ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

LOWER GRANITE DAM

2014

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INTRODUCTION

The following report on fishway activities at Lower Granite Dam is required under the Endangered Species Act consultation on the operation of the Federal Columbia River Power System and its associated fish passage facilities. This report summarizes the operation and maintenance of adult fish passage facilities at Lower Granite Dam, including the results of visual inspections of fishways conducted by fisheries staff during the adult fish passage period of March 1 to December 31, 2014. Inspection readings are provided in Appendix 1. Recommendations are provided for correcting problems found. This report also contains a synopsis of juvenile fish facility operations. Additional information on juvenile fish collection and transportation activities at Lower Granite Dam can be found in the, "2014 Juvenile Fish Collection and Bypass Report, Lower Granite Juvenile Fish Facility".

River Conditions

During the 2014 season, the average daily flow exceeded 100.0 kcfs on 26 days and did not exceed 150 kcfs. The highest daily average flow for the season was 146.4 kcfs on May 26. The lowest daily average flow for the season was 14.2 kcfs on September 25. The average flow for the season was 54.6 kcfs. Spill occurred for 152 days from April 3 through midnight on August 31, with a maximum daily average spill of 55.6 kcfs on May 26. The RSW was put into operation when Court ordered spill began on April 3, and was taken out of service for the season on August 31. River temperature averaged 58.5^{o} F for the season and ranged from 45.3^{o} F on April 1 to 67.1^{o} F on July 20.

ADULT FISH FACILITY

Facility Description

Adult fish passage facilities at Lower Granite Dam consist of one south shore adult fish ladder. The upper fish ladder extends from the forebay to tailwater and includes a ladder exit, slotted weirs, upper diffuser, overflow weirs with orifices, and fish counting stations with picketed leads. There is also an adult fish trap upstream from the adult fish count station. The lower ladder contains a powerhouse collection channels, an auxiliary water supply, channel diffusers, a transportation channel under the spillway, and ladder entrances. There are six main fish ladder entrances: two north shore entrances (NSE-1 and NSE-2), two north powerhouse entrances (NPE-1 and NPE-2), and two south shore entrances (SSE-1 and SSE-2). The powerhouse collection channel has four out of ten floating orifices operating. Three electric pumps (fish pumps) supply auxiliary water from the tailrace through the conduit that extends under ladders distributing water to the lower ladder diffusers. Additional auxiliary water is supplied from the forebay through diffuser 14.

Facility Modifications

1. Replaced NPE3 bulkhead.
2. Fabricated and installed adult trap sample gate.
3. Installed new painted picketed leads at the fish count station.

4. Repaired fish count viewing window cleaning system frame structure.
5. Replaced AWS Pump 3 lower guide bearing (needs additional work).
6. Replaced adult trap cable hoist and basket system for fish collection.

Operations and Maintenance

Fish Ladder and Collection Channel

The adult fish ladder was in service throughout 2014 with the exception of the winter maintenance season. The fish ladder was out of service for inspection and maintenance from January 3 to February 28.

The upper fish ladder is dewatered annually for maintenance activities including: debris removal, diffuser grate and structural support inspections, picketed lead, staff gauge, and fish counting window cleaning, maintenance of count station window cleaning mechanisms, and packing of leaks in expansion joints. A minimum of twenty four hours prior to dewatering, the auxiliary water is shut off to discourage newly arriving fish from starting up the ladder. The fish exit is then bulkheaded off, any exit pool fish are removed and released to the forebay, and the upper ladder is partially dewatered. Diffuser 14 is gradually closed to allow fish to move through the orifices to the tailrace. The drain for diffuser 14 is closed to maintain enough water in the ladder to flush remaining fish down the ladder as biologists and maintenance personnel go down the ladder through the orifices to remove debris, inspect the ladder, and guide remaining fish to the tailrace. One unclipped juvenile steelhead and one smallmouth bass were salvaged and released into the tailrace. All diffuser grating passed inspection.

