2012 Annual Report

SMOLT COLLECTION AND TRANSPORTATION AT LOWER GRANITE DAM ON THE SNAKE RIVER, WASHINGTON

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Summary

The 2012 fish collection season at Lower Granite Dam was characterized by early peak flow conditions, court mandated summer spill, moderate debris levels, above average summer water temperatures, high numbers of fish bypassed prior to the start of transport, and a relatively low number of fish transported. With the continued release of unclipped supplementation Chinook and steelhead above Lower Granite Dam, it is no longer possible to accurately distinguish wild Chinook, steelhead, and sockeye/kokanee in the sample. Consequently, numbers in the report tables designate fish as clipped and unclipped. A total of 5,812,430 juvenile salmonids were collected at Lower Granite Dam during the 2012 season. Of these 2,674,880 were transported to release sites below Bonneville Dam, 2,659,998 by barge and 14,882 by truck. An additional 3,133,048 smolts were bypassed back to the river during the season. This is the first year that the number of smolts bypassed was greater than the number of smolts transported.

Introduction

Lower Granite Dam is located on the Snake River, approximately 107.5 miles upstream from the confluence with the Columbia River. Lower Granite is the first of eight dams that migratory juvenile salmonids in the Snake River and its tributaries encounter on their way to the ocean. It has one of the four juvenile fish collection and transportation facilities operated by the Corps of Engineers on the Snake and Columbia Rivers. Most of the juveniles that are collected are transported in barges and trucks to release locations below Bonneville Dam on the Columbia River. From there, they complete the remaining 140-mile journey to the ocean on their own. Other smolts are bypassed to the river by way of spill, turbine passage, or for research purposes to continue their passage to the ocean on their own.

River Conditions

Flows in the Snake River during the 2012 season were somewhat of a mix. Flows were the highest in the last five years during March and April. Flows were average during May and below average from June through October. Flows for entire the juvenile fish collection period running from March 26 through October 31 averaged 62.4 kcfs. Flows exceeded the Biological Opinion target of 100 kcfs on 49 dates during 2012 but never quite reached the 200 kcfs mark. River flows for the last few days of March were between 75.5 and 100.8 kcfs – well above the norm. Flows in April averaged 119.4 kcfs and ranged between 91.4 kcfs and 191.0 kcfs. The peak flow of the season was 191.0 kcfs and occurred on April 28. In May, river flows averaged 107.1 kcfs and ranged between 75.6 kcfs and 138.9 kcfs. River flows in June averaged 90.3 kcfs and ranging between 65.7 kcfs and 128.2 kcfs. River flows in July averaged 46.5 kcfs and ranged between 33.8 and 63.0 kcfs. August flows averaged 27.3 kcfs and ranged from 22.8 kcfs to 38.5 kcfs. River flows were only slightly lower in September averaging 22.8 kcfs and ranging from 16.7 to 31.1 kcfs. The season's low flow occurred on October 21 at 15.6 kcfs. Daily flows in October averaged 19.4 kcfs and ranged up to 31.2 kcfs. The flow on October 31, the last day

of the collection season, was 31.2 kcfs.

During 2012 flows exceeded 80 kcfs on 92 days, 90 kcfs on 70 days, 100 kcfs on 49 days, 110 kcfs on 27 days, 120 kcfs on 20 days, 130 kcfs on 12 days, 140 kcfs on 6 days, and 150 kcfs or greater on only 4 days. The peak flow day of 191.0 kcfs occurred on April 28 – much earlier than normal. By contrast during the high flow year of 2011 flows averaged 88.3 kcfs over the season. Flows in 2011 exceeded the Biological opinion target of 100 kcfs on 79 dates and reached the 200 kcfs level on four dates.

As directed in the 2012 Corps Fish Passage Plan, and consistent with guidance provided by the Technical Management Team, the juvenile fish transportation season had a variable start date, based on the expected river flows. During years when the average spring seasonal flow is expected to equal or exceed 65 kcfs, transportation operations at Lower Granite begin between April 21 and May 1 as determined by TMT. Transportation at Little Goose and Lower Monumental Dams begin in a staggered fashion, with the start dates determined by TMT. In years when the average spring seasonal flows are expected to be below 65 kcfs, transportation operations begin on April 3 at Lower Granite, Little Goose, and Lower Monumental Dams. Prior to the start of transportation at a given dam, all fish are bypassed back to the river unless needed for an approved study.

Projected Snake River spring seasonal average river flows were well above 65 kcfs at the beginning of the 2012 season were cause for the Corps to forgo general April barge transport operations at the hydroelectric projects on the Snake River. A Fish Operations Plan (FOP) ordered by the Court and a regional agreement led to spill operations similar to recent years. Spill operations at Lower Granite began on April 3 and continued on a continuous basis through the month of August. Water was spilled in excess of powerhouse capacity and at or above the 20 kcfs court-ordered spill on all 78 days of the spring migration period (from April 4 – June 20) and averaged 32.8 kcfs. Spill exceeded the Biop (Biological Opinion) target of 18 kcfs only 46 of 72 days of the summer migration period (June 21 – August 31) compared to all 72 days in 2011. Summer spill averaged 19.2 kcfs during 2012 compared to 31.3 kcfs in 2011.

As in 2011, formalized spring and summer testing of the RSW did not take place during 2012. Rather, the RSW was operated as an integral part of the normal April 3 through August 31 spill period. Spring spill (from April 4 through June 20) was authorized at the 20 kcfs level. Summer spill (from June 21 through August 31) was authorized at the 18 kcfs level with approximately 6 kcfs directed through the RSW and 12 kcfs as training spill.

Table 1: Comparison of average monthly river flow and spill at Lower Granite Dam, 2008-2012.

Month	2008	2009	2010	2011	2012	'08-11 Avg.
Flow (kcfs)						
April*	51.12	79.61	39.21	103.56	114.51	68.38
May	114.30	116.45	66.59	140.61	107.14	109.49
June	129.31	116.02	128.17	173.86	90.31	136.84
July	58.76	52.15	49.78	96.77	46.49	64.37
August	37.47	32.85	30.56	39.78	27.28	36.17
September	23.62	23.47	24.17	36.33	22.82	26.90
October	20.18	22.30	19.96	28.04	19.36	22.62
Spill (kcfs)						
April[1]	15.43	16.34	13.74	30.62	29.91	19.03
May	49.85	33.25	20.45	51.49	29.54	38.76
June	57.10	30.26	46.89	63.74	32.38	49.50
July	18.66	18.68	18.78	27.37	21.37	20.87
August	18.44	18.63	16.67	26.04	14.33	19.95
September	0.43	0.27	0.27	0.44	0.27	0.35
October	0.00	0.00	0.00	0.01	0.00	0.00

* Includes March 26-31

Water temperatures in the Snake River during 2012 were not as favorable for migrating smolts as in some recent years. Water temperatures were warmer than the 2008-2011 average during April, May, June, and July and similar during August, September and October. The temperature at the start of the season on March 26 was 43.3°F. The water temperature reached 50°F on April 23. (By contrast during 2011, the temperature did not reach 50°F until May 5.) Water temperatures during the peak of the juvenile migration in late April and early May were in the high 40° to low 50° range. Temperatures stayed in the low to mid 50° through the month of May and into June. Temperatures first reached 60°F on June 25 – nearly two weeks earlier than in 2011. (Appendix 1, Table 1). Water temperatures exceeded 65.0°F (65.3°F) on July 8 – over two weeks earlier than in 2011. Despite high air temperatures during July and August, water temperatures did not reach 70º F during 2012. The peak water temperature of the year was 68.7ºF on July 24 which is a couple of weeks earlier than in 2011 when the peak water temperature of the year occurred on August 5 at 68.0 ºF. The July 24 peak water temperature is in line with some recent years when temperature peaks were: 2010 (68.5°F on August 15), 2009 (69.3°F on July 31), 2008 (67.8 ºF on August 15), 2007 (68.9 ºF on July 6), and 2006 (70.5°F on July 5). After water temperatures peaked in late July, temperatures declined slightly and then remained relatively stable - staying in the mid-60°F into early October. Temperatures then slowly declined through the rest of the month. The temperature on October 31, the last day of sampling, was 54.3°F.

Facility Modifications

The following modifications and work were made to the Lower Granite Juvenile Fish Facility and barges prior to the 2012 season:

1. Refurbished the sample diversion slide gates per PSMFC guidelines.
2. Had the problem fish counters repaired by Smith Root.
3. Replaced a small hand valve at the base of the separator.
4. Repaired a large crack on the turn to the "A" sample gate.
5. Built a pipe extension to the river to allow juvenile lamprey to pass from the upstream raceways into the river.
6. Built new lamprey-friendly tailscreens for all the raceways.
7. Repaired the seals on the sample holding tank anesthetizing bins.
8. Refurbished all the oxygen probes for the Point Four and YSI systems.
9. Cleaned up the counter tunnel wire connections in the separator control room.
10. Completed extensive fish barge PMs.
11. Checked/repaired damaged mesh in raceway tailscreens.
12. Rebuilt snorkel seals on the raceway loading boom and replaced the flexible hose.

Fish Collection

Migration and Collection

The juvenile fish bypass gallery was watered up on March 21 at 0800 hours. Fish were bypassed through the 72-inch pipe at the base of the separator (primary bypass) until 0730 hours on March 22 when water was routed over the separator bars due to relatively high numbers of juvenile lamprey and small Chinook becoming stranded on the inclined screen. Fish thus routed over the separator bars were diverted out the long bypass pipe to mid-river. On March 25, formal fish sampling (only) activities began. With the exception of sample fish, and fish collected for research barging operations, all fish were bypassed back to the river until May 1.

Fish barging operations from Lower Granite followed the general pattern of recent years with a few research barge trips taking place prior to the initiation of general fish transportation. Fish were collected 2-3 days before the actual transport date in order to allow marking crews time to mark and handle the fish. The first research barge departed Lower Granite on April 12. Subsequent research barges departed Lower Granite on April 19 and April 26. When fish were not being collected for research, all fish other than sample fish were returned to the river by way of secondary bypass (bypass through the outfall pipe to the river). Fish were collected for numerous other studies after general collection began but this had no effect on the general operation of the facility. After normal collection activities began, these fish were handled as part of the regular collection and diverted to the upstream raceways for marking operations. Collection ended at 0700 hours October 31.

An estimated 5,812,430 juvenile salmonids were collected at Lower Granite Dam during the 2012 operating season. The 2012 species collection included: 1,731,454 clipped yearling

Chinook, 962,141 unclipped yearling Chinook, 256,860 clipped subyearling fall Chinook, 430,048 unclipped subyearling Chinook, 1,746,004 clipped steelhead, 607,404 unclipped steelhead, 552 clipped sockeye/kokanee, 30,289 unclipped sockeye/kokanee and 47,678 coho (Table 2). More unclipped yearling Chinook, clipped subyearling Chinook, and unclipped steelhead were collected in 2012 than in 2011. All other species categories' declined. Unclipped yearling Chinook had the highest number of fish collected in the last five years while clipped sockeye had the lowest. Daily collection and river flow information is provided in Appendix 1, Table 1.

Peak collection dates during 2012 were quite a bit different than the long-term average (Table 3). The peak collection day of April 26 (362,200) is the second earliest in the last five years and was also the peak day for several species. Clipped yearling Chinook (135,000) peaked on April 26 which is the earliest peak date in the last five years. Unclipped yearling Chinook collection (69,400) peaked on April 26 and tied with 2009 as the earliest peak collection day in the last five years. Clipped (119,000) and unclipped steelhead (37,400) collection peaked on April 26, second only to the April 24 peak collection day in 2009 per the five year average. Clipped subyearling fall Chinook collection (15,000) peaked on June 4, the second earliest peak collection day in the last five years. Unclipped subyearling fall Chinook collection (20,800) peaked on June 5, tied for the second latest peak collection day. Clipped sockeye collection (200) peaked on May 9, the earliest peak collection day in the last five years and also easily the lowest number collected in the last five years. Unclipped sockeye collection (5,200) peaked on May 18, the second earliest peak collection day in the last five years. Coho collection (6,300) peaked on May 18, the third latest day in the last five years. The April 26 peak collection date for many species was immediately prior to the peak water flow date of April 28.

Table 2. Annual collection, bypass, and transport at Lower Granite Dam, 2008-2012.

