2015 Juvenile Fish Collection and Bypass Report
Little Goose Dam Juvenile Fish Facility

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Introduction

This report summarizes activities and results associated with the collection, transportation and bypass of out-migrating juvenile steelhead *Oncorhynchus mykiss*; Chinook salmon *Oncorhynchus tschawytscha*; sockeye salmon *Oncorhynchus nerka*; and coho salmon *Oncorhynchus kisutch* at Little Goose Dam (LGS) in 2015. The data represented in this report was collected from April 1 through October 31, 2015 by the United States Army Corps of Engineers (USACE), Blue Leaf Environmental (BLE), and Oregon Department of Fish and Wildlife (ODFW) Smolt Monitoring Program (SMP) and transportation biologists and technicians.

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.

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

Below average winter and spring precipitation preceded a hot and dry summer. As a result, flows were 57.1% of the five year average. Monthly flows were below the five year average for all months (Table 1).

During the 2015 fish passage season, April 1 through October 31, the average daily flow was 30.4 kcfs. The maximum average daily flow of 73.9 kcfs occurred on April 3 and the minimum average daily flow of 12.6 kcfs occurred on October 4 (Figure 1).

Spill to aid juvenile fish passage occurred from April 3 through August 31, 2015, in accordance with the 2015 Fish Passage Plan (FPP). The spill target of 30% of total flow was maintained during that interval except for August 21, 22, 26, and 27. Flow decreased to below 33 kcfs June 16, and, in accordance with the FPP, spill was changed to a constant rate of between 7 and 11 kcfs, whichever more closely provided the target spill rate of 30% of the total flow. The Temporary Spillway Weir was installed into spillbay 1 on April 2 and removed on June 18 due to high river water temperatures.

In compliance with the 2015 supplemental FCRPS BIOP, Minimum Operating Pool (MOP) elevations, to enhance fish migration, were placed into effect during the spill to aid fish passage season. To improve navigational safety during low flows, forebay elevations were increased from MOP elevations (633-634 feet MSL), to MOP +2 (634-636 feet MSL) from mid-June through the end of MOP restrictions on August 31. All deviations from the FPP were coordinated through the Technical Management Team (TMT), as necessary, to meet real-time operational requirements.

Table 1. Comparisons of average monthly flow and spill in kcfs at Little Goose Dam JFF 2010-2015.

Month	2010	2011	2012	2013	2014	2015	2010-2014 Average
			Flows (kcfs)				
Apr	40.28	103.34	113.60	56.68	74.33	48.27	77.65
May	64.83	133.19	102.07	79.99	99.66	59.08	95.95
Jun	124.58	163.98	87.38	55.41	84.92	41.34	103.25
Jul	49.51	93.50	46.35	33.44	45.53	27.69	53.67
Aug	29.81	42.07	28.38	23.16	26.87	20.91	30.06
Sep	22.62	33.61	21.09	18.37	19.93	17.96	23.12
Oct	18.97	26.58	18.09	21.75	17.55	15.53	20.59
			Spill (kcfs)				
Apr	11.41	30.08	36.99	16.30	22.37	12.84	23.43
May	19.40	81.37	32.28	24.75	29.34	17.68	37.43
Jun	40.91	73.32	31.86	16.62	24.95	12.74	37.53
Jul	14.83	28.54	17.89	10.57	13.97	9.11	17.16
Aug	9.40	14.00	9.52	7.64	8.73	6.98	9.86
Sep	0.18	0.39	0.18	0.50	0.17	0.13	0.28
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00

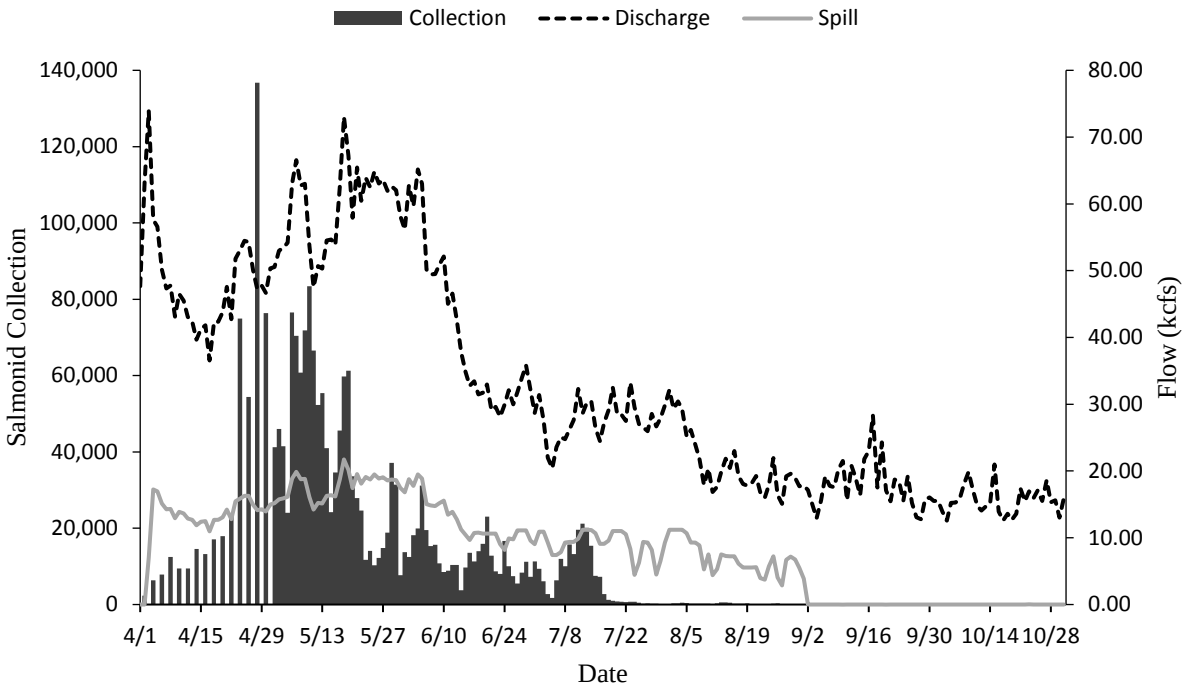

Figure 1. Total river flow, spill, and number of juvenile salmonids collected at Little Goose Dam during the fish collection and transport season, 2015.

River Temperature

The average daily river temperature during the fish passage season was 62.0°F. Average monthly water temperatures were within the range of the five year average temperatures for each month. The maximum river temperature of 70.9°F was recorded on July 14 and was slightly above the five year average maximum of 69.3°F. The 2015 minimum river temperature of 46.7°F was recorded the first day of the season, April 2, and was above the five year average minimum of 45.2°F. As per the Water Management Plan, river temperatures were tempered by scheduled cool water releases from Dworshak Reservoir. Supplemental flow from Dworshak averaged 8.9 kcfs at 42.2°F for the month of July and 6.3 kcfs at 44.9°F for the month of August (Columbia River DART). Temperatures recorded daily in the LGS JFF averaged 68.6°F during July and 68.0°F during August.

Total Dissolved Gas

Total Dissolved Gas (TDG) data are automatically collected and transmitted hourly to the Columbia River Operational and Hydromet Management System (CROHMS) to provide information for spill and gas saturation management. TDG was monitored in the forebay from March 16 through September 21 and in the tailwater year around. The USACE Reservoir Control Center (RCC) coordinates efforts to maintain dissolved gas saturation levels in accordance with the Washington State TDG Level Variance Standard of 120% saturation in the project tailwater and 115% in the forebay of the next project downstream, as measured over 12 consecutive hours.

The average daily TDG level in the LGS forebay, from April 3 through August 31, 2015 was 107.6% saturation. Total Dissolved Gas saturation ranged from 97.8% on August 30 to

115.8% on April 21. April 21 was the only day in which total dissolved gas saturation levels exceeded 115.0% in the LGS forebay.