The lower ladder is typically dewatered to a depth of one foot providing a holding pool for fish. Once the target depth is obtained, maintenance personnel and biologists inspect entrance weirs, diffuser grates, fallback fence, and exposed diffuser gate operating equipment. Staff gauges are then cleaned and debris is removed. The water was gradually lowered to $4/10^{th}$ of a foot for visual inspection of grating. When dewatering for repair is necessary; fish are crowded to the entrance pools, netted, and placed in a fish only transport containers (32 gallon containers if fish numbers are very low). Fish in the containers are raised from the collection channel with the crane to be released. Juvenile salmonids are released into the tailrace and adults are released in the forebay at Offield Landing boat ramp. Powerhouse collection channel fish salvage included 1 unclipped juvenile sockeye, 2 juvenile unclipped steelhead, and 1 clipped adult steelhead. Incidental species included 3 carp and 2 suckers. Mortalities included 1 unclipped juvenile sockeye, 1 decomposing unclipped adult Chinook, and 1 unclipped adult steelhead. Fish salvage of the spillway and north shore sections of the channel included 1 unclipped juvenile steelhead. Incidentals included 4 adult carp and 1 juvenile carp. No problems were observed during the inspection of the channels.

Auxiliary Water Supply

Fish pumps 1 and 2 were out of service (OOS) from January 3 to February 28 for annual maintenance. Annual maintenance consists of general mechanical and electrical inspection and repairs. AWS pump 3 remained out of service until April 21 for lower guide bearing replacement and shaft alignment. On April 21 at 1234 hours pumps 1 and 2 were taken out of service while returning pump 3 to service for testing. Two pump operation resumed with pumps

1 and 3 in service for the remainder of the season. Pumps 1 and 3 remained in service throughout the passage season with the exception of all AWS pumps being out of service from 0453 hours to 1750 hours on September 24 due to ground fault temperature alarm circuit tripping the entire powerhouse off line. Significant pump outages are summarized in Table 1.

Table 1. Fish pump outages at Lower Granite Dam, 2014 *

Affected Pump(s)	Dates	Reason for Outage/Comments
1 and 2	Jan 3 – Feb 28	Annual maintenance
3	Jan 1 – Apr 21	Lower Guide Bearing Replacement

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

Adult Fish Trap Operations

Lower Granite adult fish trap was operated between March 10 and November 11. Sample rates were adjusted with adult passage to meet collection and research needs. The fish trap was out of service from July 7 through July 23 due a trap basket hoist failure. Trapping operations were postponed from July 24 through August 10 due to water exceeding 68°F. Trapping occurred from 0700-1100 hours at a 100% sample rate on August 11-14, 15, 18, 21, 30, and 31. Twenty-four hour collection resumed on September 1. Adult trap fish collection for the season included 6 clipped and 95 unclipped sockeye, 1,789 coho, 635 clipped and 699 unclipped spring steelhead, 9,768 clipped and 4,647 unclipped fall steelhead, and 8,120 clipped and 4,531 unclipped spring/summer Chinook, and 10,154 fall Chinook.

Collection of adult fall Chinook for truck transport to Lyons Ferry Hatchery began on August 30. Collection for the Nez Perce Hatchery transport to Cherry Lane began on August 31. The Nez Perce transported on Sunday and Monday and Lyon's Ferry Hatchery transported Tuesday through Saturday. Trucking operations continued until needs were met in November. Of the 10,154 fall Chinook collected, 885 were transported by Nez Perce, 3,025 were transported to Lyons Ferry, and 6,244 were returned to the ladder. For additional information on Lower Granite adult trap operations and the number of fish collected and transported contact Darren Ogden (NOAA) [darren.ogden@noaa.gov] or Tiffani Marsh (NOAA) [tiffani.marsh@noaa.gov].

Special Operations for Adult Ladder Water Temperature

Ladder water temperatures were monitored hourly at the ladder exit, diffuser 14, ladder turn pool, and the bottom junction pool from June 8 to October 5. Lower Granite has three fish ladder auxiliary pumps on the forebay side of the dam designed to supply water for adult passage during forebay drawdowns. The intake depth of these pumps is about 30 feet below forebay evaluation. Pump 1 provides additional water at the ladder exit, pump 2 provides additional water in the same location as diffuser 14, and pump 3 provides water to an area that is not in use. Auxiliary pumps 1 and 2 were operated from July 9 through September 17 to mitigate for increased ladder water temperatures. Due to operation of Auxiliary pump 2 interfering with adult fish trap operation, different operational scenarios were tested on July 25 and 29. These tests confirmed that operation of Auxiliary pump 2 resulted in air becoming entrained in the adult trap attraction pool water supply line which subsequently reduced water pressure to the adult trap. On August 1 temporary rented emergency cooling pumps were installed at a depth of

about 60 below forebay elevation and operated through September 11 to pump cooler water into diffuser 14 intake. Emergency pumps were operated from 0500-1500 hours from August 1- 20 with auxiliary Pump 1 on, auxiliary Pump 2 in standby, and diffuser 14 operating in auto mode. Auxiliary pumps 1 and 2 were operated from 1500-0500 hours with diffuser 14 in auto mode. Emergency pumps operated twenty-four-hours with auxiliary pump 1 on and auxiliary pump 2 in stand-by mode from August 21 through September 11. Coordination meetings were held weekly to discuss operations of fish ladder temperatures and Emergency pump, Auxiliary pump, and adult trap operations with the region.