Year	Yearling Chinook Clipped	Yearling Chinook Unclipped	Subyearling[1] Chinook Clipped	Subyearling[1] Chinook Unclipped	Steelhead Clipped	Steelhead Unclipped	Sockeye/Kokanee[2] Clipped	Sockeye/Kokanee[2] Unclpd	Coho All	Total
Collection										
2008	1,913,873	484,791	152,792	282,084	1,675,433	490,012	10,424	3,934	68,833	5,082,176
2009	1,836,874	515,775	260,431	450,943	2,673,278	756,926	17,767	15,734	65,933	6,593,661
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
Bypass										
2008	326,382	99,567	344	9,040	288,065	89,866	203	249	1,849	815,565
2009	606,548	241,406	207	20,069	1,254,742	333,032	30	7,038	1,951	2,465,023
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	1,119,950	283,525	0	1,430	8,165	3,133,048
Truck										
2008	0	31	62	16,166	6	29	0	851	33	17,178
2009	2	10	329	6,069	1	7	27	22	233	6,700
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
Barge										
2008	1,582,205	384,695	149,429	252,309	1,386,704	399,905	10,204	2,661	66,905	4,235,017
2009	1,227,039	273,887	258,128	422,152	1,418,158	423,803	17,650	8,519	63,607	4,112,943
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
Total Transported										
2008	1,582,205	384,726	149,491	268,475	1,386,710	399,934	10,204	3,512	66,938	4,252,195
2009	1,227,041	273,897	258,457	428,221	1,418,159	423,810	17,677	8,541	63,840	4,119,643
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
Mortalities										
Facility	1,236	374	844	1,533	178	68	0	117	37	4,387
Res/Sac	0	75	0	5	24	11	0	0	0	115

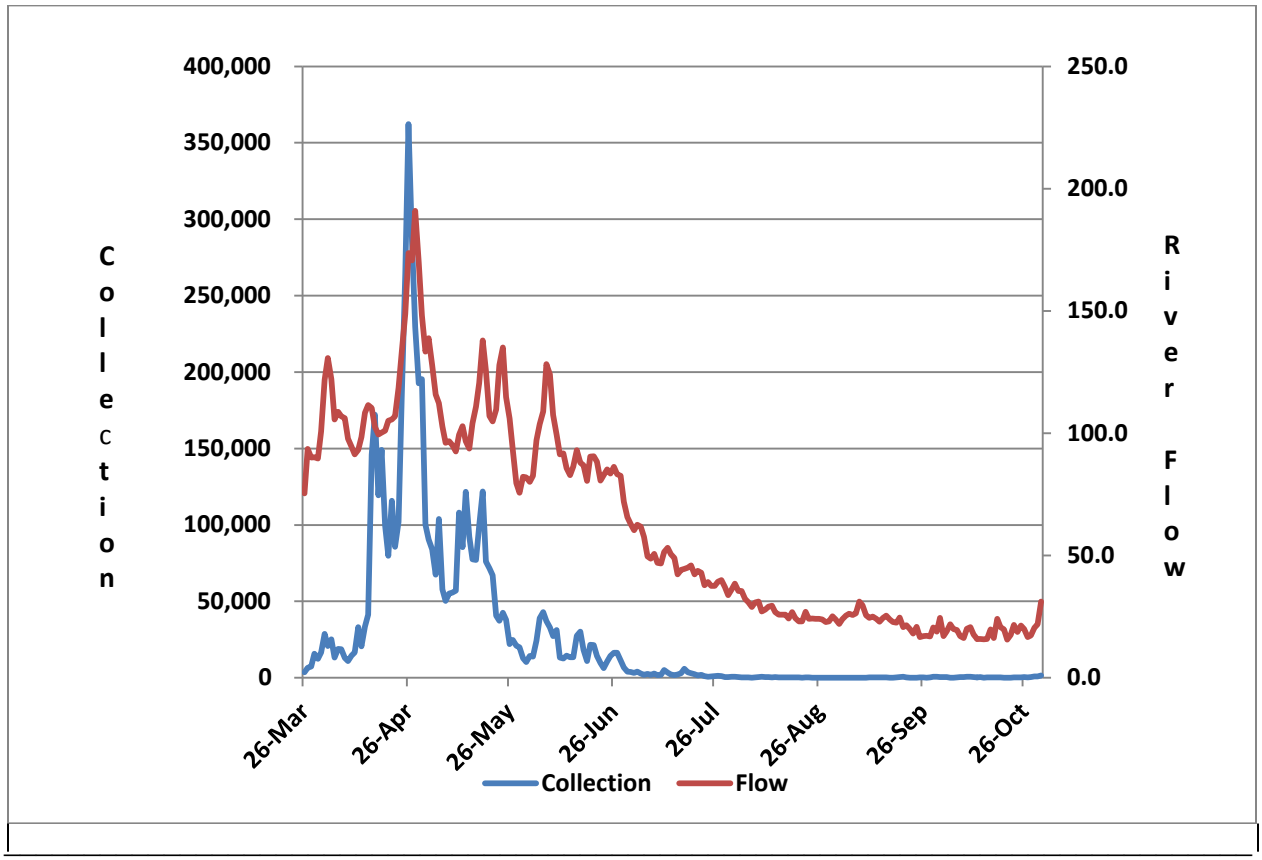
Note: 'Res/Sac' refers to research sacrificed fish and incidental research mortalities (handling and/or tagging). These fish were taken from the general collection only. Additional sacrificed research fish taken from the Sort-By-Code tank are summarized in the research section of this report.

Table 3. Annual peak collection days at Lower Granite Dam, 2008-2012.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclipped	Clipped	Unclipped[1]	Clipped	Unclipped	Clipped	Unclipped	All	
2008	May 8 (167,000)	May 8 (39,200)	June 16 (7,900)	July 5 (10,680)	May 6 (92,200)	May 10 (29,000)	May 20 (1,800)	May 10 (400)	May 8 (11,000)	May 8 (305,800)
2009	May 15 (112,000)	April 26 (29,000)	May 29 (13,600)	May 30 (21,600)	April 24 (182,000)	April 24 (68,400)	May 20 (3,200)	May 21 (1,200)	May 21 (8,200)	24 April (322,800)
2010	April 28 (73,800)	April 28 (25,200)	June 5 (23,700)	June 5 (40,200)	May 21 (81,800)	May 21 (23,600)	June 6 (400)	May 21 (800)	May 20 (4,800)	May 21 (183,000)
2011	May 12 (165,200)	May 12 (33,800)	June 19 (12,550)	May 28 (25,600)	April 3 (160,139)	May 12 (48,000)	May 25 (4,800)	May 22 (2,300)	May 12 (5,200)	May 12 (375,600)
2012	April 26 (135,000)	April 26 (69,400)	June 4 (15,000)	June 5 (20,800)	April 26 (119,000)	April 26 (37,400)	May 9 (200)	May 18 (5,200)	May 18 (6,300)	April 26[2] (362,200)

[1]Includes unmarked (unclipped) hatchery subyearling Chinook from 2008 - 2012.
[2]Fish were routed through the collection system and bypassed until the morning of May 1.

Figure 1. Daily juvenile salmonid collection, all species combined, versus daily average river flow KCFS at Lower Granite Dam, 2012.



Adult Fallbacks

During 2012 a total of 6,124 adult salmonids were removed from the Lower Granite separator during the March 26 to October 31 time period. This is significantly fewer than during 2011 when a total of 9,340 adults were removed during the same time period. The 2012 totals included 581 clipped adult Chinook, 383 unclipped adult Chinook, 716 clipped jack Chinook, 496 unclipped jack Chinook, 1,683 clipped steelhead, 2,256 unclipped steelhead, six coho and three sockeye (included in the total in Table 4). Unclipped steelhead were the most abundant adult salmonid removed from the separator and made up 36.8% of the total salmonid fallbacks followed by clipped steelhead (27.5%). The number of fallbacks for all species groups decreased from 2011 levels and all groups were less than the 2008-2011 average except for Chinook jacks. Clipped and unclipped steelhead fallback numbers were greatest during April and May. Clipped and unclipped adult Chinook fallback numbers were greatest during September and October (Table 5.)

Table 4: Annual totals of adult Chinook, steelhead and coho released into the river from the juvenile fish wet separator at Lower Granite Dam, 2008-2012.

	Adult Chinook		Jack Chinook		Steelhead		Coho	
	Clipped	Unclipped	Clipped	Unclipped	Clipped	Unclipped	All	Totals
2008	578	447	720	589	1,885	1,396	25	5,646[1]
2009	1,903	1,495	1,024	617	4,311	2,971	4	12,326[2]
2010	779	523	226	129	2,683	2,527	15	6,893[3]
2011	1,069	673	794	453	2,920	3,410	21	9,340[4]
2012	581	383	716	496	1,683	2,256	9	6,124[5]
08-11 avg.	1,083	785	691	447	2,950	2,576	16	8,551[4]

1Includes six sockeye.

2 Includes one sockeye

3Includes eleven sockeye

4 Includes four sockeye

5 Includes three sockeye

All adult and jack fallback salmonids were superficially examined for external condition before being released from the separator and 89.8% of the salmonids released from the separator were classified as in either good or fair condition compared to 87.1% in 2011, 87.8% in 2010, 95.2% in 2009, and 93.8% in 2008 (Table 6).

Adult fallbacks that passed through the separator bars were not counted by the COE separator technician and are not included in tables 4-6. These fish either passed into raceways to be transported or were bypassed before May 1, and were not counted. After May 1, if they entered the raceways they were transported. If these fish entered the sample system they were counted as incidental fish per Smolt Monitoring Program guidelines and bypassed. A total of 204 salmonid fallbacks were counted in the daily samples including 72 clipped Chinook jacks, 100 unclipped Chinook jacks, nine clipped Chinook minijacks, eleven unclipped Chinook minijacks, six clipped steelhead, four unclipped steelhead and two unclipped coho. This compares to 107 salmonid fallbacks counted in daily samples in 2011, 221 in 2010, 323 in 2009 and 1,587 in 2008. The decrease in adult and jack salmonids observed in the sample in the last few years is due to fish facility maintenance personnel installing separator bars spaced closer together that lay over the regular separator bars. These bars effectively keep most of the Chinook jack and minijack fallbacks out of the sample tank. This season these narrower spaced bars were installed on October 1. It is necessary to remove fallbacks from the sample tank before they are anesthetized with MS-222 because of the sport fishery above and below LGR and the recommended 21 day waiting period prior to human consumption identified in the Argent Chemical Laboratories MS-222 protocols.

Table 5. Monthly totals of adult salmonids released from the juvenile fish separator at Lower, Granite Dam, 2012.

	Adult Chinook		Jack Chinook		Steelhead		Coho	Totals
	Clipped	Unclipped	Clipped	Unclipped	Clipped	Unclipped	All	
Month								
April	0	0	1	0	560	987	0	1,548[1]
May	56	25	4	0	466	791	0	1,342
June	38	22	5	6	35	161	0	267
July	13	15	0	0	2	11	0	44
August	5	8	1	0	31	36	0	81
September	110	80	98	64	240	160	0	752
October	359	233	607	426	349	110	6	2,090
Totals	581	383	716	496	1,683	2,256	9[2]	6,124

[1] Includes March 26-March 31

[2] Includes three sockeye

Table 6. Condition of adult salmonids released from the juvenile fish separator at Lower Granite Dam, 2012.

	Adult Chinook		Jack Chinook		Steelhead		Coho	
	Clipped	Unclipped	Clipped	Unclipped	Clipped	Unclipped	All	Totals
Good	541	343	704	484	988	1,388	8[2]	4,456
Fair	29	33	6	9	390	578	1[3]	1,046
Poor	10	6	6	3	269	273	0	567
Dead	1	1	0	0	36	17	0	55
Total[1]	581	383	716	496	1,683	2,256	9[4]	6,124[1]

[1] Includes March 26-March 31.

[2] Includes two sockeye.

[3] Includes one sockeye

Sampling

Sampling at the juvenile fish facility 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. From March 26 to August 16 fish were sampled every day and when the sample rate was raised to 100% on August 16, through the end of the season, fish were sampled every other day. Each day's collection was kept

separate in the sample tank and on the day of transport, each day's collection was sampled separately.

During 2012 the smolt monitoring staff sampled 96,491 smolts, 1.7% of the total collection compared to 79,426 smolts (1.3%) in 2011, 66,295 (1.8%) in 2010, 70,866 smolts (1.1%) in 2009 and 97,421 smolts (1.9%) in 2008 (Table 7). The total number of smolts sampled in 2012 by species included: 13,044 clipped yearling Chinook, 8,641 unclipped yearling Chinook, 9,684 clipped subyearling fall Chinook, 44,922 unclipped subyearling fall Chinook, 13,351 clipped steelhead, 5,665 unclipped steelhead, eight clipped sockeye, 623 unclipped sockeye/kokanee and 553 coho (Table 8).

