CENWW-ODG ST. JOHN 3 March 2021

MEMORANDUM THRU:
Norman Bloom, Operations Project Manager, Little Goose Dam

FOR Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2020 Juvenile and Adult Fish Passage Report, Little Goose Dam.

1. Enclosed find the 2020 Juvenile and Adult Fish Passage Report for Little Goose Dam as requested.

2. If you have any questions contact Scott St. John at Little Goose Dam, (509) 399-2233 ext. 263.

Scott J. St. John
Supervisory Fisheries Biologist, Little Goose Dam

Enclosure

2020 Juvenile and Adult Fish Passage Report
Little Goose Dam

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and

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Environmental Assessment Services

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Introduction

Little Goose Lock and Dam (LGS), located at river mile (RM) 70.3, is the third of four hydroelectric dams impounding the lower Snake River. Little Goose Dam is 2,655 feet long and impounds Lake Bryan, a 10,025-acre reservoir with normal operating elevations ranging from 633-638 feet above mean sea level (msl). Lower Monumental Dam impounds the Snake River below LGS, forming Lake Herbert G. West, creating tailwater elevations at LGS ranging from 537-544 feet msl. LGS is comprised of five major components: the powerhouse, navigation lock, earthen embankment, spillway and adult and juvenile fish passage facilities.

Adult Fish Passage

This report summarizes the operation and maintenance of the adult fish passage facility from March 01, 2020 to December 31, 2020. The adult fishway was in service from February 27, 2020 to January 20, 2021. Fish counting activities took place from April 01 to October 31, 2020. A total of 139 fishway inspections were conducted by U.S. Army Corps of Engineers (USACE), Environmental Assessment Services (EAS) and Oregon Department of Fish and Wildlife (ODFW) biologists and technicians.

The adult fishway includes a north shore entrance and a channel under the spillway that connects to the powerhouse collection system. The powerhouse collection system has a north powerhouse entrance and a channel under the tailrace deck that connects with the fish ladder. This section also includes an adult fallout fence near the north powerhouse entrance. Ten floating orifice gates along the powerhouse channel were removed and closed off with bulkheads between 1996 and 2000. A south shore entrance also connects to the fish ladder. The ladder rises about 100’ on a 1:10 slope and exits into the forebay above the dam. Gravity provides adequate water flows for the fish ladder. For the rest of the system, however, auxiliary water is needed to attract fish into the various entrances. Auxiliary water is supplied by three turbine-driven pumps that pump water from the tailrace to the pump chamber which gravity feeds various floor diffusers in the powerhouse channel and at the bottom of the fish ladder. Additional water, gravity-fed, is provided by diverting excess water from the primary dewaterer (a juvenile fish facility component) to the pump chamber and floor diffusers.

Additionally, the fish ladder includes a fish viewing room which is not only popular for visitors but is utilized to provide adult fish count data. Fish counting by the Four Peaks Environmental, under contract with the Corps, takes place from April through October.

Juvenile Fish Passage

This report summarizes activities and results associated with the collection, transportation and bypass of out-migrating juvenile steelhead *Oncorhynchus mykiss*; Chinook salmon *O. tschawytscha*; sockeye salmon *O. nerka*; and coho salmon *O. kisutch* at Little Goose Dam (LGS) in 2020. The data represented in this report was collected from April 01 through November 01, 2020 by USACE, EAS and ODFW Smolt Monitoring Program (SMP) and transportation biologists and technicians.

The juvenile fish collection and bypass system at LGS extends from the upstream face of the dam downstream to the Juvenile Fish Facility (JFF) and tailwater area. System components include 18 extended length submersible bar screens (ESBS), 18 vertical barrier screens (VBS), 36 gatewell orifices, a collection channel, a dewatering structure, and a corrugated flume, which

routes fish diverted from the forebay to the JFF. The JFF consists of a fish separator, routing flumes, fish holding raceways, a sampling and marking laboratory, truck and barge loading facilities, and a passive integrated transponder (PIT) tag detection and diversion system.

The objective of the transport program is to improve survival of out-migrating smolts, resulting in increased adult salmon and steelhead returns. Operating parameters are set forth annually in the Fish Passage Plan (FPP) and Fish Operations Plan (FOP).

River Conditions

River Flows

Near average winter and spring precipitation and cool temperatures in early spring resulted in flows that were 95.7% of the 5-year average. Monthly flows were well below the 5-year average during April, slightly below the 5-year average during May and October, and above the 5-year average during June, July, August, and September (Table 1). During the 2020 fish passage season—April 1 to November 1—the average daily flow was 52.72 kilo cubic feet per second (kcfs). The maximum average daily flow of 158.2 kcfs occurred on June 2, and the minimum average daily flow of 13.7 kcfs occurred on October 5 (Figure 1).

Table 1. Comparisons of average monthly flow and spill in kcfs at Little Goose Dam JFF 2015-2020.

Month	2015	2016	2017	2018	2019	2020	2015 to 2019 Average
				Flows (kcfs)			
Mar	—	—	—	57.34	—	—	—
Apr	48.27	87.05	132.84	91.81	116.99	54.50	95.39
May	59.08	87.36	139.59	133.80	118.34	105.15	107.63
Jun	41.34	52.30	127.97	80.76	93.20	93.33	79.11
Jul	27.69	32.11	50.02	37.57	38.51	46.88	37.18
Aug	20.91	23.70	29.96	28.49	28.26	28.58	26.26
Sep	17.96	18.90	25.79	21.84	24.47	22.47	21.79
Oct	15.53	20.74	22.81	17.82	21.30	19.53	19.64
				Spill (kcfs)			
Mar	—	—	—	0.02	—	—	—
Apr	12.84	24.70	43.41	31.78	48.25	31.32	32.20
May	17.68	25.77	76.33	50.73	49.30	64.34	43.96
Jun	12.74	15.68	50.41	27.89	39.47	49.96	29.24
Jul	9.11	10.42	14.94	11.43	11.55	14.33	11.49
Aug	6.98	8.51	10.34	10.47	10.58	9.02	9.38
Sep	0.13	0.18	0.21	0.24	0.44	0.80	0.24
Oct	0.00	0.00	0.00	0.31	0.01	0.54	0.06

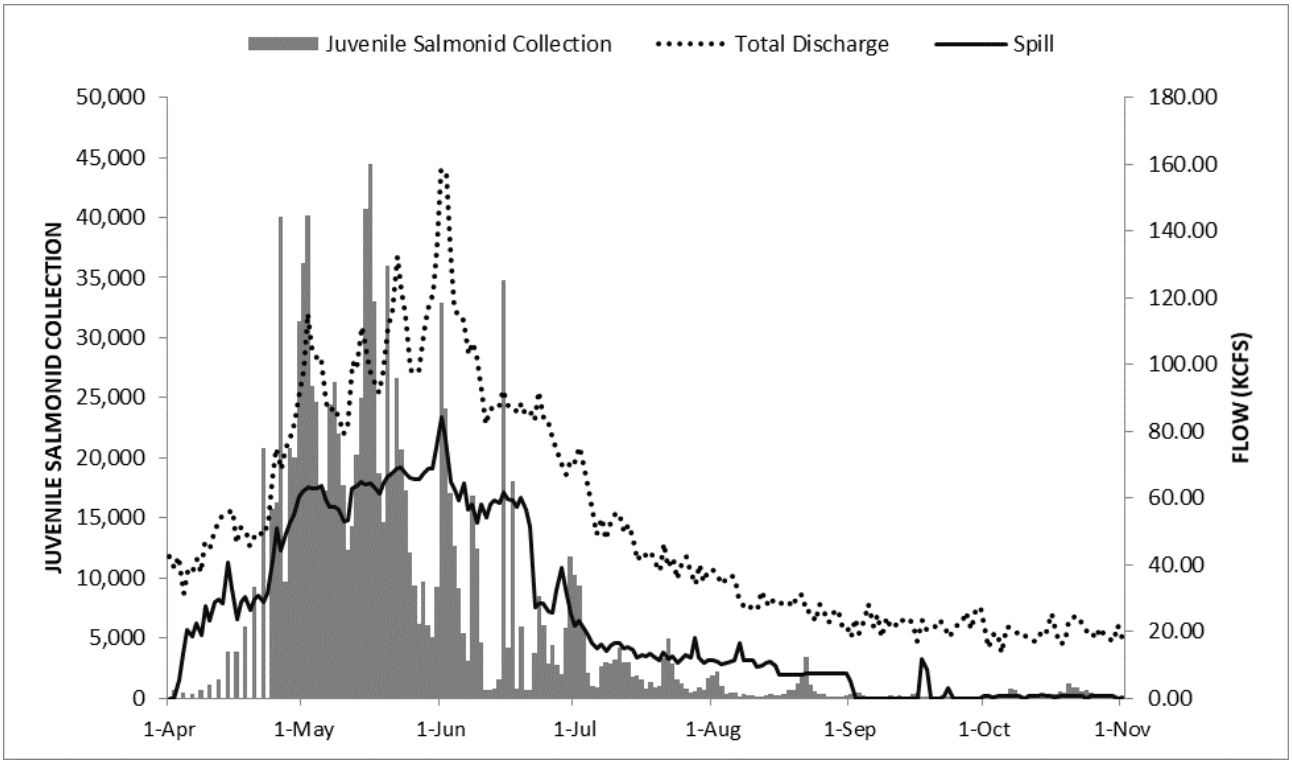

Figure 1. Total river flow, spill, and number of juvenile salmonids collected at Little Goose Dam during the fish collection and transport season, 2020.

Spill to aid juvenile fish passage occurred from April 3 to August 31, in accordance with the 2020 FOP. In the years before 2018, the spill target was 30% of total flow from April 3 to August 31. Starting in 2018, and continuing through 2020, during the spring passage season (April 3 to June 20) spill at all four projects on the lower Snake River increased due to either court mandates or regional coordination under the Flex Spill Agreement (NWF, et al. v. NBFS, et al. 2018). In 2020, the spring spill total dissolved gas concentration allowed by State of Washington (Gas Cap) was increased from 120% in the tailrace to 125%. The spring spill operation was 16 hours per day of Gas Cap spill and for the remaining 8 hours per day spill could be reduced to 30%. Target spill remained 30% of total flow during the summer passage season (June 22 to August 31). The target of 30% was not met for 14 days between June 21 and August 31. The Adjustable Spillway Weir (ASW) was operated in Spillbay 1 on April 3 and removed on August 7 due to daily average spill falling below 35 kcfs. Spill through the ASW started up again October 1 through November 15 for adult steelhead overshoots, in compliance with the 2020 National Oceanic and Atmospheric Administration Fisheries Columbia River System Biological Opinion (NOAA 2020). Spill through the ASW occurred at least three times each week on non-consecutive days for 4 hours in the morning (between 05:00 a.m. and 11:00 a.m.).

To enhance fish migration and comply with the 2019 Columbia River System Biological Opinion, the forebay elevation was at Minimum Operating Pool (633 to 634 feet MSL) from April 3 to August 31. The forebay elevation was increased to Minimum Operating Pool +2 (634 to 636 feet MSL) after September 1, 2020, when spill to aid fish passage ended. Beginning in late September, operations were under compliance with the 2020 Columbia River System Biological Opinion (NOAA 2020). All deviations from the FPP were coordinated through the Fish Passage Operations and Maintenance (FPOM) workgroup, as necessary, to meet real-time operational requirements.

River Temperature

River temperature was recorded daily at approximately 0700 in the JFF. The average daily river temperature during the 2020 fish passage season was 61.3°F. Average monthly water temperatures were significantly cooler than the 5-year average during May, June, and July, but warmer than the 5-year average for August, September, and October (Table 2). The maximum river temperature of 70.7°F was recorded on July 31 and was slightly higher than the 5-year average maximum of 70.3°F. The 2020 minimum river temperature of 46.4°F was recorded April 1 and April 2 and is only slightly above the 5-year average minimum of 46.0°F.

As per the Water Management Plan, summer river temperatures were tempered by cool-water releases from Dworshak Reservoir. Supplemental flow from Dworshak Reservoir started July 9, averaging 11.2 kcfs at 44.1°F from July 9 to July 31, 9.6 kcfs at 46.1°F for the month of August, and 5.3 kcfs at 48.8°F for the month of September (Columbia Basin Research 2020). Water temperatures recorded daily in the LGS JFF averaged 66.8°F in July, 69.4°F in August, and 67.8°F in September.

Table 2: Average Monthly River Temperatures (ºF) at Little Goose Dam, 2015 to 2020.

Month	2015	2016	2017	2018	2019	2020	2015 to 2019 Average
April	49.1	50.2	48.9	49.2	48.2	49.4	49.1
May	55.8	54.7	53.4	53.7	53.3	52.5	54.2
June	65.2	62.7	58.6	61.6	61.7	59.4	62.0
July	68.6	67.6	68.4	68.1	67.6	66.8	68.1
August	68.0	67.1	68.9	69.3	69.0	69.4	68.5
September	64.8	64.8	68.1	66.2	68.3	67.8	66.4
October	62.6	60.5	61.2	60.7	59.6	63.7	60.9
Minimum	46.7	46.4	46.7	44.7	45.4	46.4	46.0
Maximum	70.9	69.5	70.3	70.9	70.0	70.7	70.3

Total Dissolved Gas

Total dissolved gas (TDG) data are automatically collected and transmitted hourly to the Columbia River Operational and Hydromet Management System to provide information for spill and gas saturation management. TDG was monitored in the forebay from March 24 to September 10, and year-round in the tailwater.

