ADULT AND JUVENILE FISH FACILITIES MONITORING REPORT
LOWER GRANITE DAM
2011

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INTRODUCTION

This report summarizes the operation and maintenance of the adult fish passage facility at Lower Granite Dam in 2011, including the results of inspections completed by fisheries personnel from March 1 to December 31. The report also summarizes operation and maintenance of the juvenile fish passage facilities and includes an overview of the collection, transportation, and bypass of migrating juvenile salmon and steelhead at Lower Granite Dam in 2011. More detailed information on juvenile fish collection and transportation activities at Lower Granite Dam can be found in the Walla Walla District's Juvenile Fish Transportation Program 2011 Annual Report.

ADULT FISH FACILITIES

Facility Description

Adult fish passage facilities at Lower Granite Dam consist of an adult fish ladder (adjacent to the dam on the south shore of the river), an adult fish trap located in the fish ladder, two weirgate entrances on the south shore of the river (SSE-1 & 2), a powerhouse collection system comprised of ten floating orifice gates, three north powerhouse entrance gates (NPE-1, 2, 3), a channel under the tailrace deck and spillway connecting all three entrances to the ladder, three north shore entrances (NSE-1, 2, 3), and an auxiliary water supply system. The fishway ladder itself is comprised of a series of pools and weirs and covers a horizontal distance of approximately one-quarter mile while rising a vertical distance of about 100 feet.

During standard fishway operation, the two south shore weir gate entrances are open all the time. Four of the ten floating orifice gates are left open at any one time (gates 1, 4, 7, and 10). Two of the three north powerhouse entrances are normally operated (usually entrances 1 and 2). At the north shore, only the two downstream entrances are normally open at any one time.

Auxiliary water is supplied to the fishway by means of three electric motor-driven turbine pumps that take water from the tailrace area and pump it to floor diffusers located along the tailrace collection channel. Two pumps are operated at any one time and the third pump is kept as a spare and rotated occasionally with one of the other two pumps to even the operational wear. The water supply to the fish ladder proper (approximately 75 cfs) is supplied by gravity flow from the forebay through the fishway exit and upper ladder diffuser.

Automated Fishway Control System

The Lower Granite automated adult fishway control system consists of a Dell 486 computer with a 60-IBM/N card installed and a SIXNET remote terminal unit (RTU). The Dell Optiplex GX-1 computer is located in the powerhouse control room and the RTU300 is mounted adjacent to the existing fishway system control (FSC) board. The computer is used to change the control parameters of the RTU, and provides data acquisition and storage. The RTU controls the six fishway weirgates according to set points that either control the gate at depth below tailwater or a channel to tailwater head differential. NOTE: this controller system, located in the control room, broke down early during the 2011 inspection season. A trouble report was submitted. At this time it appears unlikely this system can be repaired.

The fishway control system provides the following information to the computer: 1) channel water elevation at all three pairs of entrance weirs in feet above mean sea level (MSL), 2) elevation of all six weirgates in feet above MSL, 3) tailwater elevations at three locations in feet above MSL, 4) depth of each weirgate below tailwater in feet, 5) the difference between channel water elevation and tailwater elevation in feet, and 6) the elevation of the fish attraction water pump discharge chamber above MSL.

This control system was installed between 3 January and 28 February, 1994. The system was programmed to control SSE-1 and SSE-2 at eight feet below the south shore tailwater, NPE-1 and NPE-2 at eight feet below the north powerhouse tailwater, and NSE-1 and NSE-2 were set to maintain the north shore channel one foot above the north shore tailwater elevation. (Lack of sufficient water at the north shore prevents NSE-1 and NSE-2 from being set at seven feet below tailwater. Weir depths are sacrificed to maintain the one foot of head differential.) Gate position is sensed by existing Selsyn technology inputting to an INCON model 1255 position monitor that provides gate level accuracy to .01 foot mean sea level (MSL).

Fishway collection channel elevations near the weirgates at the south shore, north powerhouse, and north shore are measured by a Milltronics multiranger plus ultrasonic level transducers which provide a 25 foot measuring range. The ultrasonic transducers are mounted at elevation 650 MSL and thus provide an accurate level indication to elevation 625 MSL (the lowest level in the fish channel). Tailwater elevations at the north powerhouse and north shore are also monitored by ultrasonic transducers, while the south shore is monitored by Selsyn technology similar to the weirgate levels.

Operation and Maintenance

During 2011, the adult fishway system was all or partially dewatered from January 3 until February 15 for maintenance purposes. The ladder portion of the fishway was dewatered on January 3. Powerhouse crews began draining the powerhouse channel portion of the ladder on January 4. Both the powerhouse and spillway sections of the collection channel were successfully dewatered on January 4.

Powerhouse crews initiated dewatering of the fish ladder on January 1 by shutting down fish pumps two and three approximately 48 hours prior to beginning the operation. On January 3 bulkheads were placed in the fish ladder exit to stop the flow of water down the ladder. The drain at diffuser 14 was left closed to keep a small amount of water in the ladder until all the fish could work their way down to the junction pool. Dewatering of the adult fish ladder section only was completed on January 3. Two dead fish (one adult steelhead, one adult carp) were removed from the ladder during dewatering (they were dead before dewatering). In addition five live fish were also removed (two wild juvenile steelhead, two juvenile bullhead catfish, one sculpin). The live fish were released directly into the dam tailrace.

Both the powerhouse and spillway sections of the adult fishway channel were dewatered on January 4. The powerhouse section was dewatered late in the morning and the spillway section was dewatered early in the afternoon. The following fish were removed from the powerhouse portion of the ladder: four (live) adult clipped steelhead, two (dead) adult steelhead, one (dead) adult American shad, one (dead) adult carp. (The dead fish were not killed during the dewatering and had been dead for some time.) The four live adult steelhead were taken upstream of the dam and released at Offield Landing.

As is normally the case, more fish were recovered from the spillway section of the collection channel than the powerhouse section. We also observed no fish mortalities while dewatering this portion of the channel. The following adult fish were salvaged (numbers are approximate): 15 adult steelhead (mixed hatchery and wild), 20 adult channel catfish, two rainbow trout, two peamouths, two bridge-lipped suckers, and one adult mountain whitefish. In addition we salvaged the following juvenile fish: 25 subyearling fall chinook, (mixed hatchery and wild), 10 steelhead (mixed hatchery and wild) , two suckers, two mountain whitefish, and one sculpin. All fish listed in this paragraph were taken to Offield Landing and released.

Normal preventative maintenance was conducted on the adult fishway system between January 4 and February 15, 2011. In addition the following work was also accomplished: 1) the picketed leads were power-washed and one and one-half inch spacers were added to the bottom of the leads for lamprey passage, 2) a new grating was installed at diffuser 14, 3) new hold-downs were installed on the diffuser gratings at the #1 and #2 diffusers, 4) a new diffuser valve was installed on diffuser 13, 5) the framework at the fish counting window and backlight was painted, 6) repaired the limit-torque screw jack at the adult fish trap, 7) repaired three fish bins at the adult fish trap, 8)

repaired leaking air lines at the adult fish trap, 9) repaired a flange on the aluminum piping at the adult fish trap anesthetic station, 10) repaired leaking hoses at the fish viewing window cleaning brushes, 11) repaired welds on broken catwalk at the window cleaning brushes, 12) painted the hatch cover and frame at diffuser #9, 13) replaced the heat exchanger at the #2 fish pump, 14) replaced the limit switch at NNO gates, 15) replaced two oil filter assemblies on fish pump #1, 16) replaced tie rods and ball joints on fish diverters at the adult fish trap, 17) the University of Idaho installed lamprey antennas at the fishway exit pool and in the lower section of the ladder (flat plates) above the junction pool area.