The TDG level in the LGS tailrace ranged between 97.6% on August 8 to 113.7% on April 21, averaging 108.7% during the spill to aid fish passage season, April 3 through August 31. Tailwater TDG levels did not exceed 120% saturation during the 2015 spill for fish passage season. Forebay TDG levels at Lower Monumental Dam (LMN) ranged from 100.9% on April 3 to 114.0% on April 23, averaging 108.4% from April 3 through August 31. The LMN forebay TDG levels did not exceed 115% from April 3 through August 31 (USACE via Columbia River DART).

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 just over 6 feet. The fish ladder water supply is gravity fed from the forebay and is representative of river conditions. Highest turbidity was recorded during periods of high outflow from March 26 through May 26, with secchi measurements ranging between 2.2 and 6.0 feet and averaging 4.4 feet. Turbidity was lowest during periods of low flow, from June 16 through October 31, with secchi measurements ranging from 4.4 feet to over 6.0 feet with an average of 5.5 feet.

Fish Collection

Migration and Collection

A total of 2,260,329 smolts were collected during the 2015 season (Table 2). Of those, 1,780,151 were transported, 477,086 were bypassed, and 3,092 were facility mortalities. During the month of April, prior to the start of the fish transport season, the facility was switched from primary to secondary bypass, for condition sampling and gas bubble trauma monitoring, every other day. An estimated total of 477,022 smolts entered the facility on sampling days in April. Of this total, 476,966 were bypassed and 56 were facility mortalities. There are no passage estimates on dates when the facility was operated in primary bypass.

Collection for transport began May 1 at 0700 hours and ended October 31 at 0700 hours. An estimated total of 1,783,307 salmonid smolts were collected for transport during this period. Of this total 1,774,069 smolts were barged, 6,082 were trucked, 120 were bypassed, and 3,036 were facility mortalities.

The maximum daily estimated collection of 136,712 fish occurred on April 28 and accounted for 6.0% of total collection (Table 3). The composition of the collection for that date was: clipped steelhead 48.3%, clipped yearling Chinook 39.2%, unclipped yearling Chinook 10.4%, unclipped steelhead 1.9%, and clipped coho 0.1%.

Table 2. Annual collection, bypass, and transport activity at Little Goose Dam JFF, 2010-2015.

	Chinook Yearling		Chinook Sub-yearling		Steelhead		Coho		Sockeye		
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
Collection											
2010	643,785	229,253	287,702	578,905	807,718	277,394	2,740	34,177	1,291	7,594	2,870,559
2011	1,125,551	323,791	232,116	508,188	868,702	263,726	0	41,631	3,487	20,869	3,388,061
2012	1,067,044	431,462	268,235	399,054	658,540	312,732	775	52,541	252	25,583	3,216,218
2013	768,720	257,791	155,896	297,206	864,292	310,421	50	36,839	15,952	6,683	2,713,850
2014	1,487,105	462,499	278,019	463,013	1,013,203	346,944	0	41,542	9,115	51,956	4,153,396
2015	643,606	163,926	169,349	478,654	590,849	158,004	8,276	33,797	11,050	2,818	2,260,329
Bypass											
2010	57,967	23,228	3	325	46,365	12,601	0	0	0	0	140,489
2011	56,672	46,496	1	92	216,725	21,908	0	401	0	5,227	347,522
2012	242,353	145,896	1	125	227,179	60,328	0	1,601	0	691	678,174
2013	24,036	22,662	5	343	56,575	9,627	0	200	0	2	113,450
2014	78,418	102,125	0	294	178,448	32,046	0	600	0	5,911	397,842
2015	192,212	69,754	0	140	191,460	21,760	400	1,320	0	40	477,086
Truck											
2010	11	15	79	10,452	7	11	0	19	1	10	10,605
2011	1	16	59	10,680	8	22	0	277	2	77	11,142
2012	1	0	133	6,306	17	26	0	7	0	106	6,596
2013	0	0	638	25,106	13	18	0	4	2	16	25,797
2014	0	4	400	7,520	4	6	0	0	0	34	7,968
2015	1	1	44	5,982	35	8	0	9	0	2	6,082
Barge											
2010	585,585	205,930	285,364	564,261	761,183	264,706	2,740	34,156	1,289	7,583	2,712,797
2011	1,067,450	276,919	230,973	494,558	651,617	241,734	0	40,943	3,480	15,416	3,023,090
2012	824,116	285,393	267,834	391,916	431,232	252,302	775	50,931	252	24,775	2,529,526
2013	744,193	235,046	155,117	271,046	807,600	300,745	50	36,635	15,950	6,657	2,573,039
2014	1,408,338	360,039	277,207	453,966	834,621	314,847	0	40,932	9,107	45,757	3,744,814
2015	451,267	94,129	168,929	470,315	399,120	136,176	7,868	32,447	11,046	2,772	1,774,069
Total Transport											
2010	585,596	205,945	285,443	574,713	761,190	264,717	2,740	34,175	1,290	7,593	2,723,402
2011	1,067,451	276,935	231,032	505,238	651,625	241,756	0	41,220	3,482	15,493	3,034,232
2012	824,117	285,393	267,967	398,222	431,249	252,328	775	50,938	252	24,881	2,536,122
2013	744,193	235,046	155,755	296,152	807,613	300,763	50	36,639	15,952	6,673	2,598,836
2014	1,408,338	360,043	277,607	461,486	834,625	314,853	0	40,932	9,107	45,791	3,752,782
2015	451,268	94,130	168,973	476,297	399,155	136,184	7,868	32,456	11,046	2,774	1,780,151

Table 3. Peak passage dates and totals by species group at Little Goose Dam JFF, 2010-2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Season
2010	May 20 (71,700)	May 2 (21,200)	June 12 (33,456)	June 12 (46,507)	May 20 (96,600)	May 20 (29,800)	May 29 (300)	May 20 (2,200)	May 20 (4,000)	May 20 (222,600)
2011	May 13 (121,429)	May 13 (28,802)	June 04 (16,859)	June 04 (39,613)	May 18 (58,203)	May 18 (27,400)	May 22 (700)	May 12 (1,406)	May 20 (4,400)	May 13 (225,048)
2012	April 30 (176,464)	April 30 (76,835)	June 16 (25,750)	June 04 (23,025)	April 30 (104,051)	April 30 (29,612)	May 29 (150)	May 23 (3,000)	May 19 (4,200)	April 30 (389,763)
2013	May 10 (156,233)	May 10 (44,008)	June 10 (15,290)	June 08 (14,452)	May 14 (107,846)	May 14 (46,209)	May 17 (4,600)	May 19 (2,400)	May 14 (5,200)	May 10 (280,443)
2014	May 06 (156,006)	April 22 (53,031)	June 02 (19,016)	June 03 (24,044)	April 22 (89,625)	May 08 (25,215)	May 10 (3,600)	May 20 (4,003)	May 10 (6,813)	May 06 (279,206)
2015	April 28 (53,656)	April 24 (16,602)	May 29 (15,400)	July 13 (18,551)	April 28 (66,016)	May 09 (11,601)	May 19 (3,500)	May 12 (400)	May 17 (4,700)	April 28 (136,712)

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 2,342 adult salmon and steelhead fallbacks occurred in 2015 (Table 4). Of these 2,340 were bypassed from the separator. The remaining 2 were small Chinook jacks that passed through the separator bars and were collected in the sample and released back to the river. Daily numbers of adult fallbacks and fallback mortalities can be found in Appendix Table 4.

There were 1,187 steelhead fallbacks in April, May and June (Table 5). Of these there were 407 clipped and 691 unclipped which were classified as 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. Table 6 lists the numbers of fish by species and condition categories.

Other fish of particular interest that were bypassed back to the river from the separator included 55 adult pacific lamprey and 11 white sturgeon. The 55 adult pacific lamprey were transported to one mile above the dam and released.

Table 4. Total Annual Adult Salmonid Fallbacks at Little Goose Dam JFF, 2010-2015.

