	0	70	70
Bass, Largemouth	*Micropterus salmoides*	0	13	13
Bass, Smallmouth	*M. dolomieui*	9	20,435	20,444
Bullhead (misc.)	*Amierus spp.*	3	580	583
Catfish, Channel	*Ictalurus punctatus*	51	530	581
Catfish, Flathead	*Pylodictis olivaris*	0	0	0
Chiselmouth	*Acrocheilus alutaceus*	3	103	106
Common Carp	*Cyprinus carpio*	43	94	137
Crappie (misc)	*Pomoxis spp.*	222	11,687	11,909
Dace, Longnose	*Rhinichthys cataractae*	0	112	112
Dace, Speckled	*R. osculus*	0	0	0
Kokanee[2]	*Oncorhynchus nerka*	0	3,240	3,240
Northern Pikeminnow	*Ptychocheilus oregonensis*	9	97	106
Pacific Lamprey (Adult)	*Entosphenus tridentatus*	2	161	163
Pacific Lamprey (Ammocoete)	*E. tridentatus*	0	191,314	191,314
Pacific Lamprey (Macrophthalmia)	*E. tridentatus*	0	187,426	187,426
Peamouth	*Mylocheilus caurinus*	22	8,296	8,318
Redside Shiner	*Richardsonius balteatus*	0	0	0
Sand Roller	*Percopsis transmontana*	1	2,139	2,140
Sculpin	*Cottus sp.*	0	218	218
Siberian Prawn	*Exopalaemon modestus*	0	668,377	668,377
Sucker (misc.)	*Catostomus spp.*	499	4,527	5,026
Sunfish (misc.)	*Lepomis spp.*	3	13,694	13,697
Trout, Bull	*Salvelinus Malma*	0	0	0
Trout, Cutthroat	*Oncorhynchus clarkii*	0	0	0
Trout, Rainbow	*O. mykiss*	351	0	351
Walleye	*Stizostedion vitreum*	17	14	31
Warmouth	*Lepomis gulosis*	0	100	100
White Sturgeon	*Acipenser transmontanus*	5	0	5
Whitefish	*Prosopium spp.*	3	2,449	2,452
Yellow Perch	*Perca flavescens*	2	1	3
Total		1,260	1,116,028	1,117,288

[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.

Fish Condition

Descaling

The standard descaling criteria is classified as a fish with scale loss of 20% or greater scale on one side of the body. Scale loss less than 20% on one side of the body is not considered descaled. PSMFC and Anchor QEA 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 2022 was 0.7% compared to 1.5% in 2021 and 1.3% for the 2018 to 2021 average (Table 10). This is the lowest descaling rate observed at LWG since at least 1995. The annual descaling rate by species group was 0.6% clipped and 0.6% unclipped yearling Chinook salmon, 0.3% clipped and 0.4% unclipped subyearling Chinook salmon, 1.7% clipped and 1.5% unclipped steelhead, 1.2% clipped and 4.5% unclipped Sockeye/Kokanee salmon and 1.3% Coho salmon.

Table 10. Annual full-sample descaling rates (>20%) by species at LWG, 2018-2022.

	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
2018	1.3	0.8	0.6	0.8	3.6	2.7	1.0	3.3	1.4	1.5
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	0.9	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	4.5	1.3	0.7
18–21 Ave.	1.4	0.9	0.7	0.7	2.5	2.4	1.5	4.6	1.4	1.3

The highest weekly descaling rate for all species combined was 1.9% for the week ending May 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 only slightly in September and October in 2022. The highest descaling rates were observed in early March, May, and early June this season. 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, 2022.