Modifications

Modifications to the adult fish trap complex at Lower Granite, operated by NOAA-Fisheries, were completed during the winter of 2007. The modifications included: expansion of the platform area; modifying the anesthesia system to provide for an additional four holding tanks; installing a pivoting flume system to route fish to the anesthesia tanks; adding two sorting tanks behind the anesthesia tanks for the working up/sorting of hatchery fish; adding four more adult holding tanks for fall chinook broodstock collection; adding a flume system to route fish to the holding tanks; adding additional electrical outlets for PIT-tag scanning and providing an additional pipe in the forebay to add the extra water needed to operate the expanded trap facilities.

The adult fish ladder and fish trap functioned well during 2011 no major repairs needed. The replacement of the controller valve for diffuser 14 in the adult fish ladder improved the water flow to the adult trap. Following installation in November of 2009, extensive flow tests were conducted. During the tests, it was possible to run all six adult holding tanks at the adult trap with a sufficient flow of water down to a forebay elevation of 734.2 feet. This allowed for improved holding of adult chinook again during the 2011 field season. About the only modifications made to the trap complex in 2011 were modification of the loading hoses from the fish tanks to the hatchery trucks. Hoses were cut specific to each transport truck and clamped onto the tank loading chutes by means of a ring clamp system.

Operations and Maintenance

Auxiliary Water Supply:

When the adult fish ladder complex was watered up in February 2011, fish pumps 2 and 3 were initially run to supply water to the adult fish ladder diffuser system. This changed on May 3 when fish pump 1 was brought on line and fish pump 3 was taken off line. Fish pumps 1 and 2 were then run until November 7 when fish pump 2 was taken off line due to a drop in oil level. At that time fish pump 3 was brought back on line and ran concurrently with fish pump 1 until they were shut down for the winter maintenance activities on the fish ladder. All three fish pumps were out of service from January 3 to

February 15, 2011 for routine annual maintenance while the adult fish ladder was out of service.

Table 9. Fish pump outages at Lower Granite Dam, 2011.*

Affected Pump(s)	Dates	Reason for Outage/Comments
Pumps 1, 2 &3	1/03 - 2/15	Fishway outage
Pump 2	11/-07 - 12/31	Drop in oil level

*Only outages involving two or more calendar days are included.

Adult Fish Trap Operations:

During the 2011 fish season, the adult fish trap at Lower Granite Dam was operated continuously between March 7 and November 22. Unlike recent seasons, it was not necessary to take the trap out of service due to water temperatures in excess of 70°F. During 2011 the adult fish trap sample rate was set at a 10% sample rate for the entire season.

Numerous activities took place at the adult trap during the course of the season. One of every 20 hatchery steelhead up to August 18, had a scale and genetic sample taken from them. After August 18, and running through the end of the trapping season, it was switched to one of every 25. All previously PIT-tagged fish regardless of origin had a scale and genetic sample taken during the entire year. All wild steelhead without a PIT tag had one implanted, along with scale and genetic samples taken for the entire trapping season. Later in the season scale samples were taken from one out of every three hatchery Chinook. Sort by code Lemhi origin Chinook were also radio-tagged and scale and genetic samples taken during the course of the spring and summer.

The goal of collecting 100 adult American shad for genetic evaluation to see what component of the shad run that crosses Bonneville Dam makes it upstream to Lower Granite Dam was repeated in 2011. Because the American shad run was lower at Lower Granite in 2011 than in the past, a total of only 25 were collected for analysis this year.

Collection of adult fall Chinook for transport to Lyons Ferry Hatchery began on August 18. Due to relatively low numbers of fish, actual transport operations did not begin until August 22. Due to a very high percentage of adult females in the fall Chinook run, brood stock goals (for females) were largely met for both Lyons Ferry and Cherry Lane hatcheries by the third week in October. Consequently protocols at the adult trap were changed and only Chinook females that were wire-tagged (2 out of 3) were hauled to Lyons Ferry. In order to increase the number of male fall Chinook available for spawning, the protocols were also changed and and untagged males $\geq$ 65 cm were hauled to Lyons Ferry starting in late October. Also at that time, the Cherry Lane Hatchery began filling any fish needs by going directly to Lyons Ferry rather than Lower Granite. Trucking operations continued on an as needed basis through mid November. The final transport of adult fall Chinook to Lyons Ferry Hatchery took place on November 17.

A grand total of 8,057 fall Chinook were handled by personnel at the adult trap. Out of this total, 2,886 were hauled to the hatcheries and 5,171 were released back into the fish ladder. Lyons Ferry Hatchery received a total of 2,302 fall Chinook (1,352 adults, 950 jacks). The Nez Perce Hatchery at Cherry Lane received a total of 584 fall Chinook (all adults). Following the conclusion of adult fish trapping activities, the adult trap complex was dewatered for the winter on November 22.

During 2011, the following species and numbers of fish (by clipped and unclipped designation) were handled by personnel working at the Lower Granite adult fish trap complex: sockeye (118 clipped, 24 unclipped), coho (53 clipped, 530 unclipped), steelhead/spring (755 clipped, 293 hatchery non-clipped, 395 wild unclipped), steelhead/ fall (13,917 clipped, 771 hatchery non-clipped, 4,038 wild unclipped), Chinook spring/summer (10,732 clipped, 519 non-clipped coded wire tagged, 2,883 non-clipped with no wire tag), Chinook fall (2,566 clipped, 1,863 clipped coded wire tagged, 4,035 unclipped, 1,456 unclipped coded wire tagged)**.**

Adult Fishway Inspections

Methods:

A total of 159 physical inspections of the adult fishway complex were conducted at Lower Granite between 1 March 2011 and 31 December 2011. This averaged out to nearly 3.6 inspections per week during the fish passage season. The routine inspections during 2011 were conducted by COE fisheries personnel stationed at Lower Granite Dam. Once per month, inspections were also conducted in conjunction with Oregon Department of Fish and Wildlife personnel stationed at Little Goose Dam. Following inspections, out of criteria readings or other problems were reported to powerhouse personnel for correction. Powerhouse operators also conducted their own inspections of the adult fishway system to help ensure proper operation.

The inspections were conducted in order to maintain the adult fishway within established operating criteria and to monitor long-term trends in operation. Inspections were not scheduled on a daily or hourly basis but rather an attempt was made to make at least three inspections per week on a no more than once per day basis. Other than avoiding inspections after lockages or other events that could impact staff gauge and weir gate readings, all inspections were made without regard to operational conditions.

Visual inspections of the adult fishway system were conducted by walking through the facility, observing fish passage conditions, and examining each criteria point. Staff gauge readings were taken at the picketed leads, viewing room pool, forebay, adult fishway exit, diffuser 14, and collection channel/tailwater areas adjacent to the entrance weirs. Weir entrance readings were also recorded on each inspection: two at the south shore entrances (SSE-1 and SSE-2), two at the north powerhouse entrances (NPE-1,

NPE-2), and two at the north shore entrances (NSE-1 and NSE-2). All readings were taken to the nearest tenth of a foot.