Table 7. Annual percentage of total juvenile salmonids collected that were sampled at Lower Granite Dam, 2008-2012.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Year	Clipped	Unclipped	Clipped	Unclipped	Clipped	Unclipped	Clipped	Unclipped	All	Total
2008	0.8	1.0	4.9	17.4	0.9	1.1	1.2	28.3	0.7	1.9
2009	0.7	0.8	2.5	5.4	0.6	0.8	0.8	1.8	1.7	1.1
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
08-11	0.7	0.8	2.8	8.6	0.7	0.9	1.0	3.2	1.2	1.5

Table 8. Weekly sample rates in percent and sample totals at Lower Granite Dam, 2012.

Week Ending	Weekly Rate (%)	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Totals
		Clipped[2]	Unclp'd[1]	Clipped[2]	Unclp'd[1]	Clipped[2]	Unclp'd[1]	Clipped[2]	Unclp'd[1]	All	
3/29	5.8	455	1,064	0	3	289	125	0	15	2	1,953
4/05	1.8	1,032	1,009	0	5	224	152	0	5	1	2,428
4/12	1.8	863	732	0	3	492	252	0	2	1	2,345
4/19	0.6	1,185	931	0	12	2,503	276	0	0	3	4,910
4/26	0.5	2,067	1,491	0	15	1,824	562	0	2	7	5,968
5/03	0.5	2,133	843	0	38	2,213	614	0	5	40	5,886
5/10	0.6	1,065	328	0	10	747	344	1	14	12	2,521
5/17	1.0	2,871	653	21	137	1,776	998	0	44	117	6,617
5/24	1.1	1,045	826	38	65	1,570	1,082	1	181	189	4,997
5/31	2.1	234	452	449	576	732	593	4	57	81	3,178
6/07	2.9	67	110	2,136	2,747	445	344	1	26	37	5,913
6/14	2.7	15	50	1,381	1,440	270	162	0	4	16	3,338
6/21	3.7	7	17	2,443	2,727	139	61	0	0	8	5,402
6/28	4.0	1	10	1,148	2,186	54	20	0	0	3	3,422
7/05	7.6	0	7	470	1,516	26	12	0	0	0	2,031
7/12	20.6	1	3	669	3,305	28	20	0	0	0	4,026
7/19	20.0	0	1	506	3,778	6	2	0	1	0	4,294
7/26	21.4	0	0	142	1,938	2	0	0	2	0	2,084
8/02	36.0	1	0	49	1,800	2	3	1	5	2	1,863
8/09	50.0	0	0	17	1,116	0	2	0	2	2	1,139
8/16	50.0	0	4	12	1,247	1	0	0	6	1	1,271
8/23	100.0	1	1	15	1,356	4	6	0	10	4	1,397
8/30	100.0	0	0	8	655	0	2	0	12	7	684
9/06	100.0	0	0	10	559	1	5	0	28	5	608
9/13	100.0	0	0	24	1,211	0	3	0	13	6	1,257
9/20	100.0	0	0	31	1,854	1	5	0	32	3	1,926
9/27	100.0	1	0	15	1,141	0	8	0	19	4	1,188
10/04	100.0	0	0	30	2,885	1	5	0	17	2	2,940
10/11	100.0	0	0	26	2,973	0	2	0	16	0	3,017
10/18	100.0	0	0	7	1,893	0	2	0	13	0	1,915
10/25	100.0	0	2	10	1,235	1	0	0	45	0	1,293
10/31	100.0	0	107	27	4,496	0	3	0	47	0	4,680
Total		13,044	8,641	9,684	44,922	13,351	5,665	8	623	553	96,491

[1]Wild Chinook, wild steelhead and wild sockeye/kokanee designated in text as unclipped.
[2]Hatchery Chinook, hatchery steelhead and hatchery sockeye/kokanee designated in text as clipped.

Transportation

An estimated 2,674,880 juvenile salmonids (46.0% of fish collected) were transported from Lower Granite in 2012 (Table 2). This is proportionately lower than in 2011 when 61.4% of the fish were transported and much lower than 2010 when 93.1% of the collected fish were transported. During 2012 high flow levels helped moved many fish past the dam prior to the initiation of general transport operations. The numbers of fish and the percentages transported of each species group in 2012 were: 706,149 clipped yearling Chinook (40.8%), 283,003 unclipped yearling Chinook (29.4%), 255,959 clipped subyearling fall Chinook (99.6%), 411,347 unclipped subyearling fall Chinook (95.7%), 625,853 clipped steelhead (35.8%), 323,799 unclipped steelhead (53.3%), 552 clipped sockeye (100.0%), 28,742 unclipped sockeye/kokanee (94.9%) and 39,476 coho (82.8%).

The COE and NMFS transported fish by barge from Lower Granite for research purposes only on April 12, April 19 and April 26. Fish collection activities for general transport began at 0700 hours on May 1. The first day of general fish barge transport was May 2. Fish were barged daily from May 2 to May 28. On May 30 every other day barge operations began and continued through August 16. Every other day trucking began on August 18 and continued until October 31. All truck trips were made with the 300 gallon pickup mounted tank except for the last trip of the season on October 31 when collection increased and the 3500 gallon tanker truck was used to transport the smolts. Due to a manpower shortage at the Little Goose Fish Facility, Lower Granite personnel transported Little Goose's fish from September 5 through October 7 and again on October 31. Because of large numbers of predacious birds around the Bonneville release site, Lower Granite trucked fish to Dalton Point from October 15 through the duration of the season.

During 2012 both the 4000 and 2000 series fish barges were direct-loaded at Little Goose Dam from May 5 to May 26. Due to regional concerns over juvenile fish migration times, fish barging operations did not begin at Little Goose until May 4 and not until May 6 at Lower Monumental. Fish barging operations at McNary do not begin until river conditions are "no longer spring like". In 2012 fish barging operations did not take place at McNary Dam. Fish barging operations at all other sites continued until mid August. The last barge for all sites left Lower Granite on August 18.

An estimated 2,674,880 (99.4%) of the total juvenile salmonids transported from Lower Granite Dam were transported by barge compared to 3,859,265 (99.6%) in 2011, 3,378,007 (99.5%) in 2010, 4,111,943 (99.8%) in 2009, and 4,235,017 (99.6%) in 2008 (Table 2). The number of fish barged and the percentages of the total transported by species group in 2012 were: 706,147 clipped yearling Chinook (almost 100%), 282,894 unclipped yearling Chinook (99.9%), 255,814 clipped subyearling Chinook (99.9%), 396,998 unclipped subyearling Chinook (96.5%), 625,847 clipped steelhead (almost 100%), 323,764 unclipped steelhead (almost 100%), 552 clipped sockeye/kokanee (100%), 28,535 unclipped sockeye/kokanee (99.3%) and 39,447 coho (99.9%).

As per previous years, fish collected at Little Goose Dam and Lower Monumental Dam were also loaded onto fish barges that originated from Lower Granite Dam during the 2012 season. This year no fish were barged from McNary Dam. The total number of fish barged from

other sites during the 2012 season was: Little Goose Dam (2,529,526) and Lower Monumental Dam (1,223,329).

As in recent seasons, no early season fish trucking activities took place during 2012. Late season trucking operations at Lower Granite began on August 18 and continued every other day through October 31. Due to low fish numbers, trucking operations resumed using the pickup-mounted midi-tank. Approximately 14,882 juvenile salmonids, 0.5% of the fish transported from Lower Granite in 2012, were transported by truck (Table 2). The number of fish trucked and the percentage of the total transported by species group were: 2 clipped yearling Chinook (< 0.1%), 109 unclipped yearling Chinook (<0.1%), 145 clipped subyearling Chinook (0.1%), 14,349 unclipped subyearling Chinook (3.5%), 6 clipped steelhead (<0.1%), 35 unclipped steelhead (<0.1%), 0 clipped sockeye/kokanee, 207 unclipped sockeye/kokanee (0.7%), and 29 coho (<0.1%).

In addition, another 1,289 juveniles were transported by truck when Lower Granite combined fish trucking operations to help Little Goose from September 5 to October 7 and again on October 31, the final day of the season. The pickup-mounted midi-tanker was used for nearly all the truck fish transport trips during 2012. It was not until the final trip of the season (October 31) that the large semi truck was used. On that date the combined estimated weight of transported fish for both Lower Granite and Little Goose was nearly 362.8 pounds – more than twice the capacity of the midi-tanker.

The physical operation of the transport barges and transport trucks went reasonably well during the 2012 season. As in 2011 there were no operational problems that prevented the normal transportation and release of fish at the designated release points. Nevertheless, as is to be expected of any large-scale operation involving considerable equipment over a lengthy period of time, there were a few minor operational problems. Perhaps the problem of most concern was a noticeable leak somewhere in the hull or plumbing mechanism of fish barge 8107. The biological technicians pumped out the front void of this barge on several occasions after noticing that the barge was riding slightly bow heavy. This leak will hopefully be evaluated and repaired during the 2012-2013 winter maintenance season. Another problem that surfaced was some minor air leaks on the cylinders that lift the fish barge plungers on barges 8106 and 8107 (the JFF maintenance crew replaced seals in several cylinders). The pump alarm on engine #2 on barge 8105 also developed problems and triggered false alarms several times during the season. Other problems that surfaced were minor problems with the oxygen sensors on the P4 system, small fuel and antifreeze leaks (quickly repaired), minor exhaust leaks, a broken fuse housing for a bow light, and a stuck valve on the plumbing on barge 2127.

As a matter of concern, the rubber fish release plungers on the 4000 and 8000 series fish barges are wearing out and beginning to deteriorate from sunlight and exposure to extreme summer heat. An examination of the plungers by fish facility personnel showed there was some cracking and leaching of material on quite a few of them. An order has been placed for six replacement plungers. It is unknown how long the barges will operate with questionable plungers but we are attempting to procure enough to be backed up through the 2013 field season and out into the reasonably near future. In addition, a new plunger is being developed in engineering. Hopefully, it will be less subject to heat deterioration and instead of replacing an

entire plunger only a bottom rubber seal would be replaced.

In recent years the oxygen monitoring systems on the fish barges have often caused as many problems (usually minor) as any of the mechanical systems. Problems are typically of a single hold nature and involve a probe in a particular hold not reading correctly or giving fluctuating readings. This is usually solved by renovating the probe and changing out the electrolyte. In other cases it has been necessary to install another probe or chase down an electrical system problem. The touch pad monitors on some of the barges are also aging and thought should be given to replacing the current system with a new system (including new monitors) to ensure reliability. In addition various parts for the present system are not available - leaving us liable should a system go down. The portable YSI oxygen/temperature monitoring systems (used as a backup system the barges) have proven invaluable over the years and allowed for monitoring of oxygen and temperature levels whenever there were problems with the main Point Four system.

There were very few problems with the Lower Granite fish trucks during the 2012 season. NOAA-Fisheries late season transport evaluation study put quite a few fish back into the river that would have normally been transported and kept transport numbers low enough to use the 1-ton pickup and midi-tanker tank for nearly the entire season. The maintenance staff had no problems with either the 1-ton pickup or the 300 gallon mini-tanker. Care was taken to add enough river ice to keep the tank temperature at an acceptable level for the trip to Bonneville and in general very little tempering was required at the release site. The semi truck was not used until the last trip of the season and operated without incident for that solo trip. That said, in previous years the refrigeration system on the large tanker truck has presented problems for the drivers. The system runs but frequently the drivers have not been able to measure any significant cooling during pre-season truck testing.

Bypass

The fish facility was placed in primary bypass mode (fish are diverted directly back to the river) on March 21. At 0800 hours on March 22 the facility was taken off primary bypass and put into secondary bypass (fish routed over the separator and through the long outfall pipe to mid-river) due to lamprey and early yearling Chinook and steelhead being stranded on the inclined screen. Collection for sampling began at 0700 hours on March 25. All fish, except those collected and transported for research purposes, were bypassed to the river until 0700 hours on May 1 when collection for general transportation operations began. Smolts were bypassed for approximately 15 minutes on June 6 to clean the separator screen and for 40 minutes on September 26 to check for debris. During these cleaning events no estimate was made of the number of fish bypassed because the fish are bypassed before encountering the sampling system (Primary Bypass). The facility was placed into secondary bypass on October 31 at 0655 hours so fish could be routed through the PIT-tag interrogation system. Fish were routed through the secondary bypass until the morning of December 20 when the juvenile fish system was dewatered for the winter.

