CENWW-ODO GRIFFITH February 2023

MEMORANDUM THRU:
Scott Green, Operations Project Manager, Lower Monumental Dam

FOR Chief, Operations Division
ATTN: Christopher Peery and Scott St. John

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

1. Enclosed find the 2022 Juvenile Fish Collection and Bypass Report for Lower Monumental Dam as requested.

2. If you have any questions contact Denise Griffith at Lower Monumental Dam, (509) 282-7211.

DENISE S. GRIFFITH
Supervisory Fisheries Biologist, Lower Monumental Dam

Enclosure

2022 JUVENILE COLLECTION AND BYPASS REPORT
LOWER MONUMENTAL PROJECT JUVENILE FISH FACILITY

February 2023

United States Army Corps of Engineers
Lower Monumental Lock and Dam
5520 Devils Canyon Road
Kahlotus, Washington 99335

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LIST OF ACRONYMS

BiOp – Biological Opinion for Operations
BPA – Bonneville Power Administration
CFS – Cubic feet per second
FPC – Fish Passage Center
GBT – gas bubble trauma
JCC – Juvenile Collection Channel
JFF – Juvenile Fish Facility
KCFS – kilo cubic feet per second
OOS – Out of service
PIT – Passive Integrated Transponder
PDS – Primary dewatering structure
PSMFC – Pacific States Marine Fisheries Commission
STS – Submersible traveling screens
RSW – Removable spill weir
USDA-WS – United States Department of Agriculture-Wildlife Services
VBS – vertical barrier screen

SUMMARY

Juvenile fish transportation and bypass operations occurred at Lower Monumental Dam Juvenile Fish Facility (JFF) in 2022. Submersible traveling screens (STSs) for all operating units were installed between March 21 and March 23. The Juvenile Collection Channel (JCC) and Primary Dewatering Structure (PDS) were watered up at 0820 hours on March 23 to test the new count box that had been installed during the winter. After testing was completed, the JFF and wet lab were fully watered up on March 29 at 0730 hours. Fish condition sampling began at 0700 hours on April 1 and continued until 0700 hours on October 1. The JCC and PDS were dewatered, and all the orifices were closed for winter maintenance on December 15.

Fish were transported by barge from April 24 through June 20. Barge loading at Lower Monumental Dam occurred without any issues during the 2022 transport season. No truck transport occurred at Lower Monumental Dam in 2022.

Total smolt collection in the 2022 season was 1,561,596. This includes expanded numbers of those sampled during pre-transport. Of the fish collected in the 2022 season, 1,328,113 were barged, and 232,875 were bypassed. This season's total collection by species group included: 667,324 clipped yearling Chinook salmon, 119,881 unclipped yearling Chinook salmon, 103,534 clipped subyearling Chinook salmon, 131,433 unclipped subyearling Chinook salmon, 366,940 clipped steelhead, 131,149 unclipped steelhead, 17,045 clipped sockeye/kokanee salmon, 1,250 unclipped sockeye/kokanee salmon, and 23,040 combined clipped/unclipped coho salmon.

Oregon Department of Fish and Wildlife (ODFW) technicians examined 1,262 fish for gas bubble trauma (GBT) in 2022. Examinations were conducted once a week from April 11 through August 11.

FACILITY INTRODUCTION AND DESCRIPTION

Lower Monumental Dam is located at river mile 41.6 on the Snake River. The dam is located at the head of Lake Sacajawea, the reservoir created by Lower Monumental Dam. Lower Monumental has six 135,000-kilowatt turbine units. To bypass the turbines, the juvenile system begins with trash racks, submersible traveling screens (STS) and vertical barrier screens (VBS). When fish enter the turbines' intake, they are diverted into the gatewell slots by the STSs. Each unit has three gatewell slots. Each gatewell slot has two orifices where lights are directed at each open orifice to enhance fish movement into the collection channel. The fish pass through these twelve-inch orifices to the juvenile collection channel which terminates at the primary dewatering structure (PDS) where all but 30 cubic feet second (cfs) flow is removed. The remaining 30 cfs flow and fish are routed through the transport flume to the separator. Upon reaching the separator, adult and non-target adult fish are released to the river and juvenile fish pass below the separator bars and enter the distribution system. The full distribution system includes transport flumes, Passive Integrated Transponder (PIT) tag bypass, sampling facilities, holding facilities, and barge and truck loading capabilities.

Downstream of the separator in the A and B flumes are the PIT tag bypass. The A and B sides each have a set of sample and PIT tag systems. Inside the JFF building is the wet lab where the fish condition sample occurs.

Finally, Lower Monumental Dam has 8 spillbays with a removable spillway weir (RSW) in spillbay 8. The RSW was installed to provide a surface passage rout and improve conditions for out-migrating juveniles.

FACIILTY MODIFICATION/MAINTENANCE AND IMPROVEMENTS

Maintenance and improvements for the 2022 year which are made to enhance the system performance over the previous seasons include a new raceway tailscreen hoist and removal of old wet lab infrastructure and piping. The wet floor lab was also resealed on March 11.

A new STS camera was purchased in March 2022 and used throughout the season. It was hard wired to the STS van on August 22 and appeared to work perfectly throughout the year.

All flume leaks were repaired in October by removing old silicone and replacing new silicone where the old gasket material had decomposed, once all the flumes had been power washed. All cracked and leaking oil misters were also replaced in October. Approximately 5 of various sizes were replaced.

Also, during the fall, large logs and washed-up trash was removed from the inside fenced area of the outfall pipe pump. Both fire hydrants at the JFF were refurbished with all new parts in October.

RIVER CONDITIONS

During the 2022 season, the average daily powerhouse flow did not exceed 210.0 thousand cubic feet per second (kcfs) (Figure 1). The highest daily average flow for the season was 205.7 kcfs on June 12. The lowest daily average flow for the season occurred on September 13 with a flow of 13.9 kcfs. The average flow for the season was 65.9 kcfs. Spring spill mandated by the National Oceanic and Atmospheric Administration Biological Opinion for Operation of the Federal Columbia River Power System (BiOp) occurred for 79 days from April 3 through midnight on June 20, with a maximum daily average spill of 106.9 kcfs on June 14. The RSW was put into operation for spring steelhead migration on March 1 to March 31 and spring spill at 0100 hours on April 3, following the initiation of BiOp-mandated spill, and was taken out of service (OOS) for the season on August 4, due to high river temperatures with low river flows. Summer spill ended at 2359 hours on August 31. The 2022 river flow and spill averages were lower than the 5-year average in early spring but surpassed the 5-year average in late spring. Summer spill was higher than the 5-year average. Average monthly flow and spill for the 2017 to 2022 collection seasons are provided in Table 1.

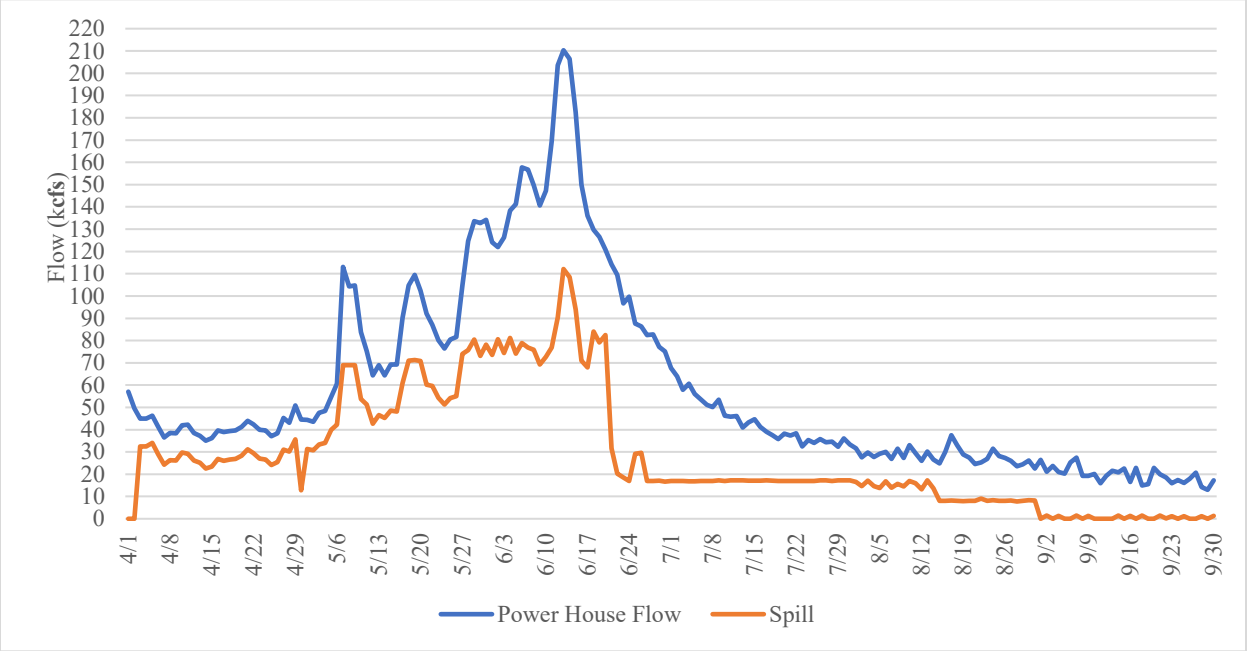

Figure 1. Comparison of daily powerhouse flow and spill at Lower Monumental Dam, 2022.

River Temperature

River temperature is measured daily at approximately 1200 hours in the JFF wetlab freshwater supply. Temperatures observed in the wetlab were less than the 5-year average in all months except September (Table 2). River temperature averaged 61.0°F for the 2022 season and ranged from the low of 46.7°F on April 20 to the high of 70.3°F recorded on August 18.

Table 1. Comparison of average monthly flow and spill at Lower Monumental Dam, 2017-2022 and the 5-year average.

Flow (kcfs)							
Month	**2017**	**2018**	**2019**	**2020**	**2021**	**2017-2021 Avg**	**2022**
April	136.5	93.7	115.8	53.5	51	90.1	42.2
May	140.6	133.3	62.6	103.7	68.9	101.82	84.0
June	126.9	78.5	87.8	92.9	52.7	87.76	132.4
July	49.7	38.1	37.7	47.3	26.9	39.94	44.6
August	29.2	27.3	26.8	26.8	22.9	26.6	28.5
Sept.	25.7	22.1	24.4	22.8	18.9	22.78	20.0
Spill (kcfs)							
Month	**2017**	**2018**	**2019**	**2020**	**2021**	**2017-2021 Avg**	**2022**
April	63.7	36.4	41.3	35.9	33.7	42.2	24.2
May	69.9	54.3	38.3	71.7	47.9	56.42	55.2
June	59.8	28.5	36.4	54.9	33.1	42.54	62.2
July	16.9	17	16.8	17.4	13.4	16.3	17.0
August	14.3	13.1	13.5	11.2	9.4	12.3	11.7
Sept.	1.7	0.4	0.2	0.2	0.2	0.54	0.8

Table 2. Average monthly river temperatures (°F), 2017-2022 and 5-year average.

