ANNUAL REPORT FOR 2011

SMOLT COLLECTION, TRANSPORTATION, AND BYPASS AT LITTLE GOOSE DAM ON THE SNAKE RIVER, WASHINGTON

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Summary

This report summarizes activities and results associated with the collection, transportation and bypass of migrating juvenile steelhead *Oncorhynchus mykiss*; chinook salmon *Oncorhynchus tschawytscha*; sockeye salmon *Oncorhynchus nerka*; and Coho salmon *Oncorhynchus kisutch* at Little Goose Dam in 2011.

A wet winter produced above average runoff throughout the fish passage season, (April through October). Flows at Little Goose were measured above 90 KCFS for a total of 94 days of the season and reached 200 KCFS on June 8 - 9. Despite the high flows, only moderate debris loading occurred and arrival of the debris at the dam was spread over a longer period of time. Debris impacted juvenile fish passage the heaviest on May 20 to 22 and June 3 to July 3. During these periods approximately 63% of the juvenile fish mortalities occurred due to debris related injuries. As in past years, additional measures were enacted to reduce debris impacts on smolt migration. Spill operations occurred from April 3 through August 31 and this was the third year that the spillway weir, located in spillway one, was used to provide a surface bypass route to assist in-river smolt downstream migration.

The juvenile fish collection and bypass system was operated from March 22 and continued to December 19. All fish collected were bypass through the primary bypass flume and outfall from March 22 to May 5 except for 6 individual 24 hour events to sample fish for condition. Fish were collected for transport to below Bonneville Dam beginning May 5 through May 22 and again from May 27 to October 31. Due to The Dalles Dam navigation lock failure, high river flows and complete powerhouse outages at Little Goose Dam, collection for transport was suspended from May 22 to May 27 and all fish collected during this period were bypassed through the secondary bypass system of the juvenile fish facility. Daily barging occurred May 6 to May 22 and alternate day barging occurred May 29 to August 15. Beginning August 17 to October 31, juvenile fish were transported by truck on alternate-days.

In 2011, an estimated 3,388,061 juvenile salmonids were collected April 1 through October 31. Composition by species was 1,449,342 yearling Chinook (42.8%), 740,304 sub-yearling Chinook (21.9%), 1,132,428 steelhead (33.4%), 24,356 sockeye (0.7%), and 41,631 Coho (1.2%). An estimate 3,034,232 (89.6%) were transported.

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. Lower Granite Dam is upstream (RM 107.5) and Lower Monumental (RM 41.60) and Ice Harbor dams (RM 9.7) are downstream from LGS. Little Goose Dam is 2,655 feet long and impounds Lake Bryan, a 10,025 acre reservoir with normal operating elevations ranging from 633 to 638 feet 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.

Construction of LGS began in 1963 and was complete by 1970. A juvenile fish facility (JFF) was included in the initial dam construction, but underwent modifications in 1982, and 1984. A new juvenile facility was constructed in the late 1980's and became operational in 1990 and remains in use.

The juvenile fish collection and bypass system at LGS extends from the upstream face of the dam downstream to the JFF or tailwater (mid-river outfall release). 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 from the collection channel to the JFF or mid channel tailrace. 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 outmigrating salmonid *Oncorhynchus sp.* smolts, to produce increase adult salmon and steelhead returns. To accomplish this objective, juvenile salmon and steelhead *O. mykiss* from each collector dam are transported by barge or truck and released below Bonneville Dam on the Columbia River. Operating parameters are set forth annually in the Fish Passage Plan (FPP).

This report summarizes the data collected from April 1 through October 31, 2011 by the United States Army Corps of Engineers (USACE) and Oregon Department of Fish and Wildlife (ODFW) Smolt Monitoring Program (SMP) and transportation biologists and technicians.

Facility Modifications

Several modifications was made prior to, during, and after the 2011 season.

1. Adult fish collection channel entrances, North Shore Entrance 3 and North Powerhouse Entrance 3 were permanently closed off in February 2011. Both these entrances faced inward perpendicular to tailrace spillways one and eight. The permanent closure consisted of removing the recessed removable bulkheads and filling the entrances with concrete and with a flush finished to match the existing concrete walls. The flush finish removes the recessed rectangular opening thus making safer passage for fish migrating in river through spillways one and eight.

2. Upgrades to ESBS include new control systems for the cleaning brushes. The new controls consist of new proximity switches located on the screen and new PLC's located in the orifice gallery, a switch to change the brush cycle between 2 or 4 hours, an emergency stop switch, and a computer monitor in the dam's control room for operators to observe ESBS operations.

3. In March of 2011, all pneumatic hoses and fittings were replaced on all 36 orifice air cylinders and valves. Pneumatic air cylinders that operated the orifice valves are being rebuilt over a 4 year period. Currently, 14 cylinders are rebuilt with 24 remaining.

4. Raceway tail screens were replaced in March of 2011. The new screens are 12.2 mm in width as measured from corner to corner. The old screens were 7.2 mm. The larger opening allows juvenile lamprey to pass through the screen without becoming entangled and volitionally passing to the tailrace via the overflow outlet.

5. A new underwater video camera, new monitor and new DVD recorder was purchased in 2010 to be used in underwater inspections of ESBS and VBS.

6. Pacific States Marine Fisheries Counsel installed a new PLC and Interface controller to operate the PIT-tag and sample gate system. The new components are an upgrade to improve sample and PIT-tag gate system performance.

River Conditions

The 2011 water year was relatively wet with 20.8 inches of precipitation or 117% of the 1971 to 2000 average observed for the Snake River basin above Little Goose. Flows were well above the five year average throughout the 2011 fish collection season. Daily average flows for the months of May, June, July and August were 133%, 166%, 203% and 141% of the 2006 – 2010 five year average (Table 1).

During the 2011 season, the average daily flow past LGS was 84.8 kcfs with a peak daily flow of 200.93 kcfs on June 9 and a minimum daily flow of 17.30 kcfs on October 29 (Figure 1). The major components of total flow at LGS were discharge through turbine units (powerhouse flow) and discharge over spillways. Minor sources of discharge were the fish passage structures and the navigation lock.

The spillway weir was placed into operation on April 3, and spill to aid fish passage occurred from April 3 to September 1 in accordance with the 2011 Fish Passage Plan (FPP). The FPP specified that spill at Little Goose was to be kept at a constant 30% of outflow. Factors that affected spill management were excess flows from runoff, total dissolved gas (TDG) levels, generation unit outages, low power demand, debris management, and adult fish passage. All deviations from the spill mandates were coordinated through the Technical Management Team (TMT). In 2011, spill exceeded 30% of flow during the peak spring runoff period. The average daily discharge from April 3 to August 31 was 106.5 kcfs. Daily spill averaged 38.4% of total flow during that time period. In 2011, spill averaged 29.7% of total flow for the month of April, 54.8% of total flow for May, 44.5% of total flow for June, 30.4% of total flow for July, and 31.9% of total flow for August.

Table 1. Comparisons of average monthly flow and spill at Little Goose Dam JFF, 2006-2011.

Month	2006	2007	2008	2009	2010	2011	2006-2010 Average
			Flow (Kcfs)				
Apr	121.27	45.40	52.67	84.50	40.28	103.34	68.83
May	136.05	77.39	110.90	111.04	64.83	133.19	100.04
Jun	89.95	46.55	124.86	109.48	124.58	163.98	99.08
Jul	40.47	31.62	57.39	50.43	49.51	93.50	45.88
Aug	26.98	23.74	35.79	32.02	29.81	42.07	29.67
Sep	21.01	17.95	22.70	21.84	22.62	33.61	21.22
Oct	18.99	18.43	19.64	21.26	18.97	26.58	19.46
			Spill (Kcfs)				
Apr	29.86	13.26	13.26	24.48	11.41	30.08	18.46
May	40.92	23.39	23.39	31.13	19.40	81.37	27.65
Jun	27.98	13.98	13.98	30.88	40.91	73.32	25.55
Jul	12.49	9.50	9.50	15.09	14.83	28.54	12.28
Aug	8.58	8.54	8.54	10.11	9.40	14.00	9.04
Sep	0.18	0.34	0.34	0.20	0.18	0.39	0.25
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature

River water temperature readings were taken at approximately 0700 hours from April 2 through October 31 in the JFF sample system using a hand-held thermometer. The average daily temperature was 58.6. Due to the cool spring and mild summer weather, average monthly water temperatures were lower than the five year average for the months of April through October. Water temperatures averaged five degrees cooler than the 5 and 10 year daily averages with the most dramatic difference occurring during the month of July, when water temperatures averaged 5.7 degrees cooler than the five year average. The maximum temperature of 68.8^{o}F was recorded on August 9, 11 and 12, and was below the five year maximum average of 70.6^{o}F. The minimum temperature of 43.8^{o}F was recorded on April 7 and 8, and was below the five year average minimum of 45.6^{o}F. Maximum temperatures recorded from 2006 through 2010 occurred on July 11, July 10, August 16, July 29, and August 14, respectively. Minimum temperatures for the same time period were recorded the first week of April. As per the Water Management Plan, river temperatures were tempered by scheduled water releases from Dworshak Dam Reservoir, which averaged 13.4 kcfs of outflow daily for the months of July and August. Dworshak tailrace temperatures averaged 45.3^{o} F during that period. Snake River temperatures averaged 65.0 ^{o} F for the same interval (Columbia River Dart).

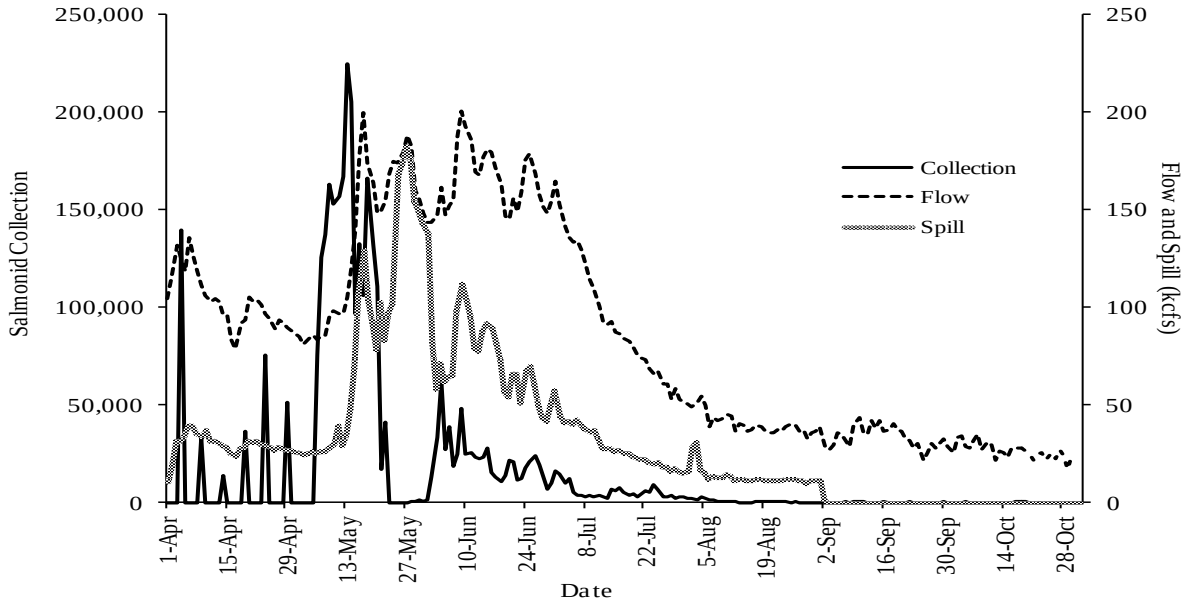

Figure 1. Total river flow, spill, and number of juvenile salmonids collected at Little Goose Dam during the fish collection and transport season, 2011.

Total Dissolved Gas

Total Dissolved Gas data are automatically collected and transmitted to the Columbia River Operational and Hydromet Management System (CROHMS) hourly to provide information for spill and gas saturation management. 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 or 115 % in the forebay of the next project downstream as measured over 12 consecutive hours. During 2011, these saturation limits were not maintained due to forced spill when high flows during runoff exceeded powerhouse capacity.