Year	Adult Chinook	Jack/mini Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
2010	976	780	1,758	1,881	22	9	5,426
2011	1,683	1,020	1,996	1,549	17	14	6,280*
2012	1,064	1,077	1,215	1,399	9	21	4,785
2013	1,341	1,050	1,469	1,061	15	2	4,938
2014	991	558	1,518	1,425	46	186	4,724
2015	515	240	659	903	15	10	2,342

*2011 total includes 1 Pink Salmonid.

Table 5. Monthly totals of fallbacks bypassed from separator at Little Goose Dam, 2015.

Month	Adult Chinook	Jack Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
April	4	0	219	361	0	0	584
May	37	0	185	355	0	0	577
June	60	15	28	39	0	0	142
July	82	26	10	7	10	0	135
August	17	9	13	22	2	0	63
September	121	68	126	80	3	4	402
October	194	122	78	39	0	6	439
Total	515	240	659	903	15	10	2,342

Table 6. Condition of adult salmonids released at Little Goose Dam, 2015.

Fish	Chinook		Chinook Jack		Steelhead		Sockeye		Coho	
Condition[1]	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
Good	227	224	92	129	552	679	3	10	10	1,926
Fair	33	25	11	8	63	137	1	1	0	279
Poor	1	3	0	0	34	73	0	0	0	111
Dead	1	1	0	0	10	14	0	0	0	26
Total	262	253	103	137	659	903	4	11	10	2,342

[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 6 does not separate post spawned "kelt" steelhead from pre-spawned healthier steelhead.

Separator Efficiency

Separator efficiency is a measure of how efficiently fish entering the facility are separated by size. Smaller fish, primarily salmon smolts, are expected to enter through the narrowly spaced "A" side sorter bars on the upstream end of the separator, and the larger fish, primarily steelhead, should enter through the more widely spaced "B" side sorter bars on the downstream end. Table 4 gives efficiency expressed as the percentage of each group, passing through the desired side of the separator, for 2010-2015. Efficiency rates are based on expanded sample counts.

Separator efficiency was highest for clipped yearling Chinook and clipped steelhead with 72.9% of clipped yearling Chinook entering on the A-side and 72.7% of clipped steelhead entering on B-Side. Separator efficiency was lowest for unclipped coho at 35.9% entering on the A-side. Separator efficiency was noticeably higher than in recent years for clipped and unclipped subyearling Chinook with 65.8% and 62.8% entering the A-side respectively (Table 7).

Table 7. Annual juvenile salmonid separator efficiency (%) at Little Goose Dam JFF, 2010-2015.

	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
2010	69.8	68.3	57.3	54.7	87.8	69.4	15.1	27.6	12.8	43.1
2011	73.6	69.9	58.0	57.7	76.9	67.3	-----	32.9	22.6	38.2
2012	75.1	72.3	59.1	59.9	83.7	64.8	45.2	42.1	0.0	37.7
2013	71.5	71.2	53.8	48.8	82.1	62.1	100.0	23.7	64.5	52.4
2014	81.8	78.6	58.5	56.5	75.9	54.7	-----	41.3	49.5	37.6
2015	72.9	69.3	65.8	62.8	72.7	57.0	39.0	35.9	45.2	38.2

Note: Counts do not include sample mortalities. There were no clipped coho sampled in 2014.

Sampling

The fish sampling system was operated without incident throughout the 2015 season. Sampling procedures followed the smolt monitoring guidelines developed by the Fish Passage Center and the USACE. The resulting data were used for management of facility and fish transport operations. Collection and fish condition data were also transmitted daily to the FPC electronic database in support of the Smolt Monitoring Program (SMP) by ODFW personnel.

Sample rates were set by USACE project biologists. To obtain the target sample of 300 to 500 smolts, sample rates were varied between 0.1% and 100% 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 8).

Table 8. Annual percentages of juvenile salmonids collected per species and clip type that were sampled at Little Goose Dam JFF, 2010-2015[1].

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
2010	0.9	1.0	1.7	6.3	0.8	0.9	1.9	1.1	0.9	2.1
2011	0.6	0.8	2.8	6.9	0.7	0.8	2.3	1.8	1.7	1.8
2012	0.5	0.7	3.0	8.0	0.8	0.9	2.4	1.5	0.9	1.8
2013	0.6	0.8	5.1	15.4	0.8	1.0	0.7	1.5	0.8	2.6
2014	0.4	0.7	3.0	6.1	0.6	0.6	0.6	0.9	0.6	1.4
2015	0.8	1.0	2.8	4.7	1.0	1.1	0.9	0.9	1.0	1.8

[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 2015 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, pop eyes, and eye hemorrhage. Injury and descaling data were used by managers to assess passage conditions at the dam.

Pound counts (number of fish per pound) were taken daily during condition sampling and provided to the USACE from April 2 through October 31. During transport, when the sample rate was set below 100%, weights were also recorded on all non-salmonid species in the sample to determine their contribution to barge loading densities. A total of 42,740 fish were sampled during the 2015 season (Table 9).

Table 9. Weekly sample as percent of collection total and sample totals at LGS JFF, 2015.

Week Ending	Weekly % Sampled (%)	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Totals[1]
2-Apr	5.0	47	21	0	1	31	16	0	2	0	118
9-Apr	5.2	546	201	0	0	553	73	0	0	1	1,374
16-Apr	2.2	465	186	0	0	334	46	0	0	0	1,031
23-Apr	1.8	411	196	0	0	305	123	0	0	2	1,037
30-Apr	0.5	714	281	0	0	647	58	0	0	6	1,706
7-May	0.7	1,190	253	0	0	609	97	0	1	30	2,180
14-May	0.6	1,184	216	0	5	804	287	1	7	56	2,560
21-May	0.9	627	177	2	40	979	380	87	11	159	2,462
28-May	1.9	170	97	243	391	668	371	8	2	102	2,052
4-Jun	2.2	21	26	1,180	1,343	326	139	3	0	32	3,070
11-Jun	2.3	11	7	759	1,538	144	63	0	0	9	2,531
18-Jun	4.3	3	18	990	1,946	134	35	0	0	7	3,133
25-Jun	3.2	2	6	606	2,410	46	8	0	0	4	3,082
2-Jul	4.2	0	1	422	1,905	151	31	0	1	2	2,513
9-Jul	3.8	0	1	259	1,716	78	15	0	0	1	2,070
16-Jul	1.9	0	0	172	1,783	13	1	0	0	1	1,970
23-Jul	9.5	0	0	25	695	23	6	0	0	0	749
30-Jul	28.7	0	0	21	617	13	2	0	0	1	654
6-Aug	50.0	0	0	13	916	33	2	0	0	0	964
13-Aug	50.0	0	0	14	958	23	3	0	0	1	999
20-Aug	87.3	0	0	15	1,950	35	4	0	0	1	2,005
27-Aug	99.8	0	0	8	1,014	5	0	0	0	3	1,030
3-Sep	100.0	0	0	4	409	3	1	0	0	1	418
10-Sep	99.7	0	0	6	308	5	1	0	0	0	320
17-Sep	99.6	0	0	6	805	5	0	0	0	0	816
24-Sep	98.9	0	1	2	924	0	3	0	0	0	930
1-Oct	100.0	0	0	0	104	0	0	0	0	0	104
8-Oct	100.0	0	0	0	33	0	0	0	1	2	36
15-Oct	100.0	0	0	3	395	2	1	0	0	0	401
22-Oct	100.0	0	0	0	104	2	0	0	1	0	107
29-Oct	100.0	1	0	3	203	1	0	0	0	0	208
31-Oct	100.0	0	0	0	108	0	0	0	0	2	110
Total Sampled		5,392	1,688	4,753	22,621	5,972	1,766	99	26	423	42,740
Total Collection		643,606	163,926	169,349	478,654	590,849	158,004	11,050	2,818	42,073	2,260,329
% of Sample		12.6	3.9	11.1	52.9	14.0	4.1	0.2	0.1	1.0	100
% of Coll.		0.8	1.0	2.8	4.7	1.0	1.1	0.9	0.9	1.0	1.9

[1]All research fish, GBT fish and sample mortality included in species group and clip type numbers.