Month	**2017**	**2018**	**2019**	**2020**	**2021**	**2017-2021 Avg**	**2022**
April	49.7	50.4	49.3	49.9	49.4	49.7	48.6
May	54.8	55	54.8	53.4	55	54.6	52.3
June	60.2	61.8	61.6	58.9	61.5	60.8	55.9
July	69.4	68	67.1	65.8	69.6	68.0	66.6
August	70.4	69.3	69.1	68.8	69.9	69.5	69.4
September	67.7	66.3	68	66.4	66.4	67.0	67.7

JUVENILE BYPASS

Migration, Collection, and Transportation of Juvenile Salmonids

Collection

Pre-transport primary bypass occurred from 0700 hours April 1 through 0700 hours April 23. Fish collection for barge transportation began at 0700 hours on April 23 and continued until 0100 hours July 5. An estimated 1,561,596 juvenile salmonids were collected in 2022 (Table 3). Within each species group, the number collected, and percent of the total collection was: 667,324 clipped yearling Chinook salmon (42.7%), 119,881 unclipped yearling Chinook salmon (7.7%), 103,534 clipped subyearling Chinook salmon (6.6%), 131,433 unclipped subyearling Chinook salmon (23.5%), 366,940 clipped steelhead (23.5%), 131,149 unclipped steelhead (8.4%), 17,045 clipped sockeye salmon (1.1%), 1,250 unclipped sockeye/kokanee salmon (0.1%), and 23,040 coho salmon (1.5%). Post-season bypass occurred from October 1 through December 15.

Table 3. Annual collection, bypass, and transport at Lower Monumental Dam, 2018-2022.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
Collection										
2018	880,575	337,530	130,343	174,478	970,517	208,054	26,600	8,605	25,044	2,761,746
2019	886,572	289,846	80,401	142,992	1,330,906	324,527	40,875	3,233	30,700	3,130,052
2020	378,434	97,869	53,739	113,590	195,230	57,550	8,145	214	18,451	923,222
2021	104,155	17,085	27,414	56,418	68,200	22,481	2,042	1564	7,488	306,847
2022	667,324	119,881	103,534	131,433	366,940	131,149	17,045	1,250	23,040	1,561,596
5-Yr Avg	583,412	172,442	79,086	123,782	586,359	148,752	18,941	2,973	20,945	1,736,693
Bypass										
2018	99,180	100,255	67	611	222,896	29,278	120	1,479	100	453,986
2019	222,211	131,218	886	4139	543,987	86,555	0	128	3424	992,548
2020	4,030	1,877	26085	65,890	2,799	739	0	10	287	101,717
2021	20,522	1,096	17,923	41,511	13,984	1791	8	72	598	97,505
2022	18,561	9,377	71,223	92,120	23,492	10,367	295	150	7,290	232,875
5-Yr Avg	72,901	48,765	23,237	40,854	161,432	25,746	85	368	2,340	375,726
Truck										
2018	0	0	11	118	0	0	0	0	0	129
2019	0	0	13	59	2	0	0	0	0	74
2020	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0	0
5-Yr Avg	0	0	5	35	0	0	0	0	0	41
Barge										
2018	781,029	237,187	130,126	173,644	747,509	178,748	26,447	7,113	24,941	2,306,744
2019	663,488	158,459	79,350	138,693	786,712	237,927	40,873	3,104	27,272	2,135,878
2020	374,299	95,939	27,619	47,643	192,349	56,792	8,142	204	18,157	821,144
2021	83,586	15,976	9,482	14,887	54,167	20,679	2,029	1490	6,885	209,181
2022	648,440	110,397	32,297	39,295	343,344	120,754	16,749	1,091	15,747	1,328,113
5-Yr Avg	510,168	123,592	55,775	82,832	424,816	122,980	18,848	2,600	18,600	1,360,212
Total Transported										
2018	781,029	237,187	130,137	173,762	747,509	178,748	26,447	7,113	24,941	2,306,873
2019	663,488	158,459	79,363	138,752	786,714	237,927	40,873	3,104	27,272	2,135,952
2020	374,299	95,939	27,619	47,643	192,349	56,792	8,142	204	18,157	821,144
2021	83,586	15,976	9,482	14,887	54,167	20,679	2,029	1490	6,885	209,181
2022	648,440	110,397	32,297	39,295	343,344	120,754	16,749	1,091	15,747	1,328,113
5-Yr Avg	510,168	123,592	55,780	82,868	424,817	122,980	18,848	2,600	18,600	1,360,253

Mid-way through May, 52.5% of the total yearly collection for 2022 had arrived. The percent of the total collection arriving by the end of June and the end of July was 99.0% and 99.9%, respectively. Juvenile salmonids passing through the Lower Monumental Dam JFF in August and September contributed 0.08% of the 2022 season collection total and consisted primarily of unclipped subyearling Chinook salmon.

In 2022, the peak daily collection total and date for each species group were: 74,400 clipped yearling Chinook salmon (May 9), 9,400 unclipped yearling Chinook salmon (May 8), 7,200 clipped subyearling Chinook salmon (June 10), 8,800 unclipped subyearling Chinook salmon (June 9), 39,600 clipped steelhead (May 9), 13,600 unclipped steelhead (May 18), 6,400 clipped sockeye/kokanee salmon (May 19), 400 unclipped sockeye/kokanee salmon (May 16), and 1,650 coho salmon (June 6). Total daily collection in 2022 peaked at 127,200 on May 9 (Figure 2). Peak collection date and daily collection total by species group are listed in Table 4.

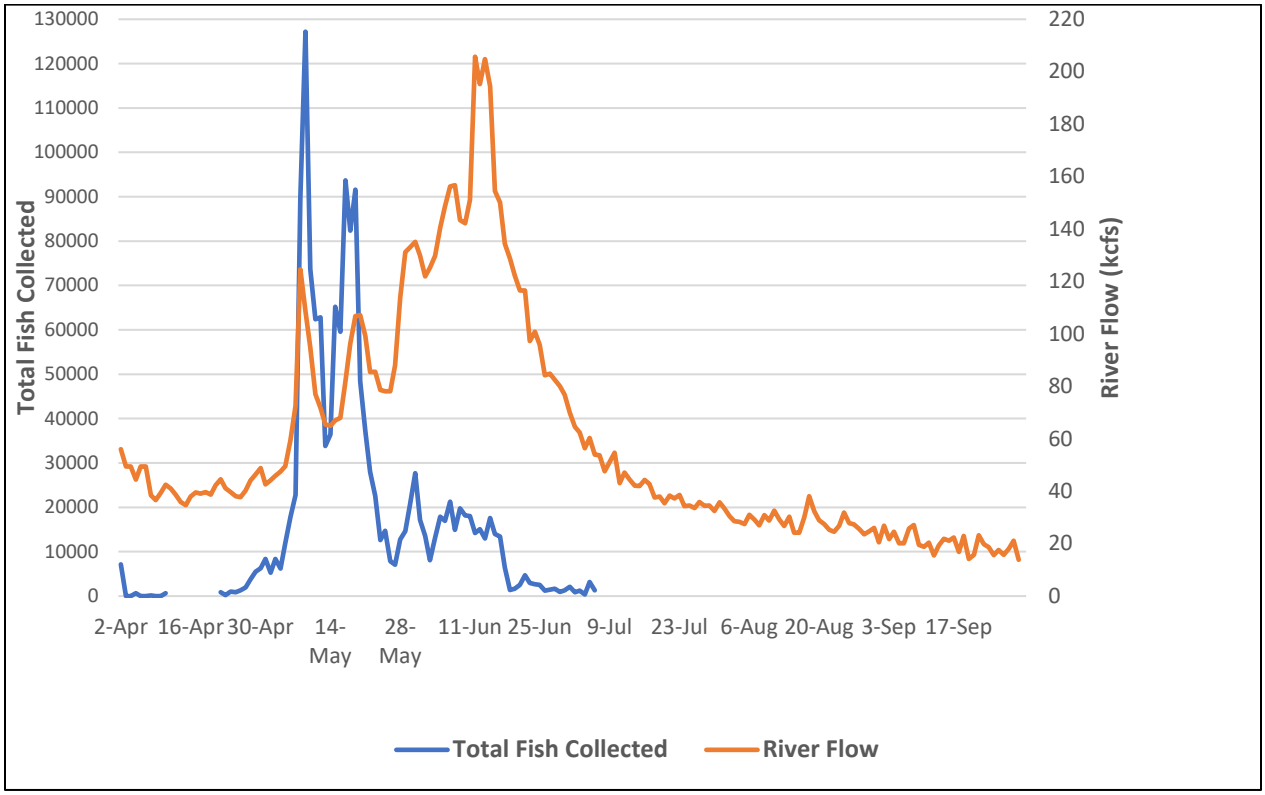

Figure 2. Daily juvenile Salmonid Collection, all species combined, versus daily average river flow at Lower Monumental Dam, 2022.

Table 4. Annual peak collection dates at Lower Monumental Dam, 2018-2022.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2018	9-May 61,646	18-Apr 26,000	30-May 19,422	30-May 21,826	2-May 71,040	2-May 12,810	18-May 4,500	18-Apr 800	10-May 2,000	1-May 129,000
2019	24-Apr 51,000	25-Mar 17,800	31-May 7,700	31-May 23,100	24-Apr 114,600	25-Apr 28,818	20-May 14,000	19-May 1,000	18-May 1,800	24-Apr 205,200
2020	May-17 31,200	May-23 5,300	Jul-03 3,100	Jul-03 6,660	Apr-26 25,300	May-08 5,400	May-17 1,600	May-19 100	May-22 1,700	Apr-26 46,600
2021	9-May 14,050	9-May 2,050	30-Jun 4,482	30-Jun 10,415	22-Apr 5,257	9-May 1,950	14-May 320	2-May 220	8-May 725	9-May 21,700
2022	May-09 74,400	May-08 9,400	Jun-10 7,200	Jun-09 8,800	May-09 39,600	May-18 13,600	May-19 6,400	May-16 400	Jun-06 1,650	May-09 127,200

Sampling

Sampling for condition and outmigration indexing at Lower Monumental Dam began at 0700 hours on April 1. Sampling for transport began at 0700 hours on April 23 and ended at 1500 hours on June 11. Daily fish sampling was concluded on July 6 and continued on an every-other-day basis until August 17, at which point sampling transitioned to every-third day sampling. Sampling concluded on October 1.