In accordance with the 2011 FPP, TDG was monitored in the forebay from April 1–August 31 and in the tailwater year around. The daily average TDG level in the Little Goose forebay was 113.2% saturation, ranging from 104.5 % saturation on April 1 to 125.1% on May 18. The 115% saturation variance standard was exceeded 45 times from April 7 through July 7. The average daily percent saturation level in the forebay of Little Goose Dam during the peak flow period from May 14 to July 12 was 116.6%.

The TDG level in the LGS tailrace averaged 117.1 from April 1 through August 31, ranging from 107.4% on April 1, to 135.7% on May 27. The average daily TDG level from April 1 through August 31 was 117.1%. The 120% saturation variance was exceeded 45 times from May 14 to July 12, averaging 123.5% saturation during that interval.

Forebay TDG levels at Lower Monumental Dam(LMN) averaged 116.9% from April 1 through August 31, ranging from 104.1% on April 1, to 136.5% on May 28. The LMN forebay saturation level exceeded the 115% variance 65 times from April 8 to July 12. TDG in the Lower Monumental Dam forebay averaged 124.6% during high flow, May 14 through July 12 (USACE via Columbia River Dart). The peak saturation levels for LMN forebay and LGS tailrace occurred while spill at LGS was 96.6% of the total flow, from May 25 through June 1, due to repairs to the main transformer.

Turbidity

We measured turbidity during all adult fish passage facility inspections. Measurements were taken in the adult fish ladder using a secchi disk that could be lowered to a maximum depth of just over 6 feet. The fish ladder water supply is gravity fed from the forebay and was representative of river conditions. Due to higher than usual snow pack and precipitation, turbidity was high for most of the fish passage season. From April through the first week of July, Secci disc measurements ranged from 0.6 feet to 2.8 feet. For the remainder of the season, clarity ranged from 3.2 to 6.0 feet. Turbidity patterns were similar to previous years, increasing as runoff increased, and decreasing as flows decreased.

Fish Collection

In 2011, fish screen deployment began on March 21 and was finished on March 28. The juvenile fish passage channel was watered up on March 22. The JFF was watered up on March 29. The system remained in primary bypass until collection for transportation began on 5 May, except for periodic 24 hour condition sampling periods. Condition sampling occurred on April 4, 9, 14, 19, 24, and 29 from 0700 to 0700 hours mimicking actual collection for transport operations. During condition sampling the facility was placed in secondary bypass that routed fish through the facility back to the tailrace outfall area. The facility was placed back in primary bypass following the sampling period. Fish collection for transport, began on May 5 at 0700 hours and continued through October 31 at 0700 hours, with one exception. From May 22 at 0700 to May 27 at 0700 there was no collection while the navigation lock at The Dalles Dam was inoperable. During this time the facility was placed in primary bypass. During the remainder of the collection season, fish entering the facility were transported by barge or truck. The fish bypassed to the river during the collection period resulted from separator cleanout events, pit tag action code directives, or were fry bypassed for continued growth.

Migration and Collection

There are no means of counting fish while operating in primary bypass therefore there are no collection estimates from March 24 to May 5 except for condition sampling events. During

condition sampling on April 4, 9, 14, 19, 24, and 29, an estimated collection of 347,497 salmonids were routed through the facility in secondary bypass operations and back to the river. Sample counts totaled 4,096 during this period. Of the 4,096 fish sampled in April, 16.3% were clipped yearling Chinook, 13.4% were unclipped yearling Chinook, 61.4% were clipped steelhead, 6.3% were unclipped steelhead, 0.1% were unclipped coho, and 1.5% were unclipped sockeye. PIT tagged fish that passed while in secondary bypass were interrogated and routed according to their agency PIT tag action code.

The 2011 estimate transportation collection from May 5 through October 31totaled 3,036,889 juvenile steelhead and salmon. Composition by species and clip type were: clipped yearling Chinook 35.1%, unclipped yearling Chinook 9.1%, clipped sub-yearling Chinook 7.6%, unclipped sub-yearling Chinook 16.6%, clipped steelhead 21.5%, unclipped steelhead 8.0%, clipped sockeye 0.1%, unclipped sockeye 0.5% and coho 1.4%.

Table 1. Annual collection, bypass, and transport activity at Little Goose Dam JFF, 2007-2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
Collection										
2007[1]	380,582	63,794	70,036	234,789	984,495	313,402	9,533	2,453	39,867	2,098,951
2008	1,394,415	312,097	288,424	464,630	1,807,231	501,014	17,036	4,921	95,874	4,885,642
2009	1,315,352	404,911	333,313	519,124	1,935,602	582,074	19,992	13,678	59,544	5,183,590
2010	643,811	229,267	287,702	578,905	807,812	277,492	1,291	7,594	36,917	2,870,791
2011	1,125,551	323,791	232,116	508,188	868,702	263,726	3,487	20,869	41,631	3,388,061
Bypass[3]										
2007	40,052	5,946	1,250	4,630	75,659	22.213	0	413	365	150,528
2008	299,945	88,906	2,783	2,633	634,902	82,649	41	31	2,764	1,114,654
2009	531,880	220,143	2,181	7,125	1,160,734	299,337	1	5,825	2,825	2,230,051
2010	57,991	23,242	3	325	46,459	12,699	0	0	0	140,719
2011	56,672	46,496	1	92	216,725	21,908	0	5,227	401	347,522
Truck										
2007	2	5	72	905	1,216	410	0	2	44	2,658
2008	0	12	153	17,403	5	7	0	125	18	17,723
2009	0	2	123	2,753	3	4	1	18	300	3,204
2010	11	15	79	10,514	7	11	1	10	19	10,667
2011	1	16	59	10,680	8	22	2	77	277	11,142
Barge										
2007	340,431	57,783	68,637	228,966	907,101	290,546	9,523	2,030	39,430	1,944,447
2008	1,091,599	222,556	284,812	443,255	1,171,970	418,242	16,981	4,736	93,078	3,747,238
2009	782,309	184,253	328,223	505,507	774,611	282,643	19,975	7,793	56,372	2,941,686
2010	585,585	205,930	285,364	564,199	761,183	264,706	1,289	7,583	36,896	2,712,735
2011	1,067,450	276,919	230,973	494,558	651,617	241,734	3,480	15,416	40,943	3,023,090
Total Transport										
2007	340,433	57,788	68,709	229,871	908,317	290,956	9,523	2,032	39,476	1,947,105
2008	1,091,599	222,568	284,965	460,658	1,171,975	418,249	16,981	4,861	93,105	3,764,961
2009	782,309	184,255	328,346	508,260	774,614	282,647	19,976	7,811	56,672	2,944,890
2010	585,596	205,945	285,443	574,713	761,190	264,717	1,290	7,593	36,915	2,723,402
2011	1,067,451	276,935	231,032	505,238	651,625	241,756	3,482	15,493	41,220	3,034,232

[1] Collection counts 2006 through 2008 do not include fish sampled prior to collection for transport.

[2]Bypass counts include fish collected as take by researchers and do not include, NOAA sort by code PIT tagged salmon or Divert During Sample PIT tagged salmon.

Fish transportation by barge began May 5 at 0700 hours and ended August 15 at 0700 hours. A total of 3,029,027 smolts were collected during this period. Of these fish, 3,023,090 fish were transported by barge, 5,844 were facility mortalities, and 93 Chinook fry were bypassed for continued growth (Table 2).

Collection for truck transportation began on August 16 at 0700 hours and ended at 0700 hours on October 31. A total of 11,537 fish were collected during this period. Of that total,

11,142 were transported by truck, 394 were facility mortalities, and one fish was left in the holding tank, missed the truck, and was bypassed.

The maximum daily collection of 225,048 smolts occurred on May 13, representing 7.4% of the collection from May 5 through October 31. Peak collection dates for yearling and subyearling Chinook salmon and steelhead corresponded to increases in flow.

Most species migration times were similar to previous years, with peak collection dates in mid May for yearling Chinook, coho, Unclipped steelhead and clipped sockeye and in early June for subyearling Chinook. Peak collection numbers for clipped steelhead and unclipped sockeye occurred during 24 hour condition sampling dates in April, prior to collection for transportation.

Table 2. Annual peak salmonid collection days and count by species group and season at Little Goose Dam JFF, 2007-2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Season
2007	May 15 (69,242)	May 22 (8,062)	June 10 (8,386)	June 10 (30,792)	May 15 (215,853)	May 15 (54,418)	May 18 (2,000)	May 12 (500)	May 15 (7,400)	May 15 (354,332)
2008	May 12 (104,404)	May 11 (17,002)	June20 (15,873)	June 25 (18,228)	May 11 (156,008)	May 11 (17,002)	May 23 (2,400)	May 26 (700)	May 22 (13,800)	May 11 (309,619)
2009	May 23 (65,408)	April 28 (23,601)	June 04 (25,720)	June 04 (37,214)	April 27 (180,448)	April 26 (57,600)	May 20, 23 (3,200)	May 7, 8, 23 (1,000)	May 23 (7,800)	April 27 (288,500)
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)	April 04 (131,101)	May 18 (27,400)	May 22 (700)	April 24 (1,907)	May 20 (4,400)	May 13 (225,048)

Starting in 2011, a higher importance was assigned to juvenile Pacific Lamprey and smolt monitoring personnel were tasked to enumerate lamprey in a manner similar to smolts on smolt monitoring paperwork. Prior to 2011, juvenile lamprey were minimally recorded as incidental species. Juvenile lamprey were enumerated as part of the daily sample. Sample numbers were expanded and added to totals from separator cleanouts to obtain a collection total. The total number of Pacific lamprey sampled along with those released from the separator was 2,219 ammocoetes and 158 macropthalmia. These numbers expanded to an estimated total of 6,584 Pacific lamprey ammocoetes, and 11,108 Pacific lamprey macropthalmia collected from April 4 through October 31.

Adult Fallbacks

Fallbacks are adult fish that have migrated above the dam and have entered the downstream juvenile fish collection and bypass system. When collected at the separator, the adult fish were usually too large to pass between the separator bars and the technician then bypassed the fish back to the river from the separator. Adult salmonid fallbacks were identified by species and fin clip and assessed for condition prior to being released to the river.

A total of 6,280 adult salmon or steelhead fallbacks occurred in 2011 (Table 4). Of these 6,271 were bypassed from separator. The remaining nine were small Chinook Jacks that passed through the separator bars and were collected in the sample. Composition by species and clip type included 1,081 clipped and 602 unclipped adult Chinook salmon, 590 clipped and 430

unclipped jack or mini jack Chinook salmon, 1,996 clipped and 1,549 unclipped steelhead, 12 clipped and 5 unclipped sockeye, 14 coho, and one unclipped pink salmon.

Table 3. Total annual adult salmonid fallbacks at Little Goose Dam JFF, 2007-2011.

Year	Adult Chinook	Jack Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
2007	358	277	1,348	839	3	5	2,830
2008	773	2,845	2,122	1,932	24	16	7,712
2009	1,192	1,372	2,997	2,131	11	35	7,738
2010	976	780	1,758	1,881	22	9	5,426
2011	1,683	1,020	1,996	1,549	17	14	6,280*

* Total includes one adult Pink salmon.

Other fish of particular interest that were bypassed back to the river from the separator included 7 bull trout, 17 adult pacific lamprey, and 10 white sturgeon. The 17 adult Pacific Lamprey removed from the separator in 2011were transported to one mile above the dam and released. In addition, another 2 adult lamprey were removed from raceways and 32 adult lamprey collected in the sample were also transported and released above the dam.

Table 4. Monthly totals of fallbacks bypassed at Little Goose Dam, 2011.