Note: Little Goose JFF was in primary bypass mode, going to secondary bypass for 24 hour condition sampling on April 2,4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30. Collection for transport with daily 24 hour sampling began on May 1 at 0700 hours and ended October 31 at 0700 hours.

Fish Condition

Fish condition was monitored daily by BLE and ODFW biologists and biological aids. "The primary role of condition monitoring is to identify the proportion of each species of migrant juvenile salmonid that are descaled or have significant injuries indicative of problems in fish passage at dams, such as debris in fish bypass apparatus" (Condition Sampling Protocol 2014 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 (Table 10).

Table 10. Annual injury rates (%) for salmonids examined at Little Goose Dam, 2010-2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Years	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip		Total
2010	1.1	0.5	0.1	0.3	1.5	0.3	0.0	4.8	0.0	0.5
2011	0.7	1.4	0.6	1.7	1.9	1.8	0.0	3.6	0.9	1.5
2012	2.5	2.7	4.9	6.0	2.0	3.3	0.0	1.8	2.7	4.6
2013	3.4	4.3	8.9	17.0	1.8	1.6	0.0	3.2	2.9	12.1
2014	8.4	8.4	9.0	12.3	4.3	3.4	13.3	12.9	8.6	9.8
2015	12.5	14.1	12.9	16.6	6.2	5.5	7.0	11.5	11.1	13.4

A total of 21,316 smolts from the condition subsample were examined for injuries. Of the fish examined, 13.4% or 2,856 individual smolts were observed with one, or more than one, injury. A total of 2,887 individual injuries were observed this year. The vast majority of injuries involved damage to fins at 90.7% of the total followed by operculum injury (4.5%), body injury (2.6%), eye injury (1.1%), and head injury (1.1%) (Table 11). The highest rates of injury this year were observed in sockeye salmon followed by subyearling fall Chinook salmon.

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 40,896 smolts were examined for descaling in 2015. The overall rate of descaling was 1.0% (414 descaled), which is similar to rates observed in previous years (Table 12). Of the 40,896 smolts examined for descaling, 52.1% or 21,316 smolts were examined as part of condition subsampling. During condition subsampling, fish with descaling equal to or greater than 20% were differentiated into two categories; descaling associated with dam passage and descaling on fish with bite marks indicative of predation attempts by birds, fish, or mammals. Of the 245 descaled smolts observed in the condition subsample, descaling associated with dam passage was 53.5% of the condition descale total and the rate of descaling on fish with predation marks present was 46.5% of the condition descale total. The rate of descaling observed in the non-condition sample was 0.9% from a sample size of 19,580 salmon. Note that all descaling

recorded from the full sample does not differentiate between descaling as a result of passage and descaling on fish with evidence of attempted predation.

For fish in the condition subsample, in addition to descaling of 20% or greater, partial descaling was also recorded. Partial descaling was considered scale loss above background levels of approximately 5% scale loss but below the 20% threshold for descaling. The rate of partial descaling was 3.0% of the 21,316 smolts examined for condition in 2015.

Overall weekly descaling rates per species and clip types are listed in Table 13. In 2009, descaling associated with predatory attempts was not included in the total descaling rate, while in 2010 through 2014, it was included. The average weekly descaling rate ranged from 0.0% to 4.9%. Weekly descaling rates were variable throughout the season and, as in previous years, appeared to coincide with peak migrations, increased river discharge, increased river debris, and/or small sample sizes.

Table 11. Percent of fish examined that were injured, had predation marks, or had signs of disease by species and clip type at Little Goose Dam, 2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total[1]
Injuries											
Eye	0.4	0.5	<0.1	<0.1	0.2	0.0	0.0	0.3	1.0	0.0	0.2
Operculum	0.9	0.5	0.6	0.3	1.6	0.7	0.0	0.3	1.0	0.3	0.6
Head	<0.1	0.0	0.0	0.1	0.3	0.5	0.0	0.3	1.0	0.0	0.2
Body	0.2	0.0	0.0	0.3	0.5	0.5	0.0	0.0	2.1	0.0	0.4
Fin	11.0	13.2	11.9	15.6	3.8	4.0	4.2	6.0	18.6	11.5	12.3
Total Injury	12.5	14.1	12.9	16.6	6.2	5.5	4.2	7.0	21.7	11.5	13.4
Disease											
Fungus	0.5	0.0	0.1	<0.1	1.1	1.8	0.0	0.3	2.0	0.0	0.4
Columnaris	0.0	0.1	0.6	7.1	1.4	0.9	0.0	0.3	0.0	3.9	4.0
BKD	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Parasites	1.4	1.4	1.1	0.6	2.7	5.5	1.4	1.0	0.0	0.0	1.2
Deformity	0.4	0.0	0.2	0.3	0.3	0.2	1.4	0.0	0.0	0.0	0.3
Disease Other	0.1	0.0	2.9	3.7	0.8	0.4	0.0	0.0	0.0	0.0	2.3
Total Disease	1.6	1.5	4.8	11.5	5.8	8.5	2.8	1.6	2.1	3.9	8.1
Predation											
Bird	0.8	0.9	0.2	0.3	4.4	3.3	0.0	0.6	0.0	3.9	1.1
Fish	0.7	0.6	0.8	0.9	0.3	1.5	0.0	2.5	2.1	0.0	0.8
Lamprey	0.0	0.0	0.3	0.4	<0.1	0.0	0.0	0.0	0.0	0.0	0.2
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	1.5	1.5	1.2	1.5	4.7	4.8	0.0	3.2	3.9	3.9	2.2
Misc. Conditions											
Pop Eye	<0.1	0.1	0.0	<0.1	<0.1	0.0	0.0	0.0	1.0	0.0	<0.1
Fin Hemorrhage	3.6	6.0	11.9	18.5	3.5	4.2	2.8	1.3	1.0	3.9	12.2
Pink Fin	10.9	14.2	33.8	45.4	15.1	15.8	2.8	4.1	3.1	0.0	31.7
Fin Discoloration	0.9	0.9	1.6	6.4	0.6	0.5	0.0	0.6	0.0	3.9	3.8
Eye Hemorrhage	0.3	0.1	0.1	<0.1	<0.1	0.0	1.4	0.0	0.0	0.0	0.1
Total Misc. Conditions	14.6	19.1	39.9	54.0	17.4	18.1	5.6	5.7	5.2	7.7	37.9
Total sample size	2,762	871	1,705	11,226	3,280	961	72	316	97	26	21,316

[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.

Table 12. Annual descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2010-2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Totals
2010	0.5	0.3	0.3	0.3	0.3	0.2	0.0	0.0	0.6	0.3
2011	0.5	0.5	0.3	0.5	0.2	0.1	0.0	0.6	0.3	0.4
2012	1.0	0.6	0.5	0.9	0.8	1.4	0.0	1.9	0.6	0.9
2013	0.7	1.0	0.8	1.0	0.6	0.8	0.9	1.1	0.7	0.9
2014	1.2	0.5	1.0	0.9	1.0	1.2	0.0	3.4	1.9	1.0
2015	1.3	1.1	0.7	0.7	1.9	1.9	0.0	3.8	1.4	1.0