Established operating criteria have long been used for each portion of the fishway. The difference between the elevation reading at the upstream staff gauge (picketed leads) and fish viewing room pool staff gauge should be no more than 0.3 feet. There should be no more than 0.5 feet of head between the adult fishway entrance and the forebay level. The water depth over the ladder weirs (measured at diffuser 14) should be within 1.0 to 1.3 feet. Head differentials at all fishway entrances (differential between entrance bay elevation and tailwater elevation) should be 1.0 to 2.0 feet. Weir depth readings (difference between the weirgate elevation reading and the tailwater level) should be 7.0 feet or greater at the north shore and 8.0 feet or greater at the south shore and north powerhouse.

Readings from each visual inspection were recorded on a standardized form and reviewed for out of criteria readings or other problems. Information from the fishway control system board (FSC Board) was also reviewed and used to supplement the information from visual inspections. When problems were found within the fishway, powerhouse operators were notified and asked to correct them within the limitations of the system.

Inspection Results:

Data from each physical inspection during 2011 was entered into an updated Excel program for analysis. The program evaluated criteria points on a per inspection basis and, when things were out of criteria, recorded the amount out of criteria by tenth of a foot blocks. The program also provided information on the percentage of time that an inspection point met criteria for the entire inspection year. Summary data was automatically copied into an Excel table by the program. This Excel table was later copied into a Word table (Table 1 below) for inclusion in this report and references to inspection results refer to data listed in this table.

Table 1. Summary of adult fishway inspections at Lower Granite Dam, 2011.[1]

			------Not Enough Depth------			-------Too Much Depth-------		
Criteria and Locations	**No. in Criteria/ No. on Sill/ No. of Inspections**	**% In Criteria/ % On Sill**	**No./% Within 0.01-0.1 Foot**	**No./% Within 0.11-0.2 Foot**	**No./% >0.2 Foot**	**No./% Within 0.01-0.1 Foot**	**No./% Within 0.11-0.2 Foot**	**No./% >0.2 Foot**
South Channel	0	0.0	***	***	***	***	***	***
Water Velocities	***	***	***	***	***	***	***	***
	159							
Differentials								
Ladder Exit	159	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	159							
Ladder Weirs	129	81.1	13	17	0	0	0	0
	***	***	8.2	10.7	0.0	0.0	0.0	0
	159							
Counting Station[3]	159	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	159							
South Shore Entrance	159	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	159							
North Powerhouse Entrance	153	96.2	3	2	1	0	0	0
	***	***	1.9	1.3	0.6	0.0	0.0	0.0
	159							
North Shore Entrance	138	86.8	6	4	6	1	2	2
	***	***	3.8	2.5	3.8	0.6	1.3	1.3
	159							
Weir Depths								
SSE-1[2]	142	89.3	2	5	1	***	***	***
	9	5.7	1.3	3.1	0.6	***	***	***
	159							
SSE-2[2]	141	88.7	1	7	1	***	***	***
	9	5.7	0.6	4.4	0.6	***	***	***
	159							
NPE-1[2]	72	45.3	2	1	***	***	***	***
	84	52.8	1.3	0.6	***	***	***	***
	159							
NPE-2[2]	75	47.2	***	***	***	***	***	***
	84	52.8	***	***	***	***	***	***
	159							
NSE-1	48	30.2	1	***	109	***	***	***
	1	0.6	0.6	***	68.6	***	***	***
	159							
NSE-2	1	0.6	0	1	156	***	***	***
	1	0.6	0.0	0.6	98.1	***	***	***
	159							

[1] Data are from Appendix 5.
[2] "On sill" means the weirgate is bottomed out on its sill due to low tailwater conditions and within criteria at this location.
[3] Data is listed as 100% in criteria because both "too much depth" readings were at the maximum allowable 0.3 feet (table is for >0.2 feet).

South Shore Channel Water Velocities

Velocity Meter Readings:

Present criteria stipulate that channel velocities (transportation velocity) in the junction pool area of the adult fishway at Lower Granite be 1.5 – 4.0 feet per second or greater. When the meter was installed at Lower Granite it was put in a part of the channel that had the lowest velocities to monitor the worst-case situation. Consequently, readings are lower in that area then they would be in other locations. During early 2006, modifications were made to the lower weirs in the adult fish ladder and the channel in the junction pool was also narrowed by adding a steel wall inside the existing structure. It was thought that this would help improve channel velocities. Velocities did improve somewhat but not enough to reach the criteria level.

At Lower Granite, six readings are taken from the velocity meter during each fishway inspection and recorded on the inspection form. The six readings are then averaged and the average velocity used as the reading for that inspection. During 2011, readings at the meter in the junction pool were out of criteria on all 159 inspections that were conducted by COE project biologists. Readings ranged from 1.22 fps to 0.73 fps in 2011 compared to 0.79 fps to 1.14 fps in 2010, 0.58 fps to 1.19 fps in 2009, 0.88 fps to 1.10 fps in 2008, 0.77 fps to 1.2 fps in 2007, and 0.70 fps to 0.90 fps in 2005 (prior to junction pool modifications). The average velocity reading during 2011 was 0.97 fps throughout the duration of the entire season.

Head Differentials

Ladder Exit:

There should be no more than 0.5 feet of head between the trashracks and fish ladder exit according to the Fish Passage Plan. The head differential readings for this criteria point were within criteria (0.5 feet or less) on all 159 inspections in 2011. Nearly all of the readings showed either no differential or from 0.1 – 0.2 feet of differential. This area was within criteria 100.0% of the time.

Ladder Weirs:

Water for the adult fish ladder is supplied by gravity flow from the reservoir through the ladder exit and also through a diffuser below the water control section. The amount of water added to the ladder through the diffuser depends on the elevation of the Lower Granite reservoir, with more water being added through the diffuser as the reservoir lowers. The water supply for the adult fish trap is tied into the diffuser and also affects the amount of water available for ladder operations when the reservoir is operated at minimum operating pool (MOP).

According to the Fish Passage Plan, 1.0 to 1.3 foot of water should flow over the top of the ladder weir at diffuser 14. Readings are taken from a staff gage that measures elevation (the top of the ladder weir is at elevation 727.0 feet). Hence, the acceptable range of readings falls between 728.0 feet and 728.3 feet. This inspection point was out of criteria 30 times during 2011. There were 13 out of criteria readings that were 0.1 feet below the 1.0 foot minimum over-flow criteria level and 17 readings that were 0.2 feet below the criteria level. Court ordered spill and pool elevations near MOP accounted for the majority of out of criteria readings. This inspection point was within criteria 81.1% of the time during 2011. By contrast it was within criteria 87.8% of the time during 2010, 85.1% of the time in 2009, 95.4% during 2008 and 62.0% of the time during 2007.

Counting Station:

Gratings (picketed leads) separate the area between the staff gage above the fish viewing window and the staff gage below the fish viewing window (counting station). Criteria calls for no more than 0.3 foot of differential between the two staff gage readings. In 2011 this inspection point remained within criteria 100% of the time.

South Shore Fishway Entrance Head Differentials:

South powerhouse fishway entrance head differential readings should range from 1.0 to 2.0 feet between the channel entrance and the tailwater level at the fishway entrance. There were no out of criteria readings during the 2011 fishway inspections. This inspection point remained within criteria 100.0% of the time during 2011.

North Powerhouse Fishway Entrance Head Differentials:

North powerhouse fishway entrance head differential readings should range from 1.0 to 2.0 feet between the channel entrance and the tailwater level at the entrance. During 2011 this inspection point was out of criteria six times. There were three readings 0.1 below criteria, two reading 0.2 feet below criteria and one reading greater than 0.2 feet below criteria. This inspection point was within criteria 96.2% of the time during 2011.

