CENWW-OD-EL HOLDREN February, 2015

MEMORANDUM THRU:
Marty Mendiola, Operations Project Manager, Lower Granite Dam

FOR Chief, Operations Division
ATTN: John Bailey / Ann Setter

SUBJECT: Submission of 2014 Juvenile Fish Collection and Bypass Report, Lower Granite Dam Juvenile Fish Facility.

1. Enclosed find the 2014 Juvenile Fish Collection and Bypass Report for Lower Granite Dam as requested.

2. If you have any questions contact Elizabeth Holdren or Ches Brooks at Lower Granite Dam, (509) 843-1493 ext. 263 and (509) 843-1493 ext. 264, respectively.

ELIZABETH A. HOLDREN
Supervisory Fisheries Biologist, Lower Granite Dam

Enclosure

2014 Juvenile Fish Collection and Bypass Report
Lower Granite Dam Juvenile Fish Facility

Prepared by

Elizabeth Holdren

U.S. Army Corps of Engineers

and

Shawn Rapp, Fred Mensik, and Allan Martin

Pacific States Marine Fisheries Commission

February, 2015

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TRANSPORT OPERATIONS - LOWER GRANITE DAM

Introduction

The 2014 collection season at Lower Granite was characterized by average flow and spill conditions and low debris. ESBSs were installed March 17 through March 24. The bypass system and juvenile collection facility were watered up at 0800 hours on March 20. The JFF was operated in secondary bypass until collection for transport began at 0700 hours on May 1. Daily twenty-four hour sampling for fish condition monitoring occurred from March 26 until collection for transport began at 0700 on May 1. On April 25 there were 34,189 juvenile salmonids collected and transported for research studies. Ten agencies conducted seven research projects at the Lower Granite juvenile collection facility this season.

Collection for transport began at 0700 hours on May 1 and ended at 0700 hours on October 31. The facility was returned to secondary bypass at that time and continued in secondary bypass mode through November 14. Smolt collection for the 2014 season was 6,688,226 which is 45.5% higher than 2013 (3,894,569). Of the 6,688,226 fish collected in the 2014 season, 21,255 were trucked, 4,008,679 were barged, and 2,653,853 were bypassed.

Pacific States Marine Fisheries Commission (PSMFC) technicians examined 861 fish for gas bubble trauma (GBT) between April 10 and June 5. Smolts examined prior to May 1 were bypassed to the river and smolts examined after that date were transported. There were no symptoms of GBT observed during the 2014 season.

The passive integrated transponder (PIT) tag system detected 173,065 tagged fish coming through the JFF during the 2014 season, of which 9,288 were diverted to the river or failed to be detected moving to the raceways, the sample, or the exits.

This season's total collection by species group included: 2,431,937 clipped yearling Chinook, 1,010,410 unclipped yearling Chinook, 242,870 clipped subyearling Chinook, 415,002 unclipped subyearling Chinook, 1,856,040 clipped steelhead, 548,219 unclipped steelhead, 18,902 clipped sockeye, 112,122 unclipped sockeye, and 52,724 coho.

Historically Snake River Basin hatchery salmonids were distinguished from wild salmonids by clipped adipose fins (occasionally pectoral or ventral fins). Before 1998, Idaho Fish and Game (IDFG) was the only agency that released sizeable numbers of unclipped hatchery fish. Starting in 1998, increasing numbers of unclipped hatchery fish were released by state, federal, tribal, or other agencies (FPC). Thus salmonids collected, sampled, bypassed, and transported from Lower Granite facilities are designated as clipped/unclipped not hatchery/wild. Snake River Basin Coho were reintroduced by the tribes and are all of hatchery progeny.

Corps of Engineers personnel included: supervisory biologists Elizabeth Holdren and Mike Halter, assistant biologist Ches Brooks, biological technicians: Robert Horal, Mike Casten, John Dammann, Bob Traufer, Dan Caldwell, Geno Sprofera, and truck driver / maintenance personnel: Raymond Cooper, Chuck Krasselt, Jeremy Krewer, Tom Ring. Representing Pacific

States Marine Fisheries Commission (PSMFC) were biologists Fred Mensik, Shawn Rapp, Allan Martin, and Washington Department of Fish and Wildlife (WDF&W) biologist Charles Morrill. PSMFC technicians Jeremy Wright, Julie LaForge, and Bill Fitzgerald conducted fish sampling, and were responsible for the numerous quality control and data keeping tasks.

Facility Modifications

The following modifications were made to the JFF prior to or during the 2014 fish collection season:

1. Refurbished the sample diversion slide gates per PSMFC guidelines.
2. Had the problem fish counters repaired by Smith Root.
3. Sealed sample holding tank floor.
4. Repaired/replaced problem pneumatic gate valves on the raceways.
5. Installed a drain on the 42-inch pipe from the 8th floor gallery to allow full pipe dewatering for post season ROV inspections (powerhouse mechanical crew).
6. Replaced the 24-inch knife gate valve on the separator.
7. Installed updated oxygen monitoring system on the barges.
8. Replaced barge hold fish release plungers.
9. Cleaned up the counter tunnel wire connections in the separator control room.
10. Lower raceway jump screens were fabricated and installed.
11. Installed upper raceways boom crane for NOAA research.
12. Replaced upper raceway stoplogs.
13. Permanent fish screen slot closure work.
14. Removal debris from south make-up water valve.

River Conditions

During the 2014 season, the average daily flow exceeded 100.0 kcfs on 25 days and did not exceed 150 kcfs. The highest daily average flow for the season was 146.4 kcfs on May 26. The lowest daily average flow for the season occurred on September 25 with a flow of 14.2 kcfs. The average flow for the season was 54.6 kcfs. Spill occurred for 152 days from April 3 through midnight on August 31, with a maximum daily average spill of 55.4 on May 26. The RSW was put into operation when Court ordered spill began on April 3, and was taken out of service for the season on August 31. River temperature averaged 58.5^{o} F for the season and ranged from 45.3^{o} F on April 1 to 67.1^{o} F on July 20. A comparison of daily powerhouse flow and spill is shown in Figure 1. Average monthly flow and spill for the 2010-2014 collection seasons are provided in Table 1.

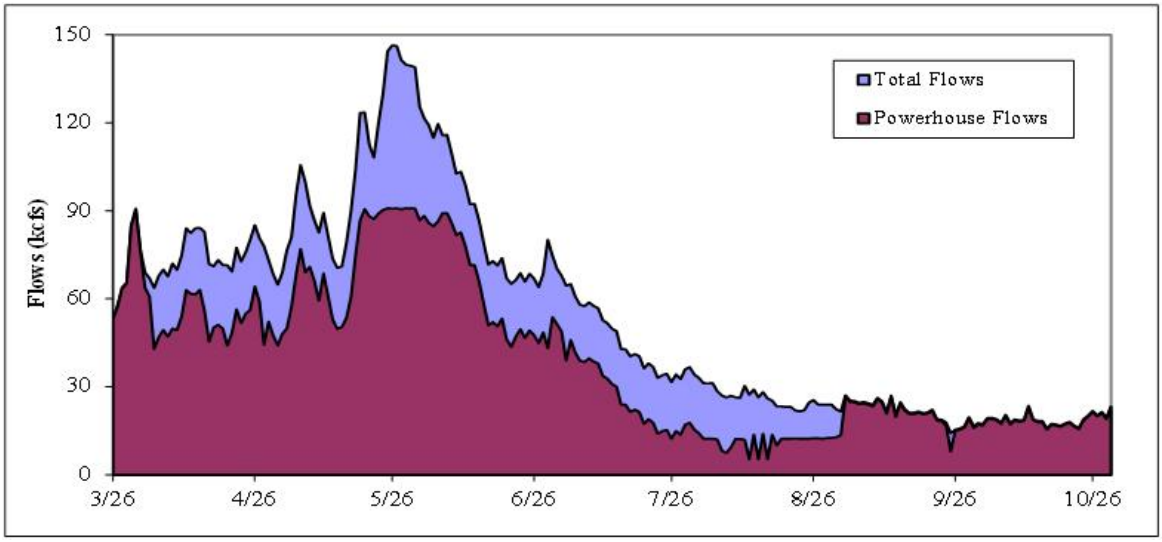

Figure 1. Daily average total flow and powerhouse flow at LWG, 2014.

Table 1. Comparison of average monthly river flow and spill at LWG, 2010-2014.

Flow (kcfs)	**2010**	**2011**	**2012**	**2013**	**2014**	**2010-13 Ave.**
April[1]	39.20	103.55	114.50	52.58	73.67	77.46
May	66.59	140.59	107.14	82.19	104.08	99.13
June	128.16	173.86	90.31	56.31	88.09	112.16
July	49.76	96.77	46.49	33.31	46.64	56.58
August	30.56	39.78	27.28	22.08	26.06	29.92
September	24.17	36.32	22.82	20.42	21.54	25.93
October	19.96	28.04	19.36	23.30	18.86	22.67
Spill (kcfs)						
April[1]	13.74	30.62	29.91	15.56	16.79	22.46
May	20.45	51.49	29.53	21.45	31.10	30.73
June	46.88	63.75	32.38	19.71	23.22	40.68
July	18.78	27.37	21.42	16.71	18.77	21.07
August	16.67	26.05	14.33	11.52	14.19	17.14
September	0.27	0.44	0.27	1.99	0.47	0.74
October	0.00	0.01	0.00	0.00	0.00	0.00

Fish Collection

Migration and Collection

Pre-transport secondary bypass occurred from March 20 through May 1. Fish collection for transportation began at 0700 hours on May 1 and continued until 0700 hours on October 31. An estimated 6,688,226 juvenile salmonids were collected in 2014. This is the highest number of salmonids collected and transported in the last five years (Table 2). Within each species group, the number collected and percent of the total collection was: 2,431,937 clipped yearling Chinook (36.4%), 1,010,410 unclipped yearling Chinook (15.1%), 242,870 clipped subyearling Chinook (3.6%), 415,002 unclipped subyearling Chinook (6.2%), 1,856,040 clipped steelhead (27.8%), 548,219 unclipped steelhead (8.2%), 18,902 clipped sockeye/kokanee (0.3%), 112,122 unclipped sockeye/kokanee (1.7%), and 52,724 coho (0.8%). Post-season secondary bypass occurred from

October 31 through November 14. Daily collection and bypass numbers are provided in Appendix, Table 1.