Month	Adult Chinook	Jack Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
April	0	0	153	178	0	0	331
May	173	14	405	567	0	0	1159
June	335	75	164	371	0	0	945
July	283	71	37	62	14	0	467
August	47	11	171	70	3	0	302
September	201	171	635	186	0	0	1193
October	644	678	431	115	0	14	1,882
Total	1,683	1,020	1,996	1,549	17	14	6,279

The majority of the steelhead observed in April, May, and June were kelts.

Of the steelhead fallbacks in April through June, the majority, 87.6%, were classified as out-migrating kelts (post spawn). Because kelts are often observed to be in less than optimal condition, steelhead during this period accounted for the majority of fair, poor and dead condition. Table 6 lists the numbers of fish by species and condition categories.

Table 5. Condition of adult salmonids released at Little Goose Dam, 2011.

Fish	Chinook		Chinook Jack		Steelhead		Sockeye		Coho	
Condition[1]	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
Good	996	548	538	408	1,665	1,123	11	5	11	5,305
Fair	65	45	46	19	240	285	1	0	2	703
Poor	16	9	5	2	66	103	0	0	1	202
Dead	4	0	1	1	25	38	0	0	0	69
Total	1,081	602	590	430	1,996	1,549	12	5	14	6,279

[1] Condition ratings for live fish were determined subjectively based on the presence/absence and severity of fungus, headburns, 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 effectively fish are separated by size. Due to the spacing of the sorter bars, smaller fish, primarily salmon smolts, should pass through the "A" side and larger fish, primarily steelhead, should pass through "B" side of the separator into the respective sample tanks. Table 7 gives efficiency, expressed as the percentage of each group passing through the desired side of the separator, for 2007-2011. Efficiency rates are based on expanded sample counts.

In 2011, separator efficiency was highest for clipped steelhead with 77.3% entering the B-side sample tank (Table 7). Separator efficiency was lowest for clipped sockeye salmon at 22.6% entering the A-side sample tank. Separator efficiency was higher than in recent years for clipped (73.7%) and unclipped yearling Chinook (70.1%), and clipped (58.0%) and unclipped subyearling Chinook (57.7%). Separator efficiency was lower for steelhead then in recent years (Table 5). In 2011, 52.9% of all salmon and steelhead species passed through the A-side, compared to 44.1% in 2010, 38.2% in 2009, 36.2% in 2008, and 26.0% in 2007. This trend reflects a decline in the number of steelhead being collected as well as slightly lower separator efficiencies for steelhead in recent years. In 2011, the overall species composition for steelhead was 33.4%, compared to 37.9% in 2010, 48.6% in 2009, 47.3% in 2008, and 61.7% in 2007.

Table 7. Annual juvenile salmonid separator efficiency (%) at Little Goose Dam JFF, 2007-2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip
Year	A-side	A-side	A-side	A-side	B-side	B-side	A-side	A-side	A-side	A-side
2007	63.1	61.0	52.7	55.4	95.2	87.6	26.1	27.1	22.9	61.9
2008	62.7	53.7	50.0	47.9	89.8	74.0	-----	38.6	52.0	30.9
2009	66.0	61.7	52.4	52.3	89.8	68.0	21.0	26.5	19.9	20.8
2010	69.8	68.3	57.4	54.8	87.8	69.4	15.1	28.0	12.8	43.1
2011	73.7	70.1	58.0	57.7	77.3	67.4	0.00	32.9	22.6	38.3

Note: Counts do not include sample mortalities.

Sampling

The fish sampling system was operated without incident throughout the 2011 season. Sampling procedures followed the smolt monitoring guidelines developed by the Fish Passage Center and the USACE. Data, collected and recorded daily by ODFW and USACE biologists, were used for management of facility and fish transport operations in compliance with the 2011 Fish Passage Plan. Data were also transmitted daily to the FPC electronic database in support of the SMP. Twenty-four hour sampling to monitor fish condition occurred on April 4, 9, 14, 19, 24, and 29. During this period a total of 4,096 fish were sampled. Twenty-four hour collection for transport with daily sampling began at 0700 hours May 5 and ended at 0700 hours on October 31. A total of 56,344 fish were sampled from May 5 through August 31. Sample collection rates were set by USACE project biologists. In an effort to collect a target sample of 300 to 500 smolts, sample rates were varied between 0.50% and 100% as fish numbers fluctuated. Occasionally, due to fluctuations in numbers of fish entering the facility, the sample rate was changed during the day, a situation known as a split sample. When this occurred, fish from each sample rate were kept separate in order to facilitate expansion to collection numbers. Split sampling occurred seven times between April 4 and June 24. The estimated total collection from April 4 through October 31 was 3,384,386; the total sampled (60,440) was about 1.8% of the collection total (Tables 8 and 9).

Table 8. Annual percentage of total juvenile salmonids collected that were sampled at Little Goose Dam JFF, 2007-2011[1].

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
2007[1]	1.9	4.7	8.4	9.7	1.8	2.3	1.6	2.8	2.3	3.1
2008[1]	0.7	0.8	3.6	9.3	0.5	0.7	1.0	4.0	0.6	1.7
2009	0.7	0.8	2.7	6.3	0.5	0.7	19.9	20.8	2.5	1.4
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

[1]Fish examined for GBT are not included. All other research fish and sample mortality are included in percentages.

All sample fish were examined to determine species, clip type, and the presence of marks or external tags. For Chinook salmon, age class was determined as subyearling or yearling. All yearling Chinook salmon smolts in the sample were examined for holdover fall Chinook salmon characteristics. All holdover fall Chinook salmon smolts were examined for coded wire tags, PIT tags, and elastomer tags. All unclipped yearling and subyearling Chinook salmon, coho, and sockeye salmon were scanned for coded wire tags. Yearling fall Chinook salmon were examined for characteristics typical of Lyons Ferry Hatchery fish.

Fish condition data were collected daily on a random subsample of 100 fish of the dominant species. Condition metrics included weight, length, descaling, injury, disease, predation, and "other" monitored conditions; specifically fin discoloration, pop eyes, fin hemorrhage, eye hemorrhage, and pink fin. Injury and descaling data were used by managers to assess passage conditions at the dam where data were collected. Therefore, old injuries and healed descaling were not recorded during condition sampling. All additional, or "non-condition", sample fish were examined for descaling greater than 20%.

Pound counts (fish per pound) taken during condition sampling were provided to the USACE on a daily basis from May 6 to October 31. On transportation days, weights were also taken on non-condition salmonids if the target number of 25 per group was not present in the condition sample. Weights were also recorded on all non-salmonid species on transportation dates from May 6 through August 13. After August 13, the sample rate was set at 100% and all non-salmonid species were removed from the sample and bypassed back to the river prior to transport.

A total of 60,440 juvenile salmonids were sampled during the season, from April 4 through October 31. This total included sample mortality, research fish, and fish examined for GBT (Table 9). From August 14 to October 31, 100% of the collection was sampled.

Table 9. Weekly sample as percent of collection total and sample totals at LGS JFF, 2011.

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]
31-Mar	-----	0	0	0	0	0	0	0	0	0	0
7-Apr	0.6	13	12	0	0	718	30	0	7	0	780
14-Apr	1.0	84	111	0	0	253	38	0	6	1	493
21-Apr	3.1	331	379	0	0	352	49	0	11	0	1,122
28-Apr	1.4	297	255	0	0	412	100	0	23	4	1,091
5-May	1.2	248	121	0	0	177	62	0	1	1	610
12-May	0.5	2,655	671	0	2	1,370	291	0	32	72	5,093
19-May	0.5	2,555	588	6	5	1,514	621	0	15	81	5,385
26-May	0.7	335	124	9	14	380	217	7	15	38	1,139
2-Jun	6.9	14	9	308	683	35	28	23	14	1	1,115
9-Jun	1.5	73	44	953	2,138	253	236	16	21	26	3,760
16-Jun	1.9	50	105	1,036	1,443	244	217	12	18	9	3,134
23-Jun	3.0	26	78	1,301	1,440	110	93	9	8	5	3,070
30-Jun	3.9	14	83	1,414	2,532	195	124	7	8	2	4,379
7-Jul	4.0	7	43	588	1,819	57	43	1	16	3	2,577
14-Jul	11.8	4	19	424	2,388	38	23	3	19	7	2,925
21-Jul	10.1	2	1	315	3,061	15	6	0	25	19	3,444
28-Jul	9.5	0	1	111	3,258	6	3	0	18	37	3,434
4-Aug	15.7	0	0	37	2,534	4	2	1	12	32	2,622
11-Aug	32.2	0	0	19	2,101	4	1	0	16	54	2,195
18-Aug	86.0	0	0	19	1,312	3	0	0	10	45	1,389
25-Aug	99.3	0	0	14	2,111	1	1	1	12	86	2,226
1-Sep	99.4	0	3	6	910	4	3	0	1	40	967
8-Sep	99.4	1	2	4	634	0	7	0	7	34	689
15-Sep	99.3	0	3	8	1,185	0	6	0	1	34	1,237
22-Sep	99.6	1	1	2	692	0	1	1	3	26	727
29-Sep	98.8	0	3	5	855	0	1	0	4	18	886
6-Oct	98.5	0	0	7	947	0	1	0	14	17	986
13-Oct	97.2	0	0	3	710	0	1	0	12	7	733
20-Oct	98.9	0	0	1	1,199	0	2	0	26	3	1,231
27-Oct	98.8	0	4	6	557	1	0	0	3	1	572
3-Nov	99.3	0	0	1	427	0	0	0	0	1	429
Total Sampled		6,710	2,660	6,597	34,957	6,146	2,207	81	378	704	60,440
% of Sample		11.1	4.4	10.9	57.8	10.2	3.7	0.1	0.6	1.2	100.0
% of Coll.		0.6	0.8	2.8	6.9	0.7	0.8	2.3	1.8	1.7	1.8

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

Note: Little Goose JFF was in primary bypass mode, going to secondary bypass for 24 hour condition sampling on April 4, 9, 14, 19, 24, and 29. Collection for transport with daily 24 hour sampling began on May 5 at 0700 hours and ended October 31 at 0700 hours.

The composition, by species and clip type, of smolts sampled in 2011 was: clipped yearling Chinook 11.1%, unclipped yearling Chinook 4.4%, clipped sub-yearling Chinook 10.9%, unclipped sub-yearling Chinook 57.8%, clipped steelhead 10.2%, unclipped steelhead 3.7%, clipped sockeye 0.1%, unclipped sockeye 0.6%, and unclipped coho 1.2%. There were no clipped coho sampled in 2011(Table 7).

Transportation

Juvenile salmonids collected for transport by barge were held in raceways or directly loaded into barges. Juveniles awaiting transportation by truck were held in tanks in the wet lab or loaded directly into the transport truck. Maximum fish holding time prior to transport varied

from 24 to 48 hours depending on the transportation schedule. Transport time from Little Goose 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 1mg/L to reduce stress and treat columnaris disease. In 2011, daily barging and direct loading operations occurred from May 6 to May 22, alternate day barging occurred from May 24 to August 15 and alternate day trucking occurred from August 17 to October 4. Fish were trucked daily from October 5 through October 31 to reduce holding stress among the fish suffering from Columnaris infection, and reduce disease transmission to the unaffected population. There were no incidents which resulted in transportation related mortalities during the 2011 season.

A total of 3,034,232 juvenile salmonids were transported from Little Goose in 2011, 99.6% by barge and 0.4% by truck/midi tank (Table 2). The species composition and clip type of the fish transported by barge was: 35.2% clipped yearling Chinook, 9.2% unclipped yearling Chinook, 7.6% clipped subyearling Chinook, 16.4% unclipped subyearling Chinook, 21.6% clipped steelhead, 8.0% unclipped steelhead, 0.5% unclipped sockeye, 0.1% clipped sockeye, and 1.4% coho. Salmonids transported by truck were 0.2% yearling Chinook, 96.4% subyearling Chinook, 0.3% steelhead, 0.7% sockeye and 2.5% coho.