Sampling is defined as diverting and segregating groups of fish in a consistent fashion so data collected from those segregated groups will accurately represent all fish collected.

Fish were sampled at Lower Monumental Dam to monitor fish condition, ensure the collection system was operating correctly, and to train personnel on facility operation and sampling protocols. This type of sampling is termed "sampling for condition". Fish sampling for condition occurred every third day from April 2 through April 14, then sampling switched to every other day through April 22, after which sampling occurred every day.

Total sampling includes both "condition sampling" as well as "non-condition sampling," which was conducted during the 2022 operating year. A total of 17,795 fish (1.1% of the total collection) were sampled in 2022. Within each species group, the number and percent sampled of those collected in that group was: 4,728 clipped yearling Chinook salmon (0.7%), 1,292 unclipped yearling Chinook salmon (1.1%), 2,456 clipped subyearling Chinook salmon (2.4%), 4,111 unclipped subyearling Chinook salmon (3.1%), 3,674 clipped steelhead (1.0%), 1,145 unclipped steelhead (0.9%), 57 clipped sockeye salmon (0.3%), 17 unclipped sockeye/kokanee salmon (1.4%), and 315 coho salmon (1.4) (Table 5).

Average weekly sample rates can be found in Table 6 and ranged from 0.3% to 50.00%.

Table 5. Annual percentage sampled of each juvenile salmonid species group at Lower Monumental Dam, 2018-2022.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2018	0.6	0.7	3.0	4.6	0.6	0.7	1.1	0.9	1.1	1.0
2019	0.7	1.0	5.5	5.5	0.6	0.6	0.6	1.1	1.3	1.3
2020	1.3	2.4	8.9	9.8	1.9	1.7	0.8	1.9	1.9	3.1
2021	4.3	9.2	13.5	11.8	4.4	5.2	4.9	5.5	7.5	6.9
2022	0.7	1.1	2.4	3.1	1.0	0.9	0.3	1.4	1.4	1.1

Table 6. Weekly average sample rates in percent and sample totals at Lower Monumental Dam, 2022.

Week Ending	Weekly Rate	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Totals*
	(%)	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
8-Apr	4.9%	686	53	0	0	11	15	0	0	0	765
15-Apr	10.0%	103	16	1	0	83	29	0	0	0	232
22-Apr	20.0%	443	74	0	0	270	75	0	0	0	862
29-Apr	10.6%	338	113	0	0	339	49	0	0	0	839
6-May	1.9%	272	122	0	0	643	63	0	6	0	1,106
13-May	0.5%	1152	161	0	0	648	136	0	1	13	2,111
20-May	0.3%	704	96	1	0	278	130	35	1	16	1,261
27-May	0.9%	378	113	4	9	201	108	11	0	9	833
3-Jun	1.4%	403	257	179	207	368	258	4	2	71	1,749
10-Jun	1.7%	150	126	550	708	261	151	2	2	100	2,050
17-Jun	1.0%	43	35	416	378	94	52	2	1	29	1,050
24-Jun	7.1%	10	25	434	638	246	42	2	4	30	1,431
1-Jul	10.0%	16	29	273	515	196	31	1	0	40	1,101
8-Jul	10.0%	9	16	255	400	35	5	0	0	7	727
15-Jul	16.7%	4	8	115	219	1	1	0	0	0	348
22-Jul	25.0%	9	10	110	214	0	0	0	0	0	343
29-Jul	25.0%	4	11	74	202	0	0	0	0	0	291
5-Aug	50.0%	0	7	24	137	0	0	0	0	0	168
12-Aug	50.0%	0	0	10	172	0	0	0	0	0	182
19-Aug	50.0%	4	9	7	169	0	0	0	0	0	189
26-Aug	50.0%	0	2	2	42	0	0	0	0	0	46
2-Sep	50.0%	0	2	0	30	0	0	0	0	0	32
9-Sep	50.0%	0	6	1	46	0	0	0	0	0	53
16-Sep	50.0%	0	1	0	17	0	0	0	0	0	18
23-Sep	50.0%	0	0	0	6	0	0	0	0	0	6
30-Sep	50.0%	0	0	0	2	0	0	0	0	0	2
Total Sampled		4,728	1,292	2,456	4,111	3,674	1,145	57	17	315	17,795
% of Sample		26.7%	7.3%	13.8%	23.1%	20.6%	6.4%	0.3%	0.1%	1.8%	100.0%
% of Collection		0.7%	1.1%	2.4%	3.1%	1.0%	0.9%	0.3%	1.4%	1.4%	1.1%

* Daily 24-hour sampling at Lower Monumental Dam began on April 22 this season.

Transportation-Barge Loading Operations

An estimated 1,328,113 juvenile salmonids (85.0% of the collection) were transported from Lower Monumental Dam in 2022. All were transported by barge; no fish were trucked in 2022. Within each species group, the number transported and percent of those collected in each group was: 648,440 clipped yearling Chinook salmon (97.2%), 110,397 unclipped yearling Chinook salmon (92.1%), 32,297 clipped subyearling Chinook salmon (31.2%), 39,295 unclipped subyearling Chinook salmon (29.9%), 343,344 clipped steelhead (93.6%), 120,754 unclipped steelhead (92.1%), 16,749 clipped sockeye salmon (98.3%), 1,090 unclipped sockeye/kokanee salmon (87.2%), and 15,747 coho salmon (68.3%). (Table 3)

Fish were transported by barge from April 24 through June 9. For safety of personnel and equipment during high river levels and flows, the June 7 and 11 barge transports were canceled at Lower Monumental Dam. The fish collected during those samples were bypassed back to the river.

Transportation-Truck Loading Operations

Juvenile fish were scheduled to be transported by truck from August 1 to October 1. Per the 2022 Fish Operations Plan, the Lower Monumental trucking schedule is contingent upon the Technical Management Team approval; the Technical Management Team decision was that no truck transport would take place from Lower Monumental Dam during the 2022 transport season.

Bypass

During the 2022 season, a total of 232,875 fish were bypassed (14.9% of the collection) (Table 3). Within each species group, the number bypassed and percent of those collected in each group was: 18,561 clipped yearling Chinook salmon (2.8%), 9,377 unclipped yearling Chinook (7.8%) 71,223 clipped subyearling Chinook salmon (68.8%), 92,120 unclipped subyearling Chinook salmon (70.1%), 23,492 clipped steelhead (6.4%), 10,367 unclipped steelhead (7.9%), 295 clipped sockeye/kokanee salmon (1.7%), 150 unclipped sockeye salmon (12.0%) and 7,290 coho salmon (31.6%). These numbers do not include fish bypassed by the PIT-tag diversion system.

Juvenile salmonids were bypassed rather than transported for the following purposes this season:

1. Condition sampling and secondary bypass occurred (see condition sampling frequency in sampling section).

2. Salmonid fry measuring less than 60 millimeters (mm) were bypassed and not sampled due to smolt monitoring protocol.

3. The PTAGIS database revealed 31,945 PIT-tagged fish of different species groups were bypassed through the PIT-tag system. These fish are not included in the facility bypass total. PIT-tag diversion gates are set to bypass PIT-tagged fish when sample rates are 20% or higher and during sampling intervals when fish are being collected for research to prevent anesthetizing study fish a second time.

The fish rearing designation used by PTAGIS is hatchery/wild, not clipped/unclipped; therefore, the hatchery/wild designation is used to report the PIT-tag numbers in the following section rather than the clipped/unclipped designation used throughout the rest of this report. According to the PTAGIS database, the total of PIT-tagged fish that were detected in the JFF was 31,945. The total by unit group was: 20,140 Chinook salmon (17,547 hatchery and 2,593 wild), 10,833 steelhead (8,966 hatchery, 1,863 wild and 4 of unknown designation), 777 sockeye salmon (771 hatchery and 6 wild), 164 Coho salmon (164 hatchery), and 31 fish of unknown species. An unknown number of other fish were bypassed incidentally with the PIT-tagged fish as the PIT-tag diversion gates opened and closed to divert the PIT-tagged fish.

Migration, Sampling and Bypass of Juvenile Lamprey

Pacific lamprey, *Entosphenus tridentatus,* the primary species found at Lower Monumental Dam, are characterized by the presence of three large teeth and posterior teeth on the oral disc. Pacific lamprey spawn in similar habitats to salmon. Spawning occurs between March and July, depending upon location within their range.

Metamorphosis from the larvae stage (ammocoetes) to the juvenile stage (macropthalmia) occurs over a period of several months. During this time, they develop eyes, teeth, and become free swimming. They drift and swim downstream as they migrate to the ocean. It is the macropthalmia stage when most of the lamprey end up in the sample collection at the JFF. Sampled data for Pacific lamprey juvenile life stages are presented in Table 7. In addition, the 5-year averages of the total collection, sampled, and fish in the separator are also presented.

Table 7. Pacific lamprey in the sample and separator, and the total collection for both life stages, 2018-2022.

Pacific lamprey (Juvenile)			
Year	**Sample**	**Separator**	**Total Collection**
2018	54,404	0	54,404
2019	65,843	0	65,843
2020	37,361	2	37,363
2021	2,930	0	2,930
2022	305,417	13	305,430
Pacific lamprey (Larvae)			
Year	**Sample**	**Separator**	**Total Collection**
2018	814	0	814
2019	1,377	0	1,377
2020	388	1	389
2021	1,096	0	1,096
2022	20,041	4	20,045

Incidental Species

Non-target fish species that were too large to pass through the separator bars were recorded and bypassed through the adult release pipe at the separator. Those small enough to pass through the separator bars were either sampled and bypassed, or held in the raceways and transported with the juvenile salmonids. Fortunately, most incidental fishes generally arrive late in the season when a high percentage of the collection is sampled. At this time, incidental species are removed while working up the sample, therefore avoiding transport. Sample fish from each incidental species were counted and their total numbers were calculated using the sample rate. These numbers were then added with separator counts of the same group to estimate the total collection for each species. The most common incidental species groups for 2022 included: juvenile Pacific lamprey macrophthalmia (305,430), juvenile American shad, *Alosa sapidissima* (82,970),

larval Pacific lamprey ammocoete (20,045), Siberian prawn, *Exopalaemon modestus* (2,867), walleye, *Stizostedion vitreum* (1,274), yellow perch *Perca flavescens* (1,026) and combined smallmouth bass, *Micropterus dolomieu* and largemouth bass, *Micropterus salmoides* (708) (Table 8).

Table 8. Estimated collection of incidental species at Lower Monumental Dam, 2022.