In 2012, 3,133,048 smolts were bypassed from the LGR Juvenile Fish Facility compared to 2,429,798 in 2011, 247,129 in 2010, 2,465,023 in 2009 and 815,565 in 2008 (Table 2). The

number and percentage of smolts bypassed by species group included: 1,024,069 clipped yearling Chinook (59.1%), 678,689 unclipped yearling Chinook (70.5%), 57 clipped subyearling fall Chinook (<0.1%), 17,163 unclipped subyearling fall Chinook (4.0%), 1,119,949 clipped steelhead (64.1%), 283,526 unclipped steelhead (46.7%), 1,430 unclipped sockeye/kokanee (4.7%) and 8,165 coho (17.1%). An estimated 3,088,372 juvenile salmonids, 53.1% of the total collection were bypassed from March 26 to May 1, before the start of the general transport season. By contrast, during 2011 27.1% of the total collection (1,709,591 smolts) was bypassed from March 26 to May 1. This is the first year that more fish were bypassed than transported from LGR.

As part of five research studies, 66,885 smolts were bypassed from LGR. The National Marine Fisheries Service (NMFS) Survival Study PIT-tagged and bypassed 57,052 smolts: 16,761 unclipped yearling Chinook, 20,133 clipped steelhead and 20,158 unclipped steelhead. The NMFS Fall Chinook Late Season Transportation Study bypassed 57 clipped and 5,685 unclipped subyearling fall Chinook. The USGS, USFWS, Pacific Northwest National Laboratory (PNNL) and NMFS "Investigating passage of ESA-listed fall Chinook salmon at Lower Granite Dam during winter when the fish bypass system is not operated" study bypassed 43 non-target smolts and 46 target previously PIT-tagged holdover subyearling fall Chinook from the sort-by-code (SBC) tanks. The Idaho Fish and Game Genetic Stock Index study bypassed 1,818 unclipped, untagged yearling Chinook and 473 unclipped and untagged steelhead. The USFWS and USGS study to evaluate early life history, migratory behavior and survival of fall Chinook salmon in the Snake River bypassed 355 target, previously PIT-tagged subyearling fall Chinook, 38 non-target bycatch and 50 fish were bypassed without being examined or identified to species due to high water temperatures, from the SBC tanks. The NMFS study to monitor the behavior and survival of wild spring/summer Chinook salmon in the Snake River basin bypassed 726 target, previously PIT-tagged unclipped yearling Chinook, 496 non-target fish were handled and bypassed and 46 non-target, previously PIT-tagged fish were bypassed from the SBC tanks.

Incidental Species

An estimated 28,236 incidental fish entered the fish facility in 2012 (Table 9). This is 28.9% less than the 39,698 non-salmonid incidental fish that entered the fish facility in 2011. The incidental species collection in some recent years was 41,723 in 2010, 20,902 in 2009 and 35,571 in 2008. During 2012, Pacific lamprey macrophthalmia were the most abundant incidental species with 5,557 collected, which is a 13.4% decrease over the 2011 total of 6,420. Suckers (misc.) were the second most abundant incidental species with 4,413 collected compared to 5,142 in 2011. Sand rollers were the third most abundant incidental species with 4,390 collected compared to 3,202 in 2011. Siberian prawns were the fourth most abundant incidental species with 3,831 collected compared to 3,400 in 2011. This was the sixth season that the invasive species Siberian Prawns were euthanized, per WDFW instructions, rather than released to the river. Peamouth were the fifth most abundant incidental species with 2,146 collected compared to 4,071 collected in 2011. Pacific lamprey ammocoetes and whitefish numbers declined in 2012 with 1,453 and 1,265 collected compared to 6,165 and 6,625 respectively in 2011.

Table 9. Estimated collection of incidental fish species at LGR, 2012.

Common Name	*Scientific Name*	Separator	Expanded Sample	Collection
Pacific Lamprey (Adult)	*Entosphenus tridentatus*	8	15	23
Pacific Lamprey (Juvenile)	*E. tridentatus*		5557	5,557
Pacific Lamprey (Ammocoete)	*E. tridentatus*		1453	1,453
American Shad (Adult)	*Alosa sapidissima*	14	16	30
American Shad (Juvenile)	*A. sapidissima*		227	227
Banded Killifish	*Fundulus diaphanous*		0	0
Smallmouth Bass	*Micropterus dolomieui*	1	619	620
Largemouth Bass	*Micropterus salmoides*		19	19
Bull Trout	*Salvelinus Malma*	0	0	0
Bullhead (misc.)	*Amierus sp.*		559	559
Common carp	*Cyprinus carpio*	54	25	79
Channel catfish	*Ictalurus punctatus*	92	1420	1,512
Chiselmouth	*Acrocheilus alutaceus*	0	821	821
Crappie (misc)	*Pomoxis sp.*	5	266	271
Cutthroat Trout	*Oncorhynchus clarkia*		0	0
Kokanee	*Oncorhynchus nerka*	0	158	158
Longnose dace	*Rhinichthys cataractae*		13	13
Northern Pikeminnow	*Ptychocheilus oregonensis*	5	60	65
Peamouth	*Mylocheilus caurinus*	14	2132	2,146
Rainbow Trout	*Oncorhynchus mykiss*	1	192	193
Redside shiner	*Richardsonius balteatus*		0	0
Sand Roller	*Percopsis transmontana*		4390	4,390
Sculpin	*Cottus sp.*		427	427
Siberian Prawn	*Exopalaemon modestus*		3831	3,831
Speckled Dace	*Rhinichthys osculus*		1	1
Sucker (misc.)	*Catostomus sp.*	1,342	3071	4,413
Sunfish (misc.)	*Lepomis sp.*		124	124
Whitefish	*Prosopium sp.*	1	1264	1,265
White sturgeon	*Acipenser transmontanus*	27	0	27
Yellow perch	*Perca flavescens*	1	0	1
Walleye	*Stizostedion vitreum*	1	0	1
Warmouth	*Lepomis gulosis*		10	10
Total		1,566	26,670	28,236

Fish Condition

Descaling

The Lower Granite smolt monitoring staff has observed and recorded gradations of scale loss in smolts beginning in 1998 to augment the standard descaling data taken from fish sampled. Standard descaling criteria identifies a fish with 20% or greater scale loss on one side of its body as descaled. If scale loss is less than 20% on one side the fish is not considered descaled. Many

fish have levels of scale loss that do not fit the standard descaling criteria. Therefore they began noting, in addition to standard descaling, if a smolt was more than 10% but less than 20% descaled or more than 50% descaled. Furthermore, each gradation of scale loss was characterized as patchy or scattered. The smolt monitors have observed that fish with scale loss less than 20% typically take more time to recover from exposure to MS-222 than fish with no scale loss. (Since 2009 some of this detailed descaling information has not been taken due to the FPC changing to a touch screen program that does not record this information.)

The 2012 descaling rate for all species combined was 2.6% compared to 2.2% in 2011, and 1.8% for the 2008-2011 average (Table 10). The weekly decaling rates began the season at low levels and increased through mid-June, which is similar to what occurred in 2011, but opposite of what occurred in previous years. During the end of June and July when small subyearling fall Chinook dominated the collection, weekly descaling rates were low, similar to previous years. During August, September and October weekly descaling rates increased to their highest levels of the season and peaked at 10.7% for the week ending on September 13 (Table 11). Descaling levels were higher than in previous years and COE staff looked through the collection system to find possible causes. Extended length Submersible Barrier Screen cleaning brush issues were identified during this time. When no obvious causes were found at the juvenile facility, powerhouse causes were investigated. Vertical Barrier Screen head differentials were measured during the week ending September 13 and the following week and found to be in criteria. Unit #1 was returned to service at the beginning of September with fixed blades and a more limited operational range than with an adjustable Kaplan blade. Due to continued high descaling rates, Unit #1 priority was changed to last on and first off on September 18. Unit #1 trash racks were raked on September 19 and 30 cubic yards of debris were removed despite head differentials that were in criteria. Additional trash rack raking occurred the following weeks and less debris was observed. It was discovered that some of the fish screens were seriously damaged and it is suspected that they were not fully deployed (not locked into place) and this may have caused the damage. Gatewell dipping in slot 2A was done on October 18, but only one dip was made because the gatewell dip net tore during the second attempt. Twenty-one unclipped subyearling fall Chinook were examined with none descaled (>20% on one side) and only three partially descaled (5-19% on one side). Debris levels increased during September and October due to the MOP restrictions being lifted. Collectively, these issues may have contributed to the higher than average descaling rates observed.

Table 10. Annual full-sample descaling rates (>20%) by species at LGR, 2008-2012.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2008	1.4	0.9	0.6	1.6	2.1	2.0	1.7	3.7	1.6	1.6
2009	2.2	0.7	1.5	1.7	1.2	1.0	1.5	7.4	2.4	1.6
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
08-11 Ave.	1.9	0.9	0.9	2.0	2.0	1.7	1.5	5.5	2.0	1.8

Table 11. Weekly descaling rates in percent for fish sampled at LGR, 2012

	Yearling Chinook		Subyearling Chinook		Steelhead		Sock/Kokanee		Coho	
Week	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	Total
3/29	1.10	0.09	---	---	0.00	1.60	---	0.00	0.00	0.41
4/05	0.69	0.40	---	---	0.45	1.97	---	0.00	0.00	0.63
4/12	2.26	0.69	---	---	1.42	0.40	---	0.00	0.00	1.39
4/19	2.10	0.84	---	---	1.04	1.35	---	---	0.00	1.31
4/26	2.97	0.88	---	---	1.60	1.07	---	0.00	0.00	1.84
5/03	3.35	2.03	---	0.00	2.13	0.82	---	0.00	0.00	2.41
5/10	2.37	0.92	---	---	3.49	0.88	0.00	0.00	0.00	2.28
5/17	3.51	0.92	0.00	0.00	4.24	1.61	---	4.65	1.71	3.06
5/24	4.41	1.46	2.70	0.00	5.68	3.24	0.00	2.23	1.06	3.80
5/31	1.72	0.89	4.30	2.47	5.63	1.69	0.00	5.36	2.47	3.08
6/07	7.46	0.91	3.54	2.75	5.19	8.45	0.00	8.70	0.00	3.58
6/14	0.00	0.00	1.39	1.71	6.67	4.32	---	0.00	0.00	2.07
6/21	14.29	0.00	0.99	0.79	4.35	1.64	---	---	0.00	1.00
6/28	0.00	0.00	0.88	1.44	3.70	10.00	---	---	0.00	1.33
7/05	---	0.00	1.92	1.14	7.69	0.00	---	---	---	1.39
7/12	0.00	0.00	1.53	0.55	15.38	10.00	---	---	---	0.86
7/19	---	---	0.40	0.35	0.00	0.00	---	0.00	---	0.36
7/26	---	---	0.00	0.52	0.00	---	---	0.00	---	0.49
8/02	0.00	---	2.13	0.50	100.0	33.33	0.00	0.00	0.00	0.70
8/09	---	---	0.00	1.26	---	0.00	---	0.00	0.00	1.24
8/16	---	0.00	8.33	1.37	0.00	---	---	0.00	0.00	1.43
8/23	0.00	0.00	0.00	2.09	0.00	0.00	---	0.00	0.00	2.03
8/30	---	---	0.00	2.80	---	0.00	---	0.00	0.00	2.71
9/06	---	---	0.00	5.21	0.00	0.00	---	9.52	0.00	5.18
9/13	---	---	4.17	10.89	---	0.00	---	16.67	0.00	10.71
9/20	---	---	6.45	8.37	0.00	0.00	---	20.83	0.00	8.45
9/27	0.00	---	0.00	6.56	---	0.00	---	0.00	0.00	6.31
10/04	---	---	3.33	5.80	0.00	0.00	---	0.00	0.00	5.74
10/11	---	---	7.69	5.76	---	0.00	---	6.25	---	5.78
10/18	---	---	33.33	3.60	---	0.00	---	8.33	---	3.72
10/25	---	0.00	10.00	2.53	0.00	---	---	14.29	---	2.96
10/31	---	0.00	11.11	3.59	---	0.00	---	9.30	---	3.61
#Dsc'd	363	72	183	1,289	398	126	0	31	6	2,468
#Smpl'd	12,925	8,579	9,579	44,241	13,303	5,649	8	570	549	95,403
%Dsc'd	2.81%	0.84%	1.91%	2.91%	2.99%	2.23%	0.00%	5.44	1.09%	2.59%

Other Injuries and Disease

In addition to standard length, weight and descaling data recorded for individual smolts in the daily subsample, smolt monitoring staff also examined sample fish for visible injuries and symptoms of disease. With the exception of descaling and columnaris, signs of visible injuries or disease were only recorded from the detailed subsample. This year, only categories of recent injuries *that may* have been caused by passage through the facility were recorded. Injuries in 2009-2012 cannot be directly compared to injuries recorded prior to 2009. A total of 27,413 smolts were examined in the detailed subsample during 2012 compared to 30,720 in 2011, 25,825 smolts in 2010, 25,217 in 2009 and 25,624 in 2008. This season a total of 4,908 (17.9%) smolts were recorded as having head, body, predator caused injury or symptom of disease compared to 4,105 (13.4%) in 2011, 3,189 (12.3%) in 2010, 2,944 (11.7%) in 2009 and 3,509 (13.7%) in 2008. The actual proportion of injured smolts is less than the rates shown because some fish have more than one visible injury.