The USACE Reservoir Control Center coordinates efforts to maintain TDG saturation levels in accordance with the Washington State TDG Level Variance Standard of 125.0% saturation in the project tailwater in the spring, as measured throughout 12 consecutive hours. The summer TDG criteria is at or below 120% in the immediate tailrace and 115% in the forebay of Lower Monumental Dam.

The average daily TDG level in the LGS forebay, from April 1 to August 31, was 112.3% saturation. TDG saturation ranged from 100.9% on April 2 to 121.7% on May 30.

The TDG level in the LGS tailrace was 100.0% on April 2 (low) and 125.8% on June 1 (high), averaging 116.2% during the spill to aid fish passage season (April 3 to August 31). Tailwater TDG levels exceeded 125% saturation only 1 day in 2020.

Turbidity

Water clarity was measured during adult fish passage facility inspections. Measurements were taken in the adult fish ladder using a Secchi disc lowered to a maximum depth of 6 feet. The fish ladder water supply is gravity fed from the forebay and is representative of river conditions. The lowest Secchi disk readings occurred during periods of high outflow from April 26 to June 7, with measurements ranging between 2.9 and 4.0 feet and averaging 3.5 feet. The highest Secchi disk readings occurred during periods of low flow, from Jun 11 to October 31, with measurements ranging from 3.9 feet to 6.0 feet and averaging 5.6 feet.

Adult Fish Facility

Facility Description

The adult fish facility is located on the downstream side of the dam and functions to attract and pass adult migrating fish upstream over the dam. The facility consists of a fish ladder and a collection channel. The collection channel acts to attract and route fish from across the tailrace to the fish ladder. Components of the collection channel system include two South Shore Entrances (SSE), two North Powerhouse Entrances (NPE), two North Shore Entrances (NSE), the collection channel itself, a fallout fence, an auxiliary water supply system, and an electronic monitoring and control system.

The pool-and-weir fish passage ladder is located on the south shore. It is approximately 1,000 feet long and rises a vertical distance of about 100 feet. The ladder begins at the junction pool near the SSE and leads upstream westward approximately 400 feet and switches back with a curve south and then east. It continues another 550 feet to the east where it passes under the dam's intake deck and exits into the forebay.

The viewing room and fish counting windows are located approximately 300 feet from the start of the ladder at the junction pool. The fish counting slot is fixed at a width of no less than 18" deep by 36" high by 48" wide. Underwater vertical fences called "Picketed Leads" guide and confine fish to pass through the counting slot.

The two SSE (SSE1 and 2) have overflow weirs that are normally open. The two NPE (NPE1 and 2) have overflow weirs and are normally open. NPE3, a lift gate entrance, was permanently closed with a concrete bulkhead in February 2011. The two north shore entrances (NSE1 and 2) are also overflow weirs and were normally open. NSE3, a lift gate entrance, was also permanently closed with a concrete bulkhead in 2011.

Additionally, ten floating orifice gates located in front of the powerhouse have been removed and permanently sealed with bulkheads. Floating orifice gates 1, 4, 6, and 10 have been closed since the 2000 fish passage season and floating orifice gates 2, 3, 5, 7, 8, and 9 have been closed since January 1996. Research has shown that adult fish attraction into the adult fish channel improved with these gates closed.

The adult collection channel begins at the NSE, passes under the spillway, past the NPE and fallout fence then continues along the base of the powerhouse, and terminates in the junction pool near the base of the ladder. A separate short channel connects the SSE to the junction pool and ladder. The fallout fence, consisting of a steel tube framework and wire mesh panels, is located in the channel near NPE1 and 2. It functions to prevent fish in the channel from leaving the channel and re-entering the tailrace via NPE.

The collection channel water is supplied from three sources. First, the fish ladder coupled with a diffuser (diffuser 13) supplies approximately 75 cfs of water and flows via gravity into the channel. Second, three turbine-driven pumps (fish pumps) supply approximately 1,700-2,000 cfs of auxiliary water. The fish pumps move water from the tailrace into a head channel for which gravity forces water through 21 sluice gates and up through 20 diffusers located on the floor of the collection channel in front of the powerhouse, near the junction pool and lower end of the ladder. Third, 175-230 cfs of excess water from the primary dewater unit of the juvenile fish collection system also flows into the head channel and up through the floor diffusers.

An electronic computer interface system for operating and monitoring the adult fishway was put in service in March 1994. The Fishway System Control (FSC) includes water elevation sensors for the fishway channel and tailrace near each entrance and elevation sensors and controls for each of the 6 entrance weirs.

An electronic water velocity meter (flow meter) was added to the collection channel near the SSE in November 1997. The meter was programmed to measure subsurface water velocities near the junction pool and diffuser 2. Diffuser 2 (the largest of the water supplying diffusers) produced upwelling and non-laminar flows making measurements unreliable. The flow meter failed in spring of 2011 and was replaced with a hydrologic current meter. In 2019, subsurface water flow velocities were measured near the NPE approximately midpoint of collection channel where flows are more representative of the entire collection channel.

Adult Fish Passage and Fishway Activities

Monitoring Activities

In 2020, a total of 89,384 salmonids were visually counted passing upstream through the adult fish ladder. The species counts were: 56,030 Chinook adults; 15,869 Chinook jacks; 50,523 steelhead; 831 sockeye; 6,136 coho adults and 1,868 coho jacks. Additionally, 27 adult lamprey and 1 bull trout were counted migrating upstream at the adult fish counting window.

Several monitoring activities involving the use of the adult fishway were in progress in 2020. These included:

- Four Peaks Environmental conducted visual fish counting activities from 0400 hours to 2000 hours April 1 – October 31[1].

- Water temperature within the adult ladder was recorded on an hourly basis in an ongoing trend study in support of safe fish passage.

[1] 0500 to 2100 Hours during daylight savings time. No nighttime counts are made at Little Goose Dam.

- Invasive species were monitored with particular attention to zebra and quagga mussels. Reports were submitted weekly to District biologists.

Operations and Maintenance

The Adult fishway was in service from February 24, 2020 to January 20, 2021. The in-water maintenance period occurred from January 6 to February 24, 2020.

The fish ladder functioned adequately throughout the season. The air bubbler located at the ladder exit to push back debris performed well all season. Diffuser 13 functioned without incident and water level over the weirs were maintained within criteria. Picketed leads remained clear of debris and the counting window backboard was routinely cleaned throughout the season.

Water clarity and temperature were measured during adult fish passage facility inspections near the fish counting window area. Water clarity was measured using a Secchi disc that was lowered to a maximum depth of just over 6 feet (see River Conditions).

The packing material in expansion joints in the fishway has decomposed over the years and when water temperatures fall below 50°F, the ladder contracts and water leaks through these joints. When temperatures drop below freezing, large icicles form overhead and large patches of ice form on the ground below. Both are hazards to safe working conditions.

An electronic computer interface system for operating and monitoring the adult fishway was put in service in March 1994. The original Fishway System Control (FSC) includes water elevation sensors for the fishway channel and tailrace near each entrance and elevation sensors and controls for each entrance weir (6). The FSC system that monitors and controls the fishway failed in March, 2012. A new control panel and updated software were installed during the winter of 2015. The updated software was placed into service for 2016, however the system failed to maintain fishway criteria and was placed back into manual mode.

The Rickly hydrologic current meter was again used in 2020 to determine subsurface velocities in the adult collection channel. Measurements were taken monthly just downstream of the NPE before the channel enters under the spillway, approximately mid-point of the length of the channel. This position best measures laminar flows that represent the overall flow rates of the channel. Subsurface velocities were measured just below the surface, at mid-depth, and just above bottom and averaged. The subsurface velocities were measured once per month and submitted in weekly reports. Average subsurface velocity measurements ranged from 1.9 to 3.5 feet per second (fps) with an average of 2.5 fps. Collection channel surface water velocities were measured using a floating stick or bubble that was timed over a distance and calculated into feet per second. Measurements ranged from 1.0 to 3.1 feet per second (fps) near the SSE's, from 1.2 to 3.7fps near the NPE's and 1.4 to 3.9 fps near the NSE's. Auxiliary water supply (AWS) system operated with three fish pumps for the majority of 2020.

The adult fishway was removed from service on January 6, 2020 when the ladder was dewatered. Fish ladder maintenance included repairing expansion joints, inspecting weirs, removing debris, cleaning the picketed leads, cleaning lamp lenses, cleaning viewing windows and installing an automatic fish window cleaning system. Collection channel maintenance included inspecting diffuser grating and supporting beams, removing debris and repairing the fallout fence from the powerhouse section of the adult channel. Sluice gates that function to pass auxiliary supply water to the fish channel are in poor or non-operating condition. These gates

are adjusted to position using a mobile electric operator. Many of the sluice gate indicator rods are bent and need replacing/repair. These gates and indicators need to be in good operational working condition to maintain correct gate position to provide the optimum water supply and flow criteria for adult fish passage.

Adult Fishway Inspections

Adult fishway inspections during the 2020 fish passage season were conducted by USACE, EAS and ODFW biologists and technicians. Inspections by the ODFW were done once a month from April through October, generally on designated days. Inspections by USACE and EAS were conducted three times a week from March through December. Problems observed during an inspection were reported to the Project Biologist and/or the Dam Operator for appropriate action. Adult fishway criteria are detailed below in the results section. All inspection data were entered into a computer spreadsheet that provided an indication as to whether operating criteria were met.

Inspection Results

The adult fish ladder section of the adult fishway includes differentials at the ladder exit, ladder weirs and counting station. The ladder exit, counting station weirs met criteria throughout the entire season (Table 3). The ladder exit trash rack and picketed leads remained relatively clean throughout the season. The air bubbler at the ladder exit was in service during the season and kept debris from collecting in front of exit area.

The collection channel continued to have mechanical and electrical problems but for the most part performed adequately throughout the season. Channel to tailwater elevation criteria (1-2 ft) was met 84.8% or better at all locations throughout the season. Weir depth criteria (6-8 ft) was met at least 91.3% of the time at NSE, 55.8% of the time at NPE and 82.7% of the time at SSE. NPE weirs were on sill for at least 42.0% of all inspections (Table 3). Low tailwater elevations will cause NPE weirs to bottom-out on its sill elevation at 532 feet.

Surface water velocities met criteria (1.5 – 4.0 fps) 97.1% of the time near the SSE and NPE and 98.5% of the time near the NSE (Tables 3 and 4). As mentioned earlier, upwelling from diffuser 2 interferes with laminar flows near the South shore junction pool.

Average tailrace elevations in 2020 were higher than the 5-year average at all locations (Table 5). To enhance fish migration, reservoirs were drafted down to minimum operating pool (MOP) elevations from April through August. During MOP, Lake Herbert G. West was operated between 537.0 and 538.0 as measured at Lower Monumental Dam.

During inspections, tailrace water elevations were simultaneously collected at the FSC for the SSE, NPE and NSE locations. These readings usually varied from 0 to 3 tenths of a foot in height difference. The variations are caused by the upwelling of water being released from the turbine draft tube and the number of and/or sequence of turbine units operating.

Table 3. Summary of results from adult fishway inspections at Little Goose Dam, 2020. [1]

LITTLE GOOSE	No. in		Not Enough Depth				Too Much Depth		
Criteria and	Criteria/	% In	No./%	No./%	No./%	No./%	No./%	No./%	No./%
Locations	No. on Sill/	Criteria/	Weir Raised	Within	Within	>0.2	Within	Within	>0.2
	No. of	% On	Or Closed	0.01-0.1	0.11-0.2	Foot	0.01-0.1	0.11-0.2	Foot
	Inspections	Sill		Foot	Foot		Foot	Foot	
Channel Velocities (SSE)	135	97.1	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	139								
Channel Velocities (NPE)	135	97.1	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	139								
Channel Velocities (NSE)	130	98.5	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	132								
Differentials									
Ladder Exit	139	100.0	***	***	***	***	0	0	0
	***	***	***	***	***	***	0.0	0.0	0.0
	139								
Ladder Weirs	139	100.0	***	0	0	0	0	0	0
	***	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	139								
Counting Station	139	100.0	***	***	***	***	0	0	0
	***	***	***	***	***	***	0.0	0.0	0.0
	139								
South Shore	136	97.8	***	2	1	0	0	0	0
	***	***	***	1.4	0.7	0.0	0.0	0.0	0.0
	139								
North Powerhouse	139	100.0	***	0	0	0	0	0	0
	***	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	139								
North Shore	117	84.8	***	10	9	1	0	0	1
	***	***	***	7.2	6.5	0.7	0.0	0.0	0.7
	138								
Weir Depths									
SSE-1	126	91.3	0	4	2	6	***	***	***
On Sill[2]	0	0.0	0.0	2.9	1.4	4.3	***	***	***
	138								
SSE-2	126	91.3	0	4	2	6	***	***	***
On Sill[2]	0	0.0	0.0	2.9	1.4	4.3	***	***	***
	138								
NPE-1	79	57.2	0	0	0	1	***	***	***
On Sill[2]	58	42.0	0.0	0.0	0.0	0.7	***	***	***
	138								
NPE-2	77	55.8	0	0	0	1	***	***	***
On Sill[2]	60	43.5	0.0	0.0	0.0	0.7	***	***	***
	138								
NSE-1	113	89.0	0	5	1	8	***	***	***
On Sill[2]	0	0.0	0.0	3.9	0.8	6.3	***	***	***
	127								
NSE-2	105	82.7	0	6	3	13	***	***	***
On Sill[2]	0	0.0	0.0	4.7	2.4	10.2	***	***	***
	127								

[1] Data are from Appendix 1.