Table 2. Annual collection, bypass, transportation and mortality at LWG, 2010-2014.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
Collection										
2010	1,193,654	428,713	176,115	454,408	1,008,668	349,497	1,925	3,932	28,365	3,645,277
2011	1,993,789	723,152	229,224	518,262	2,114,802	598,520	23,334	54,806	54,717	6,310,606
2012	1,731,454	962,141	256,860	430,048	1,746,004	607,404	552	30,289	47,678	5,812,430
2013	1,362,720	502,542	173,989	319,566	1,058,688	386,214	27,395	15,377	48,078	3,894,569
2014	2,431,937	1,010,410	242,870	415,002	1,856,040	548,219	18,902	112,122	52,724	6,688,226
Bypass										
2010	161,676	30,184	33	6,880	31,194	17,151	0	11	0	247,129
2011	659,510	350,162	22,184	65,459	1,056,462	219,457	13,591	28,464	14,509	2,429,798
2012	1,024,069	678,689	57	17,163	1,119,949	283,526	0	1,430	8,165	3,133,048
2013	184,931	123,327	12,212	1,485	303,992	52,616	0	54	210	678,827
2014	895,654	605,721	3,013	8,991	920,228	156,884	0	59,640	3,722	2,653,853
Truck										
2010	16	6	72	16,403	2	14	0	64	17	16,594
2011	2	30	52	15,274	3	11	2	89	145	15,608
2012	2	109	145	14,349	6	35	0	207	29	14,882
2013	0	130	456	40,474	3	16	0	112	1	41,192
2014	5	4	486	20,690	0	2	2	64	2	21,255
Barge										
2010	1,030,557	398,227	175,667	429,964	977,239	332,244	1,922	3,850	28,337	3,378,007
2011	1,332,596	372,515	206,271	435,419	1,058,026	378,986	9,715	25,697	40,040	3,859,265
2012	706,147	282,894	255,814	396,998	625,847	323,764	552	28,535	39,447	2,659,998
2013	1,176,085	378,497	161,004	276,789	754,419	333,510	27,386	15,188	47,807	3,170,685
2014	1,535,098	404,342	238,763	383,774	935,573	391,283	18,889	51,966	48,991	4,008,679
Total Transport										
2010	1,030,573	398,233	175,739	446,367	977,241	332,258	1,922	3,914	28,354	3,394,601
2011	1,332,598	372,545	206,323	450,693	1,058,029	378,997	9,717	25,786	40,185	3,874,873
2012	706,149	283,003	255,959	411,347	625,853	323,799	552	28,742	39,476	2,674,880
2013	1,176,085	378,627	161,460	317,263	754,422	333,526	27,386	15,300	47,808	3,211,877
2014	1,535,103	404,346	239,249	404,464	935,573	391,285	18,891	52,030	48,993	4,029,934
Morts										
Facility	1,134	310	606	1,539	142	40	11	452	9	4,243
Res/Sac	46	33	2	8	97	10	0	0	0	196

By the end of May, 91.2% of the total yearly collection had arrived. The percent of total collection arriving by the end of June and the end of July was 98.3% and 99.5%, respectively. The remaining 0.5% of juvenile salmonids was collected during August, September, and October. During this time period, 4.8% of subyearling Chinook was collected. The peak daily collection total and date for each species group were: clipped yearling Chinook 287,000 (May 6), unclipped yearling Chinook 48,000 (April 24), clipped subyearling Chinook 12,900 (June 3), unclipped subyearling Chinook 18,600 (June 3), clipped steelhead 126,200 (April 27), unclipped steelhead 31,000 (May 8), clipped sockeye 8,900 (May 18), unclipped sockeye 10,800 (May 5), and coho 5,600 (May 19). Total daily collection in 2014 peaked at 438,800 (May 6). Daily

collection of all species combined versus total flow is shown graphically in Figure 2. Peak collection date and daily collection total by species group are listed in Table 3.

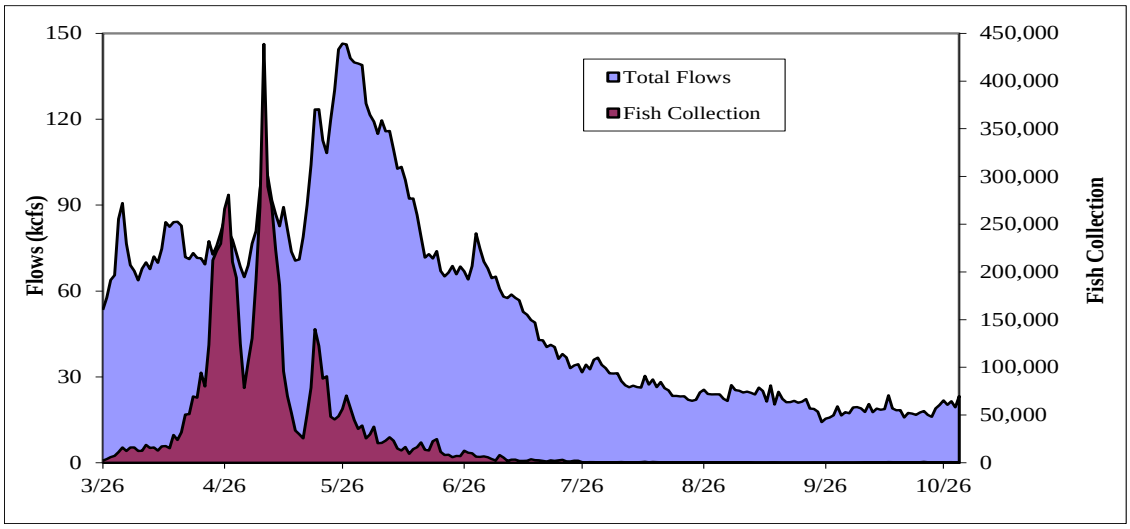

Figure 2. Fish collection and daily average flows at LWG, 2014.

Table 3. Annual peak collection days at LWG, 2010-2014.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2010	28-Apr	28-Apr	5-Jun	5-Jun	21-May	21-May	6-Jun	21-May	20-May	21-May
	73,800	25,200	23,700	40,200	81,800	23,600	400	800	4,800	183,000
2011	12-May	12-May	19-Jun	28-May	3-Apr	12-May	25-May	22-May	12-May	12-May
	165,200	33,800	12,550	25,600	160,139	48,000	4,800	2,300	5,200	375,600
2012	26-Apr	26-Apr	4-Jun	5-Jun	26-Apr	26-Apr	9-May	18-May	18-May	26-Apr
	135,000	69,400	15,000	20,800	119,000	37,400	200	5,200	6,300	362,200
2013	8-May	13-May	9-Jun	9-Jun	13-May	13-May	16-May	17-May	14-May	13-May
	129,641	37,800	20,100	16,225	89,200	42,400	13,000	4,600	9,400	244,000
2014	6-May	24-Apr	3-Jun	3-Jun	27-Apr	8-May	18-May	5-May	19-May	6-May
	287,000	48,000	12,900	18,600	126,200	31,000	8,900	10,800	5,600	438,800

Adult Fallbacks

A total of 8,104 adult salmonids fell back through the juvenile bypass system and were bypassed from the separator between March 26 and October 31, 2014 (Table 4). The total includes: 1,943 adult Chinook salmon, 848 jack Chinook salmon, 2,662 clipped steelhead, 2,546 unclipped steelhead, 26 sockeye, and 79 coho. Steelhead kelts are included in the total though they are not technically fallbacks. Fallbacks that went through the separator bars entered the raceways and were transported or were sent to the sample system and bypass to the river. These fish were not counted by the separator technician. The total fallback number in 2014 was higher than previous 5 year average with the 2011 being the highest and 2012 the lowest. From March 21 to March

25 there were 142 adult steelhead (56 clipped and 86 unclipped) released from the separator that are not included in the 8,104 collection season total. Daily adult fallbacks and fallback mortalities can be found in Appendix, Table 4.

Table 4. Annual totals of salmonids released from the separator at LWG, 2010-2014.

	Adult Chinook		Jack Chinook		Steelhead		Sockeye	Coho	
Year	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip			Totals
2010	779	523	226	129	2,683	2,527	11	15	6,893
2011	1,069	673	794	453	2,920	3,410	4	17	9,340
2012	581	383	716	496	1,683	2,256	3	6	6,124
2013	1,160	963	1,058	768	1,242	1,058	5	11	6,265
2014	951	992	455	393	2,662	2,546	26	79	8,104
10-13 avg.	897	636	698	462	2,132	2,313	6	12	7,156

Steelhead were the most common adult salmonids species removed from the separator in 2014. The months of April and May accounted for 51.4% of adult steelhead removed from the separator and August, September, and October 41.5% of the steelhead fallback in 2014. The total number of steelhead fallbacks removed from the separator include out migrating kelts. The majority of Chinook adults and jacks were removed from the separator during September and October (fall Chinook). Sockeye fallbacks were highest in July while coho fallbacks were highest in October (Table 5).