North Shore Fishway Entrance Head Differentials:

The criteria range for head differential readings at the north shore fishway entrances is also between 1.0 and 2.0 feet. Under the present situation, fish pumps two and three cannot supply enough water to the north shore to maintain both head differential readings and weir depths. This situation has also been exacerbated due to operation during minimum operating pool (MOP) conditions in the tailrace. Standard operational policy has been to sacrifice weir depth readings in order to maintain at least 1.0 foot of head differential. During 2011, the head differential readings were out of criteria 21 times. There were six readings 0.1 feet below criteria, four readings 0.2 feet

below critiera, and six readings greater than 0.2 below criteria. In addition, there were five readings in which there was too much depth. There was one reading with 0.1 feet too much depth, two readings with 0.2 feet too much depth, and two reading with greater than 0.2 feet too much depth. The failure of weirgate NSE-1 and the need to dog it off at a compromise level contributed to the higher than usual out of criteria readings this year. During 2011, this inspection point was within criteria 86.8% of the time.

Fishway Entrance Weir Depths

South Shore Entrances 1 and 2, Weir Depths

The south shore fishway system at Lower Granite consists of two fishway weir entrances: south shore entrance one (SSE-1) and south shore entrance two (SSE-2). Present criteria calls for a weir depth level of 8.0 feet or greater between the tailwater elevation and elevations at the south shore fishway entrance weir gates. South shore gates were considered to be "on sill" and bottomed out whenever the tailwater elevation was 632.9 feet or less. This is usually not too much of a problem at the south shore gates. During 2011 operation of the Little Goose pool during the summer months dropped the Lower Granite tailrace to 632.9 feet or lower on nine occasions and caused both gates to bottom out. All events in which the gates were on sill took place in August.

Weir gate depths are considered to be out of criteria whenever there is enough tailwater elevation to allow the weir gates to move off their sills and readings are not 8.0 feet or greater. During 2011, SSE-1 was out of criteria eight times (per the physical readings off the weir gate dial). There were two readings in which SSE-1 was 0.1 feet below criteria, five readings in which SSE-1 was 0.2 feet below criteria, and one reading in which SSE-1 was greater than 0.2 feet below criteria. During 2011, SSE-1 remained within full criteria 89.3% of the time and was on sill 5.7% of the time.

SSE-2 was out of criteria nine times during 2011. There was one reading in which SSE-2 was 0.1 feet below criteria, seven readings in which SSE-2 was 0.2 feet below criteria, and one reading in which SSE-2 was greater than 0.2 feet below criteria. During 2011, SSE-2 remained within full criteria 88.7% of the time and was on sill 5.7% of the time.

North Powerhouse Entrances 1 and 2, Weir Depths

Like the south shore, criteria at the north powerhouse fishway entrances also requires weir depths of 8.0 feet or greater. The north powerhouse fishway system at Lower Granite consists of two operating fishway entrances: north powerhouse entrance one (NPE-1) and north powerhouse entrance two (NPE-2). North powerhouse gates were considered to be "on sill" whenever the adjacent tailwater elevation was 635.9 feet or less. At this level, both gates "bottom out" and rest on their respective sills. During 2011, this occurred on a near constant basis from March 22 until May 14 and again from

July 9 through September 3 due to operation of the Little Goose pool at the minimum operating level most of the time. In all, both NPE-1 and NPE-2 were on sill 84 times during the season. Readings that were on sill were considered to be within criteria because nothing could be done about the minimum operating pool levels (MOP), which caused the condition.

Weir gates are considered to be out of criteria whenever there is enough tailwater elevation to allow the gates to move off their sills and readings are not 8.0 feet or greater. NPE-1 was out of criteria three times and NPE-2 was not out of criteria during 2011. Of the three times that NPE-1 was out of criteria, there were two readings in which the weir depth was 0.1 feet below criteria and one reading 0.2 feet below criteria. During 2011, NPE remained within full criteria 45.3% of the time, was on sill 52.8% of the time and was out of criteria 1.9% of the time. NPE-2 remained within full criteria 47.2% of the time and was on sill 52.8% of the time.

North Shore Entrances 1 and 2, Weir Depths

Present criteria at the north shore fishway entrances stipulates a weir depth reading of 7.0 feet or greater at both entrances. With the exception of heavy spill conditions, there is seldom enough tailwater elevation to maintain both weir depths and head differentials. It is a standard operational practice to sacrifice weir depths in order to maintain at least 1.0 foot of head differential at the north shore. Because of these unusual operating conditions, and the emphasis on maintaining head differentials, weir depth readings are almost always below the desired level. This changed somewhat during 2011 and was caused by the failure of NSE-1 on May 31. In order to deal with this problem, the gate at NSE-1 was dogged off at a compromise level. After the tailrace returned to nomal operating conditions in early September, NSE-1 met the 7 feet or greater weir depth criteria level most of the time for the duration of the season. Of the 159 fishway inspections that were conducted on north shore entrance one (NSE-1) and north shore entrance two (NSE-2), both gates were on sill (tailwater elevations at or below 632.9 feet) on only one occasion. NSE-1 actually met the 7 foot (or greater) depth criteria level on 48 occasions while NSE-2 met the depth criteria on only one occasion. In the case of NSE-1, all out of criteria depth readings were greater than 0.2 feet below the acceptable criteria level. In the case of NSE-2 there was one out of criteria reading 0.2 feet below the acceptable depth level and all other readings were greater than 0.2 feet below criteria. During 2011, NSE-1 met criteria 30.2% of the time, was on sill 0.6% of the time, and was out of criteria 69.2% of the time. NSE-2 met criteria only 0.6% of the time, was on sill 0.6% of the time, and was out of criteria 98.7% of the time.

Automated Versus Visual Inspection Results

Readings from the computer system (fishway system control board) were valuable in obtaining an “overall picture” of the functioning of the adult fishway and served as a supplement to the actual visual inspections. During most of the year, the readings between the actual visual inspections and the automated system were reasonably close.

The Corps biologists attempted to accurately read staff gauges to the nearest 0.1 foot but discrepencies did occasionally occur. The biggest factors were frequent wave action which made accurate staff gauge readings difficult and the slight time differences between the physical reading and recording the reading off the fishway system control board. During periods of high spill and wind the automated system was particularly valuable and enabled us to monitor the north shore weir gates without becoming drenched.

Recommendations for 2012

1. Repair the damaged weirgate at NSE-1 with a new gate and control system.
2. Consider replacing all the weirgates with a new improved system as parts are difficult to obtain for the existing gates.
3. Continue monitoring of the electronic fishway readings (FSC board) to ensure that electronic fishway readings match physical conditions.
4. Replace the adult fishway control system (located in the control room) with a new system as the old one appears to irreparable.
5. Continue monitoring of the adult trap water demand to ensure that things are operating as planned (following the installation of the new diffuser 14 butterfly valve) and that enough water is available to operate the full range of adult holding tanks during the critical fall period.

JUVENILE FISH FACILITIES

Facility Description

The juvenile fish passage facilities at Lower Granite Dam consist of extended-length submersible bar screens (ESBSs) to divert fish away from turbines, vertical barrier screens, orifices to divert fish from bulkhead slots and fish screen slots, a collection channel and underground pipe to transport fish from the dam to the collection facility, an inclined screen primary dewatering system, a single-stage wet separator and fish distribution system, fish holding raceways, sampling facilities, and barge and truck loading facilities.