Bypass

In 2011, primary bypass began on March 22 and ended when collection for barge transportation began on May 5 at 0700 hours. There is no estimate of the number of fish that passed the facility while in primary bypass mode. During this interval, the facility was placed in secondary bypass for 24 hour sampling from 0700 to 0700 hours on April 3-4, 8-9, 18-19, 23-24, and 28-29 to collect sample fish for SMP condition monitoring, and for WDFW GBT sampling. Estimated bypass totals for these sample dates equaled 347,429 fish.

Bypass totals during collection for transportation from May 5 at 0700 hours until October 31 at 0700 hours included 92 Chinook fry, which were bypassed for growth, and one subyearling Chinook that was overlooked in the wet lab holding tank and bypassed to the river rather than holding it for an extended period until the next trucking date.

Between May 5 and October 31, the facility was placed into primary bypass on three occasions. From May 22 at 0700 until May 27 at 0700 when the navigation lock at The Dalles Dam was removed from service for repairs, and on June 22 from 1000 to 1100 hours and August 4 from 0800 to 0850 hours to clean the separator of excessive debris. No estimate of fish numbers were made during these primary bypass events.

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. In 2009 four new full flow pit tag detectors were installed in the juvenile collection flume just upstream of the primary bypass to the river exit at the JFF. The PTAGIS database categorized all PIT tag detections based upon species, race, and clip type/rearing disposition. An additional “orphan” category was used for detections of PIT tags for which the database contained no record of tagging and release. Data 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 April 1 through October 31, a total of 254,198 PIT tagged salmonids were detected within the juvenile collection/bypass system: 181,775 Chinook salmon, 480 coho salmon, 67,641 steelhead, 2,834 sockeye salmon and 1,459 orphans. Of this total, 99,754 smolts, or 39.2%, were routed to the river, 3,567 smolts, or 1.4%, were routed to the sample, 70,634 smolts, or 27.8%, were routed to transport areas and 80,243 smolts, or 31.6%, had unknown disposition as they

were last detected at locations that did not constitute an exit from the facility. PIT tagged smolts 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 to a transport holding area when the facility operated in collection mode.

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 incidental fish removed from the separator to the expanded sample count. Incidental species fish were counted individually except when handling large numbers of juvenile American shad *Alosa sapidissima,* Siberian prawns *Exopalaemon modestus,* and juvenile peamouth *Mylocheilus caurinus.* When large numbers of these species occurred in the sample, their numbers were estimated by multiplying their total weight times the average weight per individual based on a 50-100 fish sample. Fry or species with small adult size typically occurred in the sample, while adults of larger species could not fit through the sizing bars and were removed at the separator. All sampled incidental fish were returned to the river except for Siberian prawns, which were euthanized. When the sample rate was less than 100%, incidental species were inadvertently collected and transported along with the target smolts. Therefore, when sample rates were below 100%, pound counts were calculated and used to determine the weight of incidental fish directed to transport holding areas and their contribution to transport loading densities.

The majority of incidental fish collected and released from the separator, 8.1% of the total incidental collection, in 2011were ammocoete stage lamprey *Lampetra sp*. (35.3%) and sandrollers *Percopsis transmontana* (35.2%) (Table 10). The total incidental collection count in 2011 was 62,702 fish, a decrease of 61.6% compared to counts in 2010 and the second lowest incidental collection count of the past five years (Table 11). Much of the decrease was due to lower numbers of American shad, Pacific lamprey *Lampetra tridentata*, sandrollers, and Siberian prawns.

Table10. Collection of incidental species at Little Goose Dam, 2011

Common Name	Scientific Name	Expanded Sample	Separator	Total Collection [1,2]
American Shad	*Alosa sapidissima*	2,056	66	2,122
Banded Killifish	*Fundus diaphanus*	14	-----	14
Bass-Smallmouth	*Micropterus dolomieu*	3,593	98	3,691
Bass-Largemouth	*M. salmoides*	5	2	7
Bullhead	*Amierus sp.*	387	3	390
Bull trout	*Salvelinus confluentus*	0	7	7
Channel Catfish	*Ictalurus punctatus*	45	190	235
Chiselmouth	*Acrocheilus alutaceus*	70	2	72
Common carp	*Cyprinus carpio*	97	197	294
Crappie	*Pomoxis sp.*	49	37	86
Dace	*Rhinichthys sp.*	24	-----	24
Kokanee	*Oncorhynchus nerka*	55	-----	55
Lamprey Adult-Pacific	*L. tridentata*	44	19	63
Lamprey Ammocoete-Pacific	*L. tridentata*	4,778	1,8063[3]	6,584
Lamprey Macropthalmia-Pacific	*L. tridentata*	11,078	30	11,108
Mountain Whitefish	*Prosopium williamsoni*	3,841	9	3,850
Northerrn Pikeminnow	*Ptychocheilus oregonensis*	50	22	72
Peamouth	*Mylocheilus caurinus*	7,354	277	7,631
Rainbow Trout	*O. mykiss*	10	2	12
Redside Shiner	*Richardsonius balteatus*	0	-----	0
Sandroller	*Percopsis transmontana*	5,791	1,800	7,591
Sculpin	*Cottus sp.*	996	-----	996
Siberian Prawn	*Exopalaemon modestus*	15,743	-----	15,743
Sucker	*Catostomus sp.*	1,295	465	1,760
Sunfish[4]	*Lepomis sp.*	208	10	218
Tadpole Madtom	*Noturus gyrinus*	0	-----	0
Walleye	*Stizostedion vitreum*	1	7	8
White Sturgeon	*Acipenser transmontanus*	2	10	12
Yellow Perch	*Perca flavescens*	3	52	55
Other[5]	-----	2	-----	2
Total		57,591	5,111	62,702

[1] Collection totals estimated by expanding the sample counts, then adding the separator counts.

[2] Numbers include live and dead incidental fish.

[3] In order to facilitate their safe release, the 1,806 ammoceotes released from the separator were not examined closely enough to identify them to species but were classified based on the species composition of lamprey in the sample.

[4] Sunfish includes 203 bluegill/pumpkinseed and 15 warmouth from the expanded sample.

[5] Other includes two Snake River pilose crayfish *Pacifastacus connectens.*

Based on expanded sample counts, Pacific lamprey, in various life stages, dominated the incidental species collection in 2011 at 28.3% of the total number of incidental fish collected. Siberian prawns made up 25.1% of the incidental collection. Peamouth and Sandrollers made up 12.2% and 12.1% of the collection respectively.

From 2006 through 2010, the number of Siberian prawns increased annually. This year however, the number of prawns collected declined substantially from 2010 levels. In 2010, a total of 38,676 prawns were collected at LGS. In 2011, only 15,743 prawns were collected. This was still higher, however, than the prawn collection in any other year. On 24 July 2007, Washington Department of Fish and Wildlife requested that all Siberian prawns encountered in the sample be euthanized and ODFW SMP biologists continued this practice during the 2011 fish passage season. All specimens were frozen and returned to the river at the end of the fish passage season.

The number of peamouth in the sample was slightly higher than in 2010, continuing a trend observed in recent years. The number of sandrollers, while high was substantially lower than in 2010, was higher than in years prior to 2010.

For the third consecutive year, we observed warmouth *Lepomis gulosus* and banded killifish *Fundulus diaphanous* in the sample. Historically, warmouth may not have been identified to species, but may have been documented and reported, along with other representatives from the Lepomis family, as "sunfish". As in 2009 and 2010, warmouth are listed collectively with sunfish in Tables10 and 11 with the appropriate footnotes. As the killifish are relatively new to the record, we have listed them separately in Table 11 for intra-year comparisons. A total of 15 warmouth were collected in 2011. Prior to 2009, warmouth had not been noted in the sample since 2002. Warmouth were also observed and recorded in 2000 and 1999.

A total of 14 banded killifish were collected in 2011, a substantial decrease from the 213 killifish collected in 2010. Killifish collections in 2011 were similar to the 17 and 13 fish collections reported in 2009 and 2008 respectively. The high numbers of killifish reported in 2010 may be due, in part, to sample expansion as killifish collection in 2010 peaked in late June-early July when sample rates were lower and expansions greater. In 2011, most killifish were observed in late July when sample rates were high and expansion factors were low.

Based upon historical ODFW smolt monitoring reports dating back to 1997, no records exist of white sturgeon *Acipenser transmontanus* occurring in the sample though larger individuals are occasionally removed at the separator. In 2011, two sturgeon occurred in the sample. Each specimen appeared in excellent condition; one occurred on September 1 measuring 180mm FL and the other occurred on September 10 and measured 200mm. The latter was scanned for a PIT tag and closely examined for any other type of marking; there were none. Both fish were released to the river without incident.

Table 11. Numbers of incidental species collected at Little Goose Dam JFF, 2007-2011

Common Name	Scientific Name	2007	2008	2009	2010	2011
American shad	*Alosa sapidissima*	15,300	69,925	25,388	18,803	2,122
Banded Killifish	*Fundus diaphanus*	0	13	17	213	14
Bass-Smallmouth	*Micropterus dolomieu*	1,442	15,503	5,092	4,150	3,691
Bass-Largemouth	*M. salmoides*	0	7	32	3	7
Bullhead	*Amierus sp.*	57	107	374	323	390
Bull trout	*Salvelinus confluentus*	2	5	5	9	7
Channel Catfish	*Ictalurus punctatus*	551	389	618	369	235
Chiselmouth	*Acrocheilus alutaceus*	6	13	15	14	72
Common carp	*Cyprinus carpio*	20	113	145	722	294
Crappie	*Pomoxis sp.*	872	363	1,076	318	86
Dace	*Rhinichthys sp.*	4	12	10	29	24
Goldfish	*Carassius auratus*	0	0	0	1	0
Kokanee	*Oncorhynchus nerka*	50	1	14	0	55
Lamprey Adult-Pacific	*L. tridentata*	64	144	125	11	63
Lamprey Ammocoete-Pacific	*L. tridentata*	52	1,839	5,126	1,650	6,584[1]
Lamprey Macropthalmia-Pacific	*L. tridentata*	4,568	12,532	88,415	57,802	11,108
Mountain Whitefish	*Prosopium williamsoni*	324	1,502	1,940	5,614	3,850
Northerrn Pikeminnow	*Ptychocheilus oregonensis*	42	61	565	73	72
Peamouth	*Mylocheilus caurinus*	755	1,820	2,798	6,057	7,631
Rainbow Trout	*O. mykiss*	34	112	17	99	12
Redside Shiner	*Richardsonius balteatus*	2	0	0	0	0
Sandroller	*Percopsis transmontana*	1,904	3,877	4,124	24,260	7,591
Sculpin	*Cottus sp.*	1,075	1,126	3,733	2,062	996
Siberian Prawn	*Exopalaemon modestus*	620	5,213	6,327	38,676	15,743
Sucker	*Catostomus sp.*	1,834	1,433	2,413	1,820	1,760
Sunfish[2]	*Lepomis sp.*	513	544	585	239	218
Tadpole Madtom	*Noturus gyrinus*	2	3	1	2	0
Walleye	*Stizostedion vitreum*	26	32	19	20	8
White Sturgeon	*Acipenser transmontanus*	12	10	5	11	12
Yellow Perch	*Perca flavescens*	10	28	46	14	55
Other		48	4	311	11	2
Total		30,189	116,731	149,336	163,375	62,702

Note- Numbers include expanded sample counts and separator releases

[1] I=Of the 6,584 ammocoetes collected in 2011, approximately 1,806 fish were not identified to species but were called Pacific lamprey based on the species composition of the sample.

[2] Sunfish include bluegill/pumpkinseed and warmouth.

Fish Condition

Fish condition was monitored daily by SMP biologists and biological aids. “The primary roll of condition monitoring is to identify the proportion of each species of migratory juvenile salmon that are descaled or have significant injuries indicative of problems in fish passage at dams, such as debris in fish bypass apparatus” (SMP program user manual). Since the primary purpose of condition monitoring is to alert managers to potential problems with fish passage conditions at the dam, only fresh injuries and descaling were recorded.