	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
24-Mar										
31-Mar	0.67	0.62	--	--	0.56	0.00	--	--	0.00	0.60
7-Apr	0.45	0.80	--	--	0.26	0.69	--	--	0.00	0.44
14-Apr	0.64	0.23	--	--	0.90	1.72	--	--	0.00	0.71
21-Apr	0.64	0.19	--	--	0.87	0.0	--	--	0.00	0.59
28-Apr	0.42	0.00	--	--	0.20	1.18	--	--	0.00	0.28
5-May	0.36	0.00	--	0.00	2.08	1.77	--	--	0.00	0.85
12-May	0.89	1.02	0.00	0.00	4.21	2.71	0.00	0.00	0.00	1.88
19-May	0.73	1.76	0.00	0.00	2.72	2.81	1.24	0.00	0.00	1.56
26-May	0.13	0.31	2.35	0.69	3.66	1.32	0.00	0.00	0.00	1.31
2-Jun	0.37	0.19	0.00	0.11	3.13	1.49	--	0.00	3.10	0.94
9-Jun	0.00	0.00	0.10	0.11	3.08	0.36	--	0.00	1.45	0.70
16-Jun	0.00	1.59	0.39	0.07	1.74	1.01	0.00	0.00	3.85	0.64
23-Jun	0.00	2.86	0.48	0.23	0.71	2.88	0.00	9.09	0.00	0.61
30-Jun	0.00	2.94	0.00	0.15	0.00	0.00	--	16.67	2.20	0.39
7-Jul	0.00	0.00	0.77	0.35	0.00	0.00	--	0.00	0.00	0.47
14-Jul	0.00	0.00	0.16	0.43	0.00	0.00	--	0.00	0.00	0.33
21-Jul	--	--	0.36	0.40	0.00	--	--	0.00	0.00	0.38
28-Jul	--	--	0.58	0.12	0.00	--	--	--	0.00	0.17

4-Aug	--	--	1.19	0.48	--	--	--	0.00	0.00	0.52
11-Aug	--	--	0.00	0.15	--	--	--	--	--	0.15
18-Aug	--	--	0.00	0.23	--	--	--	0.00	0.00	0.22
25-Aug	--	--	0.00	0.00	--	0.00	--	--	0.00	0.00
1-Sep	--	--	0.00	0.27	--	0.00	--	--	0.00	0.27
8-Sep	--	--	0.00	0.48	--	--	--	0.00	0.00	0.48
15-Sep	--	--	0.00	1.19	0.00	0.00	--	0.00	0.00	1.16
22-Sep	--	0.00	0.00	0.42	--	0.00	--	0.00	0.00	0.41
29-Sep	--	--	0.00	0.88	0.00	0.00	--	33.33	0.00	1.00
6-Oct	--	--	0.00	0.60	0.00	0.00	--	0.00	0.00	0.57
13-Oct	--	--	0.00	0.32	--	0.00	--	0.00	0.00	0.31
20-Oct	--	--	0.00	0.64	0.00	0.00	--	0.00	--	0.63
28-Oct	--	0.00	0.00	0.44	0.00	0.00	--	0.00	0.00	0.43
1-Nov	--	0.00	0.00	0.46	--	0.00	--	0.0	0.00	0.45
# Descaled	74	31	22	107	195	47	3	4	15	498
# Sampled	12,465	5,229	6,467	29,639	11,358	3,053	259	88	1,117	69,675
% Descaled	0.59%	0.59%	0.34%	0.36%	1.73%	1.54%	1.16%	4.55%	1.34%	0.72%

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 32,410 fish examined for injury and disease and 4,142 fish (12.8%) were afflicted with an injury or disease symptom in 2022. 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 9.5% 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 2022 was general fin injury (61.8%), followed by fin discoloration (15.2%), pink fin (14.8%), body injury (4.5%), and body deformities (3.7%). Unclipped Sockeye/Kokanee salmon had the highest incidence of body injuries (17.0%), followed by clipped Sockeye/Kokanee salmon (12.0%), clipped yearling Chinook salmon (10.9%), and unclipped subyearling fall Chinook salmon (10.0%).

Head injuries were recorded on 0.5% of the smolts examined in the detailed subsample. Unclipped Sockeye/Kokanee salmon had the highest incidence of head injury (4.5%), followed by unclipped yearling Chinook salmon (1.7%), Coho salmon (0.7%) and clipped steelhead (0.7%). Operculum injuries (39.5%) were the most frequently observed type of head injury, followed by eye hemorrhages (27.7%), eye injuries (14.1%), general head injuries (10.2%), and "pop" eye (8.5%).

Injuries associated with predators include wounds inflicted by other fish, birds, and lamprey. Predator wounds were observed on 0.5% 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 60.6% compared to 37.8% caused by fish and 1.7% caused by lamprey. Predator marks were highest on clipped Sockeye/Kokanee salmon (1.9%), followed by unclipped Sockeye/Kokanee salmon (1.1%), clipped steelhead (0.9%), and unclipped steelhead (0.8%). Injuries caused by lamprey were observed on 0.01% of all condition sampled smolts in 2022 compared to 0.53% in 2021 and 0.02% in 2020.