Table 5. Monthly totals of adult salmonids released from the separator at LWG, 2014.

	Adult Chinook		Jack Chinook		Steelhead		Sockeye	Coho	
Month	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip			Totals
April[1]	0	2	0	0	545	477	0	0	1,024
May	84	52	19	2	673	980	0	0	1,810
June	52	32	7	6	39	305	0	0	441
July	32	24	6	6	14	14	19	0	115
August	22	11	0	2	142	107	3	0	287
September	186	231	83	77	798	382	4	3	1,764
October	575	640	340	300	451	281	0	76	2,663
Totals	951	992	455	393	2,662	2,546	26	79	8,104

[1] Includes March 26-31

The condition of adult salmonids was evaluated as they were released from the separator (Table 6). Their condition was predominantly good to fair with 92.0% of the fallbacks rated in these categories. Condition ratings of the 8104 adults examined were as follows: 6,290 good (77.6%), 1166 fair (14.4%), 538 poor (6.6%), and 110 were dead (1.4%). Adult salmonid mortalities include: 5 clipped and 2 unclipped Chinook, 74 clipped and 28 unclipped steelhead, and 1 coho. Adult Chinook had a higher percentage of good/fair fish (96.6%) than steelhead (89.1%).

Table 6. Condition of adult salmonids released from the separator at LWG, 2014.

	Adult Chinook		Jack Chinook		Steelhead		Sockeye	Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip			Totals
Good	842	910	427	374	1,944	1,704	25	64	6,290
Fair	67	57	21	17	447	545	1	11	1,166
Poor	37	23	7	2	197	269	0	3	538
Dead	5	2	0	0	74	28	0	1	110
Total	951	992	455	393	2,662	2,546	26	79	8,104

Sampling

Consistent with the 2014 Fish Operations Plan (FOP), Fish Passage Plan (FPP) Appendix B and guidance provided by the Technical Management Team (TMT), the juvenile fish transportation program allows for a variable start date, based on expected river flows. During years when the spring seasonal average river flow in the Snake River is expected to equal or exceed 65 kcfs, transport operations will begin on start dates between April 21 and May 1 at Lower Granite, Little Goose, and Lower Monumental Dams. Prior to a dam's transport start date, all fish collected will be bypassed to the river. In years when the spring seasonal average river flow is expected to be below 65 kcfs, transport operations at Lower Granite Dam will start on April 1. This year TMT put out a system operational request (SOR) for the start of transportation at Lower Granite, Little Goose, and Lower Monumental to begin at 0700 hours on May 1. All fish sampled prior to transport were bypassed to the river with the exception of 34,189 research fish.

Sampling is diverting and segregating groups of fish in a consistent fashion so that data collected from those segregated groups will accurately represent the sum total of the fish being collected in real time. Sampling is not the act of evaluating those groups. Lower Granite fish sampling began at 0700 hours on March 26 and ended at 0700 hours on October 31. A total of 220 daily samples were processed this season. The sample rate was set at 10% on March 26 and fluctuated throughout the season based on guidelines provided by the Fish Passage Center (FPC) according to daily fish numbers and to accommodate research needs. Fish were sampled daily from March 26 to August 16. Every other day sampling at a rate of 100% started on August 17 through the end of the season. The sample holding tank was crowded at 0700 every other day to separate day one fish from day two fish. On transport days each day's sample was worked up separately. The sample rate was lowered to 50% on October 13-15, October 21-25, and October 27-31 due to increases subyearling fall Chinook. During 2014 the smolt monitoring staff sampled 80,606 smolts, 1.2% of the total collection compared to 100,673 smolts (2.6%) in 2013 (Table 7).

Table 7. Annual percentage of smolts sampled at LWG, 2010-2014.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2010	0.8	0.8	2.3	8.3	0.8	0.9	1.6	3.1	1.0	1.8
2011	0.6	0.7	2.0	6.9	0.8	0.8	1.1	1.7	1.5	1.3
2012	0.8	0.9	3.8	10.4	0.8	0.9	1.4	2.1	1.2	1.7
2013	1.1	1.3	5.8	15.4	1.3	1.2	0.6	1.6	0.8	2.6
2014	0.6	0.8	2.9	8.5	0.6	0.6	0.8	1.1	0.5	1.2
10-13 Ave.	0.8	0.9	3.4	9.7	0.9	0.9	0.8	1.9	1.1	1.7

The sample rate was not raised above FPC guidelines for the prototype weir/14 inch orifice evaluation study in 2014 as it was in the 2013 season. The total number of smolts sampled in 2014 by species included: 14,013 clipped yearling Chinook, 7,985 unclipped yearling Chinook, 7,025 clipped subyearling fall Chinook, 35,266 unclipped subyearling fall Chinook, 11,218 clipped steelhead, 3,479 unclipped steelhead, 150 clipped sockeye, 1,182 unclipped sockeye/kokanee, and 288 coho (Table 8).

Table 8. Weekly sample totals at LWG, 2014.

Week	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Ending	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
27-Mar	108	362	0	4	2	50	0	84	1	611
3-Apr	537	1,183	0	31	488	185	0	293	4	2,721
10-Apr	585	839	0	19	437	91	0	131	0	2,102
17-Apr	687	1,078	0	7	481	183	0	117	0	2,553
24-Apr	1,395	1,190	0	18	1,485	219	0	39	4	4,350
1-May	2,653	997	0	10	2,709	392	0	143	15	6,919
8-May	4,779	977	0	16	1,886	559	0	195	56	8,468
15-May	1,717	402	0	18	963	443	1	18	42	3,604
22-May	1,282	433	0	13	1,158	606	144	37	85	3,758
29-May	164	211	161	278	594	375	3	10	62	1,858
5-Jun	32	59	491	733	281	105	0	8	7	1,716
12-Jun	42	131	792	1,078	322	157	0	3	7	2,532
19-Jun	11	60	1,489	1,718	207	55	0	8	2	3,550
26-Jun	8	34	853	1,173	96	20	0	8	0	2,192
3-Jul	8	23	899	1,350	63	7	0	8	1	2,359
10-Jul	1	2	666	1,435	26	4	0	11	0	2,145
17-Jul	1	0	457	1,578	10	1	0	3	0	2,050
24-Jul	0	0	435	2,309	3	1	0	4	0	2,752
31-Jul	0	0	97	904	3	0	0	0	0	1,004
7-Aug	0	0	137	1,661	0	1	0	1	0	1,800
14-Aug	0	0	85	2,357	0	0	0	4	0	2,446
21-Aug	0	0	99	3,010	0	1	1	6	0	3,117
28-Aug	0	1	125	3,212	2	5	0	7	0	3,352
4-Sep	0	0	58	1,908	1	1	1	4	1	1,974
11-Sep	0	1	24	956	0	5	0	2	0	988
18-Sep	0	0	14	433	0	1	0	4	0	452
25-Sep	0	0	4	244	0	4	0	1	0	253
2-Oct	0	0	1	218	1	3	0	1	0	224
9-Oct	0	0	23	1,441	0	3	0	6	1	1,474
16-Oct	0	1	43	2,520	0	0	0	5	0	2,569
23-Oct	1	1	33	2,369	0	2	0	14	0	2,420
30-Oct	2	0	36	1,938	0	0	0	6	0	1,982
31-Oct	0	0	3	307	0	0	0	1	0	311
Total	14,013	7,985	7,025	35,266	11,218	3,479	150	1,182	288	80,606

Transportation

An estimated 4,029,934 juvenile salmonids (60.3% of the collection) were transported from

Lower Granite Dam in 2014. The number of fish and the percentage of collection that was transported of each species group included: 1,535,103 clipped yearling Chinook (63.1%), 404,346 unclipped yearling Chinook (40.0%), 239,249 clipped subyearling fall Chinook (98.5%), 404,464 unclipped subyearling fall Chinook (97.5%), 935,573 clipped steelhead (50.4%), 391,285 unclipped steelhead (71.4%), 18,891 clipped sockeye (99.9%), 52,030 unclipped sockeye/kokanee (46.4%) and 48,993 coho (92.9%). Of these, approximately were transported 4,008,679 by barge by and 21,255 by truck. Daily truck and barge transportation numbers are provided in Appendix, Table 2.

Lower Granite transported an estimated 4,008,679 (59.9% of the collection) juvenile fish by barge from May 1 through August 16. Every day barging operations occurred from May 2 through May 30. Beginning June 1 fish were transported every other day through August 16. The number of fish barged and the percent barged of the total collection for each species group included: 1,535,098 clipped yearling Chinook (63.1%), 404,342 unclipped yearling Chinook (40.0%), 238,763 clipped subyearling fall Chinook (98.3%), 383,774 unclipped subyearling fall Chinook (92.5%), 935,573 clipped steelhead (50.4%), 391,283 unclipped steelhead (71.4%), 18,889 clipped sockeye (99.9%), 51,966 unclipped sockeye/kokanee (46.3%) and 48,991 coho (92.9%). On April 25 the Corps transported 34,189 juvenile fish for NOAA research which is included in the barge total.

The aging Point Four systems on all 4000 and 8000 series barges were replaced with a new Point Four oxygen monitoring system during the barge maintenance season. The new system is easier to calibrate and operated without any problems during the 2014 transport season. Numerous YSI portable oxygen monitoring units are kept on barges as a backup for the Point Four systems.