On August 11 four adult Chinook mortalities were discovered on by the powerhouse electrical crew in the parking lot adjacent to adult fish ladder Diffuser 14. On August 12 Ken McIntyre (NOAA) reported an unclipped adult Chinook on the north side of the hill adjacent to fish ladder Diffuser 14 and on August 13 another adult Chinook was found by Corps staff in the same location. Fish jumping at this location has not been a problem historically. Implementing the emergency rented pumps for cooling the fish ladder was the only operational change that occurred during this time. As a preventative measure a temporary jump barrier net was installed on the north side of diffuser 14 section of the ladder on 12 August. A permanent jump barrier is being designed for installation during the 2015-2016 ladder outage for winter maintenance.

Adult Fishway Inspections

Methods

The automated fishway control system consists of a computer in the control room that interfaces with process level controllers and receives information from remote terminal units. The terminal units are fed by sensors detecting entrance weir gate positions, collection channel water and tailwater elevations, and upper diffuser pool levels. The Lower Granite automated fishway control system is a Dell 486 computer with a 60-IBM/N card installed and a SIXNET remote terminal unit (RTU) located in the powerhouse control room. The computer is used to change the control parameters of the terminal units and provides datum acquisition and storage. The ability to change fish ladder operating parameters of this control system has been out of service since 2011. The powerhouse electricians manually calibrate the system to operate in criteria parameters. An upgraded adult fish ladder control system is being designed and is scheduled to be installed during the 2015-2016 winter maintenance season.

Operating criteria involve normal and special operating conditions. Under normal operating condition: NSE-1 and NSE-2 are operated to meet criteria of at least 7 feet (depth criteria) or be on sill if less than 7 feet (sill criteria). NPE-1, NPE-2, SSE-1 and SSE-2 weir gates are operated to meet criteria of at least 8 feet or be on sill if less than 8 feet (sill criteria). Four floating orifice gates (1, 4, 7, and 10) are operated in the powerhouse collection channel. Normal operating criteria for the rest of the ladder include maximums of 0.5-foot heads at the exit, maximums 0.3 feet head at the picketed leads, 1.0-1.3 feet of water over the ladder weirs, 1.5-4.0 feet per second collection channel velocity, and 1.0-2.0-foot head differentials at all fishway entrances. Special operating conditions are used if normal operating criteria cannot be met.

Adult fishway inspections consist of observing facility operating conditions and recording visual readings from staff gauges, weir gate selsyns, and electronic meters. Inspections are normally conducted three or more times per reporting week with day and times randomized. Averages of

3.3 fish ladder inspections were performed each week (144 inspections /44 weeks) in 2014. Depths and head differentials that were out of criteria, as well as other problems, were reported to maintenance staff and/or powerhouse shift operators for correction. PSMFS performed a minimum of two ladder inspection each week. Once per month, inspections were also conducted in conjunction with Oregon Department of Fish and Wildlife personnel stationed at Little Goose Dam.

Inspection Results

Visual readings were recorded and compared with the automated control system readings to check for calibration problems. High variability between wave crests and troughs created by spill reduces the accuracy of biologists' staff gauge readings in the tailrace. Thus the automated ultrasonic transducers digital displays and existing fish ladder system control (FSC) board were used to check the accuracy of staff gauge readings. Data from fish ladder inspections was entered into an Excel spreadsheet (Appendix 1). The average compliance of all criteria points in 2014 was 60.7%. A summary of fish ladder performance and variability is provided in Table 2.

Ladder exits: Ladder exit head differentials were in criteria on 100% of the inspections.

Ladder weirs: The depths over the fish ladder weirs were within criteria on 100% of the inspections.

Counting stations: The head differential across the counting station picketed leads was in criteria on 100% of inspections.

Entrance heads: South shore entrance head differential was in criteria on 99.3% of inspections. The one out of criteria reading was due to an electrical failure of the gate control. The problem was reported and fixed that day.