External symptoms of disease were observed on 3.0% of the smolts examined in the detailed subsample compared to 4.5% in 2021, 4.7 in 2020, 6.5% in 2019, and 5.9% in 2018. Symptoms of disease were most common on unclipped Sockeye/Kokanee salmon (11.4%), followed by unclipped subyearling Chinook salmon (4.4%) and clipped subyearling Chinook salmon (4.1%). Of the fish afflicted, fin hemorrhages comprised the majority of disease symptoms (73.9%), followed by parasites (12.4%), fungus (10.4%), bacterial kidney disease (2.6%), and Columnaris (0.7%).

Fin hemorrhage was found on 2.2% of all species and rearing types examined. Fin hemorrhage was the primary disease afflicting subyearling Chinook salmon and was observed on 4.2% of unclipped and 3.7% of clipped subyearling Chinook salmon examined but 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 28. The 2022 Columnaris infection rate for subyearling Chinook salmon was 0.02% (6 of 36,106) compared to 2018-2021 average of 0.6%. This is the lowest Columnaris infection rate observed at LWG.

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 0.08% in 2022 and totaled 2,023 fish (Table 12). Within each species group the number of facility mortalities were 726 clipped and 239 unclipped yearling Chinook salmon, 191 clipped and 558 unclipped subyearling Chinook salmon, 110 clipped and 26 unclipped steelhead, 54 clipped and 30 unclipped Sockeye/Kokanee salmon, and 89 Coho salmon.

Table 12. Annual facility mortality in percent by species group at LWG, 2018-2022.

	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
2018	0.03	0.03	0.16	0.24	0.01	0.01	0.05	0.25	0.03	0.04
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
18-21 Ave.	0.06	0.05	0.18	0.22	0.01	0.01	0.11	0.44	0.06	0.05

Weekly facility mortality rates were highest during the week of March and September and October and peaked at 1.55% the week ending on October 13. Weekly facility mortality rates are provided in Table 13.

Table 13. Weekly facility mortality in percent by species group at LWG, 2022.

	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	--	--	--	--	--	--	--	--	--	--
31-Mar	0.42	0.58	--	1.12	0.01	0.00	--	--	0.00	0.34
7-Apr	0.05	0.07	--	0.35	0.02	0.00	--	--	0.00	0.03
14-Apr	0.03	0.10	--	1.00	0.01	0.00	--	--	0.00	0.05
21-Apr	0.03	0.05	--	0.00	0.02	0.00	--	--	0.00	0.03
28-Apr	0.08	0.16	--	0.00	0.01	0.03	--	--	0.00	0.05
5-May	0.09	0.21	--	0.20	0.04	0.00	--	--	0.00	0.08
12-May	0.07	0.07	0.09	0.04	0.01	0.01	0.00	0.17	0.02	0.05
19-May	0.10	0.06	0.09	0.20	0.01	0.02	0.14	0.00	0.02	0.07
26-May	0.03	0.06	0.13	0.14	0.02	0.01	0.00	0.00	0.07	0.04
2-Jun	0.08	0.16	0.07	0.08	0.03	0.02	--	0.00	0.21	0.08
9-Jun	0.29	0.10	0.12	0.14	0.05	0.03	--	4.00	0.55	0.13
16-Jun	0.20	0.08	0.11	0.18	0.06	0.03	0.00	3.16	0.52	0.15
23-Jun	0.00	0.00	0.20	0.22	0.04	0.00	0.00	5.29	0.30	0.19
30-Jun	0.00	0.00	0.03	0.12	0.00	0.00	--	0.77	0.00	0.07
7-Jul	0.00	0.00	0.03	0.02	0.00	0.00	--	0.00	0.00	0.02
14-Jul	0.00	0.00	0.36	0.21	0.00	0.00	--	0.00	0.00	0.26
21-Jul	--	--	0.20	0.28	0.00	--	--	0.00	0.00	0.26
28-Jul	--	--	0.23	0.16	0.00	--	--	--	0.00	0.16
4-Aug	--	--	0.12	0.11	--	--	--	0.00	0.00	0.11
11-Aug	--	--	0.45	0.35	--	--	--	--	--	0.35
18-Aug	--	--	0.65	0.15	--	--	--	0.00	0.00	0.16
25-Aug	--	--	1.05	0.36	--	0.00	--	--	0.00	0.37
1-Sep	--	--	0.91	0.34	--	20.00	--	--	0.00	0.37
8-Sep	--	--	6.25	0.58	--	--	--	10.00	6.67	0.69
15-Sep	--	--	3.13	1.43	0.00	0.00	--	0.00	0.00	1.45
22-Sep	--	0.00	7.69	0.70	--	0.00	--	0.00	0.00	0.75