[2] "On sill" means the weir gate was bottomed out on its sill and within criteria at this location.

Table 4. LGS collection channel in-criteria rates 2016-2020.[1]

Location	Collection Channel Success Rates (%) - Annual Comparison				
	2016	2017	2018	2019	2020
Channel Surface Water Velocities					
South Shore Entrance (SSE)	N/A	N/A	87.6	85.7	97.1
North Powerhouse Entrance (NPE)	96.8	97.4	99.2	96.0	97.1
North Shore Entrance (NSE)	95.7	99.1	99.2	98.1	98.5
Channel Head Differentials					
SSE	93.7	97.4	98.5	96.1	97.8
NPE	92.1	97.4	100.0	100.0	100
NSE	93.7	95.7	92.3	88.4	84.8
Channel Weir Depths					
SSE1	89.7	96.6	96.9	92.1	91.3
SSE2	84.9	93.1	97.7	92.9	91.3
NPE1 without on-sill criteria	38.1	51.7	35.4	46.5	57.2
NPE1 with on-sill criteria	87.3	100.0	100.0	98.4	99.3
NPE2 without on-sill criteria	9.5	33.3	49.1	33.8	55.8
NPE2 with on-sill criteria	19.8	90.5	100	100.0	99.3
NSE1	88.8	46.0	92.2	95.4	89.0
NSE2	88.8	45.2	91.4	94.6	82.7

[1] Data compiled from Appendix 1, previous monitoring report appendixes and inspection forms for the years 2016-2020.

Table 5. LGS average tailrace water elevations, 2015-2020.[1]

Location	Average Tailrace Water Elevations						
	2015	2016	2017	2018	2019	2020	2015 – 2019 Average
SSE	538.34	538.43	538.83	538.50	538.71	538.83	538.56
NPE	538.26	538.34	538.65	538.40	538.59	538.73	538.45
NSE	538.36	538.44	538.76	538.46	538.61	538.75	538.53

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2014-2019.

Average channel to tailwater head differentials in 2020 were slightly higher than the 5-year average at SSE and slightly lower than the 5-year average at NPE and NSE. NPE3 and NSE3 were permanently sealed with concrete in February 2011.

Average entrance weir depths at SSE and NSE were in criteria for 2020 (Table 6). The NPE entrance was on-sill or in criteria for the majority of 2020. Average entrance weir depths at all locations were close to the 5-year average with NPE averaging closer to the 7 foot over weir criteria. In 2016, NSE weir depths were lower than average due to electrical limits within the FSC software. Project staff were only able to lower weirs to approximately 532.7 feet for the majority of the passage season. New FSC software was placed into operation in 2016 but failed to maintain fishway criteria while operating in automatic mode and the system was returned to manual operation.

Fishway Modifications and Improvements

Fishway System Control (FSC) panel and software was installed in 2016. The new software was installed to automatically adjust adult fish entrance weirs and ensure the adult fishway remained in criteria. Unfortunately, improper data was programmed and the automatic

controls did not function as expected. Therefore, the control system was operated in manual for the 2020 season.

Table 6. LGS adult fishway average differentials and weir depths 2015-2020.[1]

Location	Average Differential or Depth in Feet						
Channel to Tailwater Differential	2015	2016	2017	2018	2019	2020	2015 – 2019 Average
SSE	1.21	1.41	1.40	1.42	1.42	1.41	1.37
NPE	1.61	1.67	1.65	1.62	1.57	1.51	1.62
NSE	1.09	1.32	1.29	1.16	1.21	1.19	1.21
Weir Depth							
SSE-1	8.49	8.44	8.73	8.72	8.72	8.60	8.62
SSE-2	8.45	8.38	8.68	8.71	8.78	8.60	8.60
NPE-1	5.46	6.47	6.99	6.50	6.93	7.02	6.47
NPE-2	5.47	6.45	6.94	6.50	6.77	6.99	6.43
NSE-1	6.48	5.74	6.63	6.85	6.59	6.61	6.46
NSE-2	6.53	5.62	6.60	6.77	6.55	6.57	6.41

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2015-2020.

An adult fish ladder cooling pump was installed during the 2017-2018 in water maintenance period. The adult ladder cooling pump was started on June 22 and shut off on September 16. The adult ladder cooling pump was also off to support line outages on July 27 and August 6.

Adult Fish Facility Recommendations

1. Continue to repair and/or replace ladder expansion joint seals.
2. Repair and/or replace collection channel sluice gates and indicator rods.
3. Continue to replace diffuser grating and supporting beams.
4. Replace the North Shore Rip Rap jetty that protects the NSE entrance from turbulent water forces created by the north shore clockwise eddy.
5. Repair or replace the automatic adult Fishway Control System.
6. Rotate the rebuild of fish pump gear boxes to ensure the ability to run on three fish pumps.
7. Improve adult count window visibility and water flow conditions.
8. Repair and/or replace picketed leads.

Juvenile Fish Facility

Facility Description

The Little Goose Juvenile Fish Facility was designed to bypass juvenile salmon and steelhead to the tailrace, or to collect for transport by truck and barge below Bonneville Dam. The bypass system includes extended length submersible bar screens in the turbine intakes, vertical barrier screens, 12-inch diameter gatewell orifices, a 14-inch diameter gatewell orifice, a collection channel running the length of the powerhouse, a dewatering structure, two emergency bypass routes, and a corrugated metal flume.

The transport system includes a fish separator, fish distribution system, raceways, a sampling and marking building, truck and barge loading areas, and a passive integrated

transponder (PIT) tag detection and diversion / bypass system. Untagged fish (without PIT tags) may also be bypassed from the transport system.

Juvenile Fish Collection and Bypass

Migration and Collection

The juvenile fish bypass and collection facility was placed into primary bypass operations on March 12. Every other day collection for sampling began at 0700 on April 01. A total of 1,225,858 smolts were collected during the 2020 season (Table 7). Of those, 1,046,698 were transported, 177,880 were bypassed, and 1,280 were facility mortalities (separator, raceway, or sample).

Table 7. Annual collection, bypass, and transport activity at Little Goose Dam JFF, 2015-2020.

	Chinook Yearling		Chinook Sub-yearling		Steelhead		Coho		Sockeye		
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
Collection											
2015	643,606	163,926	169,349	478,654	590,849	158,004	8,276	33,797	11,050	2,818	2,260,329
2016	1,873,536	564,588	203,981	414,605	1,261,259	339,520	29,781	74,575	18,868	4,032	4,784,745
2017	957,932	380,014	236,813	386,867	812,224	252,851	17,941	25,257	7,164	6,618	3,083,681
2018	1,358,654	498,442	233,371	336,373	1,518,859	450,840	16,892	120,257	56,863	17,830	4,608,381
2019	909,931	248,210	126,440	196,296	1,335,165	367,506	12,697	43,213	27,714	3,236	3,270,408
2020	319,868	94,808	134,826	221,775	325,285	73,310	17,900	29,511	8,044	531	1,225,858
Bypass											
2015	192,212	69,754	0	140	191,460	21,760	400	1,320	0	40	477,086
2016	1,032,728	382,708	1	2,876	766,337	163,410	3,600	10,000	6	1	2,361,667
2017	554,485	282,676	3,282	15,172	612,738	138,805	1,200	2,001	0	3,322	1,613,681
2018	163,625	142,644	342	1,387	534,670	77,151	7	447	9	7,711	927,993
2019	147,664	65,018	3,190	13,055	574,953	99,844	10	3,052	10	30	906,826
2020	6,435	2,265	45,796	79,884	38,475	4,418	471	128	4	4	177,880
Truck											
2015	1	1	44	5,982	35	8	0	9	0	2	6,082
2016	0	0	1,345	10,576	23	3	0	0	0	0	11,947
2017	0	0	435	6,156	5	3	0	0	5	41	6,645
2018	0	0	370	4,163	2	6	0	2	4	13	4,560
2019	1	1	3,888	18,583	122	17	10	2	20	1	22,645
2020	1	0	2,642	30,354	3	2	1	10	1	1	33,015
Barge											
2015	451,267	94,129	168,929	470,315	399,120	136,176	7,868	32,447	11,046	2,772	1,774,069
2016	840,410	181,791	202,183	400,476	494,818	176,078	26,140	64,542	18,645	4,024	2,409,107
2017	399,531	96,175	232,159	363,553	199,312	113,958	16,726	23,230	7,099	2,930	1,454,673
2018	1,191,502	354,645	230,891	328,304	983,890	373,576	16,843	119,534	56,450	9,684	3,665,319
2019	760,457	182,729	119,157	164,092	759,935	267,573	12,644	40,086	27,537	3,187	2,337,397
2020	313,202	92,482	86,278	110,924	286,712	68,866	17,413	29,342	7,941	523	1,013,683
Total Transport											
2015	451,268	94,130	168,973	476,297	399,155	136,184	7,868	32,456	11,046	2,774	1,780,151
2016	840,410	181,791	203,528	411,052	494,841	176,081	26,140	64,542	18,645	4,024	2,421,054
2017	399,531	96,175	232,594	369,709	199,317	113,961	16726	23,230	7,104	2,971	1,461,318
2018	1,191,502	354,645	231,261	332,467	983,892	373,582	16,843	119,536	56,454	9,697	3,669,879
2019	760,458	182,730	123,045	182,675	760,057	267,590	12,654	40,088	27,557	3,188	2,360,042
2020	313,203	92,482	88,920	141,278	286,715	68,868	17,414	29,352	7,942	524	1,046,698

Transportation

Collection for daily barging and direct loading operations occurred from April 23 and transitioned from daily to every other day barging on May 18 and concluded on June 21. Unlike previous years, direct loading operations continued during non-transport days. The JFF operated in secondary bypass between June 22 and July 31, and collection for transport by truck occurred from August 1 through November 1. An estimated total of 1,177,160 smolts were collected between April 23 and November 1. Of this total, 1,013,683 smolts were barged, 33,015 were trucked, 129,185 were bypassed, and 1,277 were facility mortalities.

Juvenile salmonids collected for transport by barge or truck were held in raceways, wet-lab holding tanks, or directly loaded into barges or trucks. Maximum fish holding time prior to transport varied from 24 to 48 hours, depending on the transportation schedule. Transport time from LGS to the approved release point was approximately 2 days by barge or 6 hours by truck. Fish transported by truck were transported in a mild saline solution of 1 to 2 grams per liter to treat presumed Columnaris disease. All fish transport operations were performed without incident in 2020.

A total of 1,046,698 juvenile salmonids were transported from LGS in 2020; 1,013,683 of them, or 96.85%, were transported by barge (Table 7). The estimated species composition and clip type of the fish transported by barge was as follows: 30.9% clipped yearling Chinook salmon, 9.1% unclipped yearling Chinook salmon, 8.5% clipped subyearling Chinook salmon, 10.9% unclipped subyearling Chinook salmon, 28.3% clipped steelhead, 6.8% unclipped steelhead, 0.8% clipped sockeye salmon, 0.1% unclipped sockeye salmon and 4.6% coho salmon.

Of the 1,013,683 juvenile salmonids transported from LGS, 33,015 of them, or 3.15% of the total, were transported by truck. The species composition of salmonids transported by truck was as follows: <0.1% clipped yearling Chinook salmon, 8.0% clipped subyearling Chinook salmon, 91.9% unclipped subyearling Chinook salmon, <0.1% clipped steelhead, <0.1% unclipped steelhead, <0.1% clipped sockeye salmon, <0.1% unclipped sockeye salmon, and <0.1% coho salmon. No unclipped yearling Chinook salmon were transported by truck in 2020. A total of 33 mortalities occurred during truck transport. Of those, 30 were unclipped subyearling Chinook salmon and 3 were clipped subyearling Chinook salmon.

In previous years, due to high numbers of fish collected, Lower Granite Fish Facility trucked Little Goose Fish using the 3,500 gallon tanker. This “piggyback” operation delayed transport time for those fish transported from Lower Granite by approximately one hour. In 2020, Little Goose conducted 3 piggyback operations with Lower Granite. Fish transported by truck from Little Goose were transported in a mild saline solution of 1 to 2 mg/L to reduce stress and treat Columnaris disease.

The maximum daily estimated collection of 44,508 fish occurred on May 16 and accounted for 3.6% of total collection (Table 8). The composition of the collection for that date was as follows: clipped yearling Chinook salmon (56.4%), unclipped yearling Chinook salmon (15.3%), clipped subyearling Chinook salmon (1.3%), unclipped yearling Chinook salmon (0.7%), clipped steelhead (13.7%), unclipped steelhead (3.1%), clipped coho salmon (1.8%), unclipped coho salmon (3.6%), and clipped sockeye salmon (4.1%).