Common Name	Scientific Name	Sample	Separator	Total[1] 2021 Collection
American shad (Adult)	*Alosa sapidissima*	991	76	1,067
American shad (Juvenile)	*A. sapidissima*	65,410	17,560	82,970
Bullhead (misc.)	*Ameiurus* spp.	0	1	1
Bull Trout	*Salvelinus confluentus*	4	1	5
Channel catfish	*Ictalurus punctatus*	0	1	1
Chiselmouth	*Acrocheilus alutaceus*	16	3	19
Common carp	*Cyprinus carpio*	0	0	0
Crappie	*Pomoxis* spp.	6	70	76
Kokanee	*Oncorhynchus nerka*	114	16	130
Northern Pikeminnow	*Ptychocheilus oregonensis*	0	1	1
Pacific lamprey (Adult)	*Lampetra tridentatus*	70	4	74
Pacific lamprey (Juvenile)	*L. tridentatus*	305,417	13	305,430
Pacific lamprey (Ammocoete)	*L. tridentatus*	20,041	4	20,045
Peamouth	*Mylocheilus caurinus*	0	0	0
O. mykiss other (Rainbow Trout)	*Onchorhynchus mykiss*	0	14	14
Sandroller	*Percopsis transmontana*	0	0	0
Sculpin	*Cottus* spp.	29	2	31
Siberian Shrimp/Prawn	*Exopalaemon modestus*	2,867	0	2,867
Largemouth/Smallmouth bass	*Micropterus dolomieu/salmoides*	701	7	708
Sucker (misc.)	*Catostomus* spp.	378	28	406
Whitefish	*Prosopium* spp.	20	2	22
White Sturgeon	*Acipenser transmontanus*	0	9	9
Walleye	*Stizostedion vitreum*	1,159	115	1,274
Yellow perch	*Perca flavescens*	992	34	1,026
Others	----------	520	71	591
Total		386,950	11,433	398,383

[1]Incidental species collection estimates are based on sampled number of group expanded by the sample rate plus separator count.

The number of juvenile shad (82,970) in 2022 is far greater than the 29,181 collected in the 2021 operating year. Other incidental fish species numbers collected at the facility have increased. In the 2022 season, 305,430 juvenile Pacific lamprey were collected, compared to 2,930 in the 2021 season. Pacific lamprey ammocoetes numbers increased from 22 in 2021 to 20,045 in 2022. Walleye numbers have increased from the 2021 (859) to the 2022 (1,274) season. Yellow perch numbers also increased from the 2021 to the 2022 season. Approximately 1,026 perch were collected in the 2022 season compared to the 29 collected in 2021. Estimated numbers of some groups may also become exaggerated high or low due to the low sample rates at the time of their collection.

Adult Fallbacks

A total of 418 adult salmonids fell back through the juvenile bypass system and were bypassed from the separator between April and October. The total includes: 125 adult Chinook salmon, 23 jack Chinook salmon, 153 clipped steelhead, 114 unclipped steelhead, 2 sockeye salmon, and 1 coho salmon (Table 9).

As has been the case in previous years, most adult fallbacks in 2022 were steelhead and most (40.8%) steelhead fallback occurred April through May (Table 10). Total monthly adult fallbacks for all salmonid species peaked in June.

Table 9. Annual totals of adult salmonids released from the separator at Lower Monumental Dam, 2018-2022.

Year	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Total
2018	106	20	236	343	1	0	706
2019	71	25	246	363	1	0	706
2020	83	44	79	112	21	8	347
2021	46	20	23	49	5	5	148
2022	125	23	153	114	2	1	418

Table 10. Monthly totals of adult salmonids released from the separator at Lower Monumental Dam, 2022.

Month	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Total
April	0	0	6	3	0	0	9
May	9	8	60	40	0	0	117
June	56	5	39	47	0	0	147
July	17	4	6	3	2	0	32
August	12	0	22	15	0	0	49
September	29	6	19	6	0	1	61
October	2	0	1	0	0	0	3
Total	125	23	153	114	2	1	418

The condition of adult salmonids was evaluated as the fish were released from the separator. Their condition was predominantly good to fair with 93.1% of the fallbacks rated in these categories (Table 11). Condition ratings of the adults examined were as follows: 329 good

(78.7%), 60 fair (14.4%), 25 poor (6.0%), and 4 were dead (1.0%). The number dead in each species group of adult salmonids was: 2 clipped Chinook, 1 unclipped Chinook and 1 clipped steelhead.

Table 11. Condition of adult salmonids released from the separator at Lower Monumental Dam, 2022.

Condition	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Total
Good	104	22	121	79	2	1	329
Fair	13	1	21	25	0	0	60
Poor	5	0	10	10	0	0	25
Dead	3	0	1	0	0	0	4
Total	125	23	153	114	2	1	418

Separator Efficiency

The separator is designed with bar spacing to allow only smaller smolts—subyearling Chinook and sockeye salmon—to divert to the A side of the collection facility. Larger smolts—steelhead and yearling Chinook salmon—divert to the B side through wider spaced bars. Separator efficiency for 2022 by species group was: clipped yearling Chinook salmon (71.4%), unclipped yearling Chinook salmon (57.9%), subyearling Chinook salmon (50.1%), clipped steelhead (49.9%), unclipped steelhead (76.9%), clipped sockeye salmon (54.6%), and unclipped sockeye/kokanee salmon (49.8%) (Table 12).

Table 12. Annual separator efficiency in percent at Lower Monumental Dam, 2018-2022.

Year	Yearling Chinook		Subyearling Chinook	Steelhead		Sockeye	Sockeye/Kokanee
	Clipped	Unclip	Clipped/Unclip	Clipped	Unclip	Clipped	Unclip
	A-side	A-side	A-side	B-side	B-side	A-side	A-side
2018	64.5	58.8	52.4	90.9	73.2	39.2	36.7
2019	51.0	47.1	46.5	88.8	69.1	44.3	5.6
2020	71.9	65.1	42.4	44.8	26.9	34.5	56.4
2021	67.6	55.3	29.2	69.0	66.8	60.4	29.9
2022	71.4	57.9	50.1	49.9	76.9	54.6	49.8

FISH CONDITION

Descaling

Descaling data were collected from all live sample fish (full sample) rather than just a portion (subsample). Full-sample data collection provides a larger sample size and therefore a better representation of fish condition.

The descaling rate for all fish sampled in 2022 was 1.7%. The annual descaling rate by species group were: clipped yearling Chinook salmon (1.2%), unclipped yearling Chinook salmon

(1.6%), clipped subyearling Chinook salmon (1.4%), unclipped subyearling Chinook salmon (2.2%), clipped steelhead (2.2%), unclipped steelhead (1.7%), clipped sockeye salmon (0%), unclipped sockeye/kokanee salmon (0%), and coho salmon (2.3%) (Table 13).

In 2022, the highest weekly descaling rate for all species combined was 50% for the week ending September 30 (with fish sampled in a week of condition sampling), while the lowest rate (0.0%) occurred in the weeks ending April 15 and September 16 (Table 14).

Table 13. Annual descaling rates in percent for fish sampled at Lower Monumental Dam, 2018-2022.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2018	2.0	2.0	1.7	1.5	2.1	2.9	2.4	1.3	1.9	1.9
2019	1.6	1.6	2.7	2.2	2.5	2.9	2.4	0.0	2.2	2.2
2020	1.5	1.6	1.6	1.1	2.5	2.9	2.4	0.0	2.9	1.9
2021	1.0	1.6	1.2	1.4	3.2	3.0	4.1	4.7	3.6	1.7
2022	1.2	1.6	1.4	2.2	2.2	1.7	0.0	0.0	2.3	1.7

Other Injury and Disease

Injury and disease data were collected from a subsample of 100 of the dominant species and not more than 100 each of the non-dominant species. A total of 14,706 fish were examined for condition. The most common symptoms observed in 2022 were fin injury (affected fish) and fin hemorrhage (affected fish).

Blood pooling is defined as the vasodilatation of the capillaries in fins (also referred to as pink fin). It seems to be a symptom of anesthetic use during higher water temperatures and is mostly found on subyearling Chinook salmon. Evidence of blood pooling was found on 2.0% of all fish examined. The incidence of blood pooling by species group was; Chinook salmon 1.1%, subyearling Chinook salmon 2.2%, steelhead 2.7%, and 0% blood pooling was found on sockeye/kokanee salmon and coho salmon.

Fin injuries were found on 13.3% of all fish examined. The incidence of fin injury was; yearling Chinook salmon 15.5%, subyearling Chinook salmon 12.3%, steelhead 12.2%, sockeye/kokanee salmon 21.1%, and coho salmon 0%. Fin hemorrhaging often coincided with split fin injuries.

Fin hemorrhaging is the discharge of blood outside the fin tissue. Fin hemorrhaging is a sign of trauma and was found on 4.7% of all fish examined for injuries. The incidence of fin hemorrhaging was; yearling Chinook salmon 5.5%, subyearling Chinook salmon 6.7%, steelhead 0.9%, sockeye/kokanee salmon 6.6%, and coho salmon 0%.

Bird marks were observed on 1.1% of all fish examined. The incidence of bird marks was: yearling Chinook salmon 0.8%, subyearling Chinook salmon 0.5%, steelhead 2.2%, sockeye/kokanee salmon 2.6%, and coho salmon 0%.