29-Sep	--	--	12.50	0.44	0.00	0.00	--	0.00	0.00	0.57
6-Oct	--	--	0.00	0.95	0.00	0.00	--	0.00	0.00	0.90
13-Oct	--	--	0.00	1.59	--	0.00	--	0.00	0.00	1.55
20-Oct	--	--	0.00	0.72	0.00	0.00	--	0.00	--	0.71
28-Oct	--	0.00	0.00	0.61	0.00	0.00	--	10.00	100.00	0.66
1-Nov	--	0.00	0.00	0.46	--	0.00	--	0.00	0.00	0.45
# mortalities	726	239	191	558	110	26	54	30	89	2,023
# collected	914,982	224,009	152,095	307,473	633,227	203,224	41,440	2,282	77,589	2,556,321
% mortality	0.08%	0.11%	0.13%	0.18%	0.02%	0.01%	0.13%	1.31%	0.11%	0.08%

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 0.56% in 2022 (Table 14) and totaled 398 fish. This is the third highest sample mortality rate since 2018, and slightly above the 0.52% sample mortality rate observed for the 2018 to 2021 average. The number of sample mortalities and percent mortality by species group included 43 clipped (0.34%) and 71 unclipped (1.34%) yearling Chinook salmon, 42 clipped (0.65%) and 209 (0.68%) unclipped subyearling fall Chinook salmon, 20 clipped (0.18%) and 4 unclipped (0.13%) steelhead, 1 clipped Sockeye/Kokanee salmon (0.38%), 5 unclipped Sockeye/Kokanee salmon (5.38%), and 3 Coho salmon (0.27%). All species groups sample mortality rates were lower than the 2018 to 2021 average except for unclipped yearling Chinook salmon, clipped subyearling fall Chinook salmon and unclipped Sockeye/Kokanee salmon. Sample mortality for all groups combined since 2018 has ranged from a high of 0.58% in 2018 to a low of 0.45% in 2019.

Table 14. Annual sample mortality by species group in percent at LWG, 2018-2022.

	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
2018	0.32	0.31	0.85	0.87	0.30	0.27	0.72	1.99	0.00	0.58
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
18–21 Ave.	0.41	0.45	0.54	0.70	0.19	0.21	0.91	4.73	0.35	0.52

Barge mortalities are salmonids removed from barge holds after the barges depart LWG. The total number of smolts barged in 2022 included: 2,159,088 fish from LWG, 1,355,206 from LGS, and 1,328,113 fish from LMN. The seasonal barge transport program mortality rate was 0.02% (868 of 4,842,407) (Table 16). Barge mortalities by species group included: 609 clipped and 36 unclipped yearling Chinook salmon, 31 clipped and 21 unclipped subyearling Chinook salmon, 111 clipped and 10 unclipped steelhead, 31 clipped and 10 unclipped Sockeye/Kokanee salmon, and 9 Coho salmon (Table 15).

Table 15. Total annual transport program barge mortalities 2018-2022.

	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
2018	2,945	782	270	311	690	283	50	47	15	1	5,394
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
18–21 Ave.	1,152	283	84	91	356	129	23	12	4	0	2,134

Fish truck transport mortality rate in 2022 was 0.10% (47 of 47,071) (Table 16). The 3500-gallon semi-truck was not used for any trips in 2022. The 1000-gallon tank was used for trips on August 3, August 19, August 31 to September 4, September 26, October 18, and October 26. The 300-gallon tank was used for all other trips during the trucking season. No trips picked up fish from LGS in 2022. A total of 47,071 fish were collected and transported by truck from LWG. Truck mortality number and percent by species included: 5 clipped (0.54%) and 40 unclipped (0.04%) subyearling fall Chinook salmon, 1 Coho salmon (1.45%) and 1 unknown steelhead.

Table 16. Annual percent truck mortality at LWG, 2018 -2022.