Table 8. Peak passage dates and totals by species group at Little Goose Dam JFF, 2015-2020.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Season
2015	28-Apr	24-Apr	29-May	13-Jul	28-Apr	09-May	19-May	12-May	17-May	28-Apr
	53,656	16,602	15,400	18,551	66,016	11,601	3,500	400	4,700	136,712
2016	30-Apr	18-Apr	11-Jun	11-Jun	24-Apr	30-Apr	21-May	12-May	9-May	28-Apr
	180,800	62,401	15,750	25,750	183,201	28,400	4,400	400	1,320	432,007
2017	28-Apr	16-Apr	6-Jun	2-Jun	28-Apr	28-Apr	20-May	26-Apr	18-May	28-Apr
	115,678	50,001	16,772	16,208	119,203	27,601	803	1,209	3,200	298,107
2018	10-May	21-Apr	29-May	29-May	9-Apr	3-May	20-May	19-May	13-May	9-Apr
	87,294	26,408	28,966	34,245	167,390	19,400	8,712	1,009	10,404	212,443
2019	24-Apr	16-Apr	7-Jun	7-Jun	24-Apr	24-Apr	19-May	19-May	18-May	24-Apr
	57,647	19,209	9,355	14,212	244,404	76,801	7,022	402	3,801	394,474
2020	16-May	16-May	15-Jun	15-Jun	26-Apr	2-May	16-May	26-May	1-Jun	16-May
	25,103	6,802	16,544	16,993	32,901	6,801	1,803	100	3,175	44,508

Bypass

From April 1 to April 23, the facility was rotated between primary bypass (fish are routed directly to the river) and secondary bypass (fish are routed through the fish facility) every 24 hours for every-other-day condition sampling and gas bubble trauma (GBT) monitoring. Fish were routed to the river without being sampled on non-sample days. An estimated total of 48,698 smolts entered the facility on sampling days between April 1 and April 23. Of this total, 48,695 were bypassed and 3 were facility mortalities. There are no passage estimates for the 12 non-sample days during the month of April.

From June 22 through July 31 no transport occurred as recommended by the Technical Management Team (TMT) and the facility operated in secondary bypass. During that time an estimated total of 129,083 smolts entered the facility. Of this total the estimated species composition consisted of 149 clipped yearling Chinook salmon, 96 unclipped yearling Chinook salmon, 45,796 clipped subyearling Chinook salmon, 79,782 unclipped subyearling Chinook salmon, 2,147 clipped steelhead, 514 unclipped steelhead and 599 coho salmon. No sockeye salmon were collected during that time.

Adult Fallbacks

Fallbacks are adult salmonids that have migrated above the dam and have "fallen back" into the downstream juvenile fish collection and bypass system. Fallbacks collected at the separator were usually too large to pass between the separator bars and were released back to the river. Fallbacks were identified by species and fin clip and assessed for condition prior to being released.

A total of 2,178 adult salmon and steelhead fallbacks occurred in 2020 (Table 9). Of those, 27 small adult salmon fallbacks were collected in the sample and released back to the river.

There were 288 steelhead fallbacks in April, May and June (Table 10). In previous years, USACE classified out-migrating kelts due to their post spawned condition, kelts collected during this period accounted for the majority of fish in fair, poor, and dead condition. In April of 2018, FPOM asked that steelhead fallbacks be classified as adult steelhead rather than steelhead kelt. Table 11 lists the numbers of fish by species and condition.

Table 9. Total annual adult salmonid fallbacks at Little Goose Dam JFF, 2015-2020.

Year	Adult Chinook	Jack/mini Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
2015	515	240	659	903	15	10	2,342
2016	643	452	1049	1272	17	9	3,442
2017	1,345	455	583	528	4	47	2,962
2018	374	210	923	667	3	0	2,177
2019	435	175	525	425	16	28	1,604
2020	485	913	324	338	87	31	2,178

Table 10. Monthly totals of fallbacks bypassed from separator at Little Goose Dam, 2020.

	Chinook		Chinook Jack		Steelhead		Sockeye		Coho	
Month	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
April	1	0	1	4	21	34	0	0	0	61
May	16	2	3	2	58	114	0	0	0	195
June	37	25	3	1	5	56	0	0	0	127
July	21	11	5	3	10	8	2	17	0	77
August	10	12	29	6	8	8	0	45	0	118
September	59	91	187	50	106	43	0	22	2	560
October[1]	74	126	484	135	116	75	0	1	29	1,040
Total	218	267	712	201	324	338	2	85	31	2,178

[1]Includes fallbacks on the last sample day, November 1.

Table 11. Condition of adult salmonids released at Little Goose Dam, 2020.

Fish	Chinook		Chinook Jack		Steelhead		Sockeye		Coho	
Condition[1]	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
Good	208	252	664	190	282	254	0	75	23	1,307
Fair	10	14	45	10	31	62	1	10	8	233
Poor	0	1	0	1	11	20	1	0	0	57
Dead	0	0	3	0	0	2	0	0	0	5
Total	218	267	712	201	324	338	2	85	31	2,178

[1] Condition ratings for live fish were determined subjectively based on the presence/absence and severity of fungus, headburn, fin wear, and other injuries.
Note: Table 11 does not separate post spawned "kelt" steelhead from pre-spawned healthier steelhead.

Separator Efficiency

Separator efficiency is a measure of how fish entering the facility are separated by size. Smaller fish, primarily salmon smolts, are expected to enter through the narrower bars on the upstream end of the separator (A-side). Larger fish, primarily steelhead, are expected to enter through the wider bars on the downstream end of the separator (B-side). Table 12 gives efficiency expressed as the percentage of each group, passing through the desired side of the separator, for 2015 to 2020. Efficiency rates are based on expanded sample counts.

Separator efficiency was highest for clipped steelhead and unclipped steelhead, with 88.3% of clipped steelhead and 78.4% of unclipped steelhead entering on B-side. Separator efficiency was lowest for clipped sockeye salmon and unclipped sockeye salmon, with 11.2% of clipped sockeye salmon and 10.2% of unclipped sockeye salmon entering on A-side. Separator efficiency was the lowest in at least 11 years for all salmon (non-steelhead) species (Table 12).

Table 12. Annual juvenile salmonid separator efficiency (%) at Little Goose Dam JFF, 2015-2020.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye	
Year	Clip A-side	Unclip A-side	Clip A-side	Unclip A-side	Clip B-side	Unclip B-side	Clip A-side	Unclip A-side	Clip A-side	Unclip A-side
2015	72.9	69.3	65.8	62.8	72.7	57.0	39.0	35.9	45.2	38.2
2016	65.4	64.0	57.3	56.1	88.6	68.7	36.0	32.2	23.9	27.3
2017	62.0	56.5	45.6	46.9	85.8	69.6	24.9	22.0	11.2	34.8
2018	69.7	71.5	55.8	52.0	81.1	62.6	31.8	33.2	24.0	13.7
2019	69.1	72.0	61.5	60.6	84.9	55.7	21.3	31.2	34.3	25.4
2020	52.0	54.9	43.1	43.2	88.3	78.4	15.0	21.3	11.2	10.2

Note: Counts do not include sample mortalities.

Sampling

The fish sampling system was operated without incident throughout the 2020 season. Sampling procedures followed the smolt monitoring guidelines developed by the Fish Passage Center and USACE. The resulting data were used for management of facility and fish transport operations. Collection and fish condition data were also transmitted daily by ODFW personnel to the Fish Passage Center electronic database in support of the Smolt Monitoring Program (SMP).

Sample rates were set by USACE project biologists. To obtain the target sample of 300 to 500 smolts, sample rates were varied between 0.25% and 100.0% as fish migration numbers fluctuated. The percentage of each species sampled was dependent on their migration timing and the overall sample rate in effect at that time (Table 13).

Table 13. Annual sample rate percentages of juvenile salmonids collected per species and clip type that were sampled at Little Goose Dam JFF, 2015-2020[1].

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye			
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Coho	Total
2015	0.3	0.5	4.7	7.8	0.5	0.6	2.9	1.0	0.7	1.3
2016	0.5	0.5	3.1	5.0	0.5	0.7	1.3	1.1	1.3	1.6
2017	0.5	0.5	3.3	6.4	0.5	0.7	1.3	1.9	1.2	1.5
2018	0.5	0.7	3.1	5.8	0.7	0.7	0.8	1.9	0.7	1.1
2019	0.7	0.7	8.4	14.3	0.6	0.6	1.3	1.9	1.5	1.8
2020	1.2	1.3	6.8	16.3	1.9	1.6	0.7	1.7	1.3	4.8

[1]All research fish and sample mortality are included in percentages.

All fish in the sample were examined to determine species, clip type, and prevalence of descaling. In addition, Chinook salmon age class was determined as subyearling or yearling. All

yearling Chinook salmon in the sample were examined for characteristics typical of holdover or Lyons Ferry Hatchery fall Chinook salmon. All unclipped salmon were scanned for coded wire tags. Chinook, sockeye and coho fry were defined by length, under 60 mm, and were bypassed for continued growth. None of the 2020 hatchery releases above LGS were marked with elastomer eye tags.

Fish condition data were collected from a random subsample of 100 fish from the dominant species in the daily sample. Data collected included weight, length, descaling, injury, disease, predation, and "other" monitored conditions including pink fin, fin hemorrhage, fin discoloration, popeyes (exophthalmos), and eye hemorrhage. Injury and descaling data were used by managers to assess passage conditions at the dam.

Number of fish per pound was calculated from the weights taken during fish condition sampling, and the species composition from the entire sample, and was provided to USACE from April 2 to November 1.

A total of 58,272 fish were sampled during the 2020 season. Of these, 56,658 were examined for descaling, 69 were salmonid fry, 446 were sample mortalities, and 1,099 smolts were removed from the separator during GBT monitoring (Table 14).

Fish Condition

Fish condition was monitored daily by EAS and ODFW biologists. "The primary role of the condition monitoring is to identify the proportion of each species of migrant juvenile salmonid and larval and juvenile lamprey (where applicable) that are descaled (salmonids only) or have significant injuries indicative of problems in fish passage at dams such as debris in fish bypass apparatus. Secondarily, the data collected on disease, predation, and other injuries will provide a relative indication of the health of fish passing at the dams." (Condition Sampling Protocol, 2019 Smolt Monitoring Season).

Injuries

Prior to 2009, recorded injuries were based solely on the presence of an injury, with no attempt made to determine the age or origin of the injury. From 2009 to date, only fresh injuries presumed to have occurred during passage through Little Goose Dam, have been recorded.

The highest rates of injury this year were observed in unclipped subyearling Chinook salmon (11.5%), followed by unclipped sockeye salmon (11.1%), unclipped yearling Chinook salmon (10.8%) and clipped subyearling Chinook salmon (10.3%; Table 15).

Table 15. Annual injury rates (%) for salmonids examined at Little Goose Dam, 2015-2020.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
2015	12.5	14.1	12.9	16.6	6.2	5.5	7.0	11.5	11.1	13.4
2016	10.2	12.2	19.5	23.5	0.1	6.4	5.6	13.5	14.8	17.9
2017	9.9	10.6	12.3	16.6	5.4	4.9	11.8	7.8	7.1	13.0
2018	10.0	13.3	14.0	14.1	3.3	4.7	10.1	15.1	7.3	10.7
2019	9.0	13.3	17.1	16.4	3.9	3.9	9.9	8.5	7.5	12.1
2020	9.3	10.8	10.3	11.5	2.8	4.1	9.1	11.1	7.4	9.4

Table 14. Weekly sample as percent of collection total and sample totals at LGS JFF, 2020.

Week Ending	Weekly % Sampled (%)	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Totals[1]
		Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
2-Apr	25.0%	7	32	0	0	104	31	1	0	0	175
9-Apr	42.9%	37	14	0	0	520	86	0	0	0	657
16-Apr	15.1%	211	116	0	0	1,109	144	0	1	0	1,581
23-Apr	2.8%	118	32	0	0	762	84	0	0	0	996
30-Apr	1.4%	363	185	0	0	1,403	175	0	0	23	2,149
7-May	0.8%	521	158	0	4	581	154	0	0	33	1,451
14-May	1.4%	1,207	167	6	12	387	97	2	1	67	1,946
21-May	0.8%	936	227	23	17	285	90	43	0	101	1,722
28-May	1.2%	325	182	47	59	332	109	8	4	149	1,215
4-Jun	1.9%	132	92	475	801	293	92	1	2	120	2,008
11-Jun	2.1%	9	33	445	519	63	21	1	0	30	1,121
18-Jun	5.1%	6	11	1,470	1,572	15	11	0	0	16	3,101
25-Jun	10.3%	8	10	1,439	1,271	148	38	0	0	39	2,953
2-Jul	5.7%	4	2	1,275	1,313	29	7	0	0	13	2,643
9-Jul	10.0%	0	0	663	1,146	16	3	0	0	5	1,833
16-Jul	11.8%	1	2	515	1,672	13	0	0	0	3	2,206
23-Jul	16.5%	0	0	486	1,987	8	1	0	0	3	2,485
30-Jul	15.9%	0	0	174	795	1	0	0	0	1	971
6-Aug	37.6%	0	0	328	2,695	2	1	0	0	2	3,028
13-Aug	99.9%	0	0	195	1,314	2	0	0	0	3	1,514
20-Aug	91.0%	1	0	379	3,069	0	0	0	0	4	3,453
27-Aug	45.0%	0	0	310	3,262	0	0	0	0	0	3,572
3-Sep	100.0%	0	0	162	1,836	0	0	0	1	1	2,000
10-Sep	99.8%	0	0	65	983	0	0	1	0	0	1,049
17-Sep	99.2%	0	0	56	1,544	0	1	0	0	0	1,601
24-Sep	99.1%	0	0	24	315	0	1	0	0	0	340
1-Oct	99.8%	0	0	40	454	1	0	0	0	0	495
8-Oct	99.7%	0	0	84	1,647	0	0	0	0	0	1,731
15-Oct	98.1%	0	0	79	1,126	0	0	0	0	0	1,205
22-Oct	93.3%	0	0	283	4,077	0	0	0	0	0	4,360
29-Oct	99.6%	0	0	108	2,361	0	0	0	0	0	2,469
1-Nov	99.2%	0	0	17	224	0	1	0	0	0	242
Total Sampled		3,886	1,263	9,148	36,075	6,074	1,147	57	9	613	58,272
Total Collection		319,868	94,808	134,826	221,775	325,285	73,310	8,044	531	47,411	1,225,858
Percent of Sample		6.7	2.2	15.7	61.9	10.4	2.0	0.1	<0.1	1.1	100
Percent of Collection		26.1	7.7	11.0	18.1	26.5	6.0	0.7	<0.1	3.9	100

[1]All research fish, GBT fish and sample mortality included in species group and clip type numbers.
[2]Separator mortalities are included in collection totals but are not sampled.