Head injuries that were associated with dam passage include generic head injuries, eye injuries, opercle injuries and "pop" or bulging eye. Since 2009 mandible and maxillary injuries have not been recorded separately from the generic head injury category. During 2012 head injuries were recorded on 0.6% of the smolts examined in the detailed subsample compared to 0.5% in 2011, 0.5% in 2010, 0.6% in 2009 and 1.0% in 2008. Injuries to the opercula comprised the majority of head injuries (42.2%) followed by eye injuries (29.5%) and generic head injuries (12.7%). Clipped steelhead had the highest occurrence of head injuries at 0.84% (33 of 3,921) followed by unclipped steelhead at 0.82% (17 of 2,080).

The body injuries associated with dam passage that were recorded by the smolt monitors this season included a generic body injury category and a generic fin injury category. Non-dam passage injuries of body deformity, pink fins and fin discoloration (a distinct line of color differentiation on the caudal fin that may be associated with cold water disease and/or stress) are still recorded while lesions, lacerations and bloated body are not recorded separately. Pink fin is also thought to be stress or anesthetic related and may or may not be caused by dam passage. Body injuries were observed on 5.2% of the smolts examined in the detailed subsample compared to 4.3% in 2011, 4.7% in 2010, 7.4% in 2009 and 6.8% in 2008. The majority of body injuries observed were pink fin (51.8%) followed by discolored fin (18.6%) and fin injuries (12.1%). Unclipped subyearling fall Chinook exhibited the highest percent of body injuries at 8.0% (915 of 11,437) followed by clipped steelhead at 4.3% (167 of 3,921).

Diseases with external symptoms include fungus, columnaris, fin hemorrhage, bacterial kidney disease and parasites. External symptoms of disease were observed on 4.4% of the smolts examined in the detailed subsample compared to 2.1% in 2011, 3.5% in 2010, 2.8% in 2009 and 5.0% in 2008. Symptoms of disease were highest on unclipped subyearling fall Chinook and the majority of these symptoms were columnaris in August, September and October. Columnaris comprised the majority of the disease symptoms (66.9%) followed by fin hemorrhages (14.3%) and parasites (8.5%).

The disease columnaris, caused by the bacterium Flavobacterium columnare, mainly infects summer and fall migrants because it becomes more virulent when water temperatures exceed 60º F. Warren Groberg, Fish Pathologist for Oregon Department of Fish and Wildlife, visited the LGR Juvenile Fish Facility September 30, 1998 and provided information on external symptoms characteristic of columnaris to the smolt monitoring staff. Groberg explained that the snout injuries (loss of protective skin tissue), yellowish blemishes without broken skin and red mouth edges were symptoms of *F. columnare* infection. Based on this information, the smolt monitoring staff continues to classify fish exhibiting these symptoms as being infected with columnaris. They do not classify a fish as being infected with columnaris unless there is some tissue loss on the snout or body. Fish with just the red mouth edges are probably infected with columnaris but they are not classified as infected unless there is some tissue loss.

The smolt monitors have recorded the incidence of columnaris since 1996 and since 1999 they have recorded columnaris symptoms based on the entire sample. The columnaris infection rate for the entire sample of subyearling fall Chinook in 2012 was 2.1% (1,119 of 53,799) compared to 1.1% (440 of 39,375) in 2011, 1.3% (550 of 41,116) in 2010, 1.0% (313 of 30,223) in 2009 and 1.1% (614 of 55,826) in 2008. The 2012 columnaris rate is higher than the 1.15% observed for the 2008-2011 average, is the highest since 2003, and is the fifth highest since 1999. In most years the first incidence of columnaris does not show up in the sample until July, after the majority of subyearling fall Chinook have already passed the project. This season the rate of columnaris symptoms observed was zero in May and June, 0.4% in July, 5.9% in August, 7.4% in September and 2.6% in October.

Injuries associated with predators include wounds inflicted by other fish, birds, and lamprey. Predator wounds were observed on 1.0% of the smolts examined in the detailed subsample compared to 0.8% in 2011, 0.8% in 2010, 1.0% in 2009 and 1.0% in 2008. Predator marks were highest on clipped steelhead, clipped yearling Chinook and unclipped steelhead. 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 (70.7%) compared to 26.6% caused by fish and 2.7% caused by lamprey. Atypical of previous years, clipped yearling Chinook had the second highest occurrence of bird bites with clipped and unclipped steelhead having the first and third highest incidences respectively. Normally, the larger clipped and unclipped steelhead smolts have the most bird bites.

Mortality

Facility mortality included 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. The overall facility mortality rate was 0.08% and tied with 2010 for the lowest level in the last five years. Other recent mortality rates were 0.09% in 2011, 0.12% in 2009 and 0.13% in 2008 (Table 12). In all, 4,387 facility mortalities were recorded from a total collection of 5,812,430 smolts. The number of facility mortalities and the mortality percentage by species group included: 1,236 clipped yearling Chinook (0.07%), 374 unclipped yearling Chinook (0.04%), 844 clipped subyearling

fall Chinook (0.33%), 1,533 unclipped subyearling fall Chinook (0.36%), 178 clipped steelhead (0.01%), 68 unclipped steelhead (0.01%), zero clipped sockeye, 117 unclipped sockeye/kokanee (0.39%) and 37 coho (0.08%). Facility mortality rates for all species groups were lower than in 2011 except for clipped subyearling fall Chinook, unclipped steelhead and coho. All species group mortality rates were lower than those observed for the 2008-2011 average. Weekly facility mortality rates were very low during April and May, did not increase over 1% until the week ending August 23 and peaked the week ending August 30 at 2.78%, when few subyearling fall Chinook were collected (Table 13).

Table 12. Annual facility mortality in percent at Lower Granite Dam, 2008-2012.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Year	Clipped	Unclipped	Clipped	Unclipped	Clipped	Unclipped	Clipped	Unclipped	All	Total
2008	0.13	0.10	0.55	0.51	0.04	0.04	0.16	4.40	0.07	0.13
2009	0.12	0.08	0.68	0.58	0.01	0.01	0.34	0.99	0.22	0.12
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
08-11	0.11	0.07	0.41	0.39	0.02	0.02	0.02	1.13	0.10	0.10

Sample mortalities include dead fish removed from the sample tank prior to sampling and those from the sorting trough in the sample lab. In 2012, 858 sample mortalities were recorded from a total of 96,491 sampled fish, a sample mortality rate of 0.89% compared to 908 of 79,426 (1.14%) in 2011, 501 of 66,295 (0.76%) in 2010, 511 of 70,866 (0.72%) in 2009 and 937 of 97,421 (0.96%) in 2008 (Table 14). The number of sample mortalities and percent mortality by species group included: 119 clipped yearling Chinook (0.91%), 62 unclipped yearling Chinook (0.72%), 105 clipped subyearling fall Chinook (1.08%), 451 unclipped subyearling fall Chinook (1.00%), 48 clipped steelhead (0.36%), 16 unclipped steelhead (0.28%), zero clipped sockeye, 53 unclipped sockeye/kokanee (8.51%) and four coho (0.72%). Clipped and unclipped yearling Chinook and clipped and unclipped steelhead had their highest sample mortality rate in the last five years.

Barge mortalities are salmonids removed from barge holds after the barges depart LGR. In previous years, barge mortalities included those from fish loaded at Little Goose, Lower Monumental and McNary into barges originating from LGR. No fish were barged from McNary Dam in 2012. The barge mortality rate of 0.049% (3,169 of 6,412,853) is slightly higher than the 0.047% (4,062 of 8,623,041) observed for the 2008-2011 average. The total number of smolts barged included 2,659,998 fish from LGR, 2,529,526 from Little Goose Dam and 1,223,329 fish from Lower Monumental Dam. Barge mortalities by species included: 1,600 clipped yearling Chinook, 364 unclipped yearling Chinook, 621 subyearling fall Chinook, 327 clipped steelhead, 137 unclipped steelhead, seven clipped sockeye, 22 unclipped sockeye/kokanee, 61 coho and 30 salmonids classified as others because they were seen at release, but could not be identified to species.

Table 13. Weekly facility mortality in percent by species group at LGR, 2012.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	
3/29	0.02%	0.05%	---	0.00%	0.00%	0.00%	---	1.03%	0.00%	0.04%
4/05	0.03%	0.01%	---	0.00%	0.00%	0.00%	---	0.00%	0.00%	0.02%
4/12	0.38%	0.17%	---	0.00%	0.01%	0.02%	---	0.67%	2.00%	0.20%
4/19	0.01%	0.01%	---	0.00%	0.00%	0.00%	---	---	0.25%	0.01%
4/26	0.01%	0.01%	---	0.00%	0.00%	0.00%	---	0.25%	0.00%	0.01%
5/03	0.04%	0.03%	---	0.03%	0.00%	0.00%	---	0.40%	0.01%	0.02%
5/10	0.22%	0.12%	---	0.10%	0.03%	0.03%	0.00%	0.17%	0.14%	0.12%
5/17	0.09%	0.07%	0.33%	0.36%	0.01%	0.01%	---	0.32%	0.06%	0.06%
5/24	0.11%	0.07%	0.38%	0.35%	0.01%	0.01%	0.00%	0.16%	0.08%	0.06%
5/31	0.10%	0.07%	0.19%	0.15%	0.06%	0.02%	0.00%	0.23%	0.10%	0.09%
6/07	0.15%	0.20%	0.30%	0.28%	0.06%	0.09%	0.00%	0.73%	0.24%	0.25%
6/14	0.17%	0.22%	0.62%	0.55%	0.08%	0.06%	---	1.14%	0.16%	0.51%
6/21	0.57%	0.47%	0.14%	0.18%	0.11%	0.13%	---	---	0.00%	0.16%
6/28	4.00%	0.80%	0.28%	0.24%	0.37%	0.20%	---	---	0.00%	0.26%
7/05	---	1.54%	0.17%	0.27%	0.00%	0.00%	---	---	---	0.25%
7/12	60.00%	7.14%	0.89%	0.59%	2.21%	1.02%	---	---	---	0.67%
7/19	---	20.00%	1.03%	0.81%	3.33%	0.00%	---	60.00%	---	0.86%
7/26	---	---	1.65%	0.55%	0.00%	---	---	11.11%	---	0.64%
8/02	0.00%	---	1.37%	0.58%	0.00%	0.00%	0.00%	0.00%	0.00%	0.60%
8/09	---	---	5.88%	0.40%	---	0.00%	---	0.00%	0.00%	0.48%
8/16	---	0.00%	0.00%	0.48%	0.00%	---	---	16.67%	0.00%	0.55%
8/23	0.00%	0.00%	0.00%	1.18%	0.00%	0.00%	---	10.00%	25.00%	1.29%
8/30	---	---	0.00%	1.98%	---	0.00%	---	41.67%	14.29%	2.78%
9/06	---	---	0.00%	0.36%	0.00%	20.00%	---	25.00%	0.00%	1.64%
9/13	---	---	0.00%	1.40%	---	0.00%	---	61.54%	0.00%	1.99%
9/20	---	---	0.00%	0.70%	0.00%	0.00%	---	25.00%	0.00%	1.09%
9/27	0.00%	---	0.00%	1.14%	---	12.50%	---	10.53%	0.00%	1.35%
10/04	---	---	0.00%	1.46%	0.00%	20.00%	---	23.53%	0.00%	1.60%
10/11	---	---	0.00%	0.74%	---	0.00%	---	0.00%	---	0.73%
10/18	---	---	14.29%	0.32%	---	0.00%	---	7.69%	---	0.42%
10/25	---	0.00%	0.00%	0.65%	0.00%	---	---	6.67%	---	0.85%
10/31	---	0.93%	0.00%	0.98%	---	0.00%	---	8.51%	---	1.05%
# morts	1,236	374	844	1,533	178	68	0	117	37	4,387
# collected	1,731,454	962,141	256,860	430,048	1,746,004	607,404	552	30,289	47,678	5,812,430
% mortality	0.07%	0.04%	0.33%	0.36%	0.01%	0.01%	0.00%	0.39%	0.08%	0.08%