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

Table 13. Weekly descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Week Ending	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total[1]
2-Apr	4.26	4.76	-----	-----	0.00	0.00	-----	-----	-----	-----
9-Apr	2.21	0.50	-----	-----	0.72	0.00	-----	-----	0.00	1.24
16-Apr	1.24	1.23	-----	-----	2.51	4.44	-----	-----	-----	1.83
23-Apr	1.16	1.66	-----	-----	2.41	1.69	-----	-----	0.00	1.71
30-Apr	1.35	1.64	-----	-----	1.27	3.70	-----	-----	0.00	1.44
7-May	1.24	0.42	-----	-----	1.85	1.14	-----	0.00	3.33	1.35
14-May	0.98	0.99	-----	0.00	1.15	1.07	0.00	14.29	0.00	1.06
21-May	0.86	0.62	0.00	2.63	3.04	1.11	0.00	0.00	2.52	1.87
28-May	1.20	1.09	0.00	0.80	2.29	2.00	0.00	0.00	0.00	1.39
4-Jun	0.00	0.00	0.69	0.62	1.35	3.13	0.00	-----	3.13	0.85
11-Jun	0.00	0.00	1.10	0.62	4.84	3.45	-----	-----	0.00	1.04
18-Jun	0.00	5.56	0.42	0.76	2.46	3.23	-----	-----	0.00	0.77
25-Jun	0.00	0.00	1.02	0.52	4.65	14.29	-----	-----	0.00	0.71
2-Jul	-----	0.00	0.49	0.50	1.41	6.90	-----	0.00	0.00	0.63
9-Jul	-----	-----	1.23	0.56	2.63	0.00	-----	-----	0.00	0.72
16-Jul	-----	-----	0.00	0.60	0.00	0.00	-----	-----	0.00	0.54
23-Jul	-----	-----	0.00	0.66	4.55	0.00	-----	-----	-----	0.77
30-Jul	-----	-----	0.00	0.82	0.00	0.00	-----	-----	0.00	0.77
6-Aug	-----	-----	0.00	0.55	0.00	0.00	-----	-----	-----	0.53
13-Aug	-----	-----	0.00	0.31	4.35	0.00	-----	-----	0.00	0.40
20-Aug	-----	-----	0.00	0.31	0.00	0.00	-----	-----	0.00	0.30
27-Aug	-----	-----	12.50	0.40	0.00	-----	-----	-----	0.00	0.49
3-Sep	-----	-----	0.00	0.25	0.00	0.00	-----	-----	0.00	0.24
10-Sep	-----	-----	0.00	0.99	0.00	0.00	-----	-----	-----	0.96
17-Sep	-----	-----	0.00	1.38	0.00	-----	-----	-----	-----	1.36
24-Sep	-----	-----	0.00	1.26	0.00	0.00	-----	-----	-----	1.25
1-Oct	-----	-----	-----	1.01	-----	-----	-----	-----	-----	1.01
8-Oct	-----	-----	-----	0.00	-----	-----	-----	0.00	0.00	0.00
15-Oct	-----	-----	0.00	1.78	0.00	0.00	-----	-----	-----	1.75
22-Oct	-----	-----	-----	3.85	0.00	-----	-----	0.00	-----	3.74
29-Oct	0.00	-----	0.00	4.98	-----	-----	-----	-----	-----	4.88
31-Oct	-----	-----	-----	1.85	-----	-----	-----	-----	0.00	1.82
Total Exam	5,034	1,561	4,603	21,746	5,731	1,675	97	26	423	40,896
% Desc	1.3	1.1	0.7	0.7	1.9	1.9	0.0	3.8	1.4	1.0
Median	1.07	0.62	0.00	0.64	1.27	0.00	0.00	0.00	0.00	1.01

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

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 also dwarfism or truncated body were also documented.

A total of 1,715 smolts or 8.1% of the total condition subsample were observed with one or more symptoms of disease (Table 11). Of the 1,748 individual signs of disease observed this year, Columnaris was the most prevalent at 49.1% of the total, followed by other disease (28.4%), parasite (14.8%), fungus (4.2%), deformity (3.4%), and presumed BKD (<0.1%). Note that the majority of "other" diseases this season consisted of observations of sick subyearling fall Chinook smolts exuding clear fluid from an inflamed vent, coupled with abdominal distention. Several subyearling fall Chinook smolt mortalities were observed with these symptoms which prompted us to collect a specimen for the Oregon Department of Fish Wildlife Fish Health Lab in LaGrande Oregon. Preliminary results were positive for the intestinal protozoan parasite *Ceratomyxa Shasta. C. Shasta* is a parasite of the Pacific Northwest known to cause losses in hatchery reared and wild salmonids and also contributes significantly to prespawing mortality of adult salmonids. Subsequent culture results were positive for a systemic *Aeromonas* infection. Observations of overall disease were highest in steelhead and subyearling fall Chinook salmon.

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 458 smolts were observed with one or more predatory wounds for an overall rate of 2.2% of the total condition subsample. The majority of marks observed in the subsample were indicative of attempted predation by bird at approximately 52.4% of the 460 total individual bite marks recorded, followed by fish bites (36.5%), and lamprey bites (11.1%). No mammalian bite marks were observed this year. Steelhead sustained the highest rate of predatory attempts, which were predominately a result of predation attempts by birds (Table 11).

The overall rate of bird bite marks increased slightly from last year and was similar to 2012 (Table 14). The highest prevalence of bird bite marks was observed on clipped steelhead.

Table 14. Annual bird bite rates (%) for salmonids examined at Little Goose Dam, 2010-2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip		Total
2010	0.8	0.0	0.5	0.2	3.0	2.7	0.0	0.0	0.7	0.7
2011	0.8	0.3	0.1	0.5	2.4	2.3	0.0	1.8	0.0	0.7
2012	0.7	0.5	0.1	0.5	3.9	3.8	0.0	0.0	0.0	1.0
2013	1.0	1.0	0.1	0.5	1.8	2.6	2.2	1.6	1.4	0.8
2014	0.5	0.5	0.3	0.3	2.7	2.5	0.0	0.7	0.9	0.7
2015	0.8	0.9	0.2	0.3	4.4	3.3	0.0	3.9	<0.1	1.1

Other Miscellaneous Conditions

The Other Miscellaneous Conditions category included popeye (exopthalmos), hemorrhaged fin, pink fin, discolored fin, and hemorrhaged eye. There were a total 8,084 smolts with one or more miscellaneous conditions for an overall miscellaneous condition rate of 37.9% of the total condition subsample (Table 11). A total of 10,187 individual observations of miscellaneous conditions were found. Many smolts that were examined had multiple conditions. For example, pink and hemorrhaged fins often occurred on the same individual fish, though in different fins. Pink fins constituted the majority of the observations in this category at 66.4% of the individual miscellaneous conditions total followed by hemorrhaged fin(s) (25.4%), fin discoloration (7.9%), eye hemorrhage (0.2%), and popeye (exopthalmos) (0.1%). Subyearling fall Chinook salmon had the highest rates in this condition category, 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 total facility mortality (raceways, separator, and sample) and sample mortality. Raceways included barge holds, wet lab tanks and routing flumes.

The rate of total facility mortality was low this year at 0.13% from a total collection of 2,260,329 smolts (Table 15). The average weekly total facility mortality rate ranged from 0.0% to 5.8% (Table 16). The minimum weekly rates of 0.0% occurred frequently during the months of April and May 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 descaling, disease, predation, and injury rates increased. The maximum weekly facility mortality rate of 10.6% occurred during the week ending October 1 with a total weekly collection of 104 fish. The median season total facility mortality rate for all smolts was 0.1%. The average monthly facility mortality rate was highest in September at a rate of 4.5% from a collection total of 2,272 smolts.

Sample mortality for smolts was low at <0.1% of 42,740 smolts sampled (Table 17). As in 2013, increased sample mortality in late summer was observed, when river temperatures and outbreaks of disease such as Columnaris were on the rise. On average, monthly sample mortality rates were lowest in May at 0.2% from a sample total of 10,557 smolts, and progressed steadily to the highest rate in September at 3.1% from a sample total of 2,258 smolts.

The total sample mortality rate for Pacific lamprey ammocoetes was 20.0% of 5 total ammocoete sampled and the rate for Pacific lamprey macropthalmia was 4.1% from a total of 221 sampled (Table 17). No notable peak in sample mortality for either life stage of juvenile Pacific lamprey was observed.