A total of 23,995 smolts from the condition subsample were examined for injuries. Of the fish examined, 2,249 (9.4%) individual smolts were observed with one or more injuries. A total of 2,275 individual injuries were observed this year. The majority of injuries involved

damage to fins (90.0%) followed by operculum injury (5.5%), eye injury (1.8%), body injury (1.6%) and head injury (1.1%; Table 16).

Table 16. Percent of fish examined that were injured, had predation marks, or had signs of disease by species and clip type at Little Goose Dam, 2020.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total[1]
Injuries											
Eye	0.7	0.3	0.1	0.1	<0.1	0.0	0.7	1.5	0.0	0.0	0.2
Operculum	0.5	1.4	0.3	0.2	1.0	1.4	2.2	0.0	9.1	0.0	0.5
Head	0.1	0.1	<0.1	0.1	0.1	0.1	0.0	0.0	1.8	0.0	0.1
Body	0.1	0.1	0.2	0.1	0.2	0.4	0.0	0.0	0.0	0.0	0.2
Fin	8.2	9.4	9.8	11.0	1.5	2.3	4.8	5.9	0.0	11.1	8.5
Total Injury	**9.3**	**10.8**	**10.3**	**11.5**	**2.8**	**4.1**	**7.4**	**7.4**	**9.1**	**11.1**	**9.4**
Disease											
Fungus	0.3	0.1	0.2	0.2	0.4	0.4	0.7	0.3	3.6	0.0	0.2
Columnaris	0.0	0.0	2.0	6.2	0.1	0.0	0.0	0.0	1.8	0.0	3.4
BKD	<0.1	0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	<0.1
Parasites	0.4	0.6	0.2	0.2	0.5	2.4	0.0	0.3	0.0	0.0	0.3
Deformity	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.9	1.8	0.0	0.2
Disease Other	0.2	0.2	0.5	1.7	<0.1	0.0	0.4	0.3	0.0	0.0	1.0
Total Disease	**1.2**	**1.2**	**3.0**	**8.3**	**1.2**	**3.0**	**1.5**	**1.8**	**7.3**	**0.0**	**5.1**
Predation											
Bird	0.8	0.5	<0.1	0.3	2.8	2.8	1.5	0.6	3.6	0.0	0.8
Fish	0.9	0.8	0.6	1.3	0.8	0.6	1.9	0.6	0.0	0.0	1.1
Lamprey	0.0	0.2	0.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Predation	**1.7**	**1.5**	**1.0**	**2.7**	**3.6**	**3.4**	**3.3**	**1.2**	**3.6**	**0.0**	**2.5**
Misc. Conditions											
Pop Eye	0.2	0.0	0.0	0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.1
Fin Hemorrhage	3.3	5.1	10.4	15.2	1.7	2.2	2.2	1.2	3.6	0.0	9.9
Pink Fin	11.2	11.9	22.0	26.5	3.5	3.0	3.7	1.2	3.6	0.0	18.6
Fin Discoloration	3.1	2.5	5.2	6.7	0.2	0.2	2.2	1.8	0.0	0.0	4.6
Eye Hemorrhage	0.3	0.4	0.1	0.1	<0.1	0.1	0.0	0.3	1.8	0.0	27.8
Total Misc. Conditions	**16.7**	**17.8**	**32.4**	**39.8**	**5.2**	**5.3**	**6.7**	**4.5**	**9.1**	**0.0**	**27.8**
Total sample size	2,757	971	2,977	12,099	354	976	270	337	55	9	23,995

[1] Overall disease and injury rates are less than the sum of the individual categories because some individual fish had more than one injury or disease.
BKD = bacterial kidney disease

Descaling

All live smolts in the sample were examined for descaling. A smolt was considered descaled if more than 20% of the scales were missing from either side of the fish. Only descaling that appeared fresh enough to have occurred at LGS was recorded. Prior to 2009, all descaling, old or new, was recorded.

A total of 56,658 smolts were examined for descaling in 2020. Smolts examined for descaling include live smolts in the sample and do not include smolts examined for GBT, sample mortalities, or fry. The overall rate of descaling was 1.0% (542 descaled), which is the lowest since 2015 (Table 17). Of the 56,658 smolts examined for descaling, 42.4% (23,995) were examined as part of condition subsampling. During condition subsampling, fish with descaling greater than or equal to 20.0% were differentiated into two categories: 1) descaling associated with dam passage, and 2) descaling on fish with bite marks indicative of predation attempts by birds, fish, or lamprey. The rate of descaling observed in the condition subsample was 1.3% (300 descaled smolts). Of the 300 descaled smolts observed in the condition subsample, descaling associated with dam passage was 62.0% of the condition descale total, and the rate of descaling on fish with predation marks present was 38.0% of the condition descale total. The rate of descaling observed in the non-condition sample was 0.7% (242 descaled smolts) from a sample size of 32,663 salmon. Note that all descaling recorded from the non-condition sample does not differentiate between descaling as a result of passage and descaling as a result of predators.

Table 17. Annual descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2015-2020.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Totals
2015	1.3	1.1	0.7	0.7	1.9	1.9	0.0	3.8	1.4	1.0
2016	1.1	0.7	1.0	1.5	1.2	1.2	1.3	2.4	1.8	1.3
2017	2.2	1.5	1.2	1.4	1.5	0.8	3.1	6.5	1.7	1.5
2018	1.7	0.8	1.2	1.0	1.3	1.9	1.1	4.6	1.9	1.2
2019	2.3	1.7	1.5	1.2	2.0	1.7	2.3	3.4	3.1	1.5
2020	1.5	2.0	0.6	0.9	1.0	1.9	3.6	0.0	1.5	1.0

Note: GBT sample numbers not included in descaling rate calculations.

For fish in the condition subsample, in addition to descaling of 20% or greater, partial descaling of 3% to 19% above background levels was also recorded. The rate of partial descaling was 2.9% of the 23,995 smolts examined for condition in 2020.

Weekly descaling rates per species and clip types are listed in Table 18. The average weekly descaling rate ranged from 0.1% to 2.2%.

Disease

Data on the presence of disease symptoms were collected from fish in the condition subsample to provide relative information about fish health. Disease classifications included fungus, Columnaris, BKD, body parasites, deformity, and other disease such as cysts or tumors. 2014 was the first season parasites were identified and documented to genus which included fish louse (*Argulus*), gill lice (*Salmincola*), and leech (*Piscicola*). Types of deformity including spinal curvatures such as scoliosis and lordosis, and dwarfism or truncated body were also documented.

A total number of 1,217 smolts (5.1%) of the total condition subsample were observed with one or more symptoms of disease (See Table 16 above). Of the 1,217 individual signs of disease observed this year, Columnaris disease was the most prevalent at 65.6% of the total, followed by other disease (18.4%), parasite (6.7%), fungus (4.7%), deformity (4.4%) and presumed BKD (0.2%). Almost all the other diseases this season consisted of observations of smolts with rotted caudal fins or smolts with symptoms of abdominal distention similar to BKD.

Table 18. Weekly descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2020.

Week Ending	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Total[1]
2-Apr	0.00	3.13	--	--	0.00	3.23	0.00	--	--	1.14
9-Apr	0.00	7.14	--	--	0.39	1.16	--	--	--	0.61
16-Apr	0.96	3.48	--	--	0.67	0.71	--	0.00	--	0.93
23-Apr	1.69	0.00	--	--	0.45	4.23	--	--	--	0.89
30-Apr	2.35	1.16	--	--	1.12	1.78	--	--	0.00	1.37
7-May	2.31	1.39	--	--	1.67	1.96	--	--	0.00	1.86
14-May	1.49	3.21	0.00	0.00	2.17	3.23	0.00	0.00	2.99	1.91
21-May	0.93	0.95	4.55	0.00	1.45	3.41	0.00	--	2.00	1.24
28-May	1.01	2.91	0.00	1.89	0.71	1.96	25.00	0.00	2.04	1.62
4-Jun	0.78	0.00	0.43	1.03	0.78	1.19	0.00	0.00	0.00	0.73
11-Jun	11.11	0.00	0.24	0.21	1.89	0.00	0.00	--	3.33	0.48
18-Jun	0.00	0.00	0.21	0.67	0.00	0.00	--	--	0.00	0.44
25-Jun	0.00	12.50	0.29	0.89	0.70	0.00	--	--	2.70	0.63
2-Jul	0.00	50.00	1.26	1.45	0.00	0.00	--	--	0.00	1.37
9-Jul	--	--	1.07	0.71	0.00	0.00	--	--	0.00	0.83
16-Jul	0.00	--	0.60	0.93	0.00	--	--	--	0.00	0.85
23-Jul	--	--	1.45	0.91	0.00	0.00	--	--	0.00	1.01
30-Jul	--	--	0.58	0.88	0.00	--	--	--	0.00	0.83
6-Aug	--	--	0.62	0.63	0.00	0.00	--	--	0.00	0.63
13-Aug	--	--	0.00	0.15	0.00	--	--	--	0.00	0.13
20-Aug	0.00	--	0.53	0.33	--	--	--	--	0.00	0.35
27-Aug	--	--	0.32	0.12	--	--	--	--	--	0.14
3-Sep	--	--	0.00	0.28	--	--	--	0.00	0.00	0.25
10-Sep	--	--	0.00	0.84	--	--	0.00	--	--	0.79
17-Sep	--	--	4.65	1.29	--	0.00	--	--	--	1.39
24-Sep	--	--	0.00	1.00	--	--	--	--	--	0.92
1-Oct	--	--	2.56	1.34	0.00	--	--	--	--	1.43
8-Oct	--	--	0.00	1.65	--	--	--	--	--	1.57
15-Oct	--	--	0.00	1.56	--	--	--	--	--	1.46
22-Oct	--	--	1.07	1.21	--	--	--	--	--	1.20
29-Oct	--	--	1.96	2.19	--	--	--	--	--	2.18
1-Nov	--	--	0.00	1.83	--	0.00	--	--	--	1.71
Total Exam.	**3,639**	**1,182**	**8,944**	**35,449**	**5,676**	**1,097**	**55**	**9**	**607**	**56,658**
Percent Desc.	**1.46**	**2.03**	**0.65**	**0.91**	**0.95**	**1.91**	**3.64**	**0.00**	**1.48**	**0.96**
Median	**0.86**	**2.15**	**0.38**	**0.90**	**0.39**	**0.71**	**0.00**	**0.00**	**0.00**	**0.93**

[1] Descaling figures do not include sample mortalities or fish examined for GBT.
[2] "-----" means species group not present in sample during this week.

In 2015, several subyearling fall Chinook salmon smolt mortalities were observed with these symptoms which prompted ODFW to collect a specimen for the ODFW Fish Health Laboratory in La Grande, Oregon. Preliminary results were positive for the intestinal protozoan parasite (*Ceratomyxa shasta*). As a result, nearly all fish exhibiting symptoms of abdominal distention have been reported as "disease other" rather than BKD since 2015.

Predation Marks

Bite marks were recorded on fish from the condition subsample, which were indicative of predation attempts by bird, fish, lamprey, and mammalian predators such as mink and otter. A total of 598 smolts were observed with one or more predatory wounds, for an overall rate of 2.5% of the total condition subsample. The majority of marks observed in the subsample were indicative of attempted predation by fish at 42.3% of the 598 total individual bite marks recorded, followed by bird bites (33.8%), and lamprey bites (23.9%). No mammalian bite marks were observed this year. The highest rate of predatory attempts were observed on clipped steelhead (3.6%), clipped sockeye salmon (3.6%), unclipped steelhead (3.4%), and clipped coho salmon (3.3%), which were predominately a result of predation attempts by birds (See Table 16 above).

The overall rate of bird bite marks was the same as in 2018 and 2019 and was slightly lower than the 5-year average of 1.0 (Table 19). The highest prevalence of bird bite marks was observed on clipped sockeye salmon (2 out of 55), clipped steelhead (99 out of 3,544) and unclipped steelhead (27 out of 975).