North powerhouse entrance head was in criteria on 89.6% of inspections. The out of criteria included six readings 0.1 feet below criteria, four readings greater than 0.1 feet below criteria and five readings greater than 0.2 feet below criteria.

North shore entrance head differential was in criteria on 35.4% of inspections. Two fish pumps operation cannot maintain both head differential readings and weir depths while operation during minimum operating pool (MOP) conditions in the tailrace. Weir depth has been sacrifice weir depth readings in order to maintain at least 1.0 foot of head differential. During 2014, the head differential readings were out of criteria 93 times. There were 45 readings 0.1 feet below criteria, 23 readings 0.2 feet below criteria, and 25 readings greater than 0.2 below criteria. Weirgate NSE-2 being out of service and set at 630.0 feet without being able to adjust for tailwater elevation changes likely contributed to the out of criteria readings this year.

South shore entrances (SSE-1 & 2): SSE-1 weir gate was in depth or sill criteria on 98.6% of inspections (98.6% depth, 0.0 % sill). The two out of criteria readings were 7.9' and 7.8 feet.

SSE-2 weir gate was in criteria on 97.9% of inspections (98.6% depth, 0.0 % sill). The three out of criteria readings were 7.9', 7.9', and 7.8 feet.

North powerhouse entrance (SPE-1 & 2) depths: NPE-1 weir gate was in depth or sill criteria on 100% of inspections (23.6% depth, 76.4% sill).

NPE-2 weir gate was in depth criteria or sill on 100% of inspections (23.6% depth, 76.4% sill).

North shore entrance (NSE-1 & 2) depths: NSE-1 weir gate was in depth or sill criteria on 0.0% of inspections.

NSE-2 weir gate was in depth criteria on 5.6% of inspections. NSE-2 met the depth criteria on eight occasions.

As with the north channel/tailwater elevation, it is possible that two fish pump operation cannot maintain both channel/tailwater head differentials and weir depths with minimum operating pool (MOP) conditions in the tailrace. Currently weir depth is sacrificed in order to maintain at least 1.0 foot of head differential. This has not been effective. Weirgate NSE-2 has been out of service and suspended at a fixed elevation with a chain hoist since the 2011 passage season. NSE-2 was set at an elevation of 630.0 feet during 2014. The gate being out of service and unable to adjust for tailwater elevation changes likely contributes to the out of criteria readings for both NSE's.

Collection channel velocity: Velocities were out of criteria on 100% of inspections (criteria: 1.5-4.0 ft/s). Electricians investigated the problem and were unable calibrate the meter or make repairs. The velocity unit is located in the collection channel junction pool transition area slightly downstream from where the south shore entrances and the channel separate. Flows in this location may be affected by effluent through the entrances or other characteristics unique to this section of the channel and are likely non-characteristic of the velocity conditions through the length of the collection channel. Physical surface velocity readings taken at the north and south shore channels were in criteria throughout the season. Alternative methods of measuring collection channel velocity are being investigated and will be installed as part of the adult fish ladder control system upgrade during 2015-2016 winter maintenance.

Recommendations

1. Replace damaged fish ladder NSE-2 that failed in 2011with a new gate and operating system.
2. Replace all entrance weirs including operating systems.
3. Install permanent fish jump barrier in the upper section of the ladder near diffuser 14.
4. Permanently fill the NPE-3 bulkhead slot with concrete.
5. Replace/upgrade velocity meter and relocate sensor to a location that typifies the velocity conditions throughout the channel.
6. Try different ladder operations in season such as leaving FOG's closed to determine if entrance depth and head differentials can be improved.
7. Upgrade adult fish ladder control system.
8. Replace/relocate staff gauges that are difficult to read.
9. Replace fish ladder exit debris boom.
10. Label adult fish trap valves (identifying their function) and develop updated O&M manual.