Table 15. Annual total facility mortality as a percentage of total collection at LGS JFF 2010-2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific lamprey	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoete	Macropthalmia
2010	<0.1	<0.1	0.8	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	-----	-----
2011	0.1	0.1	0.5	0.6	<0.1	<0.1	0.1	0.7	<0.1	0.2	0.7	0.2
2012	<0.1	<0.1	0.1	0.2	<0.1	<0.1	0.0	<0.1	0.0	<0.1	0.5	0.3
2013	<0.1	<0.1	0.1	0.2	<0.1	<0.1	0.0	0.1	0.0	0.1	0.2	<0.1
2014	<0.1	0.1	0.2	0.3	<0.1	<0.1	0.1	0.5	<0.1	0.1	0.4	0.2
2015	<0.1	0.1	0.2	0.4	<0.1	<0.1	<0.1	0.1	<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 16. Weekly total facility mortality in percent at Little Goose Dam JFF, 2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Week Ending	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total[1]
2-Apr	0.0	0.2	-----	0.0	0.2	0.3	-----	0.0	-----	0.1
9-Apr	0.0	0.0	-----	-----	0.0	0.3	-----	-----	0.0	0.0
16-Apr	0.0	0.0	-----	-----	0.0	0.0	-----	-----	-----	0.0
23-Apr	0.0	0.0	-----	-----	0.0	0.0	-----	-----	0.0	0.0
30-Apr	0.0	0.0	-----	-----	0.0	0.0	-----	-----	0.0	0.0
7-May	0.0	0.0	-----	-----	0.0	0.0	-----	0.0	0.0	0.0
14-May	0.0	0.0	-----	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21-May	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.1	0.0	0.0
28-May	0.1	0.1	0.0	0.0	0.1	0.1	0.5	1.0	0.1	0.1
4-Jun	1.4	0.5	0.0	0.0	0.2	0.2	0.0	-----	0.9	0.1
11-Jun	0.3	0.7	0.2	0.1	0.0	0.1	-----	-----	0.2	0.1
18-Jun	1.4	0.0	0.2	0.2	0.3	0.1	-----	-----	1.3	0.2
25-Jun	0.0	0.0	0.3	0.2	0.5	0.6	-----	-----	3.0	0.2
2-Jul	-----	0.0	0.6	0.4	0.7	0.1	-----	8.0	3.9	0.5
9-Jul	-----	0.0	1.3	1.7	0.8	0.9	-----	-----	4.0	1.6
16-Jul	-----	-----	0.5	0.6	0.8	12.0	-----	-----	0.0	0.6
23-Jul	-----	-----	5.5	3.0	4.1	0.0	-----	-----	100.0	3.1
30-Jul	-----	-----	1.4	0.7	0.0	0.0	-----	-----	0.0	0.7
6-Aug	-----	-----	0.0	0.9	1.5	0.0	-----	-----	-----	0.9
13-Aug	-----	-----	0.0	0.6	0.0	16.7	-----	-----	0.0	0.7
20-Aug	-----	-----	0.0	0.5	0.0	0.0	-----	-----	0.0	0.4
27-Aug	-----	-----	12.5	0.2	28.6	-----	-----	-----	0.0	0.5
3-Sep	-----	-----	25.0	0.5	0.0	0.0	-----	-----	0.0	0.7
10-Sep	-----	-----	0.0	2.3	20.0	0.0	-----	-----	-----	2.5
17-Sep	-----	-----	0.0	1.9	33.3	-----	-----	-----	-----	2.1
24-Sep	-----	0.0	60.0	6.6	100.0	25.0	-----	-----	-----	7.0
1-Oct	-----	-----	-----	10.6	-----	-----	-----	-----	-----	10.6
8-Oct	-----	-----	-----	0.0	-----	-----	-----	0.0	0.0	0.0
15-Oct	-----	-----	0.0	0.3	0.0	0.0	-----	-----	-----	0.2
22-Oct	-----	-----	-----	0.0	0.0	-----	-----	0.0	-----	0.0
29-Oct	0.0	-----	0.0	1.0	100	-----	-----	-----	-----	1.4
31-Oct	-----	-----	-----	0.0	-----	-----	-----	-----	0.0	0.0
Median Weekly Rate	0.0	0.0	0.2	0.5	0.0	0.0	0.1	0.1	0.1	0.1

Note "-----" indicates that the species group was not present in the sample during the week.

Table 17. Annual sample mortality as percent of total sample at Little Goose Dam JFF, 2010-2015.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific Lamprey	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoetes	Macropthalmia
2010	0.5	0.3	0.5	1.0	<0.1	0.2	0.0	1.2	0.6	0.8	-----	-----
2011	0.6	0.5	0.9	1.4	0.1	0.1	0.0	0.6	0.8	1.1	11.1	7.8
2012	0.4	0.3	0.3	0.5	0.2	0.2	0.0	0.8	0.0	0.4	10.8	4.5
2013	0.2	0.1	0.3	0.8	0.1	0.1	0.0	4.1	0.0	0.6	3.8	1.9
2014	0.3	0.3	0.3	0.8	0.2	0.1	1.7	4.7	0.4	0.6	20.4	5.6
2015	0.2	0.5	0.3	0.9	0.2	0.2	2.0	0.0	0.0	<0.1	20.0	4.1

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. In 2014, the sample mortality rate for Pacific lamprey ammocoete includes 2 unknown ammocoetes.

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. When the number of Siberian prawn was too large to practically count each individual, 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. For the eighth consecutive season, all Siberian prawn that occurred in the sample were euthanized per the directive issued by Washington Department of Fish and Wildlife on July 24, 2007. All Siberian prawn from the sample were frozen and returned to the river.

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.

Incidental collections totaled 498,019 fish. This included an expanded sample count of 23,602 fish and 464,586 crustaceans plus 9,831 fish from the separator (Table 18). Incidental collection counts were much higher than in 2014, and above the five year average of 104,196 fish (Table 19). The majority of the incidental catch this year consisted of Siberian prawn at 464,586 or 93.3% of the total number of incidentals collected and is the highest collection of prawn on record. This is higher than the 2010-2014 average of 40,785. Siberian prawn collection numbers were highest during the month of October totaling 349,341 or 75.2% of all Siberian prawn collected for the season. Numbers of Pacific lamprey macropthalmia were lower than in 2014, while crappie collection numbers were higher. Collection totals for most other groups that contribute substantial numbers to the incidental collection were similar to those in 2014.

Adult Pacific lamprey collections totaled 163 lamprey in 2015: 55 from the separator and 108 from the sample. The first adult Pacific lamprey of the season was collected May 4, the last on October 1, 2015. Upriver adult migrants were most frequently observed falling back into the collection system from July through August. For the fifth consecutive year, USACE transported all Pacific adult lamprey captured at the facility to above the dam, releasing them at Little Goose Landing. In addition, to avoid exposure to sampling anesthesia, any adult lamprey found in the sample tanks were removed by the USACE prior to SMP sampling.

Table 18. Collection of incidental species at Little Goose Dam, 2015

Common Name	Scientific Name	Expanded Sample	Separator	Total Collection [1]
American Shad	*Alosa sapidissima*	4,363	1,271	5,634
Banded Killifish	*Fundus diaphanus*	53	0	53
Bass-Smallmouth	*Micropterus dolomieui*	2,057	45	2,102
Bass-Largemouth	*M. salmoides*	1	0	1
Bullhead	*Amierus sp.*	284	0	284
Bull trout	*Salvelinus confluentus*	0	0	0
Channel Catfish	*Ictalurus punctatus*	397	43	440
Chiselmouth	*Acrocheilus alutaceus*	4	3	7
Common carp	*Cyprinus carpio*	19	25	44
Crappie	*Pomoxis sp.*	2,099	7,308	9,407
Dace	*Rhinichthys sp.*	3	0	3
Kokanee	*Oncorhynchus nerka*	0	1	1
Lamprey Adult-Pacific	*Entosphenus tridentatus*	108	55	163
Lamprey Ammocoete-Pacific[2]	*E. tridentatus*	88	1	89
Lamprey Macropthalmia-Pacific	*E. tridentatus*	8,155	0	8,155
Mountain Whitefish	*Prosopium williamsoni*	248	23	271
Northerrn Pikeminnow	*Ptychocheilus oregonensis*	25	7	32
Peamouth	*Mylocheilus caurinus*	955	275	1,230
Rainbow Trout	*O. mykiss*	26	1	27
Redside Shiner	*Richardsonius balteatus*	0	0	0
Sandroller	*Percopsis transmontana*	1,414	189	1,603
Sculpin	*Cottus sp.*	1,836	0	1,836
Siberian Prawn	*Exopalaemon modestus*	464,586	0	464,586
Sucker	*Catostomus sp.*	1,125	506	1,631
Sunfish[2]	*Lepomis sp.*	250	13	263
Tadpole Madtom	*Noturus gyrinus*	4	0	4
Walleye	*Stizostedion vitreum*	0	27	27
White Sturgeon	*Acipenser transmontanus*	0	11	11
Yellow Perch	*Perca flavescens*	36	27	63
Other[3]	-----	52	0	52
Total		488,188	9,831	498,019

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

[2] Sunfish collection total includes 242 bluegill/pumpkinseed and 8 warmouth.