Table 19. Annual bird bite rates (%) for salmonids examined at Little Goose Dam, 2015-2020.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip		Total
2015	0.8	0.9	0.2	0.3	4.4	3.3	0.0	3.9	<0.1	1.1
2016	0.8	0.2	0.5	1.6	2.3	2.7	1.7	0.0	1.0	1.4
2017	1.0	0.3	0.3	0.5	2.7	2.2	2.2	1.9	0.2	0.9
2018	0.8	0.5	0.2	0.3	1.8	2.0	0.6	0.6	0.6	0.8
2019	0.8	0.5	0.2	0.3	2.1	1.6	0.3	0.0	0.7	0.8
2020	0.8	0.5	<0.1	0.3	2.8	2.8	3.6	0.0	1.0	0.8

Other Miscellaneous Conditions

The other miscellaneous conditions category included popeye (exophthalmos), hemorrhaged fin, pink fin, discolored fin, and hemorrhaged eye. There were 6,681 smolts with one or more miscellaneous conditions, for an overall miscellaneous condition rate of 27.8% of the total condition subsample (See Table 16 above). A total of 7,980 individual observations of miscellaneous conditions were found. Many smolts that were examined had multiple conditions. For example, pink fin and hemorrhaged fins often occurred on the same individual fish, though in different fins. Pink fins constituted most of the observations in this category at 55.9% of the individual miscellaneous conditions total followed by hemorrhaged fin(s) (29.8%), fin discoloration (13.7%), eye hemorrhage (0.4%), and popeye (exophthalmos) (0.2%). Subyearling fall Chinook salmon had the highest rates in this condition category at 39.8% for unclipped and 32.4% for clipped, due to the high incidence of pink and hemorrhaged fin(s).

Mortality

Mortality at the JFF included fish that entered the JFF system dead as well as those that died at the facility. Mortality was recorded by location within the facility and was divided into facility mortality (raceways and separator) and sample mortality. Total facility mortality is the sum of facility mortality (raceway and separator) and sample mortality.

The total facility mortality rate this year was lower than that of the 5-year average at 0.1% from a total collection of 1,225,858 smolts (Table 20) and was lower than in 2017 and 2018. The average weekly total facility mortality rate ranged from 0.0% to 8.2% (Table 21). The minimum weekly rates of 0.1% and less than 0.1% occurred frequently during the month of April when mortalities that occurred represented a small proportion of the total collection. Increased mortality rates later in the collection season occurred when total collection numbers decreased and disease and injury rates increased, presumably due to warmer river temperatures. The average monthly total facility mortality rate was highest in September, at a rate of 4.9% from a collection total of 4,675 smolts.

The maximum weekly total facility mortality rate of 8.2% occurred during the week ending November 1, 2020, with a total weekly collection of 244 fish and 20 mortalities. The relatively high mortality rate was presumed to be the result of the high prevalence and severity of columnaris disease. The median weekly total facility mortality rate for all smolts was 0.1%. The highest number of total facility mortalities occurred during the week ending May 21 when a total of 92 mortalities were recorded.

Sample mortality for smolts was 0.8% of 58,272 smolts sampled (Table 22). As in previous years, increased sample mortality in late summer was observed when river temperatures and outbreaks of disease, such as columnaris, were higher than in the spring and fall. On average, monthly sample mortality rates were lowest in June at 0.1% from a sample total number of 10,246 smolts. The highest sample mortality rate was in September at 3.4% from a sample total number of 4,656 smolts.

The total sample mortality rate for Pacific lamprey ammocoetes was 2.3%, which was 3 of 128 total ammocoete sampled. The sample mortality rate for Pacific lamprey macropthalmia was 2.1%, which was 10 from a total of 471 sampled (Table 22). Sample mortality rates for both ammocoetes and macropthalmia were much lower than the five-year average. No notable peak in sample mortality for either life stage of juvenile Pacific lamprey was observed.

Table 20. Annual total facility mortality as a percentage of total collection at LGS JFF 2015-2020.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific lamprey	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoete	Macropthalmia
2015	<0.1	0.1	0.2	0.5	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1	<0.1
2016	<0.1	<0.1	0.2	0.2	<0.1	<0.1	1.2	0.2	<0.01	<0.1	0.2	<0.1
2017	0.4	0.3	0.4	0.5	<0.1	<0.1	0.8	4.9	0.1	0.3	0.3	0.3
2018	0.3	0.2	0.8	0.7	<0.1	<0.1	0.7	2.4	0.2	0.2	0.1	0.1
2019	0.2	0.2	0.2	0.3	<0.1	<0.1	0.5	0.6	0.2	0.1	0.5	0.2
2020	0.1	0.1	0.1	0.3	<0.1	<0.1	1.2	0.6	0.1	0.1	0.1	0.1

Note: Mortality rate for collected fish includes sample, raceway, and separator mortalities. Lamprey numbers are not included in "Totals" column.

Table 21. Weekly total facility mortality in percent at Little Goose Dam JFF, 2020.

Week Ending	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Total[1]
25-Jun	0.0	0.0	0.0	0.0	0.0	0.0	--	--	0.5	0.0
2-Jul	0.0	0.0	0.0	0.0	0.0	0.0	--	--	0.0	0.0
9-Jul	--	--	0.0	0.0	0.0	0.0	--	--	0.0	0.0
16-Jul	0.0	0.0	0.0	0.0	0.0	--	--	--	0.0	0.0
23-Jul	--	--	0.2	0.1	0.0	0.0	--	--	6.3	0.1
30-Jul	--	--	0.2	0.0	0.0	--	--	--	0.0	0.1
6-Aug	--	--	0.9	0.3	0.0	0.0	--	--	0.0	0.4
13-Aug	--	--	1.5	1.3	0.0	--	--	--	0.0	1.3
20-Aug	0.0	--	0.7	0.6	--	--	--	--	0.0	0.6
27-Aug	--	--	0.5	0.6	--	--	--	--	--	0.6
3-Sep	--	--	1.2	2.4	--	--	--	0.0	0.0	2.3
10-Sep	--	--	9.1	4.0	--	--	0.0	--	--	4.3
17-Sep	--	--	23.2	7.6	--	0.0	--	--	--	8.2
24-Sep	--	--	0.0	7.5	--	100.0	--	--	--	7.3
1-Oct	--	--	2.5	1.5	0.0	--	--	--	--	1.6
8-Oct	--	--	2.4	0.8	--	--	--	--	--	0.9
15-Oct	--	--	9.8	5.9	--	--	--	--	--	6.2
22-Oct	--	--	1.7	1.1	--	--	--	--	--	1.2
29-Oct	--	--	9.3	2.7	--	--	--	--	--	3.0
1-Nov	--	--	29.4	6.6	--	0.0	--	--	--	8.2
Median Weekly Rate	0.1	0.0	0.4	0.6	0.0	0.0	0.0	0.0	0.0	0.1

[1]Total facility mortality includes facility, sample and raceway mortality.
Note "-----" indicates that the species group was not present in the sample during the week

Table 22. Annual sample mortality as percent of total sample at Little Goose Dam JFF, 2015-2020.

	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Total	Pacific Lamprey Ammocoetes	Pacific Lamprey Macropthalmia
2015	0.2	0.5	0.3	0.9	0.2	0.2	2.0	0.0	0.0	0.6	20.0	4.1
2016	0.3	0.2	0.4	0.4	0.2	0.1	4.0	0.0	0.1	0.4	8.6	3.8
2017	0.5	0.4	0.4	0.7	0.2	0.1	0.0	12.1	0.2	0.5	4.6	2.3
2018	0.3	0.6	0.7	0.9	0.1	<0.1	0.8	3.0	0.4	0.6	2.6	4.3
2019	0.5	0.6	0.4	0.8	0.1	0.2	1.9	1.7	1.2	0.6	3.6	5.8
2020	0.4	0.2	0.7	1.0	0.1	0.1	3.5	<0.1	1.0	0.8	2.3	2.1

Note: Mortality rate in sampled fish excludes research, raceway, and separator mortalities. Includes GBT sample fish. Pacific lamprey mortalities are not included in the total mortalities to facilitate across year comparisons.

Incidental Species

The total incidental fish collection was determined by using the sample rate to expand the number of incidental fish in the sample and adding the number of incidental fish removed from the separator to the expanded sample count. Incidental species were counted individually, except when handling large numbers of Siberian prawn (*Exopalaemon modestus)* and juvenile American shad (*Alosa sapidissima).* When the number of Siberian prawn and juvenile shad became too large to practically count, a weekly fish per pound calculation was obtained for these

species. The result was then multiplied by the daily weight of the sampled species to obtain an estimated count for the day. All sampled incidental fish were returned to the river except for Siberian prawn. Siberian prawns that occurred in the sample were euthanized per the directive issued by Washington Department of Fish and Wildlife on July 24, 2007. All Siberian prawns from the sample were frozen and disposed into a landfill.

When the sample rate was less than 100%, incidental species were inadvertently collected and transported along with the smolts. Therefore, when the sample rate was below 100%, incidental fish species were weighed, and the average weight was applied to the expanded sample count to determine their contribution to transport loading densities. When the sample rate was at 100%, all incidental species, except Siberian prawns, were collected and returned to the river.

Incidental collections totaled 210,024. This included an expanded sample count of 109,842 fish and 87,409 Siberian prawn, plus 12,773 fish from the separator (Table 23).

Numbers of mountain whitefish (*Prosopium williamsoni*), rainbow trout (*Oncorhynchus mykiss)*, and sculpin (*Cottus* sp.) were much higher than the 2015–2019 average (Table 24), while collection numbers for chiselmouth (*Acrocheilus alutaceus*), adult Pacific lamprey, Pacific lamprey macropthalmia, and sand rollers (*Percopsis transmontane*) were much lower than the 2015 to 2019 average. Collection numbers of all other species were comparable to the 2015 to 2019 average.

This year saw a high number of juvenile *O. mykiss* too large to fit through the separator bars. Because it could not be determined in some cases if these fish were rainbow trout or residualized steelhead, they were all reported simply as "*O. mykiss*" and are included in the totals for rainbow trout in Tables 23 and 24.

Adult Pacific lamprey collections totaled 20 in 2020, 19 from the separator and raceways and 1 from the sample. The first adult Pacific lamprey of the season was collected June 10 and the last on August 28. Upriver adult migrants were most frequently observed falling back into the collection system from July through August. USACE transported all adult Pacific lamprey captured at the facility approximately 1 mile above the dam, releasing them at Little Goose Landing. In addition, to avoid exposure to sampling anesthesia, any adult Pacific lamprey found in the sample tanks were removed by USACE, ODFW, and/or EAS personnel prior to SMP sampling.

Research

ODFW and USACE personnel provide various types of research assistance during the fish passage season. Typically, ODFW provides research specimens that are collected on site via the sample. The summaries below describe each research or monitoring project that occurred at LGS in 2020.

Table 23. Collection of incidental species at Little Goose Dam, 2020.

Common Name	Scientific Name	Expanded Sample	Separator	Total Collection [1]
American shad	*Alosa sapidissima*	85,079	9,497	94,576
Banded killifish	*Fundus diaphanus*	1	0	1
Bass, smallmouth	*Micropterus dolomieu*	1,854	68	1,922
Bass, largemouth	*M. salmoides*	6	0	6
Bullhead	*Ameiurus* sp.	545	0	545
Bull trout	*Salvelinus confluentus*	0	0	0
Channel catfish	*Ictalurus punctatus*	83	35	118
Chiselmouth	*Acrocheilus alutaceus*	0	0	0
Common carp	*Cyprinus carpio*	11	21	32
Crappie	*Pomoxis* sp.	133	146	279
Dace	*Rhinichthys* sp.	2	0	2
Goldfish	*Carassius auratus*	0	0	0
Kokanee	*Oncorhynchus nerka*	0	0	0
Lamprey adult, Pacific[2]	*Entosphenus tridentatus*	1	19	20
Lamprey ammocoete, Pacific	*E. tridentatus*	2,670	0	2,670
Lamprey macropthalmia, Pacific	*E. tridentatus*	10,991	0	10,991
Mountain whitefish	*Prosopium williamsoni*	2,245	9	2,254
Northern pikeminnow	*Ptychocheilus oregonensis*	6	3	9
Peamouth	*Mylocheilus caurinus*	215	22	237
Rainbow trout[3]	*O. mykiss*	1	2,697	2,698
Redside shiner	*Richardsonius balteatus*	0	0	0
Sand roller	*Percopsis transmontana*	44	8	52
Sculpin	*Cottus* sp.	5,442	0	5,442
Siberian prawn	*Exopalaemon modestus*	87,409	0	87,409
Sucker	*Catostomus* sp.	249	82	331
Sunfish[4]	*Lepomis* sp.	160	15	175
Tadpole madtom	*Noturus gyrinus*	0	0	0
Walleye	*Stizostedion vitreum*	75	62	137
White sturgeon	*Acipenser transmontanus*	0	57	57
Yellow perch	*Perca flavescens*	19	32	51
Other[5]	—	10	0	10
Total		197,251	12,773	210,024

[1] Collection totals are estimated by expanding the sample counts, then adding the separator counts. Numbers include live and dead incidental fish.

[2] Number includes adult lamprey removed from the separator and from raceways.

[3] Includes all juvenile *O. mykiss* too large to fit through the separator bars.

[4] "Sunfish collection total includes bluegill/pumpkinseed and warmouth.