Each of the bulkhead slots and fish screen slots (gatewells) has 2 orifices leading into the collection channel. Bulkhead slot orifices are 10 inches in diameter and fish screen slot orifices are 8 inches in diameter. The hydraulic capacity of the collection channel and pipe do not allow all orifices to be open at once. Under normal operation, 18 bulkhead slot orifices (one per slot) and up to six fish screen slot orifices are open at any one time. Fish screen slots and Wagner Horns had closure devices installed during 1995. Cables broke on some of the Wagner Horn closures shortly after construction and allowed the devices to fall off. Replacement took place during 1996. However, not all the fish screen slot closures are 100% effective in deterring fish from moving into the

slots. Consequently fish screen slot orifices are run on an alternate basis throughout the season to allow trapped fish an escape route into the collection gallery.

Depending on the amount of debris moving through the system, the bulkhead slot orifices are normally backflushed with air every three to four hours around the clock to clear debris during the actual fish collection season. Lights are directed at each open orifice to enhance fish attraction into the collection channel. Water and fish from the collection channel are carried underground through a 42-inch diameter gravity flow pipe to the collection facility approximately 1/4 mile downstream from the dam. Upon reaching the facility, most of the water is eliminated through an inclined screen and the remaining water and fish flow into the separator. Small fish pass through the separator bars and are collected while large fish and woody debris are returned to the river. Collected fish are then routed directly to a barge, bypassed back to the river, placed in a raceway for later transport, utilized for research, or become part of the sample.

Facility Modifications

Facility Modifications

The following modifications and work were made to the Lower Granite Juvenile Fish Facility and barges prior to the 2011 season:

1. Refurbished the sample diversion slide gates per PSMFC guidelines.
2. Built new raceway tailscreens to allow juvenile lamprey to pass out of the raceways.
3. Built a pipe extension to the river to allow juvenile lamprey to pass from the upstream raceways into the river.
4. Cleaned up the counter tunnel wire connections in the separator control room.
5. Repaired separator water leaks in the slide gate area.
6. Checked/repaired damaged mesh in raceway tailscreens.
7. Rebuilt snorkel seals on the raceway loading boom and replaced the flexible hose.
8. Examined by ROV the upstream and downstream ends of the 42-inch underground fish pipe running from the juvenile fish collection gallery to the separator.
9. Repaired the anesthesia tanks on the sample holding tank system.
10. Repaired the leak on the small valve off the separator spool piece.
11. Cut an emergency fish exit in the floor of the barge mooring dock to allow separator technicians to release raceway fish in the event of a water supply emergency.
12. Refurbished the oxygen probes for the fish barges.
13. Replace some of the twist-lock electrical fittings on the barges with straight fittings.
14. Installed new strainer seals on fish barge 2127.
15. Repaired the broken aerator control valve on fish barge 8106.
16. Serviced the aerator valves on fish barge 4382.
17. Built new raceway stoplogs.

River Conditions

Flows in the Snake River during the 2011 season were easily the highest of the last five years (Table 3) and also the highest since 1997 (based on January to July flow figures). Flows for the juvenile fish collection period running from March 26 through November 1 averaged 88.3 kcfs. Flows exceeded the Biological Opinion target of 100 kcfs on 79 dates during 2011 and reached the 200 kcfs level on four dates. River flows for the last few days of March were between 77.6 and 95.7 kcfs – well above the norm. Flows in April averaged 107.8 kcfs and ranged between 81.8 kcfs and 143.0 kcfs. In May, river flows averaged 140.6 kcfs and ranged between 84.1 kcfs and 206.8 kcfs. River flows in June were much higher than May – averaging 173.9 kcfs and ranging between 154.1 kcfs and 212.5 kcfs. The peak average flow of the season occurred on June 9 at 212.5 kcfs. River flows in July averaged 96.8 kcfs and ranged between 52.2 and 172.9 kcfs. August flows averaged 39.8 kcfs and ranged from 32.4 kcfs to 51.9 kcfs. River flows remained relatively high in September and averaged 36.3 kcfs for the month. The season's low flow occurred on October 29 at 19.5 kcfs. Daily flows in October averaged 28.0 kcfs and ranged up to 36.4 kcfs. The flow on November 1, the last day of the collection season, was 26.0 kcfs.

Operations and Maintenance

Bypass and Transport Operations

The juvenile fish bypass gallery was watered up on March 17. Fish were bypassed through the 72-inch pipe at the base of the separator (primary bypass) until 0730 hours on March 23, when water was routed over the separator bars due to sockeye/kokanee (probably Dworshak flushed fish) 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 when the separator was watered-up and the actual fish collection (for transport) activities began.

With the exception of sample fish and research barged fish, all fish were bypassed back to the river through late March and April. As has been the case in recent years, the early trucking portion of fish transportation was eliminated in 2011 due to "spring seasonal average river flows" at or above the Fish Passage Plan 65 kcfs action level. Fish barging operations followed the general pattern of recent years with a few research barge trips taking place prior to the initiation of general fish transport. The first research barge departed Lower Granite on April 7. Subsequent barges departed Lower Granite on April 14, April 21, and April 28. 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 aoutfall pipe to the river.).

Collection for general barge transport operations began on May 1. Due to the relatively late start and high fish numbers, the project went straight to every day barging starting on May 2. Fish were barged every day from May 2 to May 15. Smolts were not barged on May 16-May 18 due to high flows and unsafe passage conditions for the towboats and crew. On May 19 every day barging resumed but only until May 22. From May 23 to May 28 fish were not barged due to lockage repairs at the Dalles Dam as well as high flows and questionable barge loading conditions.

Fish were direct-loaded and barged from the Little Goose project using the 2000 and 4000 series barges during the month of May. Barges direct-loaded at Little Goose were picked up by the Lower Granite fish barge on the way downstream and transported to below Bonneville where the fish on board were released in conjunction with the 8000 series barge. The first loaded fish barge departed Little Goose on May 6. Fish transport at Lower Monumental began on May 9 with collected fish loaded onto the barges from Lower Granite and Little Goose. On May 29 every other day barging began and continued through August 15. Fish trucking operations at Lower Granite started on August 17 and ended on November 1. All fish collection activities at Lower Granite ended at 0700 hours on November 1.

An estimated 6,310,606 juvenile salmonids were collected at Lower Granite Dam during the 2011 operating season. The 2011 species collection included: 1,993,789 clipped yearling chinook, 723,152 unclipped yearling chinook, 229,224 clipped subyearling fall chinook, 518,262 unclipped subyearling chinook, 2,114,802 clipped steelhead, 598,520 unclipped steelhead, 23,334 clipped sockeye/kokanee, 54,806 unclipped sockeye/kokanee and 54,717 coho. In all species catagories fish collection numbers were above the 2010 level and often considerably so. Daily collection and river flow information can be referenced in the 2011 Lower Granite Smolt Collection and Transportation Report Appendix 1, Table 1.

Peak collection dates during 2011 were slightly later than the long term average for most species. The peak total daily collection of 375,600 occurred on May 12 – a few days later than normal. Species of fish with the peak collection number occurring onMay 12 included clipped yearling Chinook (165,200), unclipped yearling Chinook (33,800), unclipped steelhead (48,000) and coho (5,200). Perhaps the most unusual aspect of this years fish collection is the large number of clipped Chinook that were released early and passed Lower Granite prior to the beginning of fish barging. The peak collection day for clipped steelhead was April 3 – well before the long term average and well before the beginning of fish barging operations.