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

Table 19. Numbers of incidental species collected at Little Goose Dam JFF, 2010-2015

Common Name	Scientific Name	2010	2011	2012	2013	2014	2015
American shad	*Alosa sapidissima*	18,803	2,122	14,614	6,678	1,799	5,634
Banded Killifish	*Fundus diaphanous*	213	14	61	117	111	53
Bass-Smallmouth	*Micropterus dolomieu*	4,150	3,691	2,442	1,279	3,528	2,102
Bass-Largemouth	*M. salmoides*	3	7	6	2	3	1
Bullhead	*Amierus sp.*	323	390	511	291	235	284
Bull trout	*Salvelinus confluentus*	9	7	2	6	4	0
Channel Catfish	*Ictalurus punctatus*	369	235	353	381	204	440
Chiselmouth	*Acrocheilus alutaceus*	14	72	2	6	10	7
Common carp	*Cyprinus carpio*	722	294	139	96	102	44
Crappie	*Pomoxis sp.*	318	86	687	1,139	887	9,407
Dace	*Rhinichthys sp.*	29	24	12	3	19	3
Goldfish	*Carassius auratus*	1	0	0	0	0	0
Kokanee	*Oncorhynchus nerka*	0	55	0	0	14	1
Lamprey Adult-Pacific	*Entosphenus tridentatus*	11	63	32	28	77	163
Lamprey Ammocoete-Pacific	*E. tridentatus*	1,650	6,584[1]	1,903	525	2,495	89
Lamprey Macropthalmia-Pacific	*E. tridentatus*	57,802	11,108	4,749	55,077	18,673	8,155
Mountain Whitefish	*Prosopium williamsoni*	5,614	3,850	697	324	163	271
Northerrn Pikeminnow	*Ptychocheilus oregonensis*	73	72	52	41	43	32
Peamouth	*Mylocheilus caurinus*	6,057	7,631	1,077	1,292	864	1,230
Rainbow Trout	*O. mykiss*	99	12	2	0	8	27
Redside Shiner	*Richardsonius balteatus*	0	0	0	0	0	0
Sandroller	*Percopsis transmontana*	24,260	7,591	2,452	6,241	3,681	1,603
Sculpin	*Cottus sp.*	2,062	996	1,732	1,239	391	1,836
Siberian Prawn	*Exopalaemon modestus*	38,676	15,743	23,183	45,015	81,310	464,586
Sucker	*Catostomus sp.*	1,820	1,760	882	1,353	1,062	1,631
Sunfish[1]	*Lepomis sp.*	239	218	602	865	791	263
Tadpole Madtom	*Noturus gyrinus*	2	0	8	8	3	4
Walleye	*Stizostedion vitreum*	20	8	7	9	14	27
White Sturgeon	*Acipenser transmontanus*	11	12	15	16	27	11
Yellow Perch	*Perca flavescens*	14	55	43	17	14	63
Other		11	2	0	7	52	52
Total		163,375	62,702	56,265	122,055	116,584	498,019

Note- Numbers include expanded sample counts and separator releases

[1] Sunfish include bluegill/pumpkinseed and warmouth.

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 2015.

Gas Bubble Trauma Monitoring

Biological technicians from the Washington Department of Fish and Wildlife (WDFW) examined juvenile salmonids for the presence of Gas Bubble Trauma (GBT). When juvenile salmonids numbers permitted, a maximum of 100 fish were sampled. Sampling occurred weekly from April 6 through July 20 when GBT monitoring was discontinued 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 eye.

A total of 1,538 smolts were handled by WDFW GBT personnel in 2015. Twenty-Four fish previously PIT tagged were enumerated and released, and thirty-five fish bypassed without examination. A total of 1,479 smolts were examined for GBT, and of those, 47.3% were subyearling Chinook salmon, 31.4% were yearling Chinook salmon, and 21.3% were steelhead smolts. Of those examined, only three showed signs of GBT. One unclipped steelhead showed bubble trauma in the anal, dorsal, and caudal fin, and in the eye, one clipped yearling Chinook showed trauma in the dorsal fin, and one clipped yearling Chinook showed trauma in the anal fin.

Lower Columbia and Snake Rivers Adult Salmon Passage study; Lower Snake River Pacific Lamprey Radio Tracking Study - UC Davis and U of I**.**

Collection and tagging of adult salmon and steelhead was conducted at the Adult Fish Facility at Bonneville Dam to evaluate upriver salmonid passage in the lower Columbia and lower Snake Rivers. Fish were tagged with radio telemetry transmitters and/or PIT tags at the Bonneville Dam Adult Fish Facility and released to begin the monitoring process. Detection equipment was installed at target hydro-projects. The LGS adult ladder count window was modified to a minimum opening of 18" during the winter maintenance period for placement of a temporary PIT tag antenna. This antenna may stay deployed for five or more years if the data is deemed critical.

Siberian Prawn Studies in the Lower Snake River- United States Geological Survey (USGS)

Beginning in late September of 2013, USGS researchers requested Siberian Prawn collections from the SMP sampling sites at Lower Granite, Little Goose, and Lower Monumental dams. Once a week in 2015, ODFW biologists collected, froze, and retained all prawn in the sample for researchers to claim at the end of the season. Researchers are evaluating the fecundity, growth, abundance, niche, and feeding habits of Siberian prawns *Exopalaemon modestus*, opossum shrimp *Neomysis sp.,* and mud shrimp *Corophium sp.,* in the Little Goose and Lower Granite pools.

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 on page 26.

Miscellaneous Monitoring

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 were observed during the 2015 season.

Turbine Strainers

The USACE monitored turbine unit strainers for the fourth consecutive year at Little Goose Dam. 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 the USACE and inspected for any fish entrapment, particularly juvenile lamprey. Results were reported throughout the season in the USACE and ODFW weekly report.

Avian Predation and Behavior

Avian activity has been monitored and recorded at Little Goose Dam by the USACE and ODFW for many years. 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 (FCRPS) hydro-projects. Collecting behavioral data will augment existing historical bird data and aid in bird hazing activities during the smolt outmigration.

BLE personnel conducted avian surveys daily from April 1 through November 6. State agency surveys were typically conducted mid-afternoon during the juvenile fishway inspection. Only two specific bird behaviors were recorded this year, foraging and non-foraging, compared to loafing/resting (on land or water), flyby, scavenging and predating behaviors recorded in the past two years. The survey list of piscivorous birds includes Caspian tern, double crested cormorant, and seagulls. American white pelican was removed from the survey list of piscivorous birds in 2015.

As in previous years, copies of the BLE juvenile inspection form were forwarded to project USACE biologists. BLE survey results, along with the USACE survey results, were entered into a USACE database by USACE fishery personnel.

Facility Operations & Maintenance

The juvenile fish bypass system was inspected at a minimum twice daily during the fish passage season. The juvenile bypass system and the collection facility were not heavily impacted by debris, and equipment and components, for the most part, met operational reliability and overall excellence in operations helping make 2015 a good year for safe fish passage.