Table 14. Weekly descaling rates in percent for fish sample at Lower Monumental Dam, 2022.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
8-Apr	0.6%	0.0%	---	---	0.0%	6.7%	---	---	---	0.67%
15-Apr	0.0%	0.0%	0.0%	---	0.0%	0.0%	---	---	---	0.00%
22-Apr	0.5%	1.4%	---	---	1.5%	1.3%	---	---	---	0.93%
29-Apr	1.3%	0.9%	---	---	1.2%	2.0%	---	---	0.0%	1.27%
6-May	1.1%	0.8%	---	---	1.7%	0.0%	---	0.0%	---	1.36%
13-May	1.9%	0.0%	---	---	2.3%	2.2%	---	0.0%	0.0%	1.90%
20-May	1.4%	3.2%	0.0%	---	2.6%	1.5%	0.0%	0.0%	0.0%	1.75%
27-May	0.8%	0.9%	0.0%	0.0%	3.5%	1.9%	0.0%	---	0.0%	1.56%
3-Jun	0.7%	1.2%	0.0%	0.0%	3.5%	1.6%	0.0%	0.0%	1.4%	1.38%
10-Jun	0.7%	0.0%	0.4%	0.3%	3.1%	1.3%	0.0%	0.0%	2.0%	0.83%
17-Jun	0.0%	5.7%	0.0%	1.6%	3.2%	2.0%	0.0%	0.0%	0.0%	1.15%
24-Jun	0.0%	0.0%	1.9%	1.4%	2.4%	2.4%	0.0%	0.0%	10.0%	1.89%
1-Jul	6.3%	3.4%	1.5%	0.6%	1.5%	3.3%	0.0%	---	2.5%	1.27%
8-Jul	0.0%	6.3%	0.8%	2.8%	0.0%	0.0%	---	---	0.0%	1.93%
15-Jul	0.0%	25.0%	7.1%	2.3%	0.0%	0.0%	---	---	---	4.34%
22-Jul	11.1%	10.0%	7.3%	6.1%	---	---	---	---	---	6.73%
29-Jul	25.0%	0.0%	0.0%	5.9%	---	---	---	---	---	4.47%
5-Aug	---	14.3%	4.2%	7.4%	---	---	---	---	---	7.19%
12-Aug	---	---	0.0%	2.3%	---	---	---	---	---	2.21%
19-Aug	0.0%	11.1%	0.0%	4.1%	---	---	---	---	---	4.23%
26-Aug	---	50.0%	0.0%	7.1%	---	---	---	---	---	8.70%
2-Sep	---	0.0%	---	3.4%	---	---	---	---	---	3.23%
9-Sep	---	0.0%	100.0%	8.7%	---	---	---	---	---	9.43%
16-Sep	---	0.0%	---	0.0%	---	---	---	---	---	0.00%
23-Sep	---	---	---	20.0%	---	---	---	---	---	20.00%
30-Sep	---	---	---	50.0%	---	---	---	---	---	50.00%
Total Descaled	55	20	34	92	81	19	0	0	7	308
Total Examined	4670	1277	2449	4102	3672	1143	57	17	331	17,718
% Descaled	1.2%	1.6%	1.4%	2.2%	2.2%	1.7%	0.0%	0.0%	2.3%	1.7%

---No fish sampled during this week.

Predatory fish marks were found on 1.3% of all fish examined. The incidence of fish marks was; yearling Chinook salmon 0.9%, subyearling Chinook salmon 1.9%, steelhead 0.9%, sockeye/kokanee salmon 1.3%, and coho salmon 0%.

Fungus was found on 0.2% of all fish examined. The occurrence of fungus is generally seen early in the season while the water is still relatively cold. Fungus on fish was often found concurrently with body injuries. The incidence of fungus was; yearling Chinook salmon 0.2%

and steelhead 0.9%, sockeye/kokanee salmon 1.3%. There were zero instances of fungus found on subyearling Chinook salmon and coho salmon.

Columnaris was seen again this year. It occurs most frequently in subyearling Chinook salmon but has been seen on coho salmon and steelhead as well. Typically, it is found on the fish during the warmer water conditions of July, August, and September. Columnaris can be recognized by the presence of yellowish lesions on the belly, as well as some damage to the gills, pelvic fins, snout, and caudal fins. It has also been found in the dorsal region. This year, subyearling Chinook salmon showed the greatest number of Columnaris-affected fish (0.3%).

Mortality

Annual facility mortality for all groups combined was 0.04% in 2022 (Table 15) and totaled 608 fish. Within each species group, the number of facility mortalities and percent of those collected in that group was: 323 clipped yearling Chinook salmon (0.05%), 107 unclipped yearling Chinook salmon (0.09%), 14 clipped subyearling Chinook salmon (0.01%), 18 unclipped subyearling Chinook salmon (0.01 %), 104 clipped steelhead (0.03%), 28 unclipped steelhead (0.02%), 1 clipped sockeye/kokanee salmon (0.01 %), 10 unclipped sockeye/kokanee salmon (0.80%), and 3 coho salmon (0.01 %). In 2022, the highest rate of mortality was 8.33% on the week ending in September 23 and the lowest rate of mortality was 0% on the weeks ending in July 29, August 19, September 16, and September 30 (Table 16).

Annual sample mortality for all groups combined in 2022 was 0.4% and totaled 74 fish. The number of sample mortalities and mortality rate by species group was: 34 clipped yearling Chinook salmon (0.7%), 10 unclipped yearling Chinook salmon (0.8%), 7 clipped subyearling Chinook salmon (0.3%), 9 unclipped subyearling Chinook salmon (0.2%), 10 clipped steelhead (0.3%), 4 unclipped steelhead (0.3%), 2 clipped sockeye kokanee (2.0%), 0 unclipped sockeye/kokanee salmon (0%), and coho salmon (0%) (Table 17).

Table 15. Annual facility mortality in percent at Lower Monumental Dam, 2018-2022.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2018	0.0%	0.0%	0.1%	0.1%	0%	0.0%	0.1%	0.2%	0.0%	0.0%
2019	0.1%	0.0%	0.3%	0.4%	0.1%	0.1%	0.0%	0.0%	0.7%	0.2%
2020	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2021	0.05%	0.08%	0.03%	0.04%	0.07%	0.05%	0.24%	0.13%	0.07%	0.05%
2022	0.05%	0.09%	0.01%	0.01%	0.03%	0.02%	0.01%	0.80%	0.01%	0.04%

Table 16. Weekly facility mortality in percent at Lower Monumental Dam, 2022.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
8-Apr	0.25%	0.36%	---	---	0.00%	0.00%	---	---	---	0.25%
15-Apr	0.00%	0.00%	0.00%	---	0.24%	0.00%	---	---	---	0.08%
22-Apr	0.04%	0.53%	---	---	0.07%	0.00%	---	---	---	0.09%
29-Apr	0.08%	0.13%	---	---	0.14%	0.00%	---	---	---	0.10%
6-May	0.02%	0.17%	---	---	0.05%	0.03%	---	0.33%	---	0.05%
13-May	0.02%	0.06%	---	---	0.02%	0.03%	---	4.00%	0.20%	0.02%
20-May	0.04%	0.04%	0.00%	0.00%	0.02%	0.00%	0.01%	0.75%	0.07%	0.03%
27-May	0.10%	0.06%	0.00%	0.00%	0.01%	0.06%	0.00%	---	0.00%	0.07%
3-Jun	0.14%	0.12%	0.00%	0.00%	0.06%	0.02%	0.00%	0.00%	0.00%	0.07%
10-Jun	0.28%	0.27%	0.02%	0.02%	0.03%	0.02%	0.00%	1.00%	0.04%	0.05%
17-Jun	0.35%	0.09%	0.00%	0.01%	0.11%	0.02%	0.00%	0.00%	0.00%	0.03%
24-Jun	0.00%	0.10%	0.03%	0.02%	0.04%	0.00%	0.00%	0.00%	0.00%	0.03%
1-Jul	0.00%	0.00%	0.04%	0.00%	0.00%	0.32%	0.00%	---	0.00%	0.02%
8-Jul	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	---	---	0.00%	0.01%
15-Jul	0.00%	0.00%	0.30%	0.00%	0.00%	0.00%	---	---	---	0.10%
22-Jul	0.00%	0.00%	0.22%	0.00%	---	---	---	---	---	0.07%
29-Jul	0.00%	0.00%	0.00%	0.00%	---	---	---	---	---	0.00%
5-Aug	---	0.00%	0.00%	0.36%	---	---	---	---	---	0.30%
12-Aug	---	---	3.33%	0.29%	0.00%	0.00%	---	---	---	0.53%
19-Aug	0.00%	0.00%	0.00%	0.00%	---	---	---	---	---	0.00%
26-Aug	---	0.00%	0.00%	0.00%	---	---	---	---	---	0.00%
2-Sep	---	0.00%	---	1.67%	---	---	---	---	---	1.56%
9-Sep	---	0.00%	0.00%	0.00%	---	---	---	---	---	0.00%
16-Sep	---	0.00%	---	0.00%	---	---	---	---	---	0.00%
23-Sep	---	---	---	8.33%	---	---	---	---	---	8.33%
30-Sep	---	---	---	0.00%	---	---	---	---	---	0.00%

---No fish collected during the week.

Table 17. Annual sample mortality in percent at Lower Monumental Dam, 2018-2022.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2018	0.1%	0.1%	0.2%	0.2%	0.1%	0.0%	0.7%	1.3%	0.0%	0.2%
2019	0.1%	0.2%	0.3%	0.4%	0.1%	0.1%	0.0%	0.0%	0.7%	0.2%
2020	0.2%	0.3%	0.3%	0.4%	0.2%	0.3%	1.5%	0.0%	0.0%	0.3%
2021	0.6%	0.6%	0.2%	0.2%	0.4%	0.4%	2.0%	1.2%	0.4%	0.7%
2022	0.7%	0.8%	0.3%	0.2%	0.3%	0.4%	0.0%	0.0%	0.0%	0.4%

RESEARCH

Gas Bubble Trauma

Juvenile Chinook salmon and steelhead were sampled once a week for GBT from April 11 to August 11. This season, 1,262 fish were sampled for GBT. Oregon Department of Fish and Wildlife (ODFW) personnel examined up to 100 individuals of each of the following groups: yearling Chinook salmon, subyearling Chinook salmon, and juvenile steelhead. The fish were examined for evidence of bubbles in paired and unpaired fins and in the eye, as per Fish Passage Center (FPC) GBT protocols. GBT fish were bypassed to the river after examination. Weekly GBT sampling continued for up to 4 hours or until 100 fish had been sampled per species group. The number of fish sampled for GBT, by species group, was: 303 clipped yearling Chinook salmon, 93 unclipped yearling Chinook salmon, 161 clipped subyearling Chinook salmon, 177 unclipped subyearling Chinook salmon, 385 clipped steelhead, and 143 unclipped steelhead. In the 2022 season, 24 fish showed signs of GBT in the fins (1.90%).

Steelhead Kelt Study

Efforts to recover declining steelhead stocks within the Columbia River Basin (CRB) have ranged from harvest reduction, habitat restoration, passage improvements at mainstem Columbia River hydropower facilities, and hatchery propagation. More recently, the use of kelt reconditioning has been investigated to increase total reproductive potential of steelhead populations (Hatch et al. 2020). Kelt reconditioning consists of the collection of post-spawned steelhead and the administration of prophylactics and feed for the purpose of improving survival relative to the untreated condition. Upon release, these fish are intended to return to natal populations, thereby increasing escapement and productivity if reconditioned individuals successfully spawn. Collection for the Nez Perce steelhead kelt study and rehabilitation began in early April, once set up of the collection tank was completed. On July 20, all the study equipment was removed for the remainder of the year, except for the holding tank, which will remain until the 2023 collection year when the study begins again.