Lower Granite Project fabricated barge hold fish evacuation plungers to replace old plungers that deteriorated from sunlight and exposure to extreme summer temperatures. Plungers were replaced on the 8000 series and replacement of the 4000 series plungers continues on a priority basis. On May 10 the pneumatic actuator shaft for the fish evacuation plunger in the right rear hold of barge 8106 failed to open due to a separation of the shaft from the coupler fitting. The barge was returned to Lower Granite with about 46,635 smolts (corrected number) in the right rear hold. Of these, 11,691 fish were part of NMFS transport survival study. Fish were continuously monitored by a biological technician until the Lower Granite mechanical crew was able to winch the plunger with a chain fall at 0900 hours on May 13. Fish were released in the Lower Granite good condition. Fish evacuation plunger shafts were inspected on the remaining 8000 and 4000 series barge holds.

There was no early season trucking from Lower Granite this year. Juvenile fish were trucked by midi-tanker or semi truck from August 18 through October 31. All truck trips were made with the 300 gallon pickup mounted except for Oct 13, 21, 23, 27, 29 and 31 when increased fish numbers necessitated using the larger capacity semi-truck and trailer. The COE transported 21,255 smolts by truck which is 0.3% of the total juvenile collection. The number of smolts trucked by species included and percent of those collected in that group was: 5 clipped yearling Chinook, 4 unclipped yearling Chinook, 486 clipped subyearling Chinook, 20,690 unclipped subyearling Chinook, 2 unclipped steelhead, 2 clipped sockeye/kokanee, 64 unclipped sockeye/kokanee, and 2 coho. Water temperatures and oxygen levels were monitored to ensure acceptable levels. When needed, raw river water is added to the midi-tanker to keep the water

temperature at an acceptable level for the trip to Bonneville. This was not required in 2014. Very little tempering was required at the release site.

Bypass

The collection facility operated in secondary bypass mode from March 20 through May 1. From March 26 through May 1, prior to collection for transport 2,602,464 fish were bypassed from the Lower Granite collection facility. During the May 1 through October 31 juvenile transport season 51,389 smolts were bypassed from the facility (Table 2). Of the 2,653,853 smolts bypassed (March 26 through October 31) the number bypassed in each species group and percent of those collected in that group was: 895,654 clipped yearling Chinook (36.8%), 605,721 unclipped yearling Chinook (59.9%), 3,013 clipped subyearling fall Chinook (1.2%), 8,991 unclipped subyearling fall Chinook (2.2%), 920,228 clipped steelhead (49.6%), 156,884 unclipped steelhead (28.6%), 59,640 unclipped sockeye/kokanee (53.2%) and 3,722 coho (7.1%). These numbers include fish examined for GBT prior to the transport season and fish given for research projects during the transport season. This does not include fish bypassed by the PIT tag diversion system. Juvenile salmonids were bypassed rather than transported for the following purposes this season.

1. Secondary bypass occurred from March 20 through May 1. Sampling occurred March 25 through May 1 for fish condition monitoring (COE). Fish sampled during this period are included in the facility bypass total.
2. GBT inspections during the non-transport period of April 10 through May 1 accounted for a total of 400 fish bypassed. Within each species group the number bypassed was: 148 clipped yearling Chinook, 112 unclipped yearling Chinook, 117 clipped steelhead, and 23 unclipped steelhead.
3. As part of five research projects 117,477 fish were collected and bypassed (See; Research Section). These fish are included in the bypass numbers of this report.
4. The facility was put in primary bypass for about 10 minutes on October 2 and about 40 minutes on October 3 to remove debris from the incline screen. Fish were diverted directly to the river and were not enumerated.
5. On October 21, PSMFC inadvertently bypassed 279 sample smolts (5 clipped and 272 unclipped subyearling Chinook, and 2 unclipped sockeye) directly to the river from the sample recover tank. Prior to truck loading procedures PSMFC personnel failed to check the position of the fish release valve. The valve was in the barge loading position.
6. The PTAGIS3 database revealed that 107,937 PIT-tagged fish of different species groups were bypassed through the PIT tag system. These fish are not included in the facility bypass total.

According to the PTAGIS database, 173,065 PIT-tagged fish were detected at LWG in 2014. Of these, 107,937 (62.4%) were bypassed to the river through the PIT-tag diversion system, 54,571 (31.5%) were diverted to the raceways, 1,269 (0.7%) were diverted to the sample tank and 9,288 (5.4%) were not detected at any of the bypass, raceway or sample exit monitors and their final disposition is unknown. Before May 1, all PIT-tagged fish were bypassed to the river except for those transported on the research barge that left LWG on April 25.

Incidental Species

Non-target fish species that were too large to pass through the separator bars were recorded and bypassed through the adult release pipe at the separator. Those that were small enough to pass through the separator bars were either sampled and bypassed, or held in the raceways and transported with the juvenile salmonids. Sample fish from each incidental species were counted and their total numbers were calculated using the sample rate. These numbers were then added with separator counts of the same group to estimate the total collection for each species.

Table 9. Estimated collection of incidental fish species at LWG, 2014.

Common Name	*Scientific Name*	Separator	Expanded Sample	Total Collection[1]
American Shad (Adult)	*Alosa sapidissima*	7	22	29
American Shad (Juvenile)	*A. sapidissima*		29	29
Banded Killifish	*Fundulus diaphanus*		25	25
Bass, Largemouth	*Micropterus salmoides*		3	3
Bass, Smallmouth	*M. dolomieui*	3	2,034	2,037
Bullhead (misc.)	*Amierus sp.*		282	282
Catfish, Channel	*Ictalurus punctatus*	23	1,117	1,140
Catfish, Flathead	*Pylodictis olivaris*			0
Chiselmouth	*Acrocheilus alutaceus*		459	459
Common Carp	*Cyprinus carpio*	21	52	73
Crappie (misc)	*Pomoxis sp.*	2	526	528
Dace, Longnose	*Rhinichthys cataractae*		216	216
Dace, Speckled	*R. osculus*		2	2
Kokanee	*Oncorhynchus nerka*		0	0
Northern Pikeminnow	*Ptychocheilus oregonensis*	3	34	37
Pacific Lamprey (Adult)	*Entosphenus tridentatus*	1	39	40
Pacific Lamprey (Ammocoete)	*E. tridentatus*		8,252	8,252
Pacific Lamprey (Macrophthalmia)	*E. tridentatus*		11,090	11,090
Peamouth	*Mylocheilus caurinus*	2	3,505	3,507
Redside Shiner	*Richardsonius balteatus*		0	0
Sand Roller	*Percopsis transmontana*		7,693	7,693
Sculpin	*Cottus sp.*		141	141
Siberian Prawn	*Exopalaemon modestus*		9,839	9,839
Sucker (misc.)	*Catostomus sp.*	932	2,204	3,136
Sunfish (misc.)	*Lepomis sp.*		1,553	1,553
Trout, Bull	*Salvelinus Malma*		0	0
Trout, Cutthroat	*Oncorhynchus clarkii*		1	1
Trout, Rainbow	*O. mykiss*		360	360
Walleye	*Stizostedion vitreum*		0	0
Warmouth	*Lepomis gulosis*		5	5
White Sturgeon	*Acipenser transmontanus*	16	0	16
Whitefish	*Prosopium sp.*	3	734	737
Yellow Perch	*Perca flavescens*		0	0
Total		1,013	50,217	51,230

[1]Separator count plus expanded sample count equals estimated total facility collect.

An estimated 51,230 non-salmonid incidental fish were collected at the fish facility during the March 26 to October 31 passage period (Table 9). This is a 53.1% increase from number of incidental species in 2013. Pacific lamprey macrophthalmia were the most abundant incidental species with 11,090 collected. Siberian prawns were the second most abundant incidental

species with 9,839 and were euthanized per WDFW instructions rather than released to the river. Pacific lamprey ammocoetes were the third most abundant incidental species with 8,252 collected. Sandrollers were the third most abundant species with 7,693 collected.

Fish Condition

Descaling

Standard descaling criteria identifies a fish with 20% or greater scale loss on one side of its body. If scale loss is less than 20% on one side the fish is not considered descaled. Descaling data was collected from all live sample fish (full sample) rather than just a portion (subsample). Full sample data collection provides a larger sample size and therefore a better representation of fish condition.

The descaling rate for all fish sampled in 2014 was 1.3% which is the lowest cumulative descaling in the last five years and the second lowest descaling rate ever observed at Lower Granite. The annual descaling rate by species group was: clipped yearling Chinook 0.9%, unclipped yearling Chinook 0.6%, clipped subyearling Chinook 0.7%, unclipped subyearling Chinook 1.8%, clipped steelhead 1.3%, unclipped steelhead 1.2%, clipped sockeye/kokanee 0.0%, unclipped sockeye/kokanee 2.6%, and coho 1.0%. Annual descaling rates ranged from a low of 1.3% in 2014 to a high of 2.7% in 2013. Annual descaling rates are summarized in Table 10.