Direct loading of smolts onto fish barges docked at the facility (rather than into raceways) is felt to be highly beneficial to the fish by eliminating secondary handling and related stress factors. An estimated 43.4% of the smolts (approximately 1,674,590 smolts out of 3,859,265 smolts barged from Lower Granite) were direct loaded onto fish barges at Lower Granite during the 2011 season. This figure has been both higher and lower in previous years and is dependent on a number of factors. As in 2007-2010, a 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. Other factors which limited direct barge loading were: a late start in general barging operations and high river flows in May (which made direct barge loading hazardous).

An estimated 3,859,265 (99.6%) of the total juvenile salmonids transported were barged from Lower Granite in 2011 compared to 3,378,007 (99.5%) in 2010, 4,111,943 (99.8%) in 2009, 4,235,017 (99.6%) in 2008, and 2,509,393 (99.7%) in 2007. With the exception of unclipped subyearling Chinook nearly all species catagories were transported almost entirely by barge.

As per previous years, fish collected at Little Goose Dam, Lower Monumental Dam, and McNary Dam were also loaded onto fish barges that originated from Lower Granite Dam during the 2011 season. The total number of fish barged from these other sites during the 2011 season was: Little Goose Dam (3,023,090), Lower Monumental Dam (1,365,734), and McNary Dam (1,063,874).

Late season trucking operations at Lower Granite began on August 17 and continued every other day through November 1. Due to low fish numbers, trucking operations resumed using the pickup-mounted midi-tanker. Fish numbers eventually increased to the point that it was necessary to utilize the semi for a few trips. During 2011 fish transport using the semi took place on September 24, September 28, and September 30. Due to repairs to the Little Goose Fish Facility transport truck, Lower Granite piggybacked with Little Goose and picked up and transported fish their fish to Bonneville on August 21, August 23, August 25, August 27, August 29, and August 31.

Following the cessation of fish transportation activities on the morning of November 1, the fish facility was switched over to secondary bypass mode (all juvenile fish routed through the separator bars and out the extended pipe to mid-river) and operated in that mode until December 15. This was done to monitor PIT-tagged juvenile salmonids (mainly subyearling Chinook) moving through the river system in late fall. (Since Lower Granite does not have provision to monitor PIT-tags through a full-flow bypass system, it is necessary to keep water over the separator bars and route fish out the bypass outfall pipe for this purpose.) Unlike recent years, during 2011we were able to operate the separator continuously from November 1 until the morning of December 15 without going to bypass mode due to the moderate winter temperatures.

Approximately 15,608 juvenile salmonids, 0.4% of the fish transported from Lower Granite in 2011, were transported by truck. In addition, another 2,836 juveniles were transported by truck when Lower Granite combined fish trucking operations with Little Goose from August 21-31. These figures are very similar to 2010 when 16,594 juvenile salmonids were transported by truck from Lower Granite. A continuing factor in the low percentage of fish transported by truck in 2011 was an extensive late season transport evaluation by NOAA-Fisheries which removed many fish which would have been transported and put them back into the river.

The physical operation of the barges and towboats proceeded smoothly during the 2011 season. There were no mechanical 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 operated over a lengthy period of time, there were a few minor operational problems. Most of the barge-related problems during 2011 were of a minor mechanical or electical nature. High river flows and a great deal of smaller debris in the river caused problems with the barge aeration systems plugging . Electrical problems mainly involved the oxygen monitoring system and engine alarm systems. When problems developed with the main Point Four oxygen/temperature monitoring system in the fish tanks, the portable YSI oxygen/temperature monitoring systems proved invaluable and allowed for proper backup monitoring .

Bypass

The LGR collection gallery was watered up on March 21. All fish were initially diverted out the large pipe at the base of the separator (primary bypass). This operation continued until 0730 hours on March 23 when the separator was watered up and put into secondary bypass mode (all fish other than sample fish diverted out to the mid-river release pipe) due to the large number of juvenile salmonids that were becoming impinged on the inclined screen. Activation of the sampling system began at 0700 hours on March 25. At that time, all fish other than those diverted to the sample holding tank were bypassed back to the river through the bypass outfall pipe (secondary bypass). The system was operated in secondary bypass mode with the exception of periods of time when it was necessary to load fish into the upstream raceways to accommodate research marking for index barge trips on April 7, April 14, April 21, and April 28. General fish collection (for barge and truck transportation) began on May 1 and continued until 0700 hours on November 1 when the facility was placed back into secondary bypass mode (smolts diverted out the outfall pipe to mid-river) to monitor for late season PIT-tagged juvenile fish. The juvenile fish collection system was operated in the secondary bypass mode continuously until 0700 hours on December 15, when the system was put into primary bypass mode. The system was then operated in primary bypass mode until the morning of December 19 when the juvenile fish collection gallery and collection/transportation facility were dewatered for the winter season following the removal of the fish screens (ESBSs).

There were numerous events during the season that lead to additional fish bypass. Smolts were bypassed for approximately 6 hours during 15 separator cleaning events during May, June and July. These cleanings were necessary to remove debris off the inclined screen (primary dewaterer) which provides water to the holding raceways, tanks, and lab. During these cleaning events no estimate can be made of the number of fish bypassed because the fish are bypassed before encountering the sampling system (Primary Bypass). In addition, the Lower Granite JFF bypassed fish May 16-May 18 due to high flows and unsafe passage conditions for the towboats and crews. From May 23 to May 28 fish (other than those diverted to a raceway for NOAA-Fisheries marking

operation) were not barged due to lockage repairs at The Dalles Dam. All fish collection activities ended at 0700 hours November 1.

In 2011 an estimated 2,429,798 smolts (38.5% of those collected) were bypassed from the LGR Fish Facility compared to 247,129 smolts (6.8%) in 2010 and 2,465,023 (37.4%) in 2009. The number and percentage of smolts bypassed by species group in 2011 (percentage of the total number of fish collected that were bypassed) included: 659,510 clipped yearling Chinook (33.1%), 350,162 unclipped yearling Chinook (48.4%), 22,184 clipped subyearling Chinook (9.7%), 65,459 unclipped subyearling Chinook (12.6%), 1,056,462 clipped steelhead (50.0%), 219,457 unclipped steelhead (36.7%), 13,591 clipped sockeye/kokanee (58.2%), 28,464 unclipped sockeye/kokanee (51.9%), and 14,509 coho (26.5%). An estimated 1,709,591 juvenile salmonids, 27.1% of the total collection were bypassed from March 26 to May 1, before the start of the general transport season. In 2010, an estimated 71,789 juvenile salmonids, 2.0% of the total collection were bypassed from March 26 to April 23.

As part of eight research studies, 225,568 smolts were bypassed from LGR. The National Marine Fisheries Service (NMFS) Survival Study PIT-tagged and bypassed 56,149 smolts: 16,046 unclipped yearling Chinook, 22,057 clipped steelhead and 18,046 unclipped steelhead. The NMFS Extra Mortality study PIT-tagged and bypassed 74,842 clipped yearling Chinook smolts and another 40,035 smolts were handled and bypassed. The NMFS Fall Chinook Late Season Transportation Study bypassed six clipped and 5,511 unclipped subyearling fall Chinook. The United States Fish and Wildlife Service (USFWS), NMFS, Nez Perce Tribe (NPT) and United States Geological Survey (USGS) Post Release Performance of Subyearling Fall Chinook Study bypassed 196 previously PIT-tagged target subyearling fall Chinook and 126 non-target smolts. 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 13 non-target smolts and 24 previously PIT-tagged holdover yearling fall Chinook. The Idaho Fish and Game Genetic Stock Index study bypassed 1,239 unclipped, untagged yearling chinook and 548 unclipped and untagged steelhead. The NMFS transportation study bypassed 46,644 smolts including 8,534 clipped yearling Chinook, 523 unclipped yearling Chinook, 4,098 clipped subyearling fall Chinook, 7,451 unclipped subyearling fall Chinook, 22,409 clipped steelhead, 514 unclipped steelhead, 1,653 clipped sockeye, 870 unclipped sockeye/kokanee and 592 coho. The USGS Bypass Probability study PIT and radio tagged and bypassed 235 unclipped subyearling fall Chinook.