--- no fish sampled

Table 14. Annual sample mortality in percent at LGR, 2008-2012.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	Total
2008	0.87	0.55	1.24	0.99	0.28	0.23	2.50	13.36	0.39	0.96
2009	0.77	0.61	1.10	1.05	0.18	0.05	2.19	6.92	0.90	0.72
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
08-11	0.73	0.50	1.17	1.19	0.22	0.14	1.29	10.11	0.55	0.91

This year was the sixth consecutive year of no early season fish truck transport from Lower Granite. The overall mortality rate for fish trucked from LGR in 2012 was 0.25% (37 of 14,882) compared to 0.45% for the 2008-2011 average (Table 19). This is the lowest truck mortality rate in the last five years. Every other day (EOD) trucking began August 18 and ended October 31, the last day of the 2012 season. The truck mortality number and percent by species included: 28 unclipped subyearling fall Chinook (0.20%) and nine unclipped sockeye/kokanee (4.35%). From September 5 to October 7, the Lower Granite pick-up mounted tank truck transported the Little Goose Dam smolts due to low fish numbers at the Little Goose fish facility. The large semi-truck and trailer was used on the last trip of the season due to increased fish numbers at LGR and Little Goose Dam. The smolts transported from Little Goose Dam fish facility were not used to calculate trucking mortalities. Trucks originating from LGR transported 1,289 smolts from the Little Goose Dam fish facility and these included: 29 clipped subyearling fall Chinook, 1,191 unclipped subyearling fall Chinook, two clipped steelhead, nine unclipped steelhead, 56 unclipped sockeye/kokanee and two coho. If the Little Goose Dam transported fish were used to calculate trucking mortality the overall rate would be 0.23% instead of 0.25%. Beginning with the October 15 truck trip until the end of the season smolts were released at Dalton Point instead of the Bonneville release location due to the large number of piscivorous birds resting on the release pipe waiting for the truck to arrive.

Gas Bubble Trauma Monitoring

The smolt monitoring staff conducted examinations once per week, on up to 100 fish from April 12 through June 14. Smolts were dip netted from the separator. GBT staff examined 854 smolts that included 245 clipped yearling Chinook, 129 unclipped yearling Chinook, 301 clipped steelhead and 151 unclipped steelhead. Twenty-eight PIT-tagged smolts were handled, not examined and returned to the separator including 11 clipped yearling Chinook, three unclipped yearling Chinook, six clipped steelhead, six unclipped steelhead, one unclipped sockeye/kokanee and one coho. After examination for GBT, the smolts were placed in raceways and transported after the general transport season began on May 2. One unclipped steelhead was observed with symptoms of gas bubble trauma at Lower Granite Dam this season.

Research

During 2012 seven different agencies and two universities conducted ten research projects that impacted 548,206 smolts compared to 602,405 in 2011, 546,340 in 2010, 750,823 smolts in 2009 and 867,442 smolts in 2008. There were 548,206 smolts taken from the collection that included: 145,957 clipped yearling Chinook, 39,311 unclipped yearling Chinook, 50,011 clipped subyearling fall Chinook, 82,828 unclipped subyearling fall Chinook, 185,000 clipped steelhead, 36,481 unclipped steelhead, 197 clipped sockeye, 3,563 unclipped sockeye/kokanee and 4,808 coho and 50 fish that were not identified to species due to high water temperatures in the SBC tanks. In addition, the University of Idaho, Nez Perce Tribe (NPT) and Columbia River Intertribal Fisheries Commission (CRITFC) continued a study on adult steelhead fallbacks which impacted 881 clipped, 72 fin eroded and 1,325 unclipped steelhead kelts.

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

NMFS marking crews handled 470,701 smolts for this study. These fish are part of an ongoing transportation evaluation study and were tagged throughout the spring and summer migration from April 10 to June 16. The NMFS crew PIT-tagged and transported 34,712 smolts; 12,623 unclipped yearling Chinook, 8,867 clipped steelhead and 13,222 unclipped steelhead. Unclipped yearling Chinook less than 124 mm fork length were used for this study to target wild Chinook and unclipped steelhead tagged do not include fin eroded fish, to target wild steelhead. Tagged fish were held for at least 24 hours prior to being loaded onto barges for transport. This year 435,735 smolts were handled, not tagged and transported. These included 145,702 clipped yearling Chinook, 6,219 unclipped yearling Chinook, 49,695 clipped subyearling fall Chinook, 68,563 unclipped subyearling fall Chinook, 155,579 clipped steelhead, 1,619 unclipped steelhead, 195 clipped sockeye, 3,362 unclipped sockeye/kokanee and 4,801 coho. Fifty-four smolts died before they were tagged including 31 clipped yearling Chinook, three unclipped yearling Chinook, 17 clipped steelhead and three unclipped steelhead. All of the smolts handled and tagged for this study were collected in the east raceways and tagged in the NMFS marking trailer adjacent to the east raceways.

NMFS-Study to Estimate Juvenile Salmonid Reach Survival

This is an ongoing study conducted to evaluate the in-river survival of juvenile salmonids bypassed into the tailrace at LGR. This study was done in conjunction with the NMFS Transportation Evaluation study from April 10 to June 16. This year 57,052 fish were PIT-tagged and bypassed including 16,761 unclipped yearling Chinook, 20,133 clipped steelhead and 20,158 unclipped steelhead. There were 110 fish that died after being tagged including 75 unclipped yearling Chinook, 24 clipped steelhead and 11 unclipped steelhead.

NMFS-Subyearling Fall Chinook Transportation Evaluation Study

The objective of this study is to compare the survival and return rate of subyearling fall Chinook that are transported to those that migrate to the ocean in-river. This study was conducted during late-season trucking from September 6 through October 31. Fish were taken from the daily samples and PIT-tagged at the juvenile fish facility three to four times each week. NMFS staff handled 11,462 subyearling fall Chinook during this study. Of these 5,742

subyearling fall Chinook were taken from daily samples, PIT-tagged and transported by truck and released below Bonneville Dam and 5,715 were taken from daily samples, PIT-tagged and bypassed to the river. There were five subyearling fall Chinook that died after tagging.

United States Fish and Wildlife Service (USFWS), United States Geological Service (USGS), Battelle, University of Washington and National Marine Fisheries Service (NMFS) –Holdover Fall Chinook Study

This study is part of the regional discovery based research titled "Investigating passage of ESA-listed fall Chinook salmon at Lower Granite Dam during winter when the fish bypass system is not operated". This is a cooperative study of the survival and prevalence of the reservoir-type life history of juvenile fall Chinook salmon in the Snake River and the passage of subyearlings and reservoir-type fish through the lower Snake River. This part of the study collected PIT-tagged yearling fall Chinook holdovers from the 2011 release of Dworshak hatchery fish in the SBC tanks at LGR during their April and May out-migration. This season NMFS personnel sampled 46 yearling fall Chinook holdovers. There were 39 non-target PIT-tagged fish bypassed from the SBC tanks including 11 clipped yearling Chinook, 10 unclipped yearling Chinook, 16 clipped steelhead and two unclipped steelhead. Four non target, previously PIT-tagged fish were bypassed including one clipped yearling Chinook, one unclipped yearling Chinook and two clipped steelhead.

Idaho Fish and Game (IDFG)-Genetic Stock Identification

The goal of this study is to develop fine-scale genetic profiles for natural origin salmon and steelhead, develop genetic stock identification (GSI) techniques to estimate stock-specific escapement over LGR, 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 LGR with regards to age composition and genetic stock identification. Scales, fork lengths and genetic samples were taken from fish in the sample from March 26 to July 7. IDFG and NMFS personnel handled 6,699 smolts during this study. A scale sample and a fin clip was taken from 1,282 non-fin eroded, unclipped steelhead, 133 non-CWT (Coded Wire Tag), unclipped yearling Chinook and 88 non-CWT, unclipped subyearling fall Chinook. A fin clip only was taken from another 5,195 smolts including 2,636 non-CWT, unclipped yearling Chinook, 2,558 non-CWT, unclipped subyearling fall Chinook and one non-fin eroded, unclipped steelhead. One non-CWT unclipped subyearling fall Chinook died during sampling.

Univ. 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

The goal of this research project is to study the physiology and endocrinology of steelhead kelts to evaluate the feasibility and success of several strategies for rehabilitating and handling of adult steelhead kelts captured at LGR. This project is a collaborative study to investigate approaches to increase adult steelhead returns by utilizing the kelt life stage. Steelhead kelts were diverted from the separator by COE technicians from April 3 to June 28. NPT/CRITFC personnel impacted 2,278 steelhead kelts during this study including 881 clipped, 72 unclipped, fin eroded and 1,325 unclipped steelhead kelts. Kelts that were PIT-tagged,

genetic sampled and returned to the tailrace including 847 clipped, 70 unclipped fin eroded and 1,192 unclipped steelhead kelts. Another 15 clipped, two unclipped fin eroded and 107 unclipped steelhead kelts were collected for transport to Dworshak National Fish Hatchery. Three clipped and one unclipped steelhead kelts were handled and bypassed. Sixteen clipped and 23 unclipped steelhead kelts died in the tank before handling by NPT/CRITFC personnel. There were two unclipped steelhead kelts that died after being PIT-tagged and genetic sampled. Battelle researchers acoustic tagged and released to the river 71 clipped, four fin eroded and 108 unclipped steelhead kelts that were also sampled by NPT/CRITFC so these fish are included in the above totals.

Battelle-Steelhead Kelt Passage Distributions and FCRPS Survival and Return Rates for Fish Tagged above and at LGR

The goal of this study is to estimate steelhead kelt (*Oncorhyncus mykiss*) returns to LGR by passage route and estimate reach survival to the estuary. Results should help managers assess the efficiency and effectiveness of available routes for passing kelts through FCRPS dams. From April 18 to June 22 Battelle researchers acoustic tagged and released to the river 183 steelhead kelts including 71 clipped, four fin eroded and 108 unclipped. These fish were first sampled by NPT/CRITFC researchers and then given to Battelle for acoustic tagging.

United States Fish and Wildlife Service (USFWS) and United States Geological Service (USGS)-Early Life History, Migratory Behavior and Survival of Fall Chinook Salmon in the Snake River

The goal of this study is to provide information to fishery managers to maximize the effectiveness of summer flow augmentation and understand how summer flow augmentation affects water temperature, water velocity, juvenile fall Chinook salmon migratory behavior, and juvenile fall Chinook salmon survival in Lower Granite Reservoir. The separation-by-code system at LGR was used to recapture some of the fish previously PIT-tagged during beach seining, to allow growth calculations and to photograph fish for morphological assessment. NMFS personnel did the fish sampling through about mid-June and after that USGS personnel did the sampling. Sampling personnel handled and bypassed 355 target PIT-tagged subyearling fall Chinook including 178 clipped and 177 unclipped subyearling fall Chinook. Seventy-two target PIT-tagged unclipped subyearling fall Chinook smolts were sacrificed. There were 25 non target PIT-tagged fish handled and bypassed including four clipped and 20 unclipped subyearling fall Chinook and one clipped steelhead. There were 13 non PIT-tagged smolts handled and bypassed including nine clipped and four unclipped subyearling fall Chinook. There were five unclipped subyearling fall Chinook handling mortalities. There was one target PIT-tag found in a non PIT-tagged clipped steelhead that was bypassed. Fifty fish of unknown species and rear type were bypassed with handling and examination due to water temperatures in excess of 68°F.