Descaling

All live smolt in the sample were examined for descaling. As in previous years, a smolt was considered descaled if more than 20% of the scales were missing from either side of the fish. However, sampling directives for reporting descaling changed in 2009, when all SMP biologists began to report and record injury observations only if they appeared fresh enough to have occurred during passage at their respective projects. Prior to 2009, all descaling, old or new, was reported. Criteria for fresh descaling was, scale removal that felt rough, with no slime coat present over the abrasion and no visible healing of the injury. In addition to the general descaling sample described above, during the condition subsample, several finer gradations of descaling were also noted such as partial descaling and descaling with predation. Fish with 6-19% of the scales missing from either side of the fish were considered partially descaled. Descaling with predation was used to designate descaling caused by predation attempts from birds, fish, and mammals. There was no distinction made as to the cause of descaling in the non-condition sample. Any smolt from the non-condtion sample that had greater than or equal to 20% scale loss on either side was simply recorded as descaled regardless of the cause of the scale loss.

A total of 57,924 smolts or 1.7% of the total smolt collection was examined for descaling in 2011. Descaling was noted on 0.4% of the smolts examined, and the overall median rate was 0.3%, a rate similar to the previous three years. Of the 57,924 smolts examined for descaling, 21,424 fish were sampled for condition. From the condition subsample, 166 fish or approximately 0.8% were descaled; 61 fish or approximately 0.3% of the condition subsample were descaled due to passage through LGS and 105 fish or 0.5% were descaled due to predation attempts. From the non-condition subsample, 36,500 fish were examined for descaling. A total of 74 fish or approximately 0.2% were descaled from the non-condition subsample. It should be noted that in 2009 descaling linked to predation attempts was not included in the total descaling rate, while in 2010 and in 2011, predator descaling was included in the total descaling rate. Minor descaling was not included in descaling rates for either year. All combined descaling is given in Table 12.

Table 12. Annual descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2006-2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Totals
2006	2.5	1.5	1.2	1.0	2.2	1.6	2.4	4.3	1.9	1.6
2007	3.2	2.6	1.6	1.2	2.4	3.2	2.0	0.0	6.1	2.2
2008	1.0	0.7	0.5	0.7	0.6	0.4	0.6	1.1	0.2	0.7
2009	0.7	0.7	0.3	0.3	0.5	0.8	0.0	0.4	0.2	0.4
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

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

The highest descaling rates were observed on unclipped sockeye at 0.6% followed by yearling Chinook and subyearling Chinook at 0.5% each. In 2011, the average weekly descaling rate ranged from 0.0% to 3.4% (Table 13). Weekly descaling rates held steady throughout most of the season. Sample numbers began to decline mid to late August. Most peaks in weekly descaling rates occurred when collection numbers were low and rates potentially were influenced by a few individuals. As we approached the end of the season, we observed an increase in the number of descaled fish with associated marks caused by predation attempts.

Table 13. Weekly descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2011.

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]
7-Apr	0.00	0.00	-----	-----	0.14	0.00	-----	0.00	-----	0.13
14-Apr	0.00	0.00	-----	-----	0.00	0.00	-----	0.00	0.00	0.00
21-Apr	1.01	0.00	-----	-----	0.00	0.00	-----	0.00	-----	0.30
28-Apr	1.12	0.00	-----	-----	0.00	0.00	-----	0.00	0.00	0.30
5-May	0.49	1.01	-----	-----	0.00	0.00	-----	0.00	0.00	0.39
12-May	0.36	0.63	-----	-----	0.15	0.00	-----	0.00	0.00	0.31
19-May	0.48	1.03	0.00	0.00	0.20	0.16	-----	0.00	0.00	0.42
26-May	0.68	0.94	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.40
2-Jun	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.09
9-Jun	2.74	2.27	0.11	0.10	1.38	0.00	0.00	0.00	0.00	0.25
16-Jun	0.00	0.00	0.10	0.36	0.00	0.00	0.00	0.00	0.00	0.20
23-Jun	0.00	0.00	0.48	0.14	0.00	0.00	0.00	0.00	0.00	0.27
30-Jun	0.00	0.00	0.29	0.12	0.00	0.88	0.00	0.00	0.00	0.19
7-Jul	0.00	0.00	0.36	0.17	1.96	0.00	0.00	0.00	0.00	0.24
14-Jul	0.00	0.00	0.24	0.22	0.00	0.00	0.00	0.00	0.00	0.21
21-Jul	0.00	0.00	0.00	0.07	0.00	0.00	-----	0.00	0.00	0.06
28-Jul	-----	0.00	0.00	0.16	0.00	0.00	-----	0.00	0.00	0.15
4-Aug	-----	-----	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20
11-Aug	-----	-----	0.00	0.19	0.00	0.00	-----	0.00	0.00	0.19
18-Aug	-----	-----	0.00	0.24	0.00	-----	-----	0.00	2.27	0.30
25-Aug	-----	-----	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05
1-Sep	-----	0.00	0.00	0.36	25.00	0.00	-----	0.00	0.00	0.46
8-Sep	0.00	0.00	0.00	0.32	-----	0.00	-----	0.00	2.94	0.44
15-Sep	-----	0.00	0.00	0.00	-----	0.00	-----	0.00	0.00	0.00
22-Sep	0.00	0.00	0.00	0.44	-----	0.00	0.00	33.33	0.00	0.56
29-Sep	-----	0.00	0.00	1.07	-----	0.00	-----	0.00	0.00	1.04
6-Oct	-----	-----	14.29	2.51	-----	0.00	-----	0.00	0.00	2.51
13-Oct	-----	-----	50.00	3.40	-----	0.00	-----	0.00	0.00	3.44
20-Oct	-----	-----	0.00	3.19	-----	0.00	-----	4.35	0.00	3.20
27-Oct	-----	0.00	0.00	2.38	0.00	-----	-----	0.00	0.00	2.31
3-Nov	-----	-----	0.00	1.43	-----	-----	-----	-----	0.00	1.42
Total Exam	6,339	2,459	6,389	33,811	5,734	2,058	81	356	697	57,924
% Desc	0.50	0.53	0.27	0.47	0.21	0.10	0.00	0.56	0.29	0.41
Median	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.30

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

Other Injuries and Disease

Condition information was gathered from a random subsample of 100 of the dominant species present in the sample. During sampling periods when yearling Chinook salmon and steelhead were equally numerous, a random subsample of 200 fish were examined for condition parameters. Approximately 50% of the condition sample was taken from each of the two sample tanks. On days that sample numbers were low, all fish were examined for condition. Condition monitoring included the following categories: descaling, injury, disease, predation, weight, length, and an "other" category which included pop eyes, pink fins, fin discoloration, and hemorrhaged fins.

In June of 2008, a new fish condition data collection program was implemented in an attempt to standardize the SMP data collection process at hydroelectric dams in the Columbia Basin. Injuries were recorded only if it appeared that the injury could have resulted from dam

passage. In previous years, injuries were recorded based solely on the presence of an injury, and no attempt was made to determine the age or origin of the injury. The injury rates reported for 2001-2003 are believed to have included minor descaling and body abrasions. From 2004-2008, minor descaling and abrasions were included in the body injury category (Table 14).

Table 14. Annual body injury rates (%) for salmonids examined at Little Goose Dam, 2001-2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Years	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip		Total
2001	3.1	4.2	2.8	9.8	9.6	5.9	8.3	4.6	13.5	7.7
2002	10.6	9.8	5.5	14.1	13.0	9.6	11.5	17.9	11.6	11.9
2003	29.2	17.8	17.7	22.4	40.0	33.9	27.3	21.2	37.2	26.3
2004	16.3	13.5	8.0	27.9	31.8	22.0	14.3	28.8	26.1	25.1
2005	14.7	13.2	9.4	11.0	22.5	17.5	14.6	25.7	10.8	13.9
2006	15.6	8.0	13.9	19.8	16.9	14.6	15.3	28.8	21.2	16.4
2007	17.0	14.9	17.7	26.8	33.3	29.8	21.8	29.9	33.6	26.1
2008	11.9	7.9	3.9	2.9	10.8	10.7	9.6	7.8	10.8	6.0
2009	0.2	0.3	0.2	0.2	0.3	0.3	0.0	1.2	0.3	0.2
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

Note- Injury data collected 2009-2011 included only body injuries that appeared recent enough to have occurred at LGS, consistent with new protocols established in 2009.

Injuries were recorded by location on the fish; operculum, eye, body, head, or fin. Injuries included cuts, contusions, scrapes, and abrasions that were fresh in appearance. Disease classifications included body fungus, columnaris, body parasites, deformity, BKD, and a disease "other" category. Predation was recorded as a separate category of condition and not included in the "injury" category. The predation category included bite marks from fish, birds, lamprey, and "other" predation. A final category included other conditions that were of unknown origin and included hemorrhaged fin, hemorrhaged eye, pink fin, discolored fin, and pop eye. A summary of 2011 condition data by category is found in table 15.

A total of 21,424 fish were examined for injuries in 2011. The overall injury rate was low at 1.5% for all species groups combined. Of the total sampled, injuries were most frequently observed on the fins (0.9%), on the operculum (0.3%), and to the body (0.2%). Injuries to the head and eye were observed on 0.1% each in the fish examined. The highest incidence of injury was observed in unclipped sockeye at 3.6% of 169 fish sampled, followed by clipped steelhead at 1.9% of the 1,797 examined, unclipped steelhead at 1.8% of the 652 examined, unclipped subyearling Chinook at 1.7% of the 14,082 examined, unclipped yearling Chinook 1.4% of 720 examined, unclipped coho at 0.9% of 345 examined, clipped yearling Chinook at 0.7% of 1680 examined, and clipped subyearling Chinook at 0.6% of 1949 examined. There were no injuries reported in the 30 clipped sockeye examined.

Data on the presence of disease symptoms were collected to provide relative information about fish health. The number of fish affected by disease in 2011 was 7.0% of the 21,424 fish examined, and was similar to the 2010 disease rate of 7.6% from 20,158 examined. The most frequently observed disease category was Columnaris (5.6%), followed by body parasites (0.9%), deformity (0.3)%, body fungus (0.2%), BKD and disease "other"(<0.1% each). The highest percentage of disease was observed was in unclipped sockeye at 17.8% (169 examined), followed by unclipped subyearling Chinook, 9.3% (14,082 examined), unclipped coho, 7.5% (345 examined), unclipped steelhead, 5.4% (652 examined), clipped steelhead 2.4% (1797 examined), clipped yearling Chinook, 1.8% (1680 examined), clipped subyearling Chinook,

1.1% (1949 examined), unclipped yearling Chinook, 0.7% (720 examined). There were no diseases noted in the 30 clipped sockeye examined (Table 15).

Of the 1,511 instances when disease symptoms were observed during the 2011 season, 78.4% were observed on the last 5,364 (25.0%) of the fish sampled, from September 1 through October 31. Of the disease rate during this period, 93% was attributed to Columnaris infection (Table 15). Toward the end of the sampling season, the prevalence of Columnaris infection declined but the disease was still observed frequently.