	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
2018	--	14.30	0.60	0.10	--	0.00	--	17.50	0.00	0.19
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	--	0.00	0.00	0.05
2022	--	0.00	0.54	0.09	0.00	0.00	--	0.00	1.45	0.10
18-21 Ave.	0.00	0.77	0.21	0.06	0.00	1.80	--	4.84	0.25	0.09

--no fish trucked

Gas Bubble Trauma Monitoring (PSMFC)

Juvenile salmonids were sampled for GBT from April 7 through June 16 in 2022. PSMFC personnel examined up to 100 clipped and unclipped yearling Chinook salmon and steelhead each week for evidence of bubbles in paired and unpaired fins, and in the eye, as per Fish Passage Center GBT protocols. This season 1,167 salmonids were netted off the separator, anesthetized, and handled by PSMFC technicians. Salmonids examined for GBT symptoms totaled 1,073 fish and included: 462 clipped and 112 unclipped yearling Chinook salmon and 389 clipped and 110 unclipped steelhead. During GBT sampling 29 PIT-tagged smolts were handled, not examined, and returned to the separator, including 10 clipped and 2 unclipped yearling Chinook salmon, and 9 clipped and 8 unclipped steelhead. An additional 65 smolts were handled and released to the separator without examination, including 4 clipped and 18 unclipped subyearling fall Chinook salmon, 1 clipped steelhead, 20 clipped Sockeye/Kokanee salmon, and 22 Coho salmon. Smolts examined for GBT prior to April 23 were released 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 292 smolts were bypassed including 129 clipped and 60 unclipped yearling Chinook salmon, and 98 clipped and 5 unclipped steelhead. A total of 875 smolts were transported including: 343 clipped and 54 unclipped yearling Chinook salmon, 4 clipped and 18 unclipped subyearling Chinook salmon, 301 clipped and 113 unclipped steelhead, 20 clipped Sockeye/Kokanee salmon, and 22 Coho salmon. There was 1 fish observed with symptoms of GBT in 2022, compared to 2 in 2021, and no fish observed with symptoms in 2020 or 2019.

Research

Corps biological staff supported ten research projects at LWG juvenile fish facility this season. Five agencies participated in five 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 supporting two PIT tag efficiency evaluations, and providing fish to support the Ocean and Estuary study. A total of 328,649 smolts (12.9% of the total collection) were handled by research groups during the 2022 season compared to 147,635 smolts (19.1% of total collection) in 2021. The 2018-2021 average number of fish handled as part of LWG research projects was 286,391 smolts. The 328,649 smolts taken from the 2022 collection season included: 119,083 clipped and 13,880 unclipped yearling Chinook salmon, 31,381 clipped and 31,989 unclipped subyearling fall Chinook salmon, 100,896 clipped and 18,400 unclipped steelhead, 3,656 clipped Sockeye/Kokanee salmon and 411 unclipped Sockeye/Kokanee salmon and 8,953 Coho salmon. Corps biological technicians collected 149 clipped and 288 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 (PNNL) conducted a juvenile lamprey survival study in which they handled 473 juvenile lamprey. CRITFC and Fish Passage Center conducted a lamprey genetics study in which they handled 1,737 larval and 1,193 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 April 13 to June 18. Raceway flows, fish behavior, and mortalities were monitored by Corps biological staff 24 hours per day. Corps biological technicians collected 286,811 smolts for NMFS that were handled in their marking trailers at LWG fish facility as part of the annual transportation study. Of these 19,019 smolts were PIT tagged and transported including 4,639 unclipped yearling Chinook salmon, 7,356 clipped steelhead, and 7,024 unclipped steelhead. There were 267,764 smolts handled that were not selected for tagging. All fish were held overnight in the east raceways prior to transport. There were 28 smolt mortalities reported by NMFS including 14 clipped and 1 unclipped yearling Chinook salmon, 4 clipped and 3 unclipped subyearling Chinook salmon, 5 clipped steelhead and 1 unclipped Sockeye/Kokanee salmon. There were an additional 416 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 April 5 to June 18 in conjunction with the NMFS Transportation Evaluation study, except fish collected April 5 and April 6 were only collected for the survival study. NMFS handled 38,523 smolts as part of this study, 37,058 that were PIT-tagged and bypassed including 6,326 unclipped yearling Chinook salmon, 20,800 clipped steelhead, and 9,932 unclipped steelhead. There were 52 post tagging mortalities including 30 unclipped yearling Chinook salmon, 21 clipped and 1 unclipped steelhead and there was 1 clipped steelhead mortality before tagging. Another 1,412 fish were handled but not utilized for the survival study and bypassed including 639 clipped and 98 unclipped yearling Chinook salmon, 659 clipped and 2 unclipped steelhead and 14 Coho salmon. There were 416 mortalities removed from the east raceways while used exclusively for NMFS as described above.