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

This study is done to monitor the migration behavior and survival of wild spring/summer Chinook salmon in the Snake River basin. The specific goals are to characterize the migration timing and estimate parr-to-smolt survival to LGR of different wild Chinook populations as they migrate from their natal rearing areas and determine migration patterns and what environmental factors influence those patterns. Fish were PIT-tagged during the summer of 2011 in natal

streams and were diverted to the SBC tanks at LGR. In past years these fish were sampled at Little Goose Dam, but in recent years the fish facility has not sampled during April, except for a condition sample and this season, only sampled for condition once every five days in April. From April 3 to June 13 NMFS personnel handled 1,272 salmonids for this study. For the season 726 target PIT-tagged unclipped yearling Chinook were sampled. Another 496 non- PIT-tagged fish were handled and bypassed including 192 clipped yearling Chinook, 68 unclipped yearling Chinook, two clipped subyearling fall Chinook, one unclipped subyearling fall Chinook, 197 clipped steelhead, 29 unclipped steelhead, one unclipped sockeye/kokanee and six coho. Forty-six previously PIT-tagged non-target fish were handled and bypassed including 19 clipped yearling Chinook, eight unclipped yearling Chinook, twelve clipped steelhead, four unclipped steelhead, two clipped sockeye and one coho. Four fish died before being handled including one clipped yearling Chinook, two unclipped yearling Chinook and one clipped steelhead.

NMFS-Evaluation of Methods to Reduce Straying Rates of Barged Juvenile Steelhead

This study addresses needs in the 2008 BiOP "To monitor and evaluate the effectiveness of the juvenile fish transportation program and modifications to operations." The goals of this study are to understand the processes that contribute to high percentages of out of basin straying and spawning with endangered and threatened populations of Columbia River salmon and, specifically, to develop methods to reduce wandering and straying of steelhead that are collected and barged from the Snake River to below Bonneville Dam. On May 1 and May 23 steelhead were obtained from the NMFS transportation and survival studies for this study. For the season, 80 steelhead (40 clipped and 40 unclipped) were sacrificed at LGR, measured for length and weight, gender, maturation status, blood plasma and other tissue samples were taken to be analyzed in the lab. Another 220 steelhead (110 clipped and 110 unclipped) were loaded into net pens aboard transportation barges. Half were sacrificed at McNary Dam and the remaining half was sacrificed at Bonneville Dam to determine physiological differences between groups.

Facility Operations and Maintenance

Turbine Operations

During 2012, turbine units 1-6 were unavailable for service 15,007.4 hours out of a possible 52,704 operational hours. This computes to an overall availability factor of 71.5%. This is on par with 2011 when the availability factor was 71.9%. The 2012 availability factor on a per unit basis was: turbine unit 1 (63.8%), turbine unit 2 (88.6%), turbine unit 3 (69.1%), turbine unit 4 (49.6%), turbine unit 5 (68.7%), and turbine unit 6 (89.4%). Turbine unit 1 was unavailable for service a total of 3,178.5 hours for various reasons. The two biggest outage factors were annual maintenance (which carried over from December 2011 and required 1,544 hours during 2012) and welding repair work to correct the angle of the fixed blades. The welding repair work (coupled with annual maintenance) was performed from July 9 until September 5 and required 1,394 hours. Turbine unit 2 was unavailable for service 1,002.6 hours. The biggest outage factor was annual maintenance in November and December which required 651 hours. Turbine unit 3 was unavailable for service a total of 2,722.8 hours. The biggest outage factor was annual maintenance/BPA fiber optic line installation which carried over from August 1, 2011 and was completed on March 28 and required 2,138 hours during 2012. The second main

reason for this unit's unavailability was annual maintenance. This work was performed from October 9 until November 2 and required 576 hours. Turbine unit 4 was unavailable for service for a large part of the year with a total of 4,428.4 hours. The main cause was cavitation repair conducted from April 3 through October 9 which required 4,380 hours. Turbine unit 5 was unavailable for service a total of 2,745 hours. The main cause was cavitation repair conducted from September 17 through the duration of the year which required 2,520 hours. Turbine unit 6 was unavailable for service a total of 930.1 hours. The biggest outage factor was annual maintenance and T2/Doble testing activities in September which required 410 hours. In general, turbine unit availability was highest during the months of April – May and lowest during August – November.

Turbine unit unavailability caused by fish-related work was fairly typical during 2012. Nearly all fish-related outages were due to fish screen installation and removal activities and video inspections of the VBSs and ESBSs. Per the Ombil database system there were approximately 80.7 hours of direct fish-related turbine unit outages during 2012. By comparison during 2011 and 2010 there were a recorded 39.6 hours, and 95.7 hours of outages, respectively. During 2012, there were also approximately 29.5 hours of unit outages related to trash raking activities in February and March which were not included in the fish-related outages. Per Ombil, the following outage hours were directly related to fish work in 2012: Unit 1 (18.5 hours), unit 2 (11.7 hours), unit 3 (11 hours), unit 4 (13 hours), unit 5 (7.2 hours) and unit 6 (19.3 hours).

Forebay Debris/Trashracks

Forebay debris removal and trash rack raking operations were completed by February 27, 2012. During most of the season forebay debris levels were moderate and debris drifted back and forth with the wind. Descaling became quite severe in the JFF lab samples (up to 10.7% of the sample fish) during mid September. The shift operators checked the gatewell draw down and the differential was within the established range. Trash racks were racked on Unit 1 on September 19 and three loads of material (approximately 30 cubic yards) was removed. Trash racks on Units 2 and 3 were then raked on September 24 and little debris was removed. Due to continuing descaling issues, the project raked the trashracks on turbine unit 2 on the morning of October 2. (The 2A trashrack had not been raked earlier due to the inability to clean it with turbine Unit 1 in operation.) Some fine material was then removed from trashrack 2A. Some very large logs were also removed from the bottom of the 2B trashrack. No further raking of trashracks took place during the remainder of the fish season. Descaling slowly subsided and other factors (such as damaged ESBSs) may have been a factor in the high descaling rate.

Removable Spillway Weir

The removable spillway weir was operated as an integral part of the spring spill program beginning at 0001 hours on April 3 and running through 2400 hours on June 20. The spill level during this time period was a mandated 20 kcfs 24 hours per day. From 0001 hours on June 21 through 2400 hours on August 31 the RSW was operated as part of the summer spill program. The spill level during this time period was a mandated 18 kcfs 24 hours per day.

Extended-length Submersible Bar Screens (ESBSs)

All operating turbine units were equipped with ESBSs during the 2012 fish passage season. Winter maintenance of the screens by the powerhouse mechanics was ongoing in late February and early March. A physical inspection of the screens was conducted by fish facility personnel in mid March - just prior to installation. No significant problems of any kind were detected. Installation of fish screens in all operating units (Units 1,2,4,5,6) was completed by March 21. Unit #3 was dewatered at that time but brought on line on March 28 following ESBS installations.

Every attempt was made to conduct video inspections of the ESBSs during the course of the fish season as outlined in the Fish Passage Plan. While it is possible to get a good view of the VBSs with the existing video equipment, it is more difficult to get an accurate assessment of the ESBSs due to the limited amount of screen area detectable on the camera. Video inspections were attempted in late April and again in mid May but were cancelled due to turbidity issues. The units were operationally rotated off line and video inspections were finally conducted on all units on June 22-23. No problems were detected with any screen on those inspections. Per the Fish Passage Plan, it is not necessary to conduct video inspections during July. Video inspections during August and late October also revealed no problems of any kind with the ESBSs.

Operation of the ESBSs appeared to be relatively trouble-free during the 2012 season until September and early October. During routine examination of the fish screens in September and October it was determined that screens were bent in several units. Damaged fish screens were eventually found in slots 1C, 2B, and 5C. The bent screen in Unit 1 was found when it was forced out of service on October 10 due to an inoperable ESBS. Lower Granite in the process of acquiring replacement fish screens from John Day. Modifications may need to be done to these screens to make them work at Lower Granite.

The ESBS scrub brushes can be individually set to clean the screens at the following interval times: 15 minutes, 1 hour, 2 hours, and 4 hours. During most of 2012 the brush cleaning times on all ESBSs were set for one cycle every four hours when the unit was operating. After problems were detected with the ESBSs in September and October, the cycle time was increased to once every hour. After the problem fish screens were detected and taken off line, the cycle time on the undamaged screens was changed back to once every four hours. All operating screens remained at a cycle time of once every four hours for the duration of the season. The last of the ESBSs were raised and dogged off for the winter maintenance season on December 19.

Vertical Barrier Screens (VBSs)

New vertical barrier screens (VBSs) were installed in all turbine units in 1996. These screens have panels of plastic mesh on the front and 25% open area perforated plate on the back. In April of 2005, three experimental VBSs were installed in unit 4 and these screens remained in place during the entire 2012 fish season. Minor problems have been detected on VBS inspections in recent years but a tight schedule for the maintenance crew has made correcting

these problems difficult As in 2011, during 2012 VBSs were inspected with an underwater video camera per FPP guidelines in conjunction with inspections of the ESBSs. The 2012 October inspections revealed that VBSs in units 2, 4, and 6 had minor issues with missing rivets or loose straps. The mechanical crew's tight winter schedule makes getting these issues addressed difficult. The VBSs seem to be structurally sound. Hopefully repair work to replace the missing straps and rivets will be accomplished as soon as time permits.

Gatewells

Gatewells were inspected during adult fishway inspections throughout the 2012 season for debris buildup, oil, dead fish, unusual concentrations of live fish, or anything else out of the ordinary. As in previous years, extended length bar screens and modified vertical barrier screens noticeably increased the turbulence in the gatewells. This caused debris to tumble around in the gatewells and exit through the orifices, rather than accumulate on the gatewell surfaces. Another factor in the lack of gatewell surface debris buildup was that gatewell drawdown with ESBSs was greater than with the earlier 20 foot traveling screens, putting the orifice closer to the surface, especially under minimum operating pool conditions. As was the case from 1998 - 2011, constant debris movement through the orifices prevented the need for extensive gatewell cleaning during 2012.

Some larger debris was removed from individual gatewell surfaces with a small dipping basket when it appeared that it might cause problems with movement through the collection gallery orifices. This operation first took place during initial water-up in late March and continued throughout the season as circumstances warranted. Gatewell dipping took place only when the units were shut down for maintenance or were off line due to lack of water for generation. During nearly all of the 2012 collection season, surface debris coverage on the gatewells easily averaged less than 1%.

Orifices and Collection Channel

The Lower Granite juvenile collection channel was watered up on March 21, 2012 to accommodate fish screen installations. Bulkhead (downstream) slot orifices were operated in the usual manner during 2012 with at least one orifice per gatewell slot opened to divert fish into the collection channel. Upstream (fish screen slot orifices) were operated to provide additional water and fish guidance as hydraulic conditions allowed. During 2007, the upstream gatewells (fish screen slots) were dipped to see if any fish were present (gatewells and Wagner Horns were sealed in the mid 1990s). Very few fish were found with the exception of fish screen slot 5B where approximately 50 steelhead and 50 Chinook were removed. Consequently, an orifice from slot 5B was always left open during the entire 2012 fish collection season to ensure fish moved out of it safely. Orifices from the other fish screen slots were operated when hydraulic conditions in the gallery permitted.

The air backflush orifice cleaning system worked reasonably well during 2012 and there were no significant maintenance issues of any kind. Due to the variability of the debris moving through the system, fish facility personnel maintained a rigorous schedule of backflushing orifices every three hours around the clock from late March through the cessation of fish

collection activities on the last day of October. After that time, orifice flushing activities were slightly reduced but still maintained on a regular basis to ensure no orifices were plugged and impeding fish passage. This operation continued until the last of the fish screens were pulled. The collection gallery orifices were closed, and the channel dewatered on the morning of December 20.

Primary Dewatering Structure

Lower Granite's primary dewatering structure consists of an inclined screen of stainless steel mesh, supported by heavy bar screen, just upstream from the porosity control perforated plate for the separator. There is no mechanical cleaning device on this screen. It is cleaned with a long handled brush or scraper at periods ranging from every hour to once or twice per day dependent on the amount of debris moving through the system. Debris buildup is usually not a problem. Exceptions are during periods of high wind when tumbleweed and other plant materials are blown into the river or during periods of high river flow when an excessive amount of small woody debris, such as wood chips or pine needles, is in the river. Debris spills can also dislodge fine material which can pass into the juvenile fish system and cause problems. In addition small invertebrates in the river can also plug the screen and make cleaning very difficult. During late May and early June 2012, debris levels were high at times resulting in the need to clean the screen on an hourly basis to prevent clogging.

When the inclined screen on the separator system becomes severely clogged with debris, it is necessary to go into primary bypass mode by closing the dewatering valve below the screen and opening the 72-inch bypass valve. This takes pressure off the top of the inclined screen and allows debris to either float off or be easily brushed off. Typically it takes about 20 - 30 minutes of time to go through the entire cleaning procedure during which time fish are bypassed back to the river through the pipe at the base of the separator (primary bypass).