Table 15. Percent of fish examined that were injured, had predation marks or had signs of disease by species and clip type at Little Goose Dam, 2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
Injuries											
Head	0.1	0.1	0.1	0.1	0.3	0.3	-----	0.0	0.0	0.0	0.1
Eye	0.2	0.3	0.1	0.1	0.1	0.2	-----	0.0	0.0	0.0	0.1
Operculum	0.1	0.4	0.2	0.1	1.4	1.1	-----	0.0	0.0	1.8	0.3
Body	0.1	0.3	0.3	0.2	0.2	0.3	-----	0.0	0.0	0.6	0.2
Fin	0.1	0.3	0.1	1.2	0.1	0.0	-----	0.9	0.0	1.2	0.9
Total Injury	0.7	1.4	0.6	1.7	1.9	1.8	-----	0.9	0.0	3.6	1.5
Disease											
Fungus	0.5	0.0	0.2	0.1	1.3	0.5	-----	0.3	0.0	1.8	0.2
Columnaris	0.0	0.1	0.6	8.1	0.0	0.3	-----	5.2	0.0	14.2	5.6
BKD	0.0	0.0	0.0	0.1	0.0	0.2	-----	0.3	0.0	0.0	0.1
Parasites	0.1	0.4	0.2	0.9	1.1	4.3	-----	1.7	0.0	1.8	0.9
Deformity	1.2	0.1	<0.1	0.2	0.1	0.2	-----	0.0	0.0	0.6	0.3
Disease Other	0.1	0.0	0.0	0.0	0.0	0.0	-----	0.0	0.0	0.0	0.0
Total Disease	1.8	0.7	1.1	9.4	2.4	5.4	-----	7.5	0.0	18.3	7.1
Predation											
Bird	0.8	0.3	0.1	0.5	2.4	2.3	-----	0.0	0.0	1.8	0.7
Fish	1.5	0.8	1.2	0.7	0.0	0.2	-----	0.4	0.0	0.0	0.8
Lamprey	0.0	0.0	0.0	0.0	0.1	0.2	-----	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	-----	0.0	0.0	0.0	0.0
Total Predation	2.4	1.1	1.3	1.2	2.6	2.6	-----	1.5	0.0	1.8	1.5
Other Condition											
Pop Eye	0.1	0.0	0.1	0.0	0.1	0.0	-----	0.0	0.0	0.0	0.0
Fin Hemorrhage	3.5	4.8	7.1	18.4	0.8	1.8	-----	9.0	3.3	10.1	13.5
Pink Fin	2.2	1.9	5.5	26.1	1.9	5.1	-----	10.7	0.0	3.0	18.4
Fin Discoloration	0.4	0.1	0.1	1.2	0.0	0.0	-----	0.0	0.0	0.6	0.8
Eye Hemorrhage	0.4	0.6	0.2	0.0	0.1	0.3	-----	0.0	0.0	0.6	0.1
Total Other	6.5	7.5	12.9	45.7	2.7	7.2	-----	19.7	3.3	14.2	32.9
Total sample size	**1680**	**720**	**1,949**	**14,082**	**1,797**	**652**	**0**	**345**	**30**	**169**	**21,424**

[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.

Predation injuries were observed on 1.5% of the 21,424 fish examined in the condition sample. Injuries were predominantly fish and bird bites at 0.8% and 0.7%, respectively, of the fish in the sample. The prevalence of fish bite marks in 2011 was slightly below the 1.1% observed in 2010. The lowest prevalence of fish bite marks was observed in 2006 at 0.4% of the fish examined. The prevalence of bird bite marks in 2011 was the same as in 2010 at 0.7%, the lowest rate observed in the last five years (Table 16). The highest rate in recent years was 2.5% which occurred in 2007.

The prevalence of lamprey bite marks on fish in the sample was relatively low at < 0.1%. Predation marks were observed most frequently on clipped steelhead and unclipped steelhead with a prevalence of 2.6% each for the 1,797 and 652 examined respectively and clipped yearling Chinook at 2.4% of the 1,680 examined. Prevalence was similar though slightly lower for unclipped sockeye with 1.8% of 169 examined, unclipped coho with 1.45% of 345 examined, clipped subyearling Chinook with 1.3% of 1,949 examined, unclipped subyearling Chinook with 1.3% of 14,082 examined, and unclipped yearling Chinook with 1.1% of 720 examined. No predation marks were observed on the 30 clipped sockeye examined.

Table 16. Annual bird bite rates (%) for salmonids examined at Little Goose Dam, 2006-2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip		Total
2006	0.6	0.3	0.1	0.2	2.3	1.8	0.8	0.3	0.5	0.8
2007	0.1	0.1	0.0	0.2	7.3	5.1	0.0	0.0	0.6	2.5
2008	0.8	0.5	0.0	0.4	4.4	3.2	1.9	0.6	1.7	1.2
2009	0.9	0.4	0.3	0.3	2.5	2.9	0.0	0.4	1.0	0.9
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

Note- From 2006-2011, rates include only those fish in the sample that were examined for condition

Approximately 29.4% of the fish had conditions that fell under the category "other". Pink fin and fin hemorrhage were most frequently observed with 18.4% and 13.0% respectively of the fish in the condition sample exhibiting signs of these conditions (Table 15). These conditions were most common in the latter part of the migration season, occurring most frequently on subyearling Chinook salmon, coho and sockeye.

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 of recovery in the JFF and was divided into facility mortality (raceways and separator) and sample mortality. We began to collect and report on lamprey in more detail in 2011 at the request of FPC. New protocols directed SMP sites to treat all live and dead Pacific lamprey ammocoete and macropthalmia on a par with the daily salmonid collection. In order to facilitate comparisons with historical data, lamprey numbers are not included in the overall salmonid mortality counts in this report, but have been added to the mortality tables for future years' comparisons (Table 17 and Table 19). The Pacific lamprey ammocoete total mortality rate was 0.7% from a total collection count of 6,584 fish. The total mortality rate for Pacific lamprey macropthalmia was 0.2% from a collection total of 11,108 fish.

Table 17. Annual total facility mortality as a percentage of total collection at LGS JFF 2006-2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific lamprey	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoete	Macropthalmia
2006	0.2	0.3	0.4	0.4	0.0	0.0	1.5	2.4	0.1	0.2	-----	-----
2007	<0.1	0.1	0.1	0.1	<0.1	<0.1	0.1	0.4	<0.1	<0.1	-----	-----
2008	0.2	0.2	0.2	0.3	<0.1	<0.1	<0.1	0.6	<0.1	0.1	-----	-----
2009	<0.1	0.1	0.8	0.7	<0.1	<0.1	<0.1	0.3	<0.1	0.2	-----	-----
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

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

There were 6,307 salmonid smolt mortalities from the total collection of 3,384,386. This equated to 2.0% of the total collection and matched that of the previous two years (Table 17). Higher than normal runoff this year brought high flows and problems with debris in May, June, and July. Total mortality peaked on May 20 with 930 smolts and was directly related to orifice blockages. The facility spilled for debris on the same day. Mortality spiked again June 12 with 266 smolts. Daily mortality continued to sporadically number in the 100's for the remainder of the month and decreased steadily in July through the remainder of the season. During the week beginning June 17, forebay debris peaked at an estimated 25,000 sq. ft. Consequently, numerous orifice blockages were reported in June and were the likely cause of the increased mortality observed during that month. USACE staff increased debris removal efforts by performing round the clock orifice cleaning and rotation, gatewell debris removal, and trash rack raking.

A total of 2,569 salmonid smolt mortalities were removed from the separator. The majority of these smolts arrived in the separator dead or dying from injuries sustained from debris blockages in the orifice gallery. Many more injured smolts passed through the separator and into the raceways or the sample where they succumbed to their injuries. In the raceways the mortalities were removed and enumerated prior to and during barge loading operations. The raceway collection of mortalities totaled 3,088. The remaining 651mortalities were removed from the sample.

The average weekly total facility mortality rate in 2011 ranged from 0.0% to 6.1% (Table 18). The minimum rate 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 occurred late in the collection season when total collection decreased and disease and injury rates increased. The maximum weekly mortality rate of 6.1% occurred during the week ending August 18, when the total weekly collection was 1,575 fish. A total of 769 fish were examined during this period, 6.0% of which had symptoms of disease and 2.6% had signs of injury. As total mortality rates were skewed, median season mortality rates were determined for each species group/clip type and also for a combined total. The median season total facility mortality rate for all smolts was 0.74%.

Mortality that occurred in the sample tanks was included in the daily sample number, which was expanded to determine the collection number. Sample mortality for the 2011 season was 1.1% from a total of 60,440 smolts sampled including GBT fish, a slight increase compared to the previous two years, and the highest of the past five years (Table 19). As in 2010, sample mortality was highest for the month of August in 2011, with a rate of 2.2% from 8,114 smolts sampled. Water temperatures and disease rates tend to increase in August.

As previously mentioned, we began to collect and report detailed data on lamprey in 2011. The total sample mortality rate in Table 19 does not include lamprey numbers, but Pacific lamprey ammocoete and macropthalmia rates have been included in the table for future year's comparisons. The total sample mortality rate for Pacific lamprey ammocoetes was 11.1% from 413 sampled and the rate for macroopthalmia was 7.8% from a total of 128 sampled in 2011.

Mortality that occurred in the process of trucking transportation totaled 33, subyearling Chinook accounted for 31 equating to a 0.3% mortality rate. Thirty of the mortalities were presumed disease related and 2 were caused by injury sustained by the fish release valve.

Table 18. Weekly total facility mortality in percent at Little Goose Dam JFF, 2011

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Week Ending	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
7-Apr	0.0	0.0	-----	-----	0.0	0.0	-----	0.2	-----	0.0
14-Apr	0.0	0.0	-----	100.0	0.0	0.0	-----	0.6	0.0	0.0
21-Apr	0.0	0.0	-----	-----	0.0	0.0	-----	0.7	-----	0.0
28-Apr	0.0	0.1	-----	100.0	0.0	0.0	-----	0.4	0.0	0.0
5-May	0.0	0.0	-----	-----	0.0	0.0	-----	0.0	0.0	0.0
12-May	0.0	0.0	-----	0.0	0.0	0.0	100.0	0.2	0.0	0.0
19-May	0.1	0.0	0.0	0.0	0.0	0.0	-----	2.0	0.0	0.1
26-May	1.4	1.3	0.2	0.1	0.4	0.1	0.1	1.1	0.0	0.7
2-Jun	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.1
9-Jun	0.0	0.1	0.2	0.2	0.0	0.0	0.1	0.0	0.0	0.2
16-Jun	0.3	0.2	0.8	1.1	0.1	0.0	0.1	0.8	0.0	0.8
23-Jun	0.1	0.1	0.5	0.5	0.1	0.2	0.0	1.0	0.0	0.5
30-Jun	0.0	0.0	0.5	0.5	0.1	0.7	0.0	1.1	0.0	0.5
7-Jul	0.5	0.0	0.3	0.4	0.1	0.1	0.0	0.5	0.0	0.3
14-Jul	3.2	0.6	0.6	0.3	0.0	0.9	0.0	0.5	0.0	0.3
21-Jul	5.0	0.0	0.3	0.3	0.8	0.0	-----	0.4	0.0	0.3
28-Jul	-----	0.0	0.8	0.7	0.0	0.0	-----	2.4	0.0	0.7
4-Aug	-----	-----	8.1	1.1	0.0	0.0	0.0	0.0	0.5	1.1
11-Aug	-----	-----	1.6	1.2	0.0	0.0	-----	0.0	0.0	1.1
18-Aug	-----	-----	10.0	6.1	0.0	-----	-----	40.0	1.8	6.1
25-Aug	-----	-----	28.6	3.0	0.0	0.0	0.0	16.7	0.0	3.1
1-Sep	-----	0.0	16.7	4.3	0.0	0.0	-----	0.0	0.0	4.1
8-Sep	100.0	0.0	0.0	3.0	---	14.3	---	0.0	0.0	3.0
15-Sep	-----	0.0	0.0	1.4	---	0.0	---	0.0	5.9	1.5
22-Sep	0.0	0.0	0.0	3.5	---	0.0	0.0	0.0	7.7	3.6
29-Sep	---	0.0	20.0	3.0	---	0.0	---	0.0	11.1	3.2
6-Oct	---	---	0.0	4.5	---	0.0	---	14.3	5.9	4.6
13-Oct	---	---	33.3	5.4	---	0.0	---	16.7	0.0	5.6
20-Oct	---	---	0.0	3.4	---	0.0	---	11.5	0.0	3.5
27-Oct	---	0.0	0.0	2.3	0.0	---	---	0.0	0.0	2.2
3-Nov	---	---	0.0	1.9	---	---	---	---	0.0	1.9
Median Wkly Mortality Rate	<0.1	0.0	0.3	1.3	0.0	0.0	0.0	0.5	0.0	0.7

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

Table 19. Annual sample mortality as percent of total sample at Little Goose Dam JFF, 2006-2011.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific Lamprey	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoetes	Macropthalmia
2006	0.9	0.6	0.5	0.5	0.1	0.1	2.4	5.5	0.1	0.5	-----	-----
2007	0.2	0.4	0.2	0.4	0.3	0.3	1.3	2.9	2.2	0.4	-----	-----
2008	0.2	0.6	0.4	0.5	0.1	0.1	1.9	3.6	0.2	0.4	-----	-----
2009	0.4	0.4	1.0	1.1	0.1	0.2	0.0	2.8	2.7	0.8	-----	-----
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

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 mortlities to facilitate across year comparisons.