Table 10. Annual full-sample descaling rates (>20%) by species at LWG, 2010-2014.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2010	1.4	0.7	0.5	2.4	2.5	1.7	0.0	11.2	0.7	2.0
2011	2.6	1.1	0.8	2.2	2.5	2.2	1.6	6.2	2.2	2.2
2012	2.8	0.8	1.9	2.9	3.0	2.2	0.0	5.4	1.1	2.6
2013	3.1	1.6	2.0	3.0	2.6	2.5	1.9	7.4	2.7	2.7
2014	0.9	0.6	0.7	1.8	1.3	1.2	0.0	2.6	1.0	1.3
10-13 Ave.	2.6	1.1	1.5	2.7	2.6	2.2	1.6	6.4	1.8	2.4

The highest weekly descaling rate for all species combined was 7.31% for the week ending October 2. The lowest descaling rates were 0.3% the week April 3 followed by 0.37% the weeks of June 19 and August 14 (Table 11). As has been observed in the past, descaling rates increased as sample size decreased during the late August, September, and October. The forebay elevation was raised to 737 feet during the last week in September resulting in a pulse of debris at the juvenile collection facility. Trashracks for units 1-3 were raked on October 9 to ensure debris buildup was not a contributing factor. Minimal debris was removed during this effort. Daily descaling rates are provided in Appendix, Table 3.

Injuries and Disease

Injury data was gathered from a sub sample of 100 of the dominant species and not more than 100 each of the non-dominant species. There were 26,724 fish examined for injury and disease

in 2014. The body injuries associated with dam passage that were recorded this season included a generic body injury category and a generic fin injury category. Head injuries that were associated with dam passage include generic head injuries, eye injuries, operculum injuries and "pop" or bulging eye. Fish were also examined for external symptoms of fungus, columnaris, bacterial kidney disease, and parasites.

Table 11. Weekly descaling rates in percent for fish sampled at LWG, 2014.

Week	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Ending	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
27-Mar	0.00%	1.11%	--	--	0.00%	0.00%	--	1.27%	0.00%	0.83%
3-Apr	0.38%	0.17%	--	0.00%	0.00%	0.00%	--	1.43%	0.00%	0.30%
10-Apr	0.69%	0.12%	--	--	0.23%	0.00%	--	2.33%	--	0.43%
17-Apr	0.29%	0.28%	--	--	1.05%	0.00%	--	0.00%	--	0.40%
24-Apr	0.94%	0.42%	--	--	0.81%	0.46%	--	0.00%	0.00%	0.72%
1-May	0.98%	0.20%	--	--	0.41%	0.51%	--	0.74%	0.00%	0.61%
8-May	1.03%	1.44%	--	--	1.65%	1.26%	--	2.08%	1.79%	1.26%
15-May	1.00%	1.26%	--	0.00%	2.61%	0.68%	0.00%	6.25%	0.00%	1.44%
22-May	1.10%	1.39%	--	0.00%	2.17%	1.65%	0.00%	2.78%	2.35%	1.55%
29-May	0.61%	0.48%	0.00%	0.00%	3.71%	2.13%	0.00%	0.00%	0.00%	1.75%
5-Jun	3.13%	0.00%	0.00%	0.29%	1.43%	3.85%	--	0.00%	0.00%	0.66%
12-Jun	0.00%	0.77%	0.64%	0.57%	1.25%	2.55%	--	0.00%	0.00%	0.80%
19-Jun	10.00%	0.00%	0.34%	0.30%	0.49%	1.82%	--	0.00%	0.00%	0.37%
26-Jun	0.00%	0.00%	0.24%	0.35%	1.04%	10.00%	--	0.00%	--	0.42%
3-Jul	0.00%	0.00%	0.45%	0.76%	1.61%	0.00%	--	0.00%	0.00%	0.65%
10-Jul	--	0.00%	0.46%	0.36%	0.00%	0.00%	--	0.00%	--	0.38%
17-Jul	0.00%	--	0.67%	0.32%	0.00%	0.00%	--	0.00%	--	0.40%
24-Jul	--	--	0.95%	0.58%	33.33%	0.00%	--	33.33%	--	0.71%
31-Jul	--	--	3.13%	0.34%	0.00%	--	--	--	--	0.61%
7-Aug	--	--	1.49%	0.61%	--	0.00%	--	0.00%	--	0.68%
14-Aug	--	--	1.19%	0.30%	--	--	--	25.00%	--	0.37%
21-Aug	--	--	3.06%	0.74%	--	0.00%	0.00%	0.00%	--	0.81%
28-Aug	--	--	0.81%	1.70%	0.00%	20.00%	--	14.29%	--	1.72%
4-Sep	--	--	5.17%	1.90%	0.00%	0.00%	0.00%	75.00%	0.00%	2.15%
11-Sep	--	0.00%	4.17%	2.43%	--	0.00%	--	100.00%	--	2.66%
18-Sep	--	--	0.00%	4.25%	--	0.00%	--	25.00%	--	4.29%
25-Sep	--	--	25.00%	5.06%	--	0.00%	--	0.00%	--	5.28%
2-Oct	--	--	0.00%	7.51%	0.00%	0.00%	--	0.00%	--	7.31%
9-Oct	--	--	0.00%	5.77%	--	0.00%	--	16.67%	0.00%	5.70%
16-Oct	--	0.00%	4.76%	4.13%	--	--	--	0.00%	--	4.13%
23-Oct	0.00%	0.00%	9.09%	3.50%	--	0.00%	--	23.08%	--	3.68%
30-Oct	0.00%	--	2.86%	5.06%	--	--	--	0.00%	--	5.00%
31-Oct	--	--	0.00%	4.28%	--	--	--	100.00%	--	4.55%
# Descaled	130	44	47	628	144	43	0	29	3	1,068
# Sampled	13,928	7,931	6,928	34,507	11,173	3,463	150	1,134	287	79,501
% Descaled	0.93%	0.55%	0.68%	1.82%	1.29%	1.24%	0.00%	2.56%	1.05%	1.34%

Body injuries were observed on 7.2% of the smolts examined in the detailed subsample. Blood pooling is defined as the vasodilatation of the capillaries in fins (also referred to as fin pinkness).

It seems to be a symptom of anesthetic use during higher water temperatures and is mostly found on subyearling Chinook. Fin hemorrhaging is the discharge of blood outside the body and is a sign of trauma. Of the smolts sampled for body injuries, the most common symptom observed in 2014 was blood pooling (43.9%), followed by discolored fin (23.2%), and fin injuries (22.6%). Unclipped subyearling fall Chinook exhibited the highest percent of body injuries at 10.5% (1,228 of 11,669 fish examined) followed by clipped steelhead at 6.6% (248 of 3,747 fish examined)

Head injuries were recorded on 0.4% of the smolts examined in the detailed subsample. Injuries to the eyes comprised the majority of head injuries (38.2%) followed by operculum injuries (37.3%) and eye hemorrhages (13.6%). Unclipped sockeye had the highest occurrence of head injuries at 0.7% (4 of 561 fish examined) followed by clipped yearling Chinook at 0.6% (20 of 3,318 fish examined).

Injuries associated with predators include wounds inflicted by other fish, birds, and lamprey. Predator wounds were observed on 0.6% of the smolts examined. Predator marks caused by birds, characterized by a distinct V-shaped descaling pattern on both sides of a fish were the most common predator mark (56.1%) compared to 42.2% caused by fish and 1.7% caused by lamprey. Predator marks were highest on clipped sockeye at 3.4% (2 of 59 fish examined), clipped steelhead at 1.4% (53 of 3,747 fish examined) and unclipped steelhead at 1.3% (20 of 1,574 fish examined). Although clipped sockeye exhibited the highest percentage of predator marks by number, examined clipped steelhead had the largest percentage of total predation marks at 30.6%. Typically larger steelhead smolts have the most predation marks due to bird bites.

External symptoms of disease were observed on 3.4% of the smolts examined in the detailed subsample compared to 4.2% in 2013, 4.4% in 2012, 2.1% in 2011 and 3.5% in 2010. Symptoms of disease were most common on unclipped subyearling fall Chinook, which exhibit the majority of the signs of columnaris. Columnaris comprised the majority of the disease symptoms (45.6%) followed by fin hemorrhages (29.8%) and parasites (13.8%).

Fungus was found on 0.2% of all fish examined. Fungus was found on all species and rearing types with the exception of coho. The occurrence of fungus is generally seen early in the season while the water is still relatively cold.

Columnaris is caused by the bacterium *Flavobacterium columnare* that becomes more virulent when water temperatures exceed 60º F. Therefore summer and fall Chinook migrants are more susceptible to infection. Columnaris can be recognized by the presence of yellowish lesions on the belly, damage to the gills, pelvic fins, snout, and caudal fins. SMP at Lower Granite only classify fish as being infected with columnaris if there is some tissue loss on the snout or body (fish with only red mouth edges are not classified as infected). Columnaris was identified at Lower Granite in 1996 and symptoms in sample fish have been recorded since1999. Typically the first incidence of columnaris is observed in July after the majority of subyearling fall Chinook have passed the project. The columnaris infection rate for the entire sample of subyearling fall Chinook in 2014 was 1.8% (736 of 41,386) compared to 1.4% (796 of 58,510) in 2013, 2.1% (1,119 of 53,799) in 2012, 1.1% (440 of 39,375) in 2011 and 1.3% (550 of 41,116) in 2010.

Mortality

Facility mortality includes fish removed from the barges or trucks before departure, sample mortalities, recovery tank mortalities, separator mortalities and raceway mortalities, including the east raceways, which are used by NMFS for research. Annual facility mortality for all groups combined was 0.06% in 2014 and totaled 4,243 fish (Table 12). This is the lowest facility mortality rate in the last five years. All species group mortality rates were lower than those observed for the 2010-2013 average except for unclipped subyearling fall Chinook. Within each species group, the number of facility mortalities and percent of those collected in that group was: 1,134 clipped yearling Chinook (0.05%), 310 unclipped yearling Chinook (0.03%), 606 clipped subyearling fall Chinook (0.25%), 1,539 unclipped subyearling Chinook (0.37%), 142 clipped steelhead (0.01%), 40 unclipped steelhead (0.01%), 11 clipped sockeye (0.06%), 452 unclipped sockeye/kokanee (0.40%) and nine coho (0.02%).