Turbine Operations

During 2011, turbine unit operating priorities at Lower Granite continued as in 2010. Operational guidelines at Lower Granite are turbine units 1, 2, 3, then 4-6 (in any order), 24 hours per day, from March 1 through December 15. From December 16 to February 28, any unit may be run 24 hours per day without regard to order. Turbine unit operating priority may be coordinated differently to allow for fisheries research activities,

construction, or project maintenance activities. The project followed the normal turbine unit operation as outlined in Table LWG-5 in the Fish Passage Plan during 2011.

During 2011, turbine units 1-6 were unavailable for service 16,205.1 hours out of a possible 52,560 operational hours. This computes to an overall availability factor of 71.9%. This is slightly better than in 2010 when the availability factor was 69.06%. The 2011 availability factor on a per unit basis was: turbine unit 1 (90.6%, turbine unit 2 (84.0%), turbine unit 3 (39.7%), turbine unit 4 (77.5%), turbine unit 5 (67.0%), and turbine unit 6 (73.2%). Turbine unit 1 was unavailable for service a total of 819.2 hours for various reasons. The biggest outage factor was annual maintenance which required 727 hours. Turbine unit 2 was unavailable for service 1404.5 hours. The biggest outage factor was annual maintenance in November and December which required 919.1 hours. Turbine unit 3 was unavailable for service for a large part of the year with a total of 5,284.5 hours attributed to a rewind and comprehensive overhaul that carried over until May 19 from the previous year – this accounted for 3,320.2 hours of the unit's unavailability. Turbine unit 4 was unavailable for service a total of 1,966.8 hours. The biggest outage factor was annual maintenance from August through October which required 1,905.3 hours. Turbine unit 5 was unavailable for service a total of 2,892.2 hours. The biggest outage factor was a 15 KV ground fault on March 9 which required 1351.3 hours. Turbine unit 6 was unavailable for service a total of 2,350.0 hours. The biggest outage factor was annual maintenance and exciter rehabilitation activities from July to October which required 2,172.7 hours. In general, turbine unit availability was highest during the months of May – July and lowest during August – December.

Fish-related work did not cause much turbine unit unavailability during 2011. 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 39 hours and 33 minutes (39.6 hours) of direct fish-related turbine unit outages during 2011. By comparison during 2010 and 2009 there were a recorded 95.7 hours, and 131.6 hours of outages, respectively. During 2011, there were also approximately 29 hours of unit outages related to trash raking activities in early March which were not included in the fish-related outages. Per Ombil, the following outage hours were directly related to fish work in 2011: Unit 1 (18.1 hours), unit 2 (4.7 hours), unit 3 (none, unit out of service more than 60% of the year), unit 4 (12 hours), unit 5 (0 hours) and unit 6 (4.6 hours).

Forebay Debris/Trashracks

Unit trashracks were raked for debris on March 1-3. Lower Granite turbine unit 1 was taken out of service between 0915 and 1430 hours for trash rack raking on March 1, 2011. Turbine unit 2 was also taken out of service for trash rack racking on March 1 between 1106 and 1640 hours. Turbine unit 3 was out of service and the rashrack was not raked. Turbine units 4-6 were taken out of service on March 3 between 1010 to 1624 hours. Trashrack cleaning on unit 6 was not completed that day but was finished on March 7. It initially appeared as if 2011 was going to be a low flow year but late season moisture quickly changed the situation and flows reached 200 kcfs for a few days in early

June. The high flows resulted in some accumulation of debris in the forebay. Most of this debris was eventually spilled downstream through the RSW. Although debris levels were problematic at the juvenile fish facility during June, it was not necessary to rake trash racks a second time in 2011. Frequent inspection of the gatewells and hand dipping of debris off the gatewell surfaces helped prevent problems at the fish facility.

Extended-Length Submersible Bar Screens (ESBSs)

All operating turbine units were equipped with ESBSs during the 2011 fish passage season. Winter maintenance on the screens was ongoing in late February and early March and an inspection of the screens was conducted by the project fisheries biologists in mid-March - just prior to installation. No significant problems of any kind were detected. Installation of fish screens was completed in all units by March 24.

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 conducted in April and no problems were detected with any ESBS. The inspections on May 21 were postponed due to high water turbidity which prevented the camera operator from seeing anything. The inspections scheduled for June 24-25 were also postponed due to high water turbidity and the fact that shutting off a unit (and spilling more water) would contribute to already high dissolved gas levels in the tailrace. Per the Fish Passage Plan, it is not necessary to conduct video inspections during July. Video inspections during August and October revealed no problems of any kind with the ESBSs.

Operation of the ESBSs was relatively trouble-free during the 2011 season. 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. Brush cycle times during 2011 ranged from one to four hours dependent on the amount of debris moving through the system. Due to relatively high debris levels this season, all brushes were set to clean the screens once per hour for most of the season. All ESBSs were raised and dogged off for the winter maintenance season by December 19.

Vertical Barrier Screens (VBSs)

New vertical barrier screens (VBSs) were installed in all turbine units during 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 2011 fish season. During 2011, VBSs were inspected with an underwater video camera per FPP guidelines in conjunction with a limited inspection of the ESBSs. One minor VBS problem was detected on those inspections. On the April 22 inspection the inspector noted that a four

foot section of strapping used for securing the mesh was possibly missing from unit 2 VBS but that poor visibility made it hard to be sure. He also noted that the mesh was still entirely in place. During the August 6 – 7 inspection the inspector noted that an approximately 3 foot section of VBS retaining strap was missing on a screen in gatewell slot 1-B. He also noted that the mesh was entirely in place. No additional problems were detected on subsequent video inspections. These items should be repaired during the 2012 winter season.

Gatewells

Gatewells were inspected during adult fishway inspections throughout the 2011 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 - 2010, constant debris movement through the orifices prevented the need for extensive gatewell cleaning during 2011.

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 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 2011 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, 2011 to accommodate fish screen installations. Bulkhead (downstream) slot orifices were operated in the usual manner during 2011 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 in the gatewells (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 left open during the entire 2011 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 well during 2011 and there were no significant maintenance issues of any kind. Due to the variability of the debris moving through the system, the project maintained a schedule of backflushing orifices every 3 hours around the clock from late March through the cessation of fish collection activities in early November. 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 system was shut down for the season on December 19.

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. Small invertebrates in the river can also plug the screen and make cleaning very difficult. During late May and early June 2011, high river flows and a preponderance of fine debris resulted in the need to clean the screen on an hourly basis to prevent clogging.

It is likely that the fish facility would have had to go into primary bypass mode constantly during late May and early June due to all the fine debris had it not been for the initiative of the Lower Granite FFF maintenance crew. A long handled brush with high pressure air jets was developed 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 remained clogged on a constant basis.

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).