Table 2. Summary of adult fishway inspections at Lower Granite Dam, 2014 [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 Water Velocities	0 *** 144	0.0 ***	*** ***	*** ***	*** ***	*** ***	*** ***	*** ***
Differentials								
Ladder Exit	144 *** 144	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Ladder Weirs	144 *** 144	100.0 ***	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Counting Station	144 *** 144	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
South Shore Entrance	143 *** 144	99.3 ***	0 0.0	0 0.0	1 0.7	0 0.0	0 0.0	0 0.0
North Powerhouse Entrance	129 *** 144	89.6 ***	6 4.2	4 2.8	5 3.5	0 0.0	0 0.0	0 0.0
North Shore Entrance	51 *** 144	35.4 ***	45 31.3	23 16.0	25 17.4	0 0.0	0 0.0	0 0.0
Weir Depths								
SSE-1[2]	142 0 144	98.6 0.0	1 0.7	1 0.7	0 0.0	*** ***	*** ***	*** ***
SSE-2[2]	141 0 144	97.9 0.0	2 1.4	1 0.7	0 0.0	*** ***	*** ***	*** ***
NPE-1[2]	34 110 144	23.6 76.4	0 0.0	0 0.0	0 0.0	*** ***	*** ***	*** ***
NPE-2[2]	34 109 144	23.6 76.4	0 0.0	0 0.0	0 0.0	*** ***	*** ***	*** ***
NSE-1	0 0 144	0.0 0.0	0 0.0	0 0.0	144 100.0	*** ***	*** ***	*** ***
NSE-2	8 0 144	5.6 0.0	1 0.7	1 0.7	134 93.1	*** ***	*** ***	*** ***

[1] Data from Appendix 1.
[2] "On sill" means the weirgate is resting on its sill and meets "on sill" criteria at this location

SYNOPSIS OF JUVENILE FISH FACILITY OPERATION

Facility Description

Juvenile fish facilities at Lower Granite Dam consist of: extended-length submersible bar screens (ESBSs), vertical barrier screens, ten inch orifices, a collection channel that terminates in an underground transport pipe, a dewatering incline screen, fish separator, and a fish distribution system that includes PIT tag bypass, sampling, holding facilities distribution, and barge and truck loading.

ESBS's guide fish in the forebay away from the turbine units into one of the 18 gatewell slots that contain two orifices for diverting fish into the collection channel. Eighteen to 21 orifices are open with a minimum of one orifice open in each bulkhead slot of operating units. Lights are directed at each open orifice to enhance fish movement into the collection channel. Fish in the collection channel are transported through an underground pipe to the wet separator. Upon reaching the separator, adult and non-target fish are released to the river and juvenile fish pass below the separator bars and enter the distribution system. Collected fish are 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.

Lower Granite also has unused upstream fish screen slots and Wagner Horns that had closure devices installed in the in 1995-1996. These closure devices are not 100% effective in deterring fish from moving into the slots. Fish screen slot orifices are run on an alternate basis throughout the season to allow trapped fish an escape route into the collection gallery. Permanent fish screen slots closure work began in October and will continue into the 2015 fish season.

Facility Modifications

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

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

14. Power house maintenance and dive team removed debris from south collection channel make-up water valve.

Operation and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within one percent of the peak efficiency from April 1 to October 31. Deviations were infrequent and brief or required by BPA. Below is a summary of unit outages and cause (Table 3).

Table 3. Summary of unit outages and cause.

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

	March 20	Install ESBS
	March 25 – 27	Exciter recommissioning
	March 31	Rake Trash
	August 4 – Sept 10	Annual Maintenance and testing
	Sept 30	Exciter warranty work
	October 9 - 22	Governor issue
Unit 5		
	Feb 10 – March 7	Prototype overflow weir and 14" orifice fishway channel modifications
	March 20	Install ESBS
	March 24 - 25	Exciter Upgrade
	March 31-April 1	Rake Trash
	June 20 – July 2	Governor Issues
	August 5 – 7	T2 bushing replacement
	August 11 – 16	T1 bushing replacement
	August 17	Doble testing
	Sept 2- Nov 18	Annual maintenance – Blade liner issue
	Dec 9	Voltage regulator exciter card replacement
Unit 6		
	Jan 1 – Feb 13	Cavitation repair - Annual Maintenance – Blade Packing
	March 10 - 11	Exciter Upgrade – Remove test equipment
	March 17 - 20	RSW dive inspections
	March 27	Exciter recommissioning
	April 1	Rake Trash
	May 12 – August 11	Repair blade seals
	August 11 – 17	T1 bushing replacement – T1 doble testing
	Sept 30	Exciter warranty work
	Oct 8 - 10	Fish screen 6B ground fault
	Nov 4 – 5	RSW dive/ROV operations

Debris/Trash Racks

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

Extended-length Submersible Bar Screens (ESBSs)

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

Vertical Barrier Screens (VBS's)

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

Gatewells

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

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

Orifices/Collection Channel

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

Primary Dewaterer

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

At 1015 hours on October 31 the juvenile fish facility operation was changed to primary bypass. Due to concerns that fish may become stranded the separator remained manned twenty-four hours to monitor the incline screen. While in primary bypass the technicians observed juvenile

fish accumulating on the dewatering incline screen. A temporary barrier screen was installed on the incline screen on October 31 to prevent fish from becoming stranded. At 0800 hours on 1 November adjustments to the water supply and modifications to the barrier screen were made. Due to the water current at the barrier screen location fish became fatigued and impinged on the barrier screen. At 0800 hours on November 2 the facility was changed to secondary bypass operation. Mortalities included 98 unclipped subyearling Chinook, 51 juvenile crappie, and 2 sandrollers.