Idaho Fish and Game (IDFG)-Genetic Stock Identification
The goal of this study is 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, and distribution of naturally produced adult and juvenile steelhead and salmon and to research 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 2,951 fish that were sorted by SMP biologists and provided to IDFG for this study March 28 to June 30. Scale samples and fin clips were taken from 1,241 non-fin eroded unclipped steelhead. Fin clips only were taken from 1,595 non-coded wire tag (CWT), unclipped yearling Chinook salmon, 1 non-CWT or PIT-tagged unclipped subyearling Chinook salmon. Another 114 fish were not sampled by IDFG because they were PIT-tagged, including 91 unclipped yearling Chinook salmon and 23 unclipped steelhead. Sampled fish for this study were bypassed prior to transport collection (April 23) and from June 20 to June 30 and included 208 unclipped steelhead without fin erosion and 733 yearling Chinook salmon without CWT.

University of Idaho/Columbia River Inter-Tribal Fisheries Commission (CRITFC)/Nez Perce Tribe (NPT)-Evaluate Reproductive Success of Natural-Origin, Hatchery-Origin, and Kelt Steelhead in the Columbia River Basin
Corps biological staff collected 437 steelhead kelts from the Lower Granite juvenile separator from March 27 to June 30. Tanks were monitored 24 hours/day for flows, fish behavior, and mortalities. The purpose of the study is to evaluate steelhead kelt physiology and endocrinology for rehabilitating. NPT/CRITFC personnel took genetic samples, PIT-tagged, and returned to the tailrace 296 steelhead, including 134 clipped and 162 unclipped steelhead kelts collected at LWG that did not meet their criteria. Of the kelts collected, 96 steelhead kelts were transported to Dworshak National Fish Hatchery for acclimation and feeding studies. Another 45 steelhead kelts were handled and examined and returned to the tailrace including 15 clipped and 30 unclipped steelhead.

National Marine Fisheries Service (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 done in 2020 or 2021 due to NMFS COVID restrictions. Fish were PIT-tagged during summer 2021 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 264 fish were handled during this study. For the season, 139 target unclipped yearling Chinook salmon were diverted to the PIT-tag tanks, sampled and bypassed. Another 108 incidental salmonids were handled and bypassed, including 70 clipped and 2 unclipped yearling Chinook salmon, 1 clipped subyearling fall Chinook salmon, 33 clipped and 2 unclipped steelhead. Another 16 previously PIT-tagged fish for other studies were handled and bypassed, including 12 clipped and 1 unclipped yearling Chinook salmon, 1 unclipped subyearling fall Chinook salmon, and 2 clipped steelhead and there was 1 clipped steelhead mortality.

National Oceanic and Atmospheric Administration (NOAA) and U.S. Geological Survey (USGS)- RSW PIT Tag Detection Efficiency Evaluation:

NOAA fisheries transported 6000-7000 juvenile fish from the Clearwater hatchery to the LWG juvenile fish facility March 15. These fish will be tagged March 16 and released through pipes attached to the LWG RSW March 17 to determine the PIT detection efficiency of the RSW array that was installed and operational in 2020. USGS will also be tagging about 1000 of these fish to determine detection efficiency using 8mm PIT tags. A total of 5,549 fish with 8mm, 9mm, or 12mm PIT tags were releases over the RSW March 17. Total number of unique detections for those fish were 1,919. Detection efficiencies were very different between tag sizes and varied between locations with the 8 mm and 9 mm tags detected at lower rate than 12 mm-tagged fish.

National Marine Fisheries Service (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, 100 clipped yearling Chinook salmon were taken from the NMFS Transportation Study on May 10. 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.

Columbia River Inter-Tribal Fisheries Commission (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 20 juvenile and 10 larval lamprey collected in the daily sample from March 26 to November 1. The original goal of collecting 500 juveniles and 1000 larval lamprey from March through September. The annual goals were increased to 1000 juveniles and 2230 larval lamprey when the original goal was met in June and sampling continued through November 1. Fin clips and lengths were taken from 1,193 juvenile and 1,737 larval lamprey this season.