Table 13. Annual facility mortality in percent by species group at LWG, 2010-2014.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2010	0.09	0.06	0.19	0.25	0.02	0.02	0.16	0.18	0.04	0.08
2011	0.08	0.04	0.31	0.39	0.01	0.01	0.11	1.01	0.04	0.09
2012	0.07	0.04	0.33	0.36	0.01	0.01	0.00	0.39	0.08	0.08
2013	0.12	0.11	0.16	0.26	0.02	0.02	0.03	0.15	0.12	0.10
2014	0.05	0.03	0.25	0.37	0.01	0.01	0.06	0.40	0.02	0.06
10-13 Ave.	0.09	0.06	0.26	0.32	0.02	0.01	0.07	0.67	0.07	0.09

Weekly facility mortality rates were low during April and May, increased during June and July but did not increase over 1% until the week ending July 24. The mortality rate increased as the sample size decreased in the middle of September to a maximum weekly mortality rate of 2.77% the week of September 25. Mortality rates decreased to the end of the season (Table 14).

Sample mortalities include dead fish removed from the sample tank prior to sampling and those from the sorting trough in the sample lab. Annual sample mortality for all groups combined was 1.05% in 2014 (Table 15) and totaled 845 fish. The number of sample mortalities and mortality rate by species group was: 85 clipped yearling Chinook (0.61%), 54 unclipped yearling Chinook (0.68%), 97 clipped subyearling fall Chinook (1.38%), 499 unclipped subyearling fall Chinook (1.41%), 45 clipped steelhead (0.40%), 16 unclipped steelhead (0.46%), 48 unclipped sockeye/kokanee (4.06%), and 1 coho (0.35%). Sample mortality for all groups combined has ranged from a high of 1.1% in 2014 to a low of 0.8% in 2010.

Barge mortalities are salmonids removed from barge holds after the barges depart LWG. The total number of smolts barged in 2014 included: 4,008,679 fish from LWG, 3,744,814 from LGS and 2,141,419 fish from LMN. The barge mortality rate of 0.04% (3,677 of 9,894,912) is lower than observed in 2013 or for the 2010-2013 average and is the lowest barge mortality rate in the last five years (Table 17). Barge mortalities by species group included: 1,562 clipped yearling Chinook, 427 unclipped yearling Chinook, 621 subyearling fall Chinook, 476 clipped

steelhead, 159 unclipped steelhead, four clipped sockeye, 328 unclipped sockeye/kokanee and 100 coho (Table 16).

Table 14. Weekly facility mortality in percent by species group at LWG, 2014.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Week Ending	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
27-Mar	0.09%	0.03%	--	5.00%	0.00%	0.00%	--	0.60%	0.00%	0.15%
3-Apr	0.04%	0.02%	--	0.43%	0.00%	0.02%	--	0.19%	0.00%	0.04%
10-Apr	0.01%	0.01%	--	0.42%	0.00%	0.00%	--	0.03%	--	0.01%
17-Apr	0.01%	0.02%	--	0.17%	0.01%	0.00%	--	0.15%	--	0.02%
24-Apr	0.01%	0.01%	--	0.17%	0.00%	0.00%	--	0.05%	0.00%	0.01%
1-May	0.00%	0.00%	--	0.20%	0.00%	0.00%	--	0.04%	0.00%	0.00%
8-May	0.09%	0.08%	--	0.44%	0.01%	0.01%	--	0.83%	0.04%	0.08%
15-May	0.04%	0.05%	--	0.06%	0.01%	0.01%	0.50%	1.00%	0.01%	0.03%
22-May	0.06%	0.03%	--	0.14%	0.01%	0.00%	0.05%	0.35%	0.00%	0.03%
29-May	0.02%	0.03%	0.06%	0.07%	0.01%	0.00%	0.17%	0.65%	0.02%	0.03%
5-Jun	0.03%	0.13%	0.11%	0.16%	0.02%	0.02%	--	0.50%	0.00%	0.11%
12-Jun	0.05%	0.12%	0.33%	0.35%	0.04%	0.01%	--	0.00%	0.00%	0.27%
19-Jun	0.92%	0.35%	0.40%	0.55%	0.06%	0.00%	--	0.36%	1.33%	0.45%
26-Jun	1.78%	0.32%	0.22%	0.29%	0.36%	0.35%	--	0.89%	--	0.27%
3-Jul	3.33%	0.19%	0.11%	0.11%	0.28%	0.65%	--	0.00%	0.00%	0.13%
10-Jul	5.00%	2.50%	0.40%	0.42%	1.29%	0.00%	--	2.31%	--	0.44%
17-Jul	0.00%	--	0.74%	1.01%	4.62%	20.00%	--	3.33%	--	0.97%
24-Jul	--	--	1.47%	0.97%	22.22%	50.00%	--	6.25%	--	1.08%
31-Jul	--	--	0.36%	0.51%	0.00%	--	--	--	--	0.49%
7-Aug	--	--	1.09%	1.32%	--	0.00%	--	0.00%	--	1.31%
14-Aug	--	--	0.59%	0.87%	--	--	--	0.00%	--	0.86%
21-Aug	--	--	0.88%	1.31%	--	0.00%	0.00%	14.29%	--	1.32%
28-Aug	--	100.00%	1.60%	1.18%	0.00%	0.00%	--	0.00%	--	1.22%
4-Sep	--	--	0.00%	0.84%	0.00%	0.00%	0.00%	0.00%	0.00%	0.81%
11-Sep	--	0.00%	0.00%	1.05%	--	0.00%	--	0.00%	--	1.01%
18-Sep	--	--	0.00%	2.08%	--	0.00%	--	0.00%	--	1.99%
25-Sep	--	--	0.00%	2.87%	--	0.00%	--	0.00%	--	2.77%
2-Oct	--	--	0.00%	2.29%	0.00%	0.00%	--	0.00%	--	2.23%
9-Oct	--	--	0.00%	1.32%	--	0.00%	--	0.00%	0.00%	1.29%
16-Oct	--	0.00%	2.04%	0.83%	--	--	--	0.00%	--	0.85%
23-Oct	0.00%	0.00%	0.00%	0.76%	--	33.33%	--	5.26%	--	0.81%
30-Oct	0.00%	--	1.56%	0.67%	--	--	--	0.00%	--	0.68%
31-Oct	--	--	0.00%	0.49%	--	--	--	0.00%	--	0.48%
# morts	1,134	310	606	1,539	142	40	11	452	9	4,243
# collected	2,431,937	1,010,410	242,870	415,002	1,856,040	548,219	18,902	112,122	52,724	6,688,226
% mortality	0.05%	0.03%	0.25%	0.37%	0.01%	0.01%	0.06%	0.40%	0.02%	0.06%

Table 15. Annual sample mortality by species group in percent at LWG, 2010-2014.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2010	0.48	0.32	0.90	1.02	0.21	0.06	0.00	3.33	0.34	0.76
2011	0.70	0.49	1.37	1.73	0.20	0.20	0.39	8.11	0.25	1.14
2012	0.91	0.72	1.08	1.00	0.36	0.28	0.00	8.51	0.72	0.89
2013	0.74	0.90	1.88	1.12	0.22	0.22	1.27	6.15	0.81	0.97
2014	0.61	0.68	1.38	1.41	0.40	0.46	0.00	4.06	0.35	1.05
10-13 ave	0.73	0.67	1.39	1.20	0.25	0.21	0.67	7.69	0.49	0.95

Table 16. Total barge mortalities from LWG 2010-2014.

	Number of Mortalities	Number Barged	Percent Mortality
2010	2,945	7,447,434	0.04%
2011	5,381	9,311,962	0.06%
2012	3,169	6,412,853	0.05%
2013	4,282	6,839,678	0.06%
2014	3,677	9,894,912	0.04%
2010-2013 ave	3,944	7,502,982	0.05%

The mortality rate for fish trucked from LWG in 2014 was 0.18% (39 of 21,255) which is the lowest truck mortality rate in the last five years (Table 17). The truck mortality number and percent by species included: 38 unclipped subyearling fall Chinook (0.18%) and one unclipped sockeye/kokanee (1.56%). On September 13 the truck originating from LWG transported 101 smolts from the LGS fish facility including 5 clipped subyearling Chinook, 93 unclipped subyearling Chinook, and 3 unclipped sockeye/kokanee. All trips were made with the 300 gallon pickup truck mounted tank except for the trips on October 13, 21, 23, 27, 29 and 31 which were made with the larger capacity semi-truck and trailer due to increased collection of subyearling Chinook.