FACILITY OPERATIONS AND MAINTENANCE

Turbine Operations

Efforts were made to operate all turbine units within 1% of peak efficiency from April 3 to October 31. Deviations were infrequent and brief or required by the Bonneville Power Administration. Unit priority was in effect from March 1 to November 30. Units were taken out of service (OOS) for various reasons throughout the year. Table 18 below provides a summary of unit outages and causes.

Spill Operations

Prior to spill season, spill only occurred if it was needed for spill excess of powerhouse capacity. Limited spill through the RSW for adult steelhead passage occurred from March 1 to 31 and again from September 1 through November 15. The spring spill program began at 0001 hours

Table 18. Unit outages and causes at Lower Monumental, 2022.

Dates out of service (OOS)	Unit	Reason out of service (OOS)
March 2	Unit 2	Faulty turbine bearing low oil flow alarm
March 3 – 8	Unit 2	Thrust Bearing pressure switch
March 15–17	All Units	Trash rack raking (6-8 hours/day alternating units)
March 21–23	All Units	STS installation
March 28	Unit 2	2B STS failure
June 6	Unit 5	5B STS out of service
June 13 – July 28	Unit 5	6-year maintenance overhaul/T2 repair
June 19 - 21	Unit 3	Annunciator breaker tripped
June 23	Unit 1	Bad Nexus board
July 19 -20	Units 1 – 4	Trash rack raking
August 1 – 18	Unit 2	Annual/Exciter Replacement
August 22	Unit 1 – 4	Preparation for T2 repair
August 22 – November 4	Unit 5	T2 repairs
August 22 – November 7	Unit 6	Annual maintenance/T2 repairs
September 26 – October 13	Unit 4	Annual maintenance
March-December monthly (2-3 days)	All Units	STS/VBS inspection/hub tapping on fixed blade units

April 3 and ended 0000 hours on June 20. The summer spill program began at 0001 hours on June 21 and ended at 0000 hours on August 31.

Spillways 1, 2, 6 and 7 were taken OOS at 1800 hours on April 22 for trunnion stress issues and resolution. This also caused the RSW to be removed from service at varied times for the repair work. Spillway 7 was RTS on May 4 at 0925 hours. The application of the grease line was completed on spillway 6 on May 3 at 0900 hours and then the spillway was RTS on May 4 at 0925 hours. Spillway 3 was OOS from 0700 hours to 1700 hours on May 5 while work was being done on spillway 2. Spillway 1 RTS on May 12 at 1430 hours. Spillway 2 RTS on May 10 at 1610 hours.

Spillway 7 was forced OOS at 1520 hours on May 12 for a motor coupler issue and was RTS on May 12 at 1536 hours. Spillway 5 was placed OOS on June 7 at 1212 hours due to motor coupling issues. The spillway was RTS on June 8 at 0835 hours.

During the spill seasons, spill adjustments for navigation were done as required. After spill season ended, spill only occurred if needed for excess of powerhouse capacity.

Removable Spillway Weir

The RSW went into service at 0001 hours on April 3 with the start of the spring spill program. Due to high river temperatures correlated with low river flows, the RSW was closed on August 4, except for the fall spill to assist with steelhead passage.

The RSW was taken OOS during 0630 hours to 1700 hours from April 25 to April 28 when the powerhouse crews were working on spillway 7.

Forebay Debris

Forebay debris was moderately light for the year. The maximum amount of debris observed during ladder inspections was around 3,100 yd^2, observed in the month of April.

Trash Racks

During the winter, trash rack measurements were not taken. Before the juvenile passage season, trash racks were cleaned at all slots from March 15 to 17. Approximately 35 cubic yards of debris, mostly consisting of tumbleweeds, were removed. Only one fish was observed during the trash rack cleaning, one decomposed adult shad. The trash racks were cleaned again at mid-season, July 19 to 20. Approximately 30 yards of debris was removed from the trash racks, mostly consisting of logs and sticks. The majority of the debris was removed from units 1 and 2. No problems were observed during any cleanings.

Gatewells

During the season, gatewell slots were checked during ladder inspections, approximately three times per week. The gatewell drawdown benchmark measurements were taken for all units on March 24.

A small amount of residual oil/film was found in the 6A slot on April 19. An absorption pad was placed into the slot and the control room was notified. A large chunk of plastic bucket was retrieved from the 6A gatewell slot on August 8, because its size could cause an orifice plug.

In addition, during the season small amounts of woody material were noted in the gatewell slots, and the debris coverage did not exceed 50% during any inspections. No large accumulations of woody material were noted.

Submersible Traveling Screens

During the winter maintenance season, electrical cables, gearboxes, motors, and screens were examined and repaired or replaced as required. The Submersible Traveling Screens (STS) were inspected and tested on March 16 prior to installation. STSs for units 5 and 6 were deployed on March 21. Units 3 and 4 were deployed on March 22, and units 1 and 2 were deployed on March 23.

STSs are usually operated in cycle mode when the average fork length of subyearling Chinook salmon and/or sockeye salmon is greater than 120 mm, and in continuous run mode when either were less than 120 mm. The STSs were placed in cycle-run mode when first deployed on March 18; they were changed to continuous-run mode on June 6 due to average sub-yearling Chinook and sockeye lengths being less than 120 mm. They were changed back to cycle-run mode on July 19 when the average lengths of collected fish were greater than 120 mm.

STS deployed in slot 2B had a motor failure on March 28, and was immediately replaced with a spare screen before the unit RTS. STS deployed in slot 3B had a motor trip with failure to reset

on October 28, the unit remained OOS until November 4 after a Bonneville Power Administration (BPA) line outage for T2 repair. STS deployed in slot 5B had a motor failure on June 6 and was immediately replaced with a spare screen before the unit RTS.

The STS in the 3B slot was found not operational on October 28 at 1550 hours. Unit 3 was kept OOS due to the failure until it could be examined by powerhouse staff. Powerhouse electricians worked on the STS operating system on October 31 and November 1. After troubleshooting the STS issue, the electrical issue with the STS was fixed and the STS was returned to service on November 2.

All STSs were raised by December 15. Unit 1 had been raised prior because the unit was OOS. After the screens were raised, they were visually inspected. The STSs appeared clean and had no apparent damage to them.

Vertical Barrier Screens

VBS differentials are not measured daily at Lower Monumental due to the general structure of the VBSs. Instead, they are spot checked during the monthly STS inspections. A thorough VBS inspection occurred this year July 7-8 and September 6-7. A few issues were found during the camera inspection of the VBSs in slots 4A, 4B, 5A and 5B.

During July 11 to 12, repairs were made to the VBSs in slots 5A and 5B. Both slots required a small strip of sheet metal to be welded to the top of the VBS to diminish the gap between the gatewell concrete wall and the top of the VBS.

During the inspections on September 6 to 7, the VBS in the 4A slot appeared to be missing a sheet of metal which butts up against the concrete wall of the gatewell. The slot was dewatered on September 28, and it was discovered that the VBS was manufactured differently and did not have this additional metal sheet. There was still an obvious ½" gap above the VBS which was corrected by the powerhouse mechanics by fabricating a piece of sheet metal onto the VBS to prevent a future problems.

During camera inspections on September 6 to 7, the VBS in the 4B slot appeared to have a gap on the top in which sticks were getting lodged. The 4B slot was dewatered and a physical inspection of the VBS occurred on September 28. After the inspection, it was determined no work was needed to the VBS. The small sticks were removed.

No other issues were found throughout the year.

Juvenile Collection Channel (JCC) Orifices

During the 2022 season, the number of open orifices varied from 17 to 20 according to forebay level. The orifices were opened on March 23, after the winter maintenance period. With the Lower Monumental reservoir at minimum operating pool, water discharge through an orifice is reduced. During this period, extra orifices were opened to supply additional water to the adult fishway. Orifices were cycled and backflushed with air daily to remove debris. Orifice lights

were also checked daily. If a light was not working, flow was directed to the other orifice in the slot until repairs could be made. The orifices were closed for the winter maintenance period on December 15 at 1055 hours.

The orifices at 5C29 and 6B33 in the channel were inspected after the powerhouse staff reported they appeared to be binding up. The JFF mechanics checked the cylinders and valves for any broken components on October 15 and reported them back in service to the control room.

Primary Dewatering Structure

During the winter maintenance period, the leak at the joint between the JCC and PDS that was discovered during the 2021 season, was replaced with a new rubber gasket. In addition, the sprocket, chain and cable from the screen cleaning brush were replaced.

The PDS operated from March 23 to December 15. The compressed air screen cleaner functioned well throughout the 2022 season. The PDS mechanical screen cleaner brush functioned well except for the issues listed below.

The air bubbler in zone 3 went out of service on April 1. JFF maintenance discovered a bad air flow solenoid. Powerhouse electrician replaced the solenoid and zone 3 went back into service at 0900 hours on June 23. High water alarms went off on July 3, 6, 7, and 8 for the PDS. However, when examining the water level in the PDS, it appeared normal. It was discovered that zone 3 had too much air flow and caused the high-water sensor to trigger. The air valve was adjusted and corrected the issue.

After multiple high-water alarms received in the control room on August 17, the PDS weirs were lowered to bring the water level 0.2-0.4 ft lower to aid with the alarms in the control room. The electricians made a few modifications to the set points on August 18. The PDS weirs were raised to a normal setting on August 19 at 0700 hours.

During the evening of September 11, the PDS screen cleaning brush stopped in the middle of the cycle. The brush was returned to park position and reset. The brush functioned effectively during the next cleaning cycles.

The air bubbler timer was increased to run every 10 minutes and the PDS screen brush timer was decreased to run only twice a week on October 15, due to the decrease in debris coming through the system. For the remainder of the season, the brush was only run manually on Mondays and Thursdays to prevent wear and tear on the brush components.

The brush timer on the brush at the PDS was modified by powerhouse electricians on December 13 to allow the brush to be set to either a 1, 3, 6 or 12 hour run time option. This decreased the over-usage on the brush. On December 15, the brush was turned off and tagged out for the winter maintenance season once the JCC was dewatered.

JUVENILE FISH FACILITY

Separator

Sudden water level drops at the separator were not a problem this year but continued to occur. Water level remained consistent at the separator with manual operation of the automated weirs of the primary dewaterer. As has been the case for the last few years, the separator was operated at a higher water level to assure no problem with exposed separator bars would occur.

PIT Tag System

The PIT tag system functioned well this season. There were no problems to report with the PIT tag system.

The PIT tag system detected 31,945 PIT tagged fish at the JFF from April 1 to October 1. None of these PIT-tagged fish are included in the bypass numbers. Juvenile hatchery Chinook salmon, hatchery coho salmon, and hatchery steelhead in the Snake River Basin are normally designated by fin clips, usually the adipose fin, but occasionally one of the pectoral or ventral fins.