Research and Monitoring

ODFW and USACE personnel provide various types of research and monitoring 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 project.

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 fish numbers permitted, a maximum of 100 fish were sampled. Sampling occurred weekly, on Mondays, from April 18 to August 29, 2011. 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 1,772 smolts were examined for GBT in 2011. Of the fish examined, 39.6% were subyearling Chinook salmon, 31.0% were steelhead and 29.3% were yearling Chinook salmon. The total GBT rate for the 2011 season was 1.2%, a slight decrease from last year's rate of 1.8%. Exactly one half of the sample was composed of clipped smolts with a trauma rate of 0.9% from 886 fish examined compared to unclipped smolts with a rate of 1.6% from 886 fish examined. By comparison, last year unclipped smolts comprised a little over half of the composition and also exhibited a higher trauma rate than clipped fish. Contrary to the trend of steelhead exhibiting the highest rates of trauma in recent years, subyearling Chinook exhibited the highest rate of trauma in 2011, followed by steelhead 0.7% and yearling Chinook 0.2%. Trauma observations first occurred June 6 at 1.0% from 100 fish examined and peaked the following week on June 13 at 14.0% from 100 fish examined. Note that peak flows at Little Goose occurred on June 9 at 200.93 kcfs. Forebay gas levels peaked on May 18 at 125.11% mmHg, exceeding the gas cap of 115% for 13 consecutive days. After June 13 and continuing weekly until July 11, trauma rates were low (1%-2%), decreasing to zero trauma from July 18 through August 29.

Individual signs of injury totaled 22 with the majority of injuries occurring in the first and second week of June. Most injury was observed in the caudal fin and totaled 13 individual signs followed by nine signs in the anal fin, six in the dorsal fin, and three signs in the eye. Some fish were observed with trauma in multiple regions of the body. In terms of trauma severity and its' ranking, a total of 22 signs were given a rank of 1 (1-5% bubble coverage of body region), six signs of a rank 2 (6-25% coverage), two signs of a rank 3 (26-50% coverage) and one sign with a ranking of 4 (>50%). The overall mortality rate for the season was low at 0.06% from the total number of smolts examined.

Salmonid Riverine Survival

The separation by code diversion tank located at the JFF was utilized by NOAA Fisheries personnel for the eleventh consecutive season. The study targeted PIT tagged wild Snake River spring/summer Chinook salmon smolts by diverting them into a holding tank where they were anesthetized, measured, and weighed by NOAA personnel. NOAA data collection continued to aid in establishing baseline information on natal stream productivity and the relationship between growth rates and parr-to-smolt survival. All fish were released back to the river upon recovery. On-site activity occurred from April 29 through June 13, 2011.

A total of 1,423 salmonids were diverted and handled during the sampling period. During periods of high fish passage it became impossible to separate tagged fish from untagged fish during diversion. In 2011, untagged bycatch totaled 62.9% of the total catch compared to tagged fish at a rate of 37.0%, with similar results occurring in previous years. Species

composition of PIT tagged fish was dominated by unclipped yearling Chinook salmon (91.2%) followed by clipped yearling Chinook (4.6%), clipped steelhead (2.7%), unclipped steelhead (1.0%), and clipped sockeye, unclipped sockeye, and unclipped coho (0.2% each). Total mortality on all diverted fish was 0.2 %.

Bull Trout Studies (USFWS)

Biologists with the United States Fish and Wildlife Service (USFWS) conducted a study on bull trout, *Salvelinus confluentus*, entitled "Monitor Subadult and Adult Bull Trout Passage through Lower Granite, Little Goose and Lower Monumental Juvenile Bypass Facilities". Study objectives focused on the presence, timing and use of the main stem Snake River as a migratory corridor by bull trout originating from the Tucannon River. In addition, researchers used genetic assignments to identify distinct populations of bull trout that use and overwinter in the Federal Columbia River Power Systems (FCRPS).

USFWS requested that the lower Snake River SMP personnel obtain tissue samples, collect morphometric data, and PIT tag bull trout entering the fish facilities. No more than five bull trout from each facility were allowed to be handled. Also, fish handling ceased when river temperatures reached or exceeded 59.0^{o}F. In 2011we handled and tagged a total of four bull trout, all collected from the separator. Per USFWS tagging protocols, all fish were PIT tagged in the dorsal sinus. All of the four specimens appeared in excellent health, with an average fork length of 390mm, ranging in size from 313mm to 450mm. All fish were released into the tailrace upon recovery from anesthesia and were detected exiting the facility. An unfortunate event occurred to the largest of the four specimens. A Washington Department Fish and Wildlife game warden confiscated two bull trout from poachers in the upper reaches of the Tucannon River July 3, 2011. Both fish were examined by WDFW personnel who discovered that one fish had been PIT tagged by an ODFW biologist at the LGS JFF on May 29, 2011.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are 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.

The state of the Divert During Sample (DDS) system was manually changed by USACE project biologists and technicians based upon sample rates. Changes typically occur in the morning at approximately 0700 hours during the drill. At low sample rates ($\leq$20%), when large numbers of fish are passing through the system, the DDS is deactivated to avoid potential sample bias caused by diverting large numbers of untagged fish away from the sample along with the detected and diverted PIT tagged fish. At this deactivated setting, any PIT tagged fish destined for other routes such as the NOAA Sort by Code system, transport or bypass, were instead routed into the sample during sampling events. At sample rates greater than or equal to 20%, (low numbers of fish passing through system), the potential for sample bias was lower and the DDS system was set to "on" or activated. With the DDS on, any PIT tagged fish destined for the Sort by Code system, transport or bypass were diverted to these destinations during sampling events. As in previous years, state changes to the DDS system were automatically logged and were documented on the PTAGIS website.

According to the PTAGIS event log, settings were correct for much of the spring outmigration. Few deviations from the recommended settings occurred, all of them pertaining to the A side tank. On June 1 the sample rate was 1% and the DDS should have been in the "Off" position beginning at 0701 hours on May 31. It was left "On" for an approximate 1.5 hours; the PTAGIS event log recorded that the system was turned to "Off" at 0825 hours. The second

deviation occurred on June 6 (collection period June 6/7) from 0700 hours through 0903 hours. The system was changed to the "On" position for an approximate two hours with a sample rate of 1%. The last deviation from the recommended settings occurred on July 29. In preparation for the sampling period ending July 30, the DDS should have been set to "On" corresponding to the 20% sample rate. The system was not turned to "On" until July 30 at 0658. A consequent 24 hour lapse in diversion efficiency occurred. Some of the minor deviations that tend to occur during split sample changes, separator cleanouts and/or power outages were not included in these estimates. A log of power outages affecting the PIT tag interrogation equipment in 2011 can be obtained at www.ptoccentral.org.

Miscellaneous Monitoring

As in previous years, the USACE and ODFW SMP personnel at the Little Goose JFF continued to monitor collections and the facility for zebra mussel *Dreissena polymorpha.* The zebra mussel monitor is a piece of substrate suspended in the adult fish ladder near the ladder exit. No zebra mussels were observed during the 2011monitoring period.

Facility Operations & Maintenance

Forebay Debris/Trashracks

Estimates of debris volume and location in the forebay were recorded daily during JFF inspections. Large accumulations of woody debris were present in the Little Goose forebay beginning June 10 and extending through July. The maximum amount of surface debris was reported on May 20 and measured an estimated 25,000 square feet. At the conclusion of MOP (first week in September) water elevations were increased that allowed shoreline debris to floated from the banks and accumulated in the forebay.

Debris entered into the immediate forebay area and turbine intakes as follows. Waterlogged submerged debris entered by passing under the trash-shear and log booms. Floating debris entered when winds pushed debris over the log boom and/or through the log boom boat access opening. Debris also collected along the trash-shear boom and was held in place and pulled under the boom by entrained water for turbine operations.

As in past years, debris caused the majority of smolt injury and mortality by blocking or clogging fish passage routes. The majority of the debris was removed from the forebay by passing through the spillways. Debris that accumulated directly in front of the trash rack intakes was manually removed using the trash rack rake and truck/trailer removal. Debris that entered into the juvenile collection system was manually removed using hand equipment, and air "back-flushing".

In 2011 the trashrack rake again failed when attempting to remove debris from turbine unit 1A trash rack. The rake bound against debris causing the cables to slack and become dislodged, impinged and damaged. Repairs took several months. Video inspection of trash rack 1A on January 10, 2012 showed that the trash rack is congested with debris and is 50% blocked. Near vertical timbers are impinged in the rack that prevent the rake to remove debris. It is estimated that 20 thousand cubic yards of woody debris has collected in front of and on trash rack 1A. The debris will require dredging and divers to remove it.

In 2010, a debris stop consisting of a large log was attached to the spillway side of trash/shear boom attachment frame. In 2011 the log remained in place and continued to act as a one way valve that prevented debris in the spillway section from entering the powerhouse intake section. Debris would then flow over the SW and into the tailrace.

Spillway Weir

In 2011 the spillway weir (SW) was placed into operation on April 3 in the low crest position. The weir height was changed to high crest on July 26 and was removed from service on September 1. As in 2009 and 2010 there were no debris blockages and the SW operated satisfactorily in 2011.

The SW was originally installed in 2009 in spillway one to provide in-river surface passage route for downstream migrating juvenile salmonids. The weir is a vertically shortened bulkhead and becomes operational when the spillway tainter gate is fully raised. Water spills over the weir as freefall waterfall and intersects with the downstream sloap of spillway approximately 80 feet below. The SW has two operating heights, low crest (618 ft. msl) which discharges approximately 10.7 kcfs and high crest (622 ft. msl) which discharges approximately 6.7 kcfs. Low crest is designed to operate during high flows (> 75 kcfs) and high numbers of juvenile fish migrating downstream. High crest is designed to operate during low flows (<75 kcfs) and low numbers of fish passage. The crest height is controlled using two different bulkheads which require the use of the 100 ton gantry crane and a 5 person mechanical crew (20 man hours) to remove and/or install.

Also in 2009, a new design spillway deflector was installed on spillway one and eight on the downstream slope approximately 7-10 feet below the tailwater surface elevation. The new deflector has a convex shape that guides the water to ride up toward the surface preventing a deep plunge thus reducing gas saturation.

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. Reportable deviations consist of operations outside the 1% criteria for more than 15 minutes in duration and/or 5 or more periods of at least 5 minutes during a single calendar day. In 2011, there were two deviations from the 1% best efficiency. all units were operated within the best efficiency range. There were three reportable deviations occurring on turbine unit one operation. These occurred on May 4 for 25 minutes, June 23 for 88 minutes and July 6 for 17 minutes.

Drawdown inspections across trashracks and ESBS/VBS were performed according to the FPP. Heavy debris loading occurred with the high flows in June however the debris did not interfere with turbine operations. All drawdown inspection measurements were within criteria throughout the season. Debris removal using the trash rack rake occurred in 2011 but at a reduced rate due to mechanical problems. A large pile of debris remains entangled on turbine unit one trash rack which cannot be removed with the rake.

During the 2011 fish passage season, scheduled and unscheduled turbine outages lasting longer than 24 hours are listed in Table 20. There were several other scheduled and unscheduled outages that lasted less than 24 hours. These outages supported short term repairs, inspections, trash rack raking and to install and remove fish screens before and after the fish passage season.

Table 20. 2011 Turbine Unit Outages greater than 24 hours (April 1 to December 08).