Pacific Northwest National Laboratory (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. Juvenile lamprey were collected at LWG, implanted with acoustic and PIT tags, and released upstream of LWG at Blyton Landing. Fish were tracked as they re-approached and passed through LWG. Juvenile lamprey were collected primarily from the daily sample and raceways at LWG. The trap at Asotin Creek provided few fish. Juvenile lamprey were released on 5 dates between April 1 to June 9. For the season, 473 juvenile lamprey were collected, including 35 from the Asotin Creek trap, 344 from the LWG daily sample, and 94 from the raceways at LWG. A total of 342 juvenile lamprey were acoustic-tagged and bypassed at Blyton Landing, 127 were not tagged and bypassed at LWG, 1 died before tagging, and 3 died after being acoustic-tagged.

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 2022.

Table 17. Lower Granite turbine unit outages, 2022.

Unit	Date OOS	Reason out of service
Units 1 – 6	Feb 21-24	Trash rack raking
Units 1 – 6	Mar 21-23 and Mar 29	ESBS Installation
Units 1 – 6	Monthly Mar-Nov	VBS/ESBS Inspection
Units 1 – 6	Aug 8-11	Doble Testing
Units 1-4 & 6	Nov 14-17	ESBS Removal
Unit 5	Nov 23	ESBS Removal
Units 1 – 6	Nov 14-Nov 18	500 KV Line Outage – Line 1
Unit 1	Nov 29, 2021-Feb 10, 2022	Annual Maintenance
	Mar 3	Tripped offline Regulator Trouble
	Apr 11-Apr 22	T1 transformer oil leak
	June 10	VBS Inspection to find source of torn VBS screen
	Dec 1-22	Annual Maintenance
Unit 2	Mar 14-Apr 7	DCLV Switchgear
	Apr 11-Apr 22	T1 transformer oil leak
	June 26-June 29	ESBS/VBS Inspection – Repairs needed to 2B VBS

	Oct 31-Nov 21	Annual Maintenance
Unit 3	Feb 14-Mar 10	Annual Maintenance, DCLV, and Bearing Temp Upgrade
	Apr 11-Apr 22	T1 transformer oil leak
	Sept 20	Repair excessive Wicket Gate Leakage
	Oct 3-20	Annual Maintenance
	Nov 21	Excitation Problems
Unit 4	Apr 11-May 10	SU/CE/Gov oil pump replacement
	July 11-28	Annual Maintenance
	Sept 22	Inspect Gatewell 5A Stop Logs
	Nov 21, 2022-Feb 2, 2023	Thrust Bearing & Bearing Indication Upgrades
Unit 5	April 19	Add oil to T1 transformer
	April 21-22	Doble Testing T1
	Aug 22-Oct 5	Annual Maintenance/Overhaul
Unit 6	April 19	Add oil to T1 transformer
	April 21	Doble Testing T1
	April 22	Doble Testing T1
	Aug 1-18	Annual Maintenance
	Oct 19	Shear Boom Inspection

Debris/Trash Racks

Trashracks were raked February 21-24. 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 21-23. Unit 2 ESBSs were installed March 29 prior to being returned to service. Brush cleaning cycle was set to operate automatically every two hours this season.

Vertical Barrier Screens (VBSs)

VBSs were video inspected in conjunction with ESBSs during the 2022 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 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 March 15. Primary dewaterer (PDW) 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. The center screen cleaner was tagged out of operation when it was observed stuck in the down position. This issue was identified as a 2x6 board being wedged under the screen cleaner operating chain when the PDW was dewater November . 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 19. Loading from the raceways went smoothly this season. Direct loading did not occur.

Truck Loading Operations

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

Recommendations

1. Complete Phase 1a modifications and resolve programming issues.
2. Look into redesigning 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 researcher 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. Replace PVC sample line with a 12-inch flume.
13. Replace sample PIT array with new upgraded flume PIT array.
14. Install inline Vaki Pipeline Counter into the PVC sample line to test system as an alternative method to enumerate fish.
15. Replace PDW floor brushes.

APPENDIX TABLES

Appendix Table 1. Daily collection and bypass numbers and river conditions at Lower Granite Dam, 2022.

Appendix Table 2. Percent descaling and daily facility mortality numbers at Lower Granite Dam, 2022.

Appendix Table 3. Daily number of fish trucked and barged from Lower Granite Dam, 2022.

Appendix Table 4. Daily number of adult fallbacks and fallback mortality at Lower Granite Dam, 2022.