Wet Separator/Distribution and Sampling Systems

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

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

Barge Loading Operations

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

Truck Loading Operations

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

Avian Predation

Predator marks caused by birds, characterized by a distinct V-shaped descaling pattern on both sides of a fish were the most common predator mark (56.1%) followed by fish (42.2%) and lamprey (1.7%). Although clipped sockeye exhibited the highest percentage of predator marks by number examined, clipped steelhead had the largest percentage (30.6%) of total predation marks. Normally larger clipped and unclipped steelhead smolts have higher rates of avian predation marks.

Control Measures

Areas of avian monitoring included: the forebay, turbine and spillway discharge, and the JFF bypass outfall. Deterrent measures included: bird wires across the tailrace of the powerhouse and

hazing (April 1 through June 30) under the animal control contract (APHIS). Two shift hazing coverage (daylight to dusk) occurred from April 21 through June 1. This appeared to be effective at reducing the number of gulls returning to feed after the control agent left for the day. Hazing efforts included the use of 15 mm pyrotechnics, long-range rockets, and fused rope salutes. Due to safety concerns propane canons were not utilized at Lower Granite.

Gull Counts

Lower Granite biological technicians made binocular gull counts in the tailrace extending from immediately below the dam to about one half mile downstream. Daily count observations were made one hour after sunrise and one hour before sunset from March 25 through October 31. Additional counts were taken through November 14 to take advantage of the additional monitoring opportunities. During the general March 25 to October 31 counting period 961 gulls sighted in the morning and 666 were sighted in the evening. This is considerably less than in 2013 when 1,474 were counted in the morning and 1,274 were counted in the evening. An additional 85 morning and 33 evening gull sightings were reported during the 2014 extended count period. The highest count day for gulls during 2014 was May 14 when 39 were counted in the morning and 47 were counted in the evening. The peak juvenile collection date at Lower Granite for all species combined was May 6.

Avian Foraging Behavior

Foraging behavior was recorded for gulls, cormorants, and Caspian terns. Gulls had the highest percent of foraging behavior observed (84.8%) followed by cormorants (7.4%) and Caspian terns (0.0%).

Cooling Water Strainer Counts

Turbine unit cooling water strainers were examined for biologic content once per month throughout operating year 2014. Timing of the lamprey entry into the strainers represents migration timing coupled with susceptibly of being drawn into the cooling water system. Annual unit run time totaled 20,176.1 hours and 1,143 lamprey were recovered from cooling water strainers this year. Juvenile lamprey were most abundant in February (207), March (473), May (181), and December (241).

Recommendations

1. Repair/replace problem raceway pneumatic knife gates (fish evacuation valves) and retain 10 inch knife gates from orifice gallery as spares for raceways after they are removed as part of Phase 1.
2. Permanently seal base of sample holding tank floor to the tank.
3. Complete installation of upstream raceway jump barrier screens.
4. Operate the full season with lamprey raceway tailsceen in place.
5. Design stainless steel separator bars to replace PVC. The PVC bends creating wider spaces between the bars that jacks and small adults fit between.
6. Cover upstream raceways to provide shade.

7. Improve flow/elevation in the sample recovery truck loading pipe to eliminate fish being stranded in the pipe.
8. Operate the facility secondary bypass at all times when the collection channel is watered up to prevent fish from becoming stranded on the incline screen.
9. Rebuild motors for pneumatic fish evacuation system on the 2000 barges.
10. Install bumper system to replace cable and tire system on barges.
11. Paint hulls on 8000 barges.
12. Install ballast material in voids of 4394 and 4382 to eliminate the need to use river water.
13. Upgrade air compressors and generators on 4394, 4382, 8107, and 8108.
14. Complete plunger and cylinder installation.
15. Purchase a 1000 gallon fish tank and truck, a 3500 gallon tank and semi, and a service truck dedicated to trap and transport truck/barge maintenance.

APPENDIX