[5] "Other" fish include expanded counts of live non-salmonid and unidentifiable/decomposed non-salmonid.

Kelt Reconditioning and Reproductive Success Evaluation Research

USACE staff collected 90 steelhead kelts from the Little Goose juvenile separator from May 15 to June 25 for University of Idaho, Columbia Intertribal Fish Commission (CRITFC) and the Nez Perce Tribe (NPT). The purpose of the study is to evaluate steelhead kelt physiology and endocrinology for rehabilitating post-spawned steelhead. NPT/CRITFC personnel took genetic samples, PIT-tagged, and returned to the tailrace 35 unclipped steelhead collected at LGD that did not meet their criteria. Of the kelts collected, 55 steelhead were transported to Dworshak National Fish Hatchery for acclimation and feeding studies. No steelhead died before handling or after handling.

Table 24. Numbers of incidental species collected at Little Goose Dam JFF, 2015-2020.

Common Name	Scientific Name	2015	2016	2017	2018[1]	2019	2020	2015 to 2019 Average
American shad	*Alosa sapidissima*	5,634	157,259	136,814	91,725	81,366	94,576	94,560
Banded killifish	*Fundus diaphanous*	53	0	1	0	0	1	11
Bass, smallmouth	*Micropterus dolomieu*	2,102	2,992	8,977	2,939	4,896	1,922	4,381
Bass, largemouth	*M. salmoides*	1	13	5	28	2	6	10
Bullhead	*Ameiurus* sp.	284	166	1,263	574	403	545	538
Bull trout	*Salvelinus confluentus*	0	10	1	0	1	0	2
Channel catfish	*Ictalurus punctatus*	440	80	91	99	118	118	166
Chiselmouth	*Acrocheilus alutaceus*	7	19	3	57	71	0	31
Common carp	*Cyprinus carpio*	44	49	296	103	61	32	111
Crappie	*Pomoxis* sp.	9,407	3,135	38,778	3,807	1,043	279	11,234
Dace	*Rhinichthys* sp.	3	0	6	3	4	2	3
Goldfish	*Carassius auratus*	0	0	0	0	0	0	0
Kokanee	*Oncorhynchus nerka*	1	101	4	0	0	0	21
Lamprey adult, Pacific	*Entosphenus tridentatus*	163	117	232	137	66	20	143
Lamprey ammocoete, Pacific	*E. tridentatus*	89	1,592	5,157	4,794	2,674	2,670	2,861
Lamprey macropthalmia, Pacific	*E. tridentatus*	8,155	33,631	2,431	31,332	22,010	10,991	19,512
Mountain whitefish	*Prosopium williamsoni*	271	81	973	3,189	1,744	2,254	1,252
Northern pikeminnow	*Ptychocheilus oregonensis*	32	29	106	0	9	9	35
Peamouth	*Mylocheilus caurinus*	1,230	512	4,687	707	624	237	1,552
Rainbow trout[2]	*O. mykiss*	27	2	25	336	1,483	2,698	375
Redside shiner	*Richardsonius balteatus*	0	0	0	0	0	0	0
Sand roller	*Percopsis transmontana*	1,603	294	559	138	71	52	533
Sculpin	*Cottus* sp.	1,836	633	199	2,908	5,786	5,442	2,272
Siberian prawn	*Exopalaemon modestus*	464,586	51,518	31,668	11,159	36,217	87,409	119,030
Sucker	*Catostomus* sp.	1,631	504	1,225	797	1,345	331	1,100
Sunfish[3]	*Lepomis* sp.	263	501	1,182	736	123	175	561
Tadpole madtom	*Noturus gyrinus*	4	3	1	1	0	0	2
Walleye	*Stizostedion vitreum*	27	65	110	170	101	137	95
White sturgeon	*Acipenser transmontanus*	11	15	4	20	45	57	19
Yellow perch	*Perca flavescens*	63	78	77	120	92	51	86
Other[4]	—	52	2	0	11	21	10	17
Total		**498,019**	**253,401**	**234,875**	**155,891**	**160,376**	**210,024**	**260,512**

Notes:
Numbers include expanded sample counts and separator releases.
[1] No data on incidentals exist for 19 days between September 16 and October 13 in 2018 due to the system being in primary bypass.
[2] Starting in 2018, includes all juvenile O. mykiss too large to fit through the separator bars.
[3] Sunfish include bluegill/pumpkinseed and warmouth.
[4] "Other" fish include expanded counts of live non-salmonid and unidentifiable/decomposed non-salmonid.

Gas Bubble Trauma Monitoring

GBT monitoring was performed by PSMFC biological technicians from Lower Monumental Dam. When juvenile salmonid numbers permitted, a maximum of 100 fish were examined. Sampling occurred weekly from April 5 to July 26, and GBT monitoring ended for the season the week of July 26 due to small sample sizes. Sampling was designed to determine the relative proportion of migrating juvenile salmonids passing the dam that exhibited symptoms of GBT in the unpaired fins and eyes. In addition to examining salmonids, this year non-salmonid species were also examined when they could be netted off the separator. A total of 3 non-salmonids were examined for GBT: 2 mountain whitefish and 1 smallmouth bass.

A total of 1,147 fish were handled by PSMFC GBT personnel in 2020. Of the 45 fish handled and enumerated but not examined for GBT, 18 were coho salmon, 2 were clipped sockeye salmon, and 11 were salmonids that had been previously PIT-tagged. A total number of 1,102 fish were examined for GBT. Of those, 40.0% were steelhead smolts, 31.7% were subyearling Chinook salmon, 28.0% were yearling Chinook salmon, and 0.3% were non-salmonids (2 mountain whitefish and 1 smallmouth bass). Of those examined, 21 (1.9%) showed signs of GBT. The total GBT mortality rate was 0 (0.0%) of the 1,147 fish handled.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are maintained and operated by the Pacific States Marine Fisheries Commission. PIT tagged salmonids have been monitored for movement and behavior in the Columbia and Snake rivers since 1987. At Little Goose Dam, there are 11 PIT tag monitors located throughout the JFF. Further discussion of the PIT Tag System, including the Divert During Sample (DDS) system, can be found in the Facility Operations & Maintenance portion of this report.

Miscellaneous Monitoring

Juvenile Lamprey Monitoring

Beginning in 2011, all SMP sites were directed to report juvenile lamprey collections in more detail. Lamprey numbers are not included in the overall salmonid mortality data in this report but have been added to the mortality tables for future years' comparisons (Tables 20 and 22). The lamprey ammocoete total mortality rate in 2020 was 0.1%, from a total collection count of 2,670 lamprey ammocoetes. The total mortality rate for Pacific lamprey macropthalmia this year was 0.1%, from a collection total number of 10,991 Pacific macropthalmia. No notable peak in total facility mortality for either life stage of juvenile lamprey was observed.

Mussel Monitoring

USACE personnel at the Little Goose JFF monitored the facility for both zebra mussel *Dreissena polymorpha* and quaggu mussel *Dreissena rostriformis bugensis* infestations. The mussel monitor is a piece of substrate suspended in the adult fish ladder near the ladder exit. There were no zebra or quaggu mussels observed during the 2020 season.

Turbine Strainers

USACE continued to monitor turbine unit strainers this year at LGS. Strainers are located in the piping associated with the cooling water intake valve for each of the six turbine units. Strainers were rotated and flushed weekly by USACE staff. Inspections took place at least once per month from January through July and again in December, in accordance with the Fish Passage Plan. USACE staff inspected for any fish entrapment, particularly juvenile lamprey, and results were reported monthly to District biologists.

Avian Predation and Behavior

Avian activity was monitored and reported by USACE and EAS. New bird protocols documenting bird behavior were established and implemented in 2012 and revised in 2014 by the USACE Fisheries Field Unit. One of the main goals of the avian data collection process is to standardize bird survey methodologies amongst the eight Federal Columbia River Power System hydro-projects. Collecting behavioral data will augment existing historical bird data and aid in bird hazing activities during the smolt out-migration.

EAS personnel conducted avian surveys daily from April 1 to November 1, 2020. Surveys were typically conducted between 1100 hours and 1400 hours during the juvenile collection system inspection. Only two specific bird behaviors were recorded this year—foraging and non-foraging—compared to the loafing/resting (on land or water), flyby, scavenging, and predating behaviors previously recorded. Piscivorous birds present in 2020 included seagulls, double crested cormorants, American white pelicans, western grebe, and osprey. The number of piscivorous birds sighted remained low between April and June, averaging fewer than 10 birds per day. Numbers increased late in the season when the number of juvenile American shad entering the facility increased. The maximum number of birds counted was 309 on October 25: 276 gulls and 33 cormorants.

Juvenile Facility Operations & Maintenance

The juvenile fish bypass system was inspected a minimum of three times daily during the fish passage season. The juvenile bypass system and the collection facility were moderately impacted by debris during the 2019 fish passage season.

Forebay Debris/Trashracks

The surface area covered by debris and its location in the forebay was estimated daily by Anchor QEA personnel during juvenile bypass system and adult fishway inspections. In 2014, the trash sheer boom cable separated rendering the equipment ineffective. It was repaired in 2018 prior to the start of the season. Consequently, this year all forebay debris was recorded as outside trash sheer boom, inside trash sheer boom, or in front of the spillway. All debris passed through the project via spill, turbine intakes, or the juvenile collection system. Minimal to moderate accumulations of woody debris averaging 9,244 square feet and ranging from 3000 to 23,000 square feet were present in the forebay from April 01 through June 15. Orifice blockages were most frequent from April through June. Increased orifice rotations were necessary to decrease debris accumulations within the juvenile collection system this year. Forebay debris decreased to minimal amounts after June 15 averaging 309 square feet from June 15 through August 31 and 1,840 square feet September 01 through November 01.

Spillway Weir

The ASW was placed into operation on April 03 in the high crest (622 ft. msl) position. The ASW was operated in both high and low crest during peak adult Chinook salmon passage to facilitate upstream passage. The spillway weir was removed from service for the 2020 season on August 7.

The ASW was operated in high crest, four hours in the morning, three days a week to provide passage for adult steelhead overshoots. This operation began on October 1 and ended on November 15.

Turbine Operation

Efforts were made to operate all turbine units within 1% limitation of best efficiency from April 1 to October 31. There were numerous scheduled and unscheduled turbine unit outages during the fish passage season. Unit out of service (OOS) and return to service (RTS) dates, times and descriptions are listed in Table 25.

Extended-Length Submersible Bar Screens (ESBS)

All ESBS were installed the week of March 16 and performed satisfactorily for the majority of the season. Fish screen 4B and 6B failed immediately after installation due to a faulty proximity switch sensor and had to be repaired. All screens were removed for the end of fish passage season on December 16 and 17. Drawdown inspections across trashracks and ESBS/VBS were performed according to the FPP. All inspections measured within criteria throughout the season. Video inspections and manual operation inspections showed all screens in good operating condition.

Vertical Barrier Screens (VBS)

Inspections of all VBS were performed by underwater video camera per FPP requirements. Underwater camera inspections occurred on June 8 and 9 for all Units except Unit 5. Camera inspections in conjunction with Unit annuals occurred on July 9 for Unit 6, August 13 for Unit 4, September 24 for Unit 3, November 10 for Unit 2 and December 3 for Unit 1. Unit 5 ESBS screens are stored in a position that does not allow underwater inspections. Worn screens were repaired or replaced. Screens will continue to be replaced with new during Unit annual maintenance.

In conjunction with ESBS/VBS underwater video camera inspections, orifice liners were also inspected. Throughout 2020, orifice liners for orifices 1C2, 2A1, 3A1 and 6C2 were found to be missing bolts which secure the liner to the inside of the gatewell.

Gatewells

Gatewells were checked for debris and oil contamination daily. As needed, debris was removed using a dip basket or grappling hook. In 2020, the occasional oil films were observed on the water surface in several gatewells similar to previous years. Some oil films appeared to be petroleum based and may have been produced, in part, from rain-washed oil/grease residue associated with mechanical equipment and vehicles. A fish salvage occurred in gatewell 1A to

Table 25. Little Goose turbine unit outages, 2020.