Sample

The JFF was watered up for testing at 0820 hours on March 23. The JFF and wet lab was fully watered up on March 29. Every-third-day fish condition sampling began at 0700 on April 1. The first sample was processed on April 2, and continued every third day up until April 14, after which condition sampling took place every other day. Early-season condition monitoring consisted of a 24-hour sample on target days from 0700 hours to 0700 hours. Every-other-day sampling continued until the start of transportation operations on April 23, at which time sampling was conducted every day. During this period, fish were examined and returned to the river. Every-day sampling continued up until June 9, when the fish facility switched to every-other-day sampling in accordance with the newly updated FPC high water temperature guidelines due to Snake River water temperatures exceeding 68.5°F.

Collection for barge transport began at 0700 hours on April 23 and ended at 1300 hours on June 9. Due to high river levels and flow, June 7 fish transport was canceled at Lower Monumental, and those fish collected were release back to the river. Beginning June 10, all fish collected were sampled for condition and then bypassed. This operation continued until October 1, when the facility was returned to primary bypass. The JFF was dewatered for winter maintenance on October 3.

The sample screen which controls the switch gates stopped working on August 10 at 2030 hours. The technician on duty checked the timing of the gates with a stopwatch to ensure the gates were still collecting at an accurate percentage. The screen was able to be rebooted on August 11 at 0745 hours.

The B side count tank pipe was found plugged on August 11 at 0615 hours. The lead biological technician and mechanics were able to unplug the pipe at 0830 hours. The plug consisted of two dead incidental fish, a walleye and a bass, and some smaller sticks.

Other Facility Issues

Nuisance bird detourants were place up around all the PIT-tag boxes in late June to prevent the starlings from continuing to nest behind the boxes.

The JFF mechanical shop air conditioner was replaced on July 25. During the last few weeks in July, the raceway flow coming from the diffusers appeared to be lessor than previous months. The raceway water was lowered, and the diffuser plates were cleaned on July 25. This corrected the issue with a lower water pressure.

A power outage occurred at the fish facility on August 18 at 1615 hours that lasted approximately 5 minutes. The only noticeable effect was the outfall cannon had to be restarted.

An air cylinder for the lamprey bypass system started leaking on August 20. Air supply was turned off until the repair was made on August 31. This did not affect operations since the lamprey bypass is not used when fish are not going to the raceways.

A power outage occurred at the JFF on August 22 at 0655 and then again at 1315 to assist with the XJ breaker and T-2 rehabilitation. No issues occurred from the power outages, except the bird cannon had to be reset after each power outage. Two additional power outages occurred on August 23, with no issues caused from the outages.

The B-side PIT tank valve would not close using the electrical switch on September 12. The powerhouse electricians examined the PIT tank system that same day. The electricians believed the corrosion on the switch contacts caused the PIT tank to not function. In the afternoon, after the inspection, the B-side PIT tank was RTS.

The PIT tag slide gate pins were replaced on both the A and B side on October 6.

The sample gate screen in the separator booth stopped functioning in the evening of September 12. The screen was reset twice and did not reboot correctly. The fish biologist rebooted the screen by removing the breaker and allowing it to cool for approximately 10 minutes. Once rebooted, the screen was able to be used. As a precaution, since this had occurred already in the season, Pacific States Marine Fisheries Commission (PSMFC) was notified of the issue.

A brief power outage occurred on October 31 from 0815 to 0840 hours while during the preparation for the BPA power grid modification. A loss of power occurred to the station service on November 3 from 1643 to 1830 hours. The project was not running any units during the power outage, as BPA was performing power grid modifications. The single project operator was able to restore power for approximately 30 minutes during that time while troubleshooting the power loss issue. All systems returned to service at 1830 hours once station service was able to be restored.

During the JCC dewater on December 15, the winch that lifts the gate covering access to the return to river pipe was damaged. A new winch was ordered and will be replaced during the 2023 winter maintenance period.

FISH SALVAGE

Only juvenile fish salvage at various locations will appear in this report. Fish were not always examined for clips as their survival was a higher priority.

The fish rescue occurred for the North adult fish ladder and powerhouse collection channel on January 11 at 0700 hours. There was a total of 27 live clipped adult steelhead and 5 lived adult unclipped steelhead returned to the river. Most of the steelhead were less than 20 inches in length. In addition, there were 55 adult catfish, 3 smallmouth bass, 1 walleye, 1 carp and 1 perch returned to the river at the tailrace.

Unit 4 scrollcase fish rescue took place on July 22 at 1300 hours. One catfish was released and there were no mortalities found.

A fish salvage took place from the gatewell slot of 4A. The fish salvage occurred while the maintenance bulkhead was being removed from the 4A slot. The mechanical crew realized the fish were trapped on top of the bulkhead and immediately stopped all operations. They then called the fish team who came and removed the trapped fish who were returned to the river unharmed. There were three clipped steelhead rescued during the salvage. A fish salvage occurred at unit 6 scrollcase once it was dewatered on October 6 at 0825 hours. There were no fish observed in the scrollcase.

The juvenile collection channel was dewatered on December 15. The orifices were closed at 1055 hours and the channel dewatering was completed by 1230 hours. Thirty-four adult clipped steelhead, twenty-three adult unclipped steelhead, one adult unclipped Chinook, eight juvenile lamprey, five juvenile sculpin, and one adult catfish were returned to the river live and unharmed. In addition, the mortalities included twenty-five juvenile shad, one adult walleye and two adult shad were also placed into the tailrace. In the channel end of the PDS, a stick blockage was discovered once the JCC was dewatered. In the stick blockage is where the mortalities were discovered.

COOLING WATER STRAINERS

Turbine unit cooling water strainers were examined for biologic content once per month from January until June and then again in December. The vast majority of other species found within the strainers were American shad. The number of each group and percent of the individual groups consisted of 1,348 American shad (53.7%), 1,092 juvenile lamprey (43.6%), 65 salmonid species (<1%), 1 steelhead (<1%), and 1 Siberian prawn (<1%).

Probability of any individual being alive at the time of strainer cleaning was likely more related to time of entry rather than which unit's strainer it was found in. Units 5 and 6 were unable to be inspected because of mechanical issues with the units on December 8. Repairs to unit 5 and 6

will be completed during the unit outages in January and February 2023. Table 19 below reflects the results of this year's main unit cooling water strainer examinations.

Table 19. Cooling Water Strainer Results at Lower Monumental Dam, 2022.

Month	Lamprey Mortality	Live Lamprey	Smolt Mortality	Live Smolts
Jan	1	0	0	0
Feb	11	1	0	0
Mar	48	1	0	0
Apr	100	0	2	0
May	538	14	47	1
Jun	373	1	14	0
Jul	4	0	2	0
Dec	0	0	0	0

INVASIVE SPECIES

During winter maintenance, other dewatering activities and monthly mussel station examinations, no issues were found.

A total of 2,867 Siberian prawns were removed from the sample and disposed of in landfills in accordance with the Washington Department of Fish and Wildlife (WDFW) permit requirements this season. Siberian prawns appeared in many of the samples during the later spring and summer, with the last ones found in the samples during the last few weeks of September.

AVIAN PREDATION

Avian Predation-General

Areas of avian predation monitoring included: forebay, turbine discharge, spillway discharge and JFF bypass outfall. Deterrent measures included: bird wires across the tailrace of the powerhouse, water cannon sprinklers at the exit of the bypass outfall pipe, bird deterrent spikes at common perching areas, and hazing (April 1 through June 2) under the animal control contract with United States Department of Agriculture-Wildlife Services (USDA-WS). Two shift hazing coverage (daylight to dusk) occurred from May 3 to June 2. After the USDA-WS staff was no longer hazing due to the end of the contract season, JFF staff hazed birds on several days when the trigger point was exceeded. Between July 12 to August 4, JFF staff hazed birds due to the number of piscivorous birds feeding in the tailrace area.

Avian predators tend to rest in the forebay and chase juvenile fish as they jump. They also spend time perched on the lock wall facing the tailrace. At the downstream navigation lock guidewall, bird wires were added along the top rail of the handrail during winter 2008-2009, which effectively reduced the perching previously seen there, however, to a great extent the perching only relocated to the deck in front of the handrails.

The bird observations take place during fish ladder inspections with supplemental counts by WS or JFF personnel on days with no ladder inspection. Figure 3 shows the daily count of gulls, cormorants, grebes and pelicans in the tailrace from April 1 to September 30.

The outfall bird cannon was placed into service on March 17 at 1430 hours. Due to a power outage which occurred on August 18 at 1615 hours, the outfall cannon had to be restarted. Another power outage at the JFF on August 22 at 0655 hours and then again at 1315 hours caused the outfall cannon to lose function. The outfall cannon had to be restarted both times. The outfall bird cannon was winterized on October 13.

A broken anti-bird wire was noticed broken/missing on the September 23 inspection. USDA-WS was contacted, and the repair was made on October 13 by JFF and USDA-WS staff.