Debris impingement on the inclined screen was quite a bit worse during 2011 than in 2010 when only a couple of bypass events were necessary to clean the screen. During 2011 it was necessary to go into primary bypass mode on 15 separate occasions to clear the inclined screen of material. These cleaning events took place between May 21 and July 16. Cleaning events took from 15 minutes up to nearly an hour dependent on the severity of impingement of fine debris in the screen and the need to powerwash the screen to clean it sufficiently. Separator technicians were able to stay away from having to dewater the inclined screen most of the season by cleaning the screen on an hourly basis when high levels of debris were moving through the system. This was especially problematic during early to mid June when river flows were high.

Another problem that developed during the 2011season at Lower Granite was a relatively high level of the aquatic plant Elodea moving through the system. 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. We 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.

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 2011 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. It was not necessary to partially dewater the separator bin (below the bars) to remove debris during 2011. After high debris levels dropped off in July, there were very few problems with the separator and related mechanisms. Both the 72-inch and 42-inch separator controller valves were replaced during the winter of 2003-2004 and they continued to perform flawlessly during most of the 2011 fish collection season. Late in the 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 season. Operation of the separator in the normal collection/sampling mode took place from 0700 hours on March 25 through 0700 hours on November 1.

In 2011 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. (Unlike 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) through December 15. The JFF maintenance crew kept electric/diesel heaters available for use at the separator and other exposed pipe areas. Maintenance and separator personnel started the heaters whenever overnight temperatures dropped to the point that pipes could potentially freeze. Unlike recent seasons, temperatures remained mild enough during November and December that we were able to operate the system in the secondary bypass mode continuously and avoid going into primary bypass. The separator technicians and maintenance crew kept diesel/electric heaters near the separator and utilized them during the few evenings temperatures dropped low enough to cause the possibility of freezing pipes.

During 2011 small Chinook jacks caused some problems by falling through the separator bars and ending up in the sample. This is problematic because the jacks tend to thrash around quite a bit while being anesthetized and can cause injury to the much smaller juvenile fish in the sample. 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 bars with a smaller spacing were place on top of the existing separator bars on the morning of September 26. These bars were removed after the end of fish collection and sampling activities when the system had been switched back to secondary bypass mode. These bars were first utilized during the 2009 season when jack Chinook numbers were very high and large numbers of them were ending up in the sample. During 2010 it was not necessary to use them at all due to lower numbers of jacks. The 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 2011 this occurred from startup on March 25 until the morning of August 2. From 0700 hours on August 2 until the end of normal separator operations on November 1, the PIT-tag diversion system was set to divert all PIT-tagged fish and override the sample diversion gate.

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 15 when the system was switched to a 100% sample rate. The sample rate remained at 100% for most of the extended season but was reduced to less than 50% on September 22-24 due to too many fish in the sample and the lab not finishing the sample until late in the morning. This was impacting the departure of fish transport trucks to Bonneville. 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 2011.

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. This decreases handling a second time and is thought to reduce the overall stress to the fish. 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 direct 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 direct 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 ability to direct load is dependent a number of factors including time of arrival of fish barges, spill patterns, total river flow and fish marking operations. The increased diversion of fish into the upstream raceways to accommodate NOAA-Fisheries research marking operations has significantly impacted the direct-loading of fish onto barges at Lower Granite in recent years.

Avian Predation

Control Measures

Smolt monitoring personnel at Lower Granite check for bird predation marks in the daily subsample of juvenile smolts. Injuries associated with predators include wounds inflicted by other fish, birds, and lamprey. During 2011 predator wounds were observed on 0.7% of the smolts examined in the detailed sample compared to 0.8% in 2010, 1.0% in 2009, 1.0% in 2008, and 0.8% in 2007. Predator marks were highest on clipped steelhead (39.6%), unclipped subyearling fall Chinook (29.7%) and clipped yearling and unclipped steelhead (20.3%). 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 (65.3%) compared to 31.2% for predator marks caused by fish. Similar to previous years the larger clipped and unclipped steelhead smolts had the most bird bites.

Bird wires in the Lower Granite Dam tailrace area were replaced by USDA Wildlife Services personnel during March, 2004 (immediately prior to the beginning of the 2004 fish season). To help ensure the wires were less susceptible to damage by watercraft, braces were built on the powerhouse tailrace deck during 2006 to raise the wires higher above the water. Six anchor points were built and the extended braces were installed on the tailrace deck by Corps of Engineers personnel. This system continued to work well during 2011. Several bird wires were replaced by USDA-APHIS personnel in September 2010 but no damaged wires were noted during 2011.

Avian predation control measures at Lower Granite and Little Goose dams in 2011 were similar to those conducted during 2004-2010. The actual hazing period was reduced somewhat in 2011 to the April 1 to June 30 time period. This was done to allow for additional hazing efforts during the period of time the most juvenile fish were being spilled over the dam. Hazing took place 16 hours per day (essentially dawn to dusk) between April 24 and June 4. This appeared to be highly effective and stopped the problem we have had during previous years of gulls returning to feed after the control agent left for the day. An individual agent was assigned to Lower Granite Dam during the work week and was able to devote his entire time to controlling avian predation at this site. Additional agents filled in during the April 24 to June 4 time period to allow for 16 hour per day coverage on weekdays and weekends. The control measures utilized included: 15 mm pyrotechnics, long-range rockets, fused rope salutes, and propane canons.

Gull and Cormorant Counts

Gull counts initially began at Lower Granite Dam during 1999 and continued each succeeding year including 2011. Utilizing binoculars, technicians assigned to the separator were instructed to count all gulls visible in the tailrace area (an area immediately below the dam to a defined point approximately one half mile downstream). Counts were made twice daily; at approximately one half hour after sunrise and then again at approximately one half hour before sunset. Daily count data was recorded on

forms and entered into an Excel spreadsheet for later evaluation. General gull counting began on March 25 and continued through October 31. In addition, counts were extended through December 15 to take advantage of the additional monitoring opportunity due to late season separator operations. During the general March 25 to October 31 counting period a total of 2,122 gull sightings were recorded. This is considerably less than in 2010 when 3,030 gull sightings were recorded. During 2011 more gulls were seen on morning counts (1,216) than on evening counts (906). Surprisingly the highest count day for gulls during 2011 was on April 5 when a total of 68 were counted on the combined morning and evening counts. This is very near the April 3 peak passage date for clipped steelhead and just prior to the (slightly delayed) beginning of hazing activities on April 6.

During the extended November 1 through December 15 counting period, only an additional 32 gulls were observed. A total of 24 were observed on the morning counts and 8 on the afternoon counts. Clearly gulls moved out of the tailrace area late in the season when prey items were less available. As in 2010 specific cormorant counts were not conducted at Lower Granite during 2011.

Recommendations

1. Install a generator to power the fish facility during electrical outages.
2. 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 fail in the not too distant future).
3. Tune up/recondition the Cat engines on barges 8105 and 8106 and develop a plan to tune/repair/overhaul engines on the remaining barges over a several year period.
4. Tune up the Cummins barge engines (per company specs this should be done every 1,000 hours).
5. Pour concrete to serve as ballast in fish barges 4394 and 4382. Paint exterior of both barges while concrete work is being done. (Try to contract this work in FY 2012 or 2013).
6. Refurbish the concrete on the raceway interiors with a new sac-rub finish (pending a new JFF).
7. Paint exteriors of all fish barges.
8. Paint the holds on fish barge 4382.
7. Replace the lab chiller system. (The chiller for the recirculation system is unable to keep the recirculation water at spring/summer temperatures.)
8. Refurbish the chain drive system for the sample holding tank.
9. Increase size of catch basin which is used to drain water from cans holding research fish from the sample.
10. 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.