Units One – Four	Scheduled	24 May. – 1 Jun.	T-1 Down for Bushing Replace.
Unit One	Scheduled	24 Oct. – 22 Nov.	6 Year Overhaul / Maintenance
Unit Two	Scheduled	28 Sep. – 19 Oct.	Annual Inspection / Maintenance
Unit Three	Scheduled	12 Sep. – 22 Sep.	Annual Inspection / Maintenance
Unit Four	Scheduled	18 Aug. – 8 Sep.	Annual Inspection / Maintenance
Unit Five	Scheduled	10 May. – 1 Jun.	T-2 Down for Bushing Replace.
Unit Five	Scheduled	5 Jul. – 21 Jul.	Annual Inspection / Maintenance
Unit Five	Scheduled	1 Aug. – 9 Aug.	HV Disconnect/ Inspection
Unit Five	Unscheduled	29 Sep. – 4 Oct.	CO2 Discharge
Unit Six	Unscheduled	8 May. – 10 May.	Repair Maintenance, Field Ground
Unit Six	Scheduled	06 May. – 21 Jun.	T-2 Down for Bushing Failure
Unit Six	Scheduled	25 Jul. – 15 Aug.	Annual Inspection / Maintenance

In recent years, it has become evident that juvenile fish were being trapped in cooling water strainers. Beginning in March 2010, turbine unit cooling water strainers were checked weekly for juvenile fish entrapment. The cooling water originates from an inlet located in the scrollcase. The grating covering the inlet has open spaces large enough to allow small fish to pass through and thus getting entrapped into the strainer. In 2010 there were a total of 212 juvenile lamprey and 4 Salmonid smolts, all mortalities collected from the strainers. In 2011 there were a total of 906 juvenile Lamprey and 53 Salmonid smolts. Most of the Lamprey were collected in February which coincided with the first increased flow event of the 2011 water year.

Extended-Length Submersible Bar Screens (ESBS)

Initial drawdown measurements were conducted on April 4, and weekly thereafter through June, every two weeks from July through October. All drawdown measurements met criteria.

Underwater camera inspections were attempted on the ESBS screens on April 4 and were canceled due to high turbidity. Visibility was less than a foot. Units #1 and #6 were performed on May 10 when water conditions improved. Inspections were performed thereafter during turbine unit annual maintenance. During the video inspections ESBS were observed to be in good operating condition and clear of debris.

Beginning with the high flow and debris events in May, ESBS cleaning brushes were switched to operate from 4 hour interval to 2 hour interview. By increasing the frequency of cleaning brush operations to every 2 hours reduced the amount of debris collected on the screens between brush operations. This in turn, reduced debris swept up into the gatewell during each brush operation and helped to reduce orifice blockages.

Vertical Barrier Screens (VBS)

Scheduled inspections of the VBS were performed by underwater video camera concurrently with ESBS inspections. Thorough VBS inspections of screens 1A -6C were performed on June 22. 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. As in most years, small traces of oil were occasionally observed in gatewells during the season. The oil contamination was attributed to

rain-washed drippings from vehicles and mechanical equipment which accumulated on intake deck or gatewell walls. In 2011, observation of oil traces was less than those in previous years.

Orifices and Collection Channel

The juvenile collection channel and flume were placed into service March 22 with the Juvenile fish facility in Primary bypass. The collection channel was operated throughout the season with 18 to 22 open orifices depending on forebay elevations. Minimum operating pool (633.0 feet msl) plus 1' elevation (MOP +1) occurred from April 1 through September 3.

Orifices were inspected and/or back-flushed 1 to 3 times per 10 hour shift. Flushing's were increased in frequency in response to debris loading. Full-time night shifts were added when needed to operate and back-flush orifices to clear and prevent debris blockages.

All orifice operations (opening, closing, backflushing) were manually performed throughout the year. The orifices, collection channel, dewatering structure and flume were taken out of service for winter maintenance on December 19.

Primary Dewaterer

Overall, the primary dewatering structure functioned adequately throughout the season. All components operated satisfactorily throughout the season. Excess water was diverted to the adult fish channel pump chamber the entire season to help supplement flows for adult fish migration. Freezing temperatures caused the primary dewater to drain below the bypass flume entrance. On Sunday Dec. 11, the stilling basin surface water froze resulting in erroneous electronic surface water elevation readings. This caused the weirs to lower and prevent flow to the bypass flume. This caused all fish to be bottled-up in the collection channel and primary dewaterer for up to 24 hours. As a result, 2 adult Steelhead were found dead at the flume entrance. Upon discovery of problem, the weirs were raised and flow was restored to the bypass flume. The weir controls were placed into manual operation through the end of the fish passage season.

Flume

The primary bypass flume functioned satisfactorily in 2011. During winter maintenance 2010, the primary bypass outfall flume was relocated from near shore to mid channel. The relocation extended the release site approximately 400 feet towards the mid-channel. This new section of outfall is made of 36 inch corrugated metal pipe. The new point of release will allow bypassed fish to migrate downstream with less delay. The old point of release was located close to shore and further upstream where bypassed smolts were likely to be entrained into a back current eddy slowing downriver out migration. The flume was inspected during the winter maintenance period 2011 and observed in good condition and found free of obstructions and rough edges.

Separator

The separator was operated in a similar fashion as previous years. The water level was kept about 1 to 2 inches above the downstream ends of the A-side separator bars. At times the water level was lowered to force fish to pass through the bars. Heavy accumulations of debris occurred in the separator which prompted the facility to clean the separator on June 21 and August 3. The facility switched to primary bypass operations for 1 hour to clean debris from the separator. During debris removal, large numbers of Juvenile Pacific Lamprey (Ammocoete life

stage) were salvaged and released to the river unharmed. During the winter maintenance period, the interior and exterior surfaces of the separator were cleaned and/or 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 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. A new "full flow" unit that monitors the main channel of the juvenile flume upstream from the JFF was added in 2009. Upon the completion of construction and winter maintenance operations, the full flow unit was brought into service for the first time March 23, 2009.

In 2011 the PIT-tag system functioned adequately. There were several occasions early in the season when the timing of the diversion gates were off or the sensor did not adequately detect gate opening an/or closure. These problems were relatively minor and generally did not affect fish diversion. PSMFC personnel usually serviced and corrected the problems within 24 hours.

Direct Barge Loading Operations/Transportation

In 2011, The Juvenile Fish Facility (JFF) was watered up on March 29 with the facility running in Primary by-pass. 24 hour samples were run approximately every 5 days on April 3, 8, 14, 18, 23 and 28. Daily barging and direct loading operations started on May 5. Alternate day barging occurred from May 29 to August 15. On May 22 to May 26 fish were by-passed back to the river due to high flows, large amounts of debris, and barges not able to travel against the current coming down the river. Collection resumed on May 27 with every other day barging beginning on May 29 and ending on August 15. Alternate day trucking occurred from August 17 to October 6. Starting on October 7 every day trucking started and ran through October 31. Every day trucking was initiated because of higher mortality rates presumed to be from Columnaris. Barged fish were transported to a release point at mid-channel below Bonneville Dam.

The 3,500 gallon tanker semi-tractor combination assigned to LGO was not used in 2011. All truck transportation was performed using the one ton truck and 300-gallon midi-tank starting on August 18. On August 21, 23, 25, 27, 29 and 31 LGO piggy backed with LGR due to mechanical problems with the LGO one ton pick-up. On October 8 everyday trucking started and continued through the end of the season due to high mortality (presumed Columnaris). A second truck was equipped with the mini-tank holding 150 gallons. Salt in small concentrations of approximately 1 g/L is added to the midi-tank water to treat potential Columnaris disease and reduce stress. In 2011 trucked fish were again released into the outfall fish flume located at the juvenile fish facility downstream of Bonneville dam.

Avian Predation

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 continuously observed in the tailrace area for several weeks from late April to mid-June, during the peak of the smolt migration season. On some days, up to 300 to 400 gulls were observed roosting on the North Shore riprap. Since 1999, these numbers have been significantly reduced due to bird hazing activities.

In 2011, APHIS bird hazing activities at Little Goose took place from April 13 through June 27. Gulls (*Larus spp.*) were observed throughout the entire year with the peak period

recorded between May 9 and May 15. During the peak period in 2010, daily observations ranged between 25 and 150 gulls. Maximum gull numbers seen in one day in 2011 was 33. In 2011 about half of the numbers of gulls were seen. Total gull numbers counted in 2011 was 4,145. 2010 total gull numbers were 8,112. On average gull numbers were much lower than that observed in previous years. This could be related to the higher flows seen in 2011 over previous years. Higher flows forced the birds farther downstream outside of the counting area.

Double Crested Cormorants (*Phalacrocorax auritus)* numbers continued to be lower in 2011. Cormorant numbers seen in 2010 were 1,030. In 2011 the total count was 438. Cormorants were observed throughout the early juvenile fish migration season but their numbers were usually less than 10. The peak period for Cormorants occurred late July through November also in response to juvenile shad out migration. During the peak period, up to 18 Cormorants were observed during a single sighting (July 26). The majority of the birds were counted within the area one half mile upstream and downstream of the dam. These numbers are far less than the 100 to 200 observed during the previous years (2005-2008) during the same period. The decline in 2009 and 2010 may be the result of lethal take for research purposes. Approximately 45 Cormorants were taken in the fall/winter of 2007-08 and 2008-09.

American White Pelicans (*Pelecanus erythrorhynchos*) numbers increased between 2007 and 2009. In 2010, Pelican observations and numbers were less than that observed in 2009 and in 2011 only a few sightings were recorded near the Dam.

Other piscivorous bird species observed during the 2011 season include Western Grebes (*Aechmophorus occidentalis*) Belted Kingfisher (Ceryle alcyon) and Caspian Terns (*Sterna caspia*).

A summary of actions taken by the Corps to reduce avian predation at Little Goose as follows:

1. Fifteen bird wires were installed over the tailrace area below the powerhouse, thirteen in 1992, one each in 2007 and 2008. Additionally, one bird wire was replaced in 2008. Gulls avoid flying under the wires. Since 1992, proposals have been made to have wires strung below the spillway as well. However, this was not presently feasible due to the lack of an existing structure to which wires could be attached. Bird wires effectively deter gulls, as they tend to locate prey from above. In the case of cormorants, bird wires do not appear to be effective as they approach prey at or below water level.
2. The two 10” bypass pipes were rerouted to swifter water in the middle of the river in 1997. The pipes and much of the support structure are outfitted with needle strips to prevent gulls from perching. The primary bypass flume/pipe was rerouted to this site in 2010. It too was outfitted with needle strips to prevent gulls from perching.
3. A large “sprinkler” is located at the outfall of the bypass flume and pipes. The sprinkler interferes with gull flight patterns, except in high winds.
4. A propane bird scare cannon was successfully utilized in the tailrace to help haze away birds in 2008. A second cannon was purchased in 2008 however, only one cannon was used at a time. The cannon proved to be effective for short-term dispersal of piscivorous birds.
5. The U.S. Department of Agriculture, under contract with the Corps, provided an animal control specialist to work at Little Goose (and Lower Granite) from 1999 to 2002. An animal control specialist has been solely assigned to Little Goose during weekdays from 2003 – 2007. Beginning in 2007, and continuing through 2011, specialists performed hazing activities seven days a week. It is anticipated that similar work will continue well into the future.
6. The upstream 200 feet of the vertical wall of the trash-shear boom located in the forebay was outfitted with needle strips in 2008. The needle strips prevented gulls and cormorants from perching along the top of the wall.

7. The Corps continues to sponsor research to determine best methods to deter prey on salmonid smolts and juvenile Lamprey.

Recommendations

- Inspect and service the trash-shear boom hold down cables.
- Reposition the trash-shear boom to extend it further upstream removing some of the slack created when it was repositioned in March 2009.
- Repair/replace the failed terminal section of the emergency fish bypass/facility drain water pipe
- Install a new log boom with removable closure over the boat access opening.
- Re-lamp the outdoor lighting around the collection facility.
- Prepare and paint the exterior surfaces of pipes and framework of the JFF.
- Install a new back-up generator.
- Rebuild/install new separator.

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