Turbine Unit	Date OOS	Date RTS	Description
Unit 1	18-Feb 06:05	25-Feb 06:29	Isophase bus work
	18-Mar 11:16	18-Mar 15:00	ESBS install
	13-Apr 06:05	13-Apr 17:20	Line outage for XJ7/XJ8
	02-May 15:26	02-May 17:34	Fish screen trouble
	05-May 11:56	05-May 14:19	VBS inspection
	26-May 15:06	26-May 16:50	Debris in orifice 1A2
	27-May 11:56	27-May 13:25	Debris in orifice
	09-Jun 10:26	09-Jun 14:10	Trash raking and ESBS/VBS inspections
	27-Jul 09:17	27-Jul 18:15	Line outage for Doble
	06-Aug 06:25	06-Aug 17:32	Line outage for Doble
	16-Sep 17:26	17-Sep 16:53	T1 Line tripped, over pressure relay
	22-Sep 05:28	22-Sep 17:03	T2 neutral bushing
	24-Nov 07:12	24-Nov 08:45	Trash raking
	30-Nov 08:00	26-Feb 17:00	6-year overhaul
Unit 2	18-Feb 06:05	18-Feb 17:42	Isophase bus work
	17-Mar 10:58	17-Mar 15:05	ESBS install
	13-Apr 06:05	13-Apr 17:20	Line outage for XJ7/XJ8
	09-Jun 07:35	09-Jun 10:15	Trash raking and ESBS/VBS inspections
	27-Jul 09:17	27-Jul 18:15	Line outage for Doble
	06-Aug 06:25	06-Aug 17:32	Line outage for Doble
	16-Sep 17:26	17-Sep 16:53	T1 Line tripped, over pressure relay
	22-Sep 05:28	22-Sep 17:03	T2 neutral bushing
	26-Oct 03:08	17-Dec 15:32	Unit annual
	17-Dec 07:15	17-Dec 10:50	ESBS removal
Unit 3	18-Feb 06:05	18-Feb 17:42	Isophase bus work
	17-Mar 07:20	17-Mar 10:50	ESBS install
	13-Apr 06:05	13-Apr 17:20	Line outage for XJ7/XJ8
	08-Jun 14:00	08-Jun 16:35	Trash raking and ESBS/VBS inspections
	27-Jul 09:17	27-Jul 18:15	Line outage for Doble
	06-Aug 06:25	06-Aug 17:32	Line outage for Doble
	16-Sep 17:26	17-Sep 16:53	T1 Line tripped, over pressure relay
	21-Sep 03:20	03-Nov 11:00	Unit annual
	16-Dec 13:03	16-Dec 16:17	ESBS removal
Unit 4	09-Feb 15:51	10-Feb 08:50	Isophase bus work
	18-Feb 06:05	18-Feb 17:42	Isophase bus work
	16-Mar 11:55	16-Mar 16:00	ESBS install
	18-Mar 10:01	18-Mar 15:00	ESBS 4B
	19-Mar 12:30	19-Mar 13:37	ESBS 4B
	13-Apr 06:05	13-Apr 17:20	Line outage for XJ7/XJ8
	29-Apr 05:58	29-Apr 06:26	86GT thrust bearing overheat
	08-Jun 11:26	08-Jun 15:00	Trash raking and ESBS/VBS inspections
	27-Jul 09:17	27-Jul 18:15	Line outage for Doble
	06-Aug 06:25	06-Aug 17:32	Line outage for Doble
	10-Aug 03:00	17-Sep 12:46	6-year overhaul
	22-Sep 05:28	22-Sep 17:03	T2 neutral bushing
	23-Sep 10:23	23-Sep 14:38	Replace brake solenoid coil
	23-Nov 11:58	23-Nov 14:30	Trash raking
	16-Dec 09:39	16-Dec 13:39	ESBS removal
Unit 5	14-Apr-2017 07:00		Spider and upper guide bearing repair

Table 25. Continued

Turbine Unit	Date OOS	Date RTS	Description
Unit 6	13-Jan 15:30	16-Jan 16:05	Output breaker opening without valid input signal
	18-Feb 06:05	18-Feb 07:20	Isophase bus work
	18-Feb 17:15	18-Feb 17:42	Close line disconnect
	28-Feb 08:31	01-Mar 08:00	Catch basin flinging oil
	16-Mar 07:35	16-Mar 11:55	ESBS install
	18-Mar 06:59	18-Mar 10:00	ESBS 6B
	19-Mar 13:45	19-Mar 15:50	ESBS 6B
	05-Apr 05:21	27-Apr 10:07	XJ6 output breaker opening without valid signal
	19-May 04:40	19-May 08:28	XJ6 output breaker opening without valid signal
	08-Jun 07:15	08-Jun 11:20	Trash raking and ESBS/VBS inspections
	16-Jun 07:00	16-Jun 07:42	Pre-annual testing
	06-Jul 07:25	30-Jul 17:00	Unit annual
	27-Jul 09:17	22-Sep 17:03	T2 neutral bushing/Doble
	27-Oct 06:45	27-Oct 09:45	XJ6 output breaker opening without valid signal
	23-Nov 07:10	23-Nov 10:43	Trash raking
	16-Dec 07:07	16-Dec 10:43	ESBS removal

support Unit annual maintenance. Approximately 119 juvenile subyearling Chinook salmon and 1 juvenile coho salmon were released to the tailrace. An additional 14 juvenile subyearling Chinook salmon mortalities were observed.

Orifices and Collection Channel

The collection channel was operated throughout the season with 18 to 22 open orifices depending on forebay elevations. Orifices were inspected and/or back-flushed two to five times per day. All orifice operations were manually performed throughout the year.

The collection channel was dewatered and removed from service on December 21. Fish salvage operations during the dewatering included releasing approximately 70 adult steelhead, 3 juvenile subyearling Chinook salmon and 75 juvenile lamprey to the tailrace via the emergency release pipe.

Primary Dewaterer/Primary Bypass Pipe

The primary dewatering structure and components functioned adequately throughout the season. However, the limitorque motor that controls the overflow weirs failed near the end of the season. Weirs were adjusted manually when needed. Inspection of the primary dewaterer and manual operation of the cleaning brushes was performed twice daily. As in past years, the excess water was diverted to the adult fish channel pump chamber throughout the season to improve adult fish attraction and migration.

Bypass Flume/Pipe

The primary bypass flume functioned satisfactorily in 2020. During winter maintenance 2010, the flume outfall was relocated from near shore to mid channel. The relocation extended the release site approximately 400 feet north into the river mid-channel. This new section of outfall is made of 36 inch corrugated metal pipe. The new point of release returns bypassed fish

farther from the shoreline and in an area of higher velocity to reduce exposure to piscivorous predation. The flume was inspected during the winter maintenance period and observed in overall good condition and found free of obstructions and rough edges.

Separator

The separator was operated similar to previous years. The water level was kept about one to two inches above the downstream end of the B-side separator bars. During the winter maintenance period, the interior and exterior surfaces of the separator were cleaned and refurbished.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are maintained and operated by the Pacific States Marine Fisheries Commission. PIT tagged salmonids have been monitored for migration in the Columbia and Snake rivers since 1987. At Little Goose Dam, there are 11 PIT tag monitors located throughout the JFF.

In previous years, the state of the Divert During Sample (DDS) system was manually changed by USACE project biologists and technicians based upon fish passage and sample rates. However, in 2012, the DDS system was upgraded during the winter maintenance period to allow for automatic changes of operational mode per entry of the sample rate. However, the system still retains the ability to override the automation and change the system manually.

At low sample rates ($\leq$20%), when large numbers of fish are passing through the system, the DDS setting is deactivated. When the DDS is deactivated, the PIT tag slide gate will not open when the sampling system is engaged. This setting helps avoid potential sample bias caused by diverting large numbers of untagged fish, along with the targeted PIT tagged fish, away from the sample during a sampling event. At sample rates greater than or equal to 20%, (low numbers of fish passing through system), the potential for sample bias is lower and the DDS system is set to "On" or activated.

DDS settings for the A and B side sample tanks followed recommendations for most of the season. Minute deviations (hundredths of a second) typically occur daily at approximately 0700 as a result of equipment operation as the facility prepares for a new 24 hour sampling period. In addition, deviations from the recommended settings occur when debris removal is conducted at the separator. During a separator clean out, large volumes of fish and debris are flushed from the separator and thus it becomes essential to turn the DDS off. There were no separator cleanouts conducted this year. There were no problems with the DDS system in 2020.

Pit Tag Detections

The PIT-tag detection system records data on PIT-tagged salmonids as they pass through the juvenile collection system. The PIT Tag Information System database categorized all PIT-tag detections based on species, race, and clip/rearing type. An additional "orphan" category was used for detections of PIT tags for which the database contained no record of tagging and release. Fish dispositions were categorized as follows based upon exit monitor detections: 1) to the river; 2) to transport holding areas; 3) to the smolt monitoring sample; and 4) unknown. This last category included final detections of PIT-tagged fish at locations that did not constitute an exit from the facility.

From March 24 to November 1, a total of 28,539 PIT-tagged fish were detected within the juvenile collection/bypass system: 17,187 Chinook salmon, 10,486 steelhead, 387 sockeye salmon, 356 coho salmon, 1 Pacific lamprey (*Entosphenus tridentatus*), and 122 orphans of unknown species/rearing type. Of the total number of detections, 14,765 (51.7%) were routed to the river and 13,774 (48.3%) were routed to transport areas. PIT-tagged fish in the sample were treated as the other fish in the sample and were either released to the river—if the facility was operating in secondary bypass mode—or transported—when the facility was operating in collection mode. Approximately 413 (1.4%) of the PIT-tagged fish detected at LGS were last detected in the sample, and of these, 277 (67.1%) were transported, and 136 (32.9%) were returned to the river during pre-transport operations or while operating in secondary bypass mode. Prior to the start of the transportation season, and between June 22 and July 31, all PIT-tagged fish were bypassed to the river. Approximately 4,761 (16.7%) of the total PIT-tagged fish detected were detected prior to the start of collection for transportation, or between June 22 and July 31 when no transport was taking place.

Avian Predation Deterrence

USDA Animal and Plant Health Inspection Service (APHIS) began bird hazing activities in 1999. In 2020, APHIS bird hazing activities at Little Goose took place from March 30 through June 20. The hazing schedule included 8 hours per day, 7 days per week of land-based hazing and 8 hours per day, 3 days a week of boat based hazing from March 30 through June 20. Additionally, a second 8 hour per day shift was conducted from April 12 through May 23. Bird hazing took place in the areas of the juvenile bypass outfall, spillway and powerhouse discharge areas, and areas where birds congregate or feed, ranging from about 2,000 feet upstream of the dam to as much as 1 mile downstream of the dam.

USACE Biologists and personnel from Anchor QEA conducted bird counts extending from the immediate tailrace and forebay to approximately one half mile upstream and downstream of Little Goose Dam and were broken into two zones; tailrace (T1) and forebay (FB1).

Counts were conducted using binoculars 2 to 3 times daily from April 01 through October 31, 2020. Bird counts also monitored foraging and non-foraging activities of gulls, cormorants and terns. Maximum daily bird counts were utilized to tabulate weekly and annual reporting.

Avian counts reached the maximum threshold allowed per the Fish Passage Plan from April 01 to August 31 on a single occasion. A total of 151 gulls were observed on July 23, after bird hazing ended for the season. Gull counts exceeded the 100 bird threshold 10 more times throughout the bird counting season, all within the month of October. Cormorant counts exceeded the 50 bird threshold once throughout the bird counting season, also in October. Lethal take was implemented with 99 gulls and 3 cormorants sacrificed during the 2020 season. Additional hazing by project personnel utilized bird scare products including propane scare cannons, bird bangers and bird screamers deployed intermittently throughout the remainder of the fish passage season. The water cannon located at the bypass outfall was used continuously throughout the season. Little Goose continued to use passive bird deterrent devices to include needle strips, bird wires and visual scare devices.

Gull Counts

The maximum total daily number of 276 gulls counted occurred on October 25. The average daily total count was 25.7 gulls. The maximum daily count in the forebay was 211 gulls and occurred on October 25 with a daily average of 14.4 gulls. The maximum daily count in the tailrace was 125 gulls and occurred on October 30 with a daily average of 11.4 gulls.

Double Crested Cormorant Counts

The maximum total daily number of 57 cormorants occurred on October 30. The average daily total count was 5.9 cormorants. The maximum daily count in the forebay was 27 cormorants and occurred on October 27 with a daily average of 4.1 cormorants. The maximum daily count in the tailrace was 45 cormorants and occurred on October 30 with a daily average of 1.9 cormorants.

Caspian Tern Counts

There were no terns observed during the 2020 season.

Other Piscivorous Bird Counts

The maximum total daily number of 3 grebes occurred on August 26. The average daily total count was <1 grebe. The maximum total daily number of 2 pelicans occurred on May 16. The average daily total count was <1 pelican.

Avian Foraging Behavior

Foraging behavior was monitored and recorded for gulls, cormorants and Caspian terns. Gulls had the highest overall percent of observed foraging behavior (38.5%) followed by cormorants (20.5%). Gulls had the highest percent of feeding behavior in the tailrace (74.0%) followed by cormorants (64.7%). Gulls had the highest percent of feeding behavior in the forebay (10.5%) followed by cormorants (0.6%). Caspian terns were not observed at Little Goose in 2020. The majority of all avian foraging occurs in the tailrace with resting, loafing and perching occurring in the forebay.

Facility Modifications

Several modifications and repairs were made prior to, during and after the 2020 season.

1. XJ7/XJ8 upgrade and install to provide permanent power to the adult ladder cooling pump and station power to the Juvenile Fish Facility.
2. Repaired and replaced PIT tag gate components per FPP requirements.
3. Replaced barge loading hose.
4. Repaired separator and resurfaced and painted various sections.
5. Repaired/replaced multiple ESBS screen cleaning motors.
6. Repaired juvenile bypass system orifice cylinders.

Juvenile Facility Recommendations

1. Continue to write revisions and updates to the operations maintenance manual pertaining to new equipment and facility collection and transport procedures
2. Continue to rebuild orifice valve cylinders.
3. Repair or replace corroded outer steel orifice pipe with stainless steel.
4. Review protocols yearly to ensure effective communication between all parties during truck/barge loading, dewatering events, separator cleanouts, etc. This will ensure that fish are properly routed, flush water is available for fish transfer, and that there is sufficient water in holding tanks
5. Continue to remove scale and rough edges in the facility flumes, tanks, and transition areas.

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