Table 17. Annual truck mortality at LWG, 2010-2014.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2010	0.00	0.00	2.78	0.27	0.00	0.00	--	0.00	0.00	0.28
2011	0.00	0.00	0.00	0.30	0.00	0.00	0.00	1.12	0.00	0.30
2012	0.00	0.00	0.00	0.20	0.00	0.00	--	4.35	0.00	0.25
2013	--	0.77	0.00	0.23	0.00	0.00	--	3.57	0.00	0.24
2014	0.00	0.00	0.00	0.18	--	0.00	0.00	1.56	0.00	0.18
10-13 Ave.	0.00	0.36	0.28	0.25	0.00	0.00	0.00	2.97	0.00	0.26

Gas Bubble Trauma Monitoring (PSMFC)

Juvenile salmonids were sampled for GBT from April 10 through June 5 in 2014. PSMFC personnel examined up to 100 clipped and unclipped yearling Chinook and steelhead each week

for evidence of bubbles in paired and unpaired fins, and in the eye, as per Fish Passage Center GBT protocols. This season 861 fish were sampled for GBT: 247 clipped yearling Chinook, 145 unclipped yearling Chinook, 365 clipped steelhead, and 104 unclipped steelhead. Sixty-three PIT-tagged smolts were handled, not examined and returned to the separator including: 23 clipped yearling Chinook, one unclipped yearling Chinook, 36 clipped steelhead and three unclipped steelhead. Prior to May 1, smolts examined for GBT were released in the sample recovery tank and bypassed. Smolts examined for GBT after May 1 were returned to the raceways and transported. A total of 400 smolts were bypassed including: 148 clipped yearling Chinook, 112 unclipped yearling Chinook, 117 clipped steelhead and 23 unclipped steelhead. A total of 461 smolts were transported including: 99 clipped yearling Chinook, 33 unclipped yearling Chinook, 248 clipped steelhead, and 81 unclipped steelhead. No fish were observed with symptoms of gas bubble trauma at Lower Granite this season. In addition, two coho identified in the lab were returned to the raceway for transport.

Gatewell Dipping

In 2012 three John Day ESBSs were used to replace LWG damaged fish screens in slots 2C, 3B and 3C. John Day fish screens have 1/16 inch spacing compared to 1/8 inch spacing on the LWG fish screens and have the top three rows of the perforated plates behind the screens with large holes. Over the past couple years, PSMFC and COE personnel performed gatewell slot sampling to evaluate performance of the screens and compare descaling rates. This season gatewells stots in units 2 and 3 were dipped on April 17. During this procedure, 1,305 fish were recovered, 641 fish from the unit 2 gatewell slots and 664 fish from the unit 3 gatewell slots. Each gatewell was dipped one time and the number of fish in each dip ranged from 224 to 800 and averaged about 450 fish. Consistent with the previous year, the average rate of descaling in the slots with the John Day fish screens (2.1 %) was less than the slots with LWG fish screens (2.5%).

Research

Ten agencies participated in seven research projects at Lower Granite that impacted 471,305 juvenile fish this season (the total includes smolts and juvenile lamprey). By comparison 458,554 were handled in 2013, 548,206 in 2012, 602,405 in 2011, and 546,340 in 2010. The 471,305 smolts taken from the collection included: 144,365 clipped yearling Chinook, 50,115 unclipped yearling Chinook, 36,845 clipped subyearling fall Chinook, 58,472 unclipped subyearling fall Chinook, 135,463 clipped steelhead, 33,327 unclipped steelhead, 1,730 clipped sockeye, 7,377 unclipped sockeye/kokanee, 2,815 coho and 796 lamprey. In addition, the University of Idaho, Nez Perce Tribe (NPT) and Columbia River Intertribal Fisheries Commission (CRITFC) continued a study on adult steelhead fallbacks that impacted 1,000 clipped and 1,785 unclipped steelhead kelts. Nez Perce supplied 94 steelhead kelts for the Blue Leaf 14 inch orifice/overflow weir evaluation. Following are brief descriptions of research projects that took place at Lower Granite in 2014.

National Marine Fisheries Service (NMFS)-Study to Compare the Adult Returns of In-river Migrating versus Barged Juvenile Anadromous Salmonids (Transportation Study)

Smolts were collected in the east raceways and tagged in the NMFS marking trailer at Lower Granite JFF from April 24 to June 14. NMFS handled 347,987 smolts as part of this

transportation evaluation study. Of these, 29,158 unclipped yearling Chinook with fork lengths less than 124 mm and unclipped steelhead with non-eroded fins smolts PIT tagged and transported. There were 318,787 smolts handled that were not selected for tagging as part of this study. All fish were held overnight in raceways prior to transport. There were 42 mortalities including 22 clipped yearling Chinook, 3 unclipped yearling Chinook, 4 clipped subyearling Chinook, 1 clipped subyearling Chinook, 7 clipped steelhead, 2 unclipped steelhead, and 3 unclipped sockeye.

National Marine Fisheries Service (NMFS)-Study to Estimate Juvenile Salmonid Reach Survival

This juvenile salmonid in-river survival study was done in conjunction with the NMFS Transportation Evaluation study from April 24 to June 14. NMFS handled 70,168 smolts for this study. Of these, 53,138 fish were PIT-tagged and 16,975 fish were collected and bypassed without being tagged. There were 54 post tagging mortalities including 33 unclipped yearling Chinook, 11 clipped steelhead, and 10 unclipped steelhead. There was 1 clipped yearling Chinook mortality before it was PIT-tagged.

National Marine Fisheries Service (NMFS)-Monitoring the Migrations of Wild Snake River Spring/Summer Chinook

This study to monitor the migration behavior and survival of Snake River Basin wild spring/summer Chinook salmon aims to characterize migration timing and estimate individual wild population parr-to-smolt survival to LWG and the influence of environmental factors on migration patterns. Fish PIT-tagged in natal streams during the summer of 2013 were diverted to the sort-by-cod (SBC) tanks at LWG from April 2 to June 19. NMFS handled and bypassed 506 unclipped yearling Chinook as part of this study. An additional 45 untagged smolts and 126 non-target PIT-tagged fish were incidentally diverted to the SBC tanks and bypassed.

Blue Leaf Environmental/Biomark/UC Davis LWG Juvenile Fish Collection Channel Prototype Overflow Weir and Enlarged Orifice Biological Evaluation

The evaluation of the prototype weir and 14 inch orifice installed in gatewell slot 5A during the winter of 2012/2013 occurred from April 23 to June 16. Metrics included travel times, survival, and debris passage characteristics associated with each style of passage structure (unmodified 10-inch orifice, 14-inch orifice, 14-inch with light ring, and "broad crested" overflow weir). Results of this study will be used to determine which type of structure warrants installation in the future Lower Granite facility upgrade. Fish from NMFS marking trailer were held overnight, PIT-tagged the following day, held overnight again, and released into gatewell 5A, 5B or directly into the orifice gallery channel. There were 46,960 fish impacted during this study including 93 steelhead kelts and 776 lamprey. Released smolts were recaptured in the Granite SBC tanks and examined for injuries and descaling. A total of 7,455 target fish were recaptured. Mortalities included 4 clipped yearling Chinook and 1clipped steelhead prior to being PIT-tagged and 135 fish after being PIT-tagged (43 clipped yearling Chinook, 6 unclipped subyearling Chinook, and 86 clipped subyearling Chinook). Kelts were collected from Lower Granite juvenile fish separator. Lamprey used in this study came from the raceways at Lower Granite, Little Goose, and Lower Monumental. Most were obtained from the raceway head boxes at Lower Granite.

Idaho Fish and Game (IDFG)-Genetic Stock Identification

The goal of this study is to develop detailed genetic profiles for natural origin salmon and

steelhead, develop genetic stock identification (GSI) techniques to estimate stock-specific escapement over LWG, monitor abundance, productivity and distribution of naturally produced adult and juvenile steelhead and salmon and research and monitor stock-specific life history characteristics. The objective of the study was to enumerate and characterize the natural production of spring/summer Chinook salmon and steelhead above LWG with regards to age composition and genetic stock identification. Scales, fork lengths and genetic samples were taken from March 26 to July 4 on fish given to IDFG during the daily sample. IDFG personnel handled 4,478 smolts during this study with 2,014 bypassed between March 26 and May 1 and the remainder transported.

University of Idaho/Columbia River Intertribal Fisheries Commission (CRITFC)/Nez Perce Tribe (NPT)-Evaluate Reproductive Success of Natural-Origin, Hatchery-Origin, and Kelt Steelhead in the Columbia River Basin

This project studies steelhead kelt physiology and endocrinology to evaluate strategies for rehabilitating and handling steelhead kelts captured at LWG. Steelhead kelts were diverted from the separator by COE technicians to the kelt tanks from March 26 to June 26. NPT/CRITFC personnel handled 2,785 kelts. Of these 2,565 kelts were PIT-tagged, genetic sampled, and returned to the tailrace and 109 were transported to Dworshak National Fish Hatchery for acclimation and feeding studies. There were 98 kelts were handled and bypassed due to their poor condition. Mortalities included 7 clipped and 6 unclipped steelhead kelts. NPT/CRITFC personnel gave Blue Leaf researchers 94 steelhead kelts.

U.S. Geological Survey (USGS)/U.S. Fish and Wildlife Service (USFWS)-Research, monitoring and evaluation of spawning and early life history of the Snake River fall Chinook salmon ESU

This study aims to reconstruct the juvenile subyearling run at LWG to estimate the number of hatchery and natural fish in the sample tank using identifiable morphological characteristics to differentiate hatchery from natural fall Chinook salmon subyearlings. This is done by photographing known origin fish and conducting a discriminate analysis of principal components obtained from morphological measures on the fish. Fish were sampled once per week and a total of 1,262 fish sampled and photographed from May 30 to August 1. Mortalities included 8 subyearling Chinook.

Operation and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within one percent of the peak efficiency from April 1 to October 31. Deviations were infrequent and brief or required by BPA. Below is a summary of unit outages and cause.

Table 18. Turbine unit outages at LWG, 2014.