Forebay Debris/Trashracks

We estimated the surface area covered by debris and the location of that debris in the forebay daily during JFF inspections. On March 1, 2014 the trash shear boom failed. Consequently, any upriver debris, if not entirely entrained in the current during spill operations, passed through the project via turbine intakes or the juvenile collection system. Moderate accumulations of woody debris were present in the Little Goose forebay from May through June triggering various debris related issues within the juvenile collection system. Orifice blockages were numerous from early through mid-June. Increased orifice rotation, gatewell dipping, and a separator cleanout were all necessary to decrease debris accumulations within the juvenile collection system this year.

Spillway Weir

The spillway weir (SW) was placed into operation on April 2 in the high crest (622 ft. msl) position. The installation of the spillway weir on April 2 was one day earlier than scheduled due to available personnel. The spillway weir did not operate in the low crest position during 2015. On June 18, the weir was removed from service to "smooth-out" flows for the remainder of the passage season. There were no debris blockages during the operation of the weir.

Turbine Operation

Efforts were made to operate all turbine units within 1% limitation of best efficiency from April 1 to October 31. Best efficiency operations provide greatest fish passage survival through operating turbines. Deviations outside the 1% criteria are reportable if it occurs for more than 15 minutes in duration and/or there are 5 or more periods of at least 5 minutes during a single calendar day. In 2015, there were no reportable 1% violations.

There were numerous scheduled and unscheduled turbine unit outages during the fish passage season. Short term outages, less than 24 hours in duration were required to perform minor maintenance repairs, fish passage inspections and debris removal. Long term outages, greater than 24 hours are listed below.

Unit # 1

1) Planned outage starting February 26, 2015, 120 hours duration for packing replacement.
2) Forced outage starting March 2, 2015, 384 hours duration due to electrical problems in the governor cabinet and to replace the governor restoring cable.
3) Planned outage starting September 28, 2015, 792 hours duration to install new digital governors.
4) Planned outage starting November 30, 2015, 432 hours duration for annual maintenance.

Unit # 2

1) Planned outage starting July, 13 2015, 936 hours duration to install new digital governors.
2) Forced outage starting August 24, 2015, 72 hours duration due to wiring issues between Unit 2 and SSC.
3) Planned outage starting November 9, 2015, 240 hours duration for annual maintenance.

Unit # 3

1) Planned outage starting June 15, 2015, 48 hours duration to prepare for digital governor upgrade.
2) Planned outage starting July 6, 2015, 240 hours duration for annual maintenance.
3) Planned outage starting August 24, 2015, 768 hours duration to install new digital governors.
4) Forced outage starting September 29, 2015, 168 hours duration because the gate lock would not disengage.
5) Forced outage starting October 14, 2015, 480 hours duration due to regulator trouble.
6) Forced outage starting November 14, 2015, 648 hours duration because the unit tripped on 86GX excitation.

Unit # 4

1) Forced outage starting January 11, 2015, 24 hours duration because the exciter tripped.
2) Planned outage starting August 18, 2015, 648 hours duration for the 6-year overhaul.
3) Planned outage starting December 14, 2015, 408 hours duration in 2015 to install new digital governors.

Unit # 5

1) Forced outage starting February 16, 2015, 384 hours duration due to a loss of oil in the turbine guide bearing.

Unit # 6

1) Planned outage starting June 8, 2015, 48 hours duration for governor inspection.
2) Planned outage starting July 27, 2015, 240 hours duration for annual maintenance.
3) Planned outage starting November 2, 2015, 936 hours duration to install new digital governors.

Extended-Length Submersible Bar Screens (ESBS)

All ESBS performed satisfactorily. Drawdown inspections across trashracks and ESBS/VBS were performed according to the FPP. All drawdown inspections were measured within criteria throughout the season. Video inspections and manual operation inspections showed all screens in good operating condition throughout the fish passage season.

Vertical Barrier Screens (VBS)

Inspections of all VBS were performed by underwater video camera in the month of April. All inspections showed VBS in good operating condition.

Gatewells

Gatewells were checked for debris and oil contamination daily. As needed, debris was removed using a dip basket or grappling hook. In 2015, 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.

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 unharmed back to the river an estimated 125 adult steelhead.

Primary Dewaterer/Primary Bypass Pipe

The primary dewatering structure and components functioned adequately throughout the season. Inspection of the primary dewaterer and manual operation of the cleaning brushes was performed 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 2015. 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 allows bypassed fish to migrate downstream with improved guidance. 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. One separator clean out was conducted this year. The sample rate settings for that particular day were less than 20% so the system was off and did not need adjustment.

Pit Tag Detections

The Passive Integrated Transponder (PIT) tag detection system records data on PIT tagged salmonids as they pass through the juvenile collection system. The PTAGIS database categorized all PIT tag detections based upon 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 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 April 1 through October 31, a total of 60,422 PIT tagged fish were detected within the juvenile collection/bypass system: 33,429 Chinook salmon, 23,505 steelhead, 2,734 sockeye salmon, 591 coho salmon, and 163 orphans of unknown species/rearing type. Of the total number of detections, 64.8% or 39,124 fish were routed to the river, and 35.2% or 21,298 fish were routed to transport areas. PIT tagged fish in the subsample were treated as the other fish in the sample and were either routed back to the river, if the facility was operating in secondary bypass mode, or routed to a transport holding area when the facility operated in collection mode. There were 575 PIT tagged smolts routed to the sample this year, of which 79.3% were transported and 20.7% returned to the river during pre-transport operations (April 1- May 1). This group comprised approximately 1.0% of all PIT tagged fish detected at LGS. Pre-transport operations additionally routed all PIT tagged fish back to the river, constituting approximately 31.4% or 18,965 of total PIT tagged fish detected.

Barge and Truck Loading Operations

Barge loading and transport operations occurred from May 1 through August 14. All fish loading and barge operations at LGS were performed satisfactorily. Truck loading and transport operations occurred on alternate days from August 16 to October 31. In previous years, due to high numbers of fish collected, Lower Granite Fish Facility trucked Little Goose Fish using the 3500 tanker. This "piggyback" operation delayed transport time for those fish transported from Lower Granite by approximately one hour. In 2015, Little Goose did not conduct any piggybacking 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.

Avian Predation Deterrence

Springtime gull predation on juvenile salmon and steelhead at Little Goose has been significantly reduced since 1999 when the USDA Animal and Plant Health Inspection Service (APHIS) began bird hazing activities. Prior to 1999, 150 to 200 birds were common sight in the tailrace area during the smolt migration. On some days, up to 400 gulls were observed during the peak period in May. In 2015, APHIS bird hazing activities at Little Goose took place from April 1 through June 11. Additional hazing by project personnel using bird scare products including propane scare cannons, bird bangers and bird screamers continued intermittently through 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 that included needle strips, bird wires and visual scare devices.

Facility Modifications

Several modifications were made prior to, during and after the 2015 season.

1. An updated Adult Fishway Control System was installed to replace the outdated electronic control system.
2. A broken portion of the Juvenile Fish Facility emergency discharge pipe was removed and a new pipe was installed.
3. All 36 push button electronic orifice valve operators were replaced with manual 2-way valves.
4. Air and vacuum relief valves were installed to prevent back blow of the Juvenile Fish Facility drain system.

Recommendations

1. Continue to write revisions and updates to the operations maintenance manual pertaining to new equipment and facility collection and transport procedures
2. Repair the trash/shear boom.
3. Continue to rebuild orifice valve cylinders.
4. Repair or replace corroded outer steel orifice pipe with stainless steel.
5. Close off the gap between the concrete wall of the adult collection channel and diffuser 12, near the 90 degree turn that transitions from the powerhouse stretch to the spillbay stretch of the collection channel. Currently, the gap allows fish to get into an area that is inaccessible during a fish rescue.
6. 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
7. Continue to remove scale and rough edges in the facility flumes, tanks, and transition areas.

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