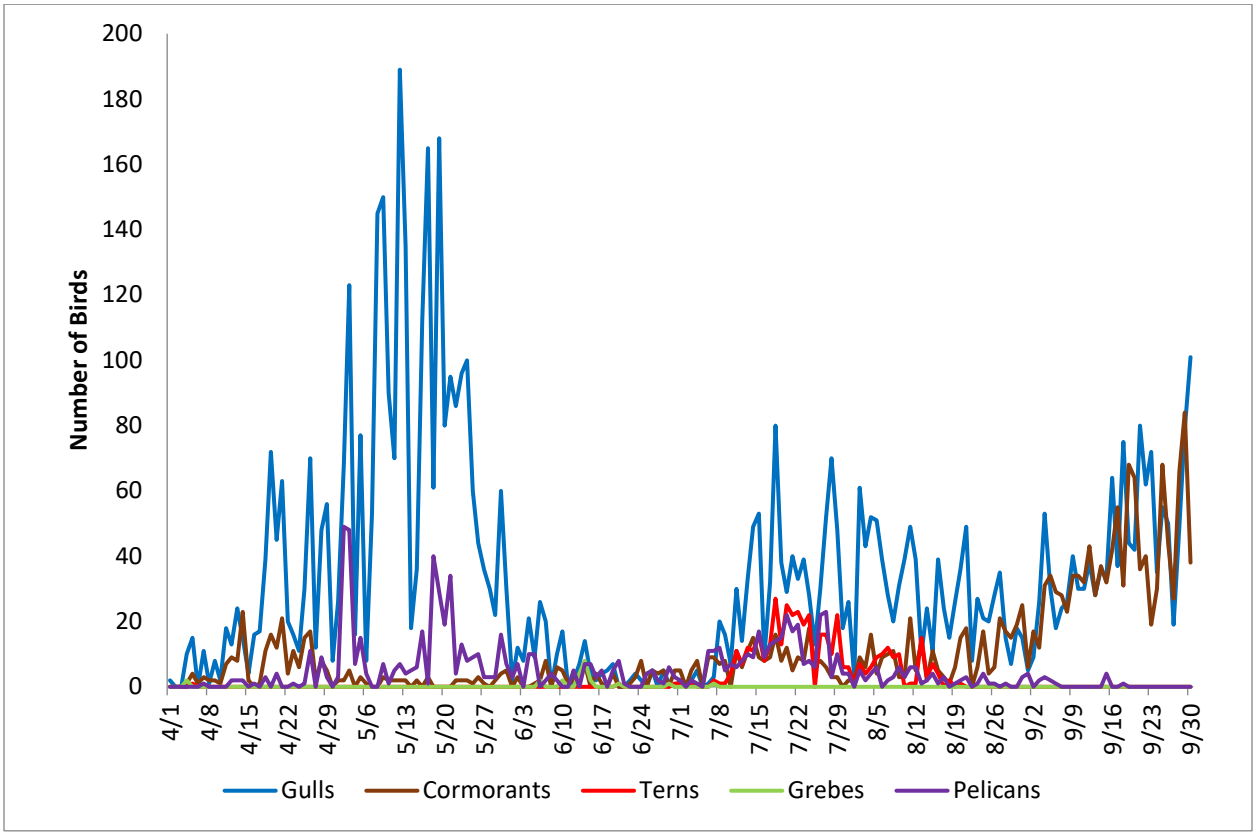

Figure 3. Daily count of gulls, cormorant, grebes and pelicans in the tailrace and forebay, 2022.

Adult Fishway Inspection Bird Counts/Wildlife Services Bird Monitoring

These inspections were conducted at random times and contain counts during active bird hazing as well as in its absence. On Mondays and Thursdays (April 1 through June 2), USDA-WS contracted employees collected bird information in the same format as the ladder inspection data and this information was added to the spreadsheet for inclusion in this report. During daylight hours, gulls were present if hazing was not occurring. High juvenile fish numbers passing the dam via spill related to higher gull numbers. In the absence of hazing, gulls appeared to be

effective at feeding in the tailrace areas. Each ladder inspection included an avian predator count section for five areas that included: forebay (FB), spillway (SWT1), under the bird wires of the turbine discharge (PHT1), downstream of the bird wires below the turbine discharge (PHT2), and lastly the juvenile bypass outfall (JFOF). Each area included counts of both foraging and resting birds. The following summarizes the data collected from April 1 through September 30 of the 2022 season. The averages offered in each category include all data through the period; it is an average of all the fish ladder inspections, USDA-WS and JFF supplemented bird monitoring inspections for that condition (feeding/resting) in each zone.

Gulls

Gull numbers were highest from April 11 to May 31 with later waves from June 4 to 10 after the end of hazing efforts and July 8 until September 30 after the end of barge transport. In all areas, gull numbers dropped after May 31 as juvenile salmonid numbers became increasingly sparse and then numbers increased again as the young of the year American shad became abundant in the area.

The maximum number of gulls observed in all areas was 189 (May 12), with an overall daily average of 34.5 gulls. The number of gulls feeding in the FB ranged from 0 to 25 (May 19) and averaged 1.1 while the number of gulls resting in the FB ranged from 0 to 120 (May 8) and averaged 12.7 gulls. Gulls in the FB are typically seen resting on the navigation lock guide wall. The number of gulls feeding in SWT1 ranged from 0 to 95 (May 19) and averaged 7.7 while the number of resting gulls in SWT1 ranged from 0 to 75 (September 18) and averaged 7.5. Gulls in SWT1 are typically seen avoiding the pyrotechnics of the hazers firing over the spillway discharge from the navigation lock deck (elevation 536). The number of gulls feeding in PHT1 ranged from 0 to 5 (September 20) and averaged <1 gull. The number of gulls resting in PHT1 ranged from 0 to 6 (September 20) and averaged <1 gull. PHT1 gulls are only typically seen when the hazer is not present. The number of gulls feeding in PHT2 ranged from 0 to 80 (May 20) and averaged 3.3 gulls while the number of resting gulls in PHT2 ranged from 0 to 37 (July 18) and averaged <1 gull. Gulls in PHT2 are only typically seen when the hazer is not present. The number of feeding gulls at the JFOF ranged from 0 to 25 (May 19) and averaged 1.5 gulls. Gulls were not observed resting at the JFOF. JFOF gulls are typically seen when large numbers of juvenile salmonids are bypassed.

Hazing was effective at moving gulls out of the area. Two shifts were used to provide daylight to dusk coverage throughout the historic peak of salmonid outmigration (Table 20). The second shift of hazing was equally as effective as the morning shift. On days when hazing did not occur, but fish passage numbers were high, the birds returned and resumed normal feeding behaviors. Gull numbers correlated well with the peak of the juvenile fish outmigration this season, as has been the rule in the past. Observers noticed that during higher spring spill volume, large numbers of feeding gulls were seen just below SWT1, so were not included in the tailrace observation numbers. This newly observed feeding location also decreased the effectiveness of hazing efforts.

Table 20. USDA-WS hazing program schedule for Lower Monumental Dam, 2022

Personnel	Days	Dates	Shift
WS Hazer #1	Monday - Friday	4/1/2022 – 6/2/2022	Regular Coverage
WS Hazer #2	Monday - Friday	5/3/2022 – 6/2/2022	Peak Season
WS Hazer #3	Saturday & Sunday	4/1/2022 – 6/2/2022	Regular Coverage
WS Hazer #4	Saturday & Sunday	5/3/2022 – 6/2/2022	Peak Coverage

Cormorants

Overall cormorant abundance was fairly consistent throughout the season. Cormorants tend to be more prevalent in the fall and winter than during juvenile salmonid outmigration. The maximum number of cormorants observed in all areas was 84 (September 29), with an overall daily average of 10.9 cormorants. The number of cormorants feeding in the FB ranged from 0 to 8 (April 21) and averaged <1 cormorants while the number of cormorants resting in the FB ranged from 0 to 17 (August 27) and averaged 2 cormorants. Cormorants in the FB are commonly seen foraging and are impervious to hazing. The number of cormorants feeding in SWT1 ranged from 0 to 49 (September 20) and averaged 1.1 cormorants while the number of resting cormorants in SWT1 ranged from 0 to 76 (September 29) and averaged 4.6 cormorants. Cormorants in SWT1 are not effectively prevented from foraging by the pyrotechnics of the hazers. The number of cormorants feeding in PHT1 ranged from 0 to 15 (September 4) and averaged <1 cormorant while the number of cormorants resting in PHT1 ranged from 0 to 4 (September 17) and averaged <1 cormorants. Cormorant abundance in PHT1 is erratic and individuals are impervious to hazing. The number of cormorants feeding in PHT2 ranged from 0 to 32 (September 5) and averaged 1 cormorant while the number of resting in PHT2 ranged from 0 to 2 (May 4) and averaged 1.7 cormorants. Cormorant observations in PHT2 are similar to those in PHT1. The number of cormorants feeding at the JFOF ranged from 0 to 4 (August 30) and averaged <1 cormorant while the number of cormorants resting ranged from 0 to 1 (April 11) and averaged <1 cormorant. Feeding cormorants are frequently underwater and hard to accurately count

Terns

Tern numbers observed were extremely high when compared to past seasons. The first one was observed on June 30. The maximum number of terns observed in all areas was 27 (July 18), with an overall daily average of 2.3 terns. The number of terns feeding in the FB ranged from 0 to 2 (July 23) and averaged <1 tern while the number of cormorants resting in the FB ranged from 0 to 17 (August 21) and averaged 1 tern. The number of terns feeding in SWT1 ranged from 0 to 11 (July 22) and averaged <1 tern while the number of resting terns in SWT1 ranged from 0 to 12 (July 18) and averaged <1 tern. There were no terns observed feeding or resting in PHT1. The number of terns feeding in PHT2 ranged from 0 to 7 (July 24) and averaged <1 tern while the number of resting in PHT2 ranged from 0 to 4 (July 11) and averaged <1 tern. Terns were not observed feeding or resting at the JFOF

Grebes

Grebes were only seen in the forebay (FB) during the season. The number of grebes feeding in FB ranged from 0 to 8 (June 14) and averaged <1 grebe while no grebes were observed resting in the FB. Grebes are frequently underwater and hard to accurately count.

Pelicans

The first pelican was observed on April 13 with the last observation on September 18. The maximum number of pelicans observed in all areas was 49 (May 2), with an overall daily average of 5 pelicans. The number of pelicans feeding in the FB ranged from 0 to 9 (April 28) and averaged <1 pelican with the number of pelicans resting in the FB ranging from 0 to 7 (April 26) and averaging <1 pelican. Pelicans in the FB are typically seen cruising as a group, generally along the north shoreline. The number of pelicans feeding in SWT1 ranged from 0 to 37 (May 18) and averaged 1.6 pelicans while the number of pelicans resting in SWT1 ranged from 0 to 3 (April 20) and averaged <1 pelican. Pelicans in SWT1 are typically not impacted by WS activities. The number of pelicans feeding in PHT1 ranged from 0 to 11 (July 21) and averaged <1 while the number of pelicans resting in PHT1 ranged from 0 to 4 (July 16) and averaged <1 pelican. The number of pelicans feeding in PHT2 ranged from 0 to 34 (May 26) and averaged 1.8 pelicans while the number of pelicans resting in PHT2 ranged from 0 to 7 (June 4) and averaged <1 pelican. The number of pelicans feeding at the JFOF ranged from 0 to 6 (May 19) and averaged <1 pelican while the number of pelicans resting at JFOF ranged from 0 to 2 (July 20) and averaged <1 pelican. Pelicans near the JFOF are typically seen when large numbers of juvenile salmonids are bypassed.

Avian Hazing-United States Department of Agriculture-Wildlife Services

Deck hazers worked eight-hour shifts for seven days a week. Start and end times varied to reduce habituation of birds. Bird hazing efforts by USDA-WS personnel began on April 1. The USDA-WS hazing program is outlined in Table 20.

RECOMMENDATIONS

Research converting the pipe system between the PIT facility counter tanks and the PIT facility holding tank exits with an open system that eliminates the need to hold fish in the PIT system holding tanks.

Research a new juvenile count system to replace the Smith-Root count system.

Remove sand and debris from the supply conduits and replace all original ladder diffuser grates, support structures, and mud valves.

Replace staff gauges with fiberglass reinforced plastic staff gauges.

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