Unit	Date Out of Service	Reason Out of Service
All Units	Monthly	ESBS/VBS inspection.
All Units	Sept 24	DC ground on T1/T2 relayed plant
All Units	Nov 13 - 14	ESBS removal due to cold weather
Unit 1		
	January 10	Dive operation to inspect and clear debris from south make-up water valve intake
	March 17	Rake trash
	March 24-25	Install ESBS – ESBS cable issues
	August 5 - 7	T2 bushing replacement
	August 11 - 17	T1 bushing replacement
	October 9	Rake trash to address increased juvenile descaling
	Oct 21 – Dec 31	Annual Maintenance- Fish screen slot closure
Unit 2		
	Feb 3 – 4	Loading and unloading problems
	March 17	Rake trash
	March 21	Install ESBS
	March 24-25	Install ESBS, Fish screen 2C ground fault
	April 17	Out of service for gatewell dipping
	August 5 - 7	T2 bushing replacement
	August 11 - 17	T1 bushing replacement
	October 9	Rake trash to address increased juvenile descaling
	Nov 14	ESBS removal
	Dec 1 - 31	Annual Maintenance
Unit 3		
	March 17	Rake trash
	March 21	Install ESBS
	March 31	Rake trash
	April 17	Out of service for gatewell dipping
	June 25	Upper guide bearing #38 overheat
	August 5 - 7	T2 bushing replacement
	August 11 - 17	T1 bushing replacement
	August 29 – Sept 2	Generator field did not flash on start up, causing an incomplete start up sequence
	October 9	Rake trash to address increased juvenile descaling
	November 17	Relay testing
Unit 4		
	Feb 3 - March 6	Thrust bearing and Resistive thermal device repair
	March 20	Install ESBS
	March 25 – 27	Exciter re-commissioning
	March 31	Rake Trash
	August 4 – Sept 10	Annual Maintenance and testing
	Sept 30	Exciter warranty work
	October 9 - 22	Governor issue

Table 18. Turbine unit outages at LWG, 2014 continued.

Unit 5		
	Feb 10 – March 7	Prototype overflow weir and 14" orifice fishway channel modifications
	March 20	Install ESBS
	March 24 - 25	Exciter Upgrade
	March 31-April 1	Rake Trash
	June 20 – July 2	Governor Issues
	August 5 – 7	T2 bushing replacement
	August 11 – 16	T1 bushing replacement
	August 17	Doble testing
	Sept 2- Nov 18	Annual maintenance – Blade liner issue
	Dec 9	Voltage regulator exciter card replacement
Unit 6		
	Jan 1 – Feb 13	Cavitation repair - Annual Maintenance – Blade Packing
	March 10 - 11	Exciter Upgrade – Remove test equipment
	March 17 - 20	RSW dive inspections
	March 27	Exciter re-commissioning
	April 1	Rake Trash
	May 12 – August 11	Repair blade seals
	August 11 – 17	T1 bushing replacement – T1 doble testing
	Sept30	Exciter warranty work
	Oct 8 – 10	Fish screen 6B ground fault
	Nov 4 – 5	RSW dive/ROV operations

Debris/Trash Racks

Units 1 and 2 trashracks were raked on March 17. The remaining units were raked on March 31 and April 1 due to a problem with the trashrack crane. About 60 cubic yards of debris was removed. Unit's 1-3 trashracks were raked on October 9 to address PSMFS descaling rate concerns. As expected, a minimal amount of debris (5-10 cubic yards) was removed. Debris was light this season.

Extended-length Submersible Bar Screens (ESBSs)

ESBS's were inspected and tested on the week of March 10. The screens were installed from March 17 through March 24. Video inspection took place April 25-26, June 27 and 28, August 29-30 and September 8, and October 17-18. ESBS/VBS inspections were attempted on May 30 but were cancelled due to water turbidity. No problems with the ESBSs were detected during video inspections. The brush cleaning cycle was set to operate every two hours for the majority of the season. The cleaning brush for the screen in gatewell slot 6B was out of service from 1050 hours on October 8 through 1300 on October 10 due to a failed transducer. The screen cleaner programming operation for slot 6B was changed to secondary backup when the screen was returned to service.

Vertical Barrier Screens (VBS's)

The VBSs were video inspected in conjunction with ESBSs during the 2014 fish passage season. No significant problems were found.

Gatewells

Gatewells were normally less than 1% covered with debris and did not exceed the 50% debris surface coverage criterion. Turbulence in gatewells with ESBSs causes debris to tumble around and exit through the orifices rather than accumulate on the gatewell surfaces. Surface debris was removed from individual gatewells with a hand dipping basket during initial water-up in late March and continued throughout the season. Occasional oil sheens were dealt with by floating oil absorbent pads in the affected gatewells.

Gatewell dipping to compare descaling rates in slot with John Day ESBS's and Lower Granite ESBSs occurred on April 17. Slots with John Day fish screens had a descaling rate of 2.1% and gatewell slots with Lower Granite screens had a descaling rate of 2.5%.

Orifices/Collection Channel

During the 2014 season the number of open orifices varied from 18 to 21 depending on forebay elevations. With the Lower Granite reservoir at minimum operating pool, water discharge through an orifice is reduced. Orifices were cycled and backflushed with air remove debris every three hours from March 20 through November 14 when the channel was dewatered. The automated backflush system was not operational this season. Orifice obstructions were not a problem this season. Orifice lights were checked daily. Orifices with burnt out lights were switched to the other orifice in the slot until the bulb was replaced. A prototype weir and a 14-inch orifice were installed in gatewell slot 5A during the winter of 2012-2013. These were tested during the spring/summer of 2013 and 2014. An orifice in fish screen slot 5B was open during the 2014 fish season.

Primary Dewaterer

Lower Granite's primary dewatering structure is an inclined screen just upstream from the porosity control perforated plate for the separator. Debris is removed from the screen with a long handled brush every half hour to once a shift depending on debris level. When the inclined screen becomes severely clogged the facility is put in primary bypass mode to take pressure off the top of the inclined screen. Debris then either floats off or is brushed off. This cleaning procedure takes about 20-30 minutes to complete. During 2014 it was necessary to go to primary bypass on October 2 and October 3 due to debris accumulating on the incline screen. Due to concerns with personnel injuries incurred while cleaning the incline screen a pneumatic incline screen cleaning system was installed during the 2013-2014 maintenance season but was ineffective at removing debris from the incline screen.

At 1015 hours on October 31 the juvenile fish facility operation was changed to primary bypass. Due to concerns that fish may become stranded the separator remained manned twenty-four hours to monitor the incline screen. While in primary bypass the technicians observed juvenile fish accumulating on the dewatering incline screen. A temporary barrier screen was installed on the incline screen on 31 October to prevent fish from becoming stranded. At 0800 hours on 1 November adjustments to the water supply and modifications to the barrier screen were made. Due to the water current at the barrier screen location fish become fatigued and impinged on the barrier screen. At 0800 hours on 2 November the facility was changed to secondary bypass

operation. Mortalities included 98 unclipped subyearling Chinook, 51 juvenile crappie, and 2 sandrollers.

Wet Separator/Distribution and Sampling Systems

Separator water levels fluctuated due the south shore makeup water valve not being to able properly adjust changes related to testing of the 14-inch orifice and the prototype weir in the collection gallery. Water levels in the separator also varied with the forebay elevation requiring adjustment in the number of orifices operating and adjustments of the 42-inch valve to maintain proper water level. The electronic control for the 42-inch sluice gate valve was out of service from March 24 to May 13 due to a failed transformer. Separator personnel manually operated the valve to maintain separator water levels.

To prevent Chinook jacks from being collected in the sample additional bars measure 1 inch in diameter and are spaced approximately 1 1/16 to 1 1/8 inches apart were installed from October 3 through October 10. The jack bars were removed on October 10 due to low Jack numbers and the potential of slightly more debris accumulating between the bars descaling fish.

Barge Loading Operations

Barge loading operations occurred from May 1 through August 16. Both direct loading and loading from the raceways went smoothly this season.

Truck Loading Operations

Juvenile fish were loaded every other day from August 18 through October 31 either into the midi-truck tank or the semi-truck tanker trailer with no problems this season.

Recommendations

1. Repair/replace problem raceway pneumatic knife gates (fish evacuation valves) and retain 10 inch knife gates from orifice gallery as spares for raceways after they are removed as part of Phase 1.
2. Seal base of sample holding tank floor to the sample holding tank.
3. Complete installation of upstream raceway jump barrier screens.
4. Operate the full season with lamprey raceway tailsceen in place.
5. Design stainless steel separator bars to replace PVC. The PVC bends creating wider spaces between the bars that jacks and small adults fit between.
6. Cover upstream raceways to provide shade.
7. Improve flow/elevation in the sample recovery truck loading pipe to eliminate fish being stranded in the pipe.
8. Operate the facility secondary bypass at all times when the collection channel is watered up to prevent fish from becoming stranded on the incline screen.
9. Rebuild motors for pneumatic fish evacuation system on the 2000 barges.
10. Install bumper system to replace cable and tire system on barges.
11. Paint hulls on 8000 barges.

12. Install ballast material in voids of 4394 and 4382 to eliminate the need to use river water.
13. Upgrade air compressors and generators on 4394, 4382, 8107, and 8108.
14. Complete plunger and cylinder installation.
15. Purchase a 1000 gallon fish tank and truck, a 3500 gallon tank and semi, and a service truck dedicated to trap and transport truck/barge maintenance.

APPENDIX TABLES

Appendix Table 1. Daily collection and bypass numbers and river conditions at Lower Granite Dam, 2014.

Appendix Table 2. Percent descaling and daily facility mortality numbers at Lower Granite Dam, 2014.

Appendix Table 3. Daily number of fish trucked and barged from Lower Granite Dam, 2014.

Appendix Table 4. Daily number of adult fallbacks and fallback mortality at Lower Granite Dam, 2014.