Unlike 2011 when debris blockages on the separator inclined screen resulted in having to go to primary bypass mode to clean the screen on 15 occasions, during 2012 it was necessary to dewater the inclined screen on only two occasions. The first event took place on June 6 when debris impingement on the screen became bad enough to prevent normal control of the separator. The second event took place on September 26 and was related to investigating a descaling issue and not for debris impingement.

It is likely that the fish facility would have had to go into primary bypass mode to clean the inclined screen numerous times during late May and early June due to debris blockages had it not been for a tool developed by the JFF maintenance crew. A long handled brush with high pressure air jets was developed during 2011 to help clear the debris from the screen. In practice the separator technician hooked the hose on the brush into the facility air supply. The brush was then pushed as far back on the inclined screen as possible and slowly pulled forward. The high pressure air pushed through the screen material and then bubbled back up freeing the debris immediately in front of the brush. By slowly pulling the brush forward it was possible to clean the debris off a portion of the screen one section at a time. Had it not been for this development, it is highly likely the screen would have had to be dewatered and cleaned on a more frequent basis during 2012.

A problem that did not occur during 2012 that caused management problems in 2011 was a sudden influx of the aquatic plant Elodea moving through the system and clogging the inclined screen. This was something that had not previously been encountered to any extent at this site. Bushels of this plant were removed off the inclined screen and from raceways during early to mid July of 2011. Fish facility personnel attempted to chase down the cause of this influx of material (thinking that perhaps someone upstream might have been cleaning vegetation from around docks) but were unsuccessful in finding the source. Hopefully this was a onetime event but assuming this plant is established in the river system it seems likely similar problems will occur in the future.

Separator

The separator at Lower Granite is a single stage separator and currently has no provision for size separation of juvenile fish. The separator functioned well during the 2012 season with the exception of the few periods of time when high levels of debris became an issue. It was necessary to check the separator exits more frequently than normal during the late May to mid-July time frame due to debris blockages. Descaling of juvenile fish became quite severe during September 2012. The separator was partially dewatered on September 26 from 1455 to 1535 hours in order to remove the bars and see if debris in the bin might be a factor in the high descaling rate. The inspection revealed that the separator bin was almost entirely clear with less than half a five gallon bucket of shells and small sticks removed.

Late in the 2011 collection season the 42-inch valve electric controller failed due to a bad circuit card. It was necessary to manually operate the valve for the last portion of the 2011 season. This card was replaced prior to startup operations in 2012 and both the 42-inch and the 72-inch valve functioned well during the 2012 season.

As in recent seasons the separator was also operated in the standard mode (water over the bars) to monitor for late season PIT-tagged juveniles passing through the system in November and December of 2012. (Unlike some other sites, Lower Granite does not have a full flow bypass with PIT-tag detection for juvenile fish. PIT-tag detection of juveniles normally ceases with the end of separation activities on the last of October.) No sampling or handling of juvenile fish took place during the extended separator operations. They were simply routed through the separator and out the long bypass pipe back to the river (secondary bypass) until the morning of December 20 when the juvenile collection system was dewatered for the season. The JFF maintenance crew kept electric/diesel heaters available for use at the separator and other exposed pipe areas. Separator personnel started the heaters whenever overnight temperatures dropped to the point that pipes could potentially freeze. As was the case in 2011, temperatures remained mild enough during November and December of 2012 that we were able to operate the system in the secondary bypass mode (PIT-tag monitoring mode) continuously and avoid going into primary bypass to keep from breaking pipes. It was necessary to operate the diesel heaters on only one or two nights.

As has been the case during recent years, during 2012 small Chinook jacks caused some problems by falling through the separator bars and ending up in the sample. This is especially

problematic because the jacks tend to thrash around quite a bit while being anesthetized and can potentially injure the much smaller juvenile fish in the anesthetizing bins. In addition, jacks could potentially be caught by anglers soon after release and should not be consumed early on due to the possible latent effects of MS-222. In order to prevent jacks from entering the sample, an additional set of separator bars with a smaller spacing were place on top of the existing separator bars on the morning of October 1. These bars were removed after the end of fish collection and sampling activities when the system had been switched back to secondary bypass mode. The new bars measure 1 inch in diameter, are constructed of rigid wall aluminum tubing, and are spaced approximately 1 1/16 to 1 1/8 inches apart. They are built in three full length panels and secured in place overlaying the existing separator bars.

Sample System/PIT Tag System

The sample system at Lower Granite consists of two slide gates located in the bottom of the separator exit flumes a few feet downstream of the separator, a large slide gate which separates PIT-tagged fish from sample fish, a PIT-tag tank and routing system to a holding tank or the river, a sample tank with four operational 4-inch counter tunnel exits, an enclosed pipe that carries fish from the sample tank to a sample holding tank which is divided into two equal halves (each with two pre-anesthetizing chambers). The two primary slide gates, which are controlled by a touch pad calibrated to within 0.001%, also act as PIT-tag diversion gates. The system has the capability to send PIT-tagged fish that exit the separator during a sample either to the sample or to the river. Most of the time, the system is set so the sample overrides the PIT-tag diversion system, sending PIT-tagged fish to the sample instead of being diverted back to the river. During 2012 this occurred from startup on March 25 until 0700 hours on August 2 when the system was switched over to “divert during sample mode”. (In this mode the sample is over-ridden to allow PIT-tagged fish to be diverted while a sample is in progress.) The system was operated in divert during sample mode until the end of normal separator operations on October 31.

At the start of the season on March 25 the sample gates were set to divert 10% of the fish to the sample while the remaining fish were diverted back to the river through the bypass outfall pipe. Samples were taken four to six times per hour during the course of the season until August 16 when the system was switched to a 100% sample rate due to lower fish number and also in order to help facilitate truck loading operations. The sample rate remained at 100% for the duration of the season on the morning of October 31. Weekly sample rates ranged from 0.500% to 50.000% prior to the 100% sample period. During the course of the season, the sample system only needed minor adjustments in air pressure and gate timing by Pacific States Marine Fisheries Commission personnel.

A new slide gate system with PIT-tag detection capabilities was added to the flume leading to the upstream raceways and bypass outfall pipe during the 2007 winter outage period. This system was installed by NOAA-Fisheries and PSMFC personnel between March 12 and March 21, 2007. The system now has four modes: 1) bypass marking, 2) bypass, 3) general collection, and 4) marking. When the system is in bypass marking mode all fish are diverted to the raceways for marking purposes except sort by code fish which are bypassed back to the river. When the system is in bypass mode all fish are diverted through the bypass outfall pipe (secondary bypass) to the river. When the system is in general collection mode, fish are diverted

down the flume to the east raceways for normal collection and marking activities. And finally when the system is set for marking mode, previously PIT-tagged fish (sort by code) are diverted to raceway 10 through an additional pipe to avoid being handled again. Untagged fish are routed down the flume for normal marking activities. This system continued to work well during 2012.

Cooling Water Strainers

In accordance with District policy the turbine unit cooling water strainers were inspected for juvenile lamprey on a monthly basis again during 2012. An attempt was made to inspect all unit strainers each month but this was not always possible due to some units being tagged out for maintenance. During 2012 February was the highest month for lamprey entrainment with a total of 496 lamprey mortalities removed from the strainers. January and March also had relatively high entrainment rates with respective monthly totals of 238 and 288 juvenile lamprey. September and October were the low months with no lamprey found in the strainers during that entire time period. For the entire 12-month period, a total of 1,449 juvenile lamprey were removed from the cooling water strainers at Lower Granite over a combined run time of 21,974.2 hours.

Barge/Truck Loading Operations

It has long been the policy at Lower Granite to try and load as many fish as possible directly onto fish barges to avoid raceway loading/holding. Direct loading of smolts onto waiting fish barges (rather than into raceways) is felt to be highly beneficial to the fish by eliminating secondary handling and related stress factors. An estimated 12.4% of the smolts (approximately 329,210 smolts out of 2,659,998 smolts barged from Lower Granite) were directly loaded onto fish barges at Lower Granite during the 2012 season. By contrast, during 2011, an estimated 43.4% of the smolts barged from Lower Granite (1,674,590 smolts out of 3,859,265 smolts barged) were directly loaded into barges at Lower Granite. This is nearly the same as in 2010 but somewhat better than most recent years. During 2010, 1,499,663 smolts were directly loaded out of 3,378,007 smolts barged (44.4%). Direct load percentages for other years were: 2009 (32.5%), 2008 (38.8%), and 2007 (24.5%).

The low direct load percentage during 2012 was caused by a number of factors. As in previous years, one factor limiting direct loading of barges was the need to divert large numbers of smolts to the upstream raceways to accommodate research marking operations during the peak of the juvenile outmigration. However, the biggest factor in 2012 for the personnel actually handling the fish was the constant threat of debris clogs in the direct load line to the barge. It is now mandatory to report even minor blockages and related fish mortalities to the region. Following two “incidents” it was decided to direct load raceways rather than risk continuing problems due to relatively high debris levels. Direct loading of fish barges at Lower Granite took place from May 6 until May 16. Other factors which limited direct barge loading were a late start to general transport operations and occasional late arrival times of returning fish barges.

Truck loading operations at Lower Granite went relatively well. As per recent years, there was no early season trucking during 2012. Trucking operations began immediately after fish barging ended and ran from August 18 until October 31. NOAA-Fisheries late season

transport evaluation reduced the number of fish transported and allowed the facility to use the pickup-mounted midi tank system for nearly all the season. Fish were diverted from the lab directly onto the waiting midi-tank reducing fish handling operations. The Lower Granite semi-tractor/3500 gallon fish trailer tanker combination was only used on the very last day of the season during 2012 when fish numbers (combined with those of Little Goose) exceeded midi-tank capacity.

Recommendations

1. Install a generator to power the fish facility during electrical outages.
2. Dependent on the initiation of the Phase 1 fish facility upgrade, refurbish the existing separator inclined screen with bar screen material; add an airburst cleaning system under the inclined screen; beef up the existing screen support system (it is rusted and could possibly fail in the not too distant future).
3. Replace the aging Point Four oxygen monitoring systems on the 4000 and 8000 series fish barges.
4. As needed, replace the cracked barge fish hold plungers with new plungers.
5. Tune up the Cummins barge engines (per company specs this should be done every 1,000 hours).
6. Paint the holds on fish barge 4382 in FY 2013.
7. Pour concrete to serve as ballast in fish barges 4394 and 4382 as soon as funding becomes available.
8. Paint the hulls on all the fish barges as soon as funding becomes available.
9. Refurbish the concrete on the raceway interiors with a new sac-rub finish (pending a new JFF).
10. Replace the aging lab chiller system with an improved system.
11. Install or remove push knees (as needed) on the barges and explore a new bumper system to use in place of the present cable and tire system.
12. Repair concrete erosion damage in the upwell structure as soon as possible (rebar is showing).

Acknowledgements

A total of 22 people were employed in various capacities at the Lower Granite Juvenile Fish Facility during 2012. Corps of Engineers biologists in charge of collection and transportation activities were Mike Halter (project fishery biologist) and Ches Brooks (assistant project fishery biologist). Corps technicians assigned to the barges were: Cady Tyron, Gene Sprofera, Robert Traufer, and Dan Caldwell. Corps separator technicians were: Robert Horal, Joel Dirks, John Dammann, Chris Foster, and Chris Lorz. The Corps maintenance and truck driving staff consisted of Taylor Nelson and Robert Enzi. Raymond Cooper (vice Bradley Clarke) served as the engineering equipment operator leader. Mike Knapp served as the heavy mobile equipment operator.

Washington Department of Fish and Wildlife (WDF&W) Biologists in charge of COE Transport Oversight Contract activities and Smolt Monitoring Program activities were Shawn Rapp (Task Order Biologist), Fred Mensik (SMP Supervisory Biologist), and Alan Martin (SMP Biologist). The WDF&W also employed Bill Fitzgerald, Sarah Smith, and Ann Blachly as sample technicians and Jeremy Wright as an anesthetist.

APPENDIX TABLES

Appendix Table 1. Daily Collection and Bypass Numbers at Lower Granite Dam, 2012.

Appendix Table 2. Percent Daily Descaling and Daily Facility Mortality Numbers at Lower Granite Dam, 2012.

Appendix Table 3. Daily Number of Fish Trucked and Barged from Lower Granite Dam, 2012.

Appendix Table 4. Daily Number of Adult Fallbacks and Fallback Mortality at Lower Granite Dam, 2012.