CENWW-ODO BARNES (1130) 22 April 2021

MEMORANDUM THRU:
Ray Guajardo, Operations Project Manager Lower Monumental Dam

FOR: Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2020 Adult and Juvenile Fish Facility Monitoring Report, Lower Monumental Dam.

1. Enclosed find the 2020 Adult and Juvenile Fish Facility Monitoring Report Lower Monumental Dam, as requested.

2. If you have any questions contact Chuck Barnes at Lower Monumental Dam, (509) 282-7211.

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Supervisory Fish Biologist, Lower Monumental Dam

Enclosure

ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

LOWER MONUMENTAL DAM

2020

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U.S. Army Corps of Engineers

Enclosure

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INTRODUCTION

The following report on fishway activities at Lower Monumental Dam is required under the Endangered Species Act consultation on the operation of the Federal Columbia River Power System (FCRPS) and its associated fish passage facilities. This report summarizes the operation and maintenance of adult fish passage facilities at Lower Monumental 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, 2020. Inspection readings are provided in Appendix 1 (2020 Ladders LoMo.xlsx). 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 Monumental Dam can be found in the report titled "2020 Juvenile Fish Collection and Bypass Report, Lower Monumental Juvenile Fish Facility".

River Conditions

The highest daily average flow for the 2020 season was 159.4 kcfs on June 1. The lowest daily average flow for the season occurred on November 15 with a flow of 13.6 kcfs. The average flow for the season was 44.4. Mandatory Spill occurred for 151 days from 00:00 hour on April 3, 2020 through midnight on August 31, 2020, with a maximum daily average spill of 116.0 kcfs on May 31, 2020. The Removable Spillway Weir (RSW) was put into operation when Biological Opinion (BiOp) spill began on April 3, 2020 and was taken out of service for the season on August 10, 2020 due to inflow being less than 30kcfs for 3 consecutive days and trending downward as stated in the Fish Passage Plan.

Average river temperature for the 2020 season was 55.7°F and ranged from 41.0 °F (March 1 – 6 and December 31) to 71.0 °F (July 30).

ADULT FISH FACILITY

Facility Description

The adult fishways at Lower Monumental are comprised of north and south shore fish ladders. The upper ladders extend from the forebay to tailwater and include: ladder exits, slotted weirs, upper diffusers, overflow weirs with orifices, and fish counting stations with picketed leads. The lower ladders contain: collection channels, channel diffusers, and ladder entrances. The north shore lower fish ladder has two north shore entrances (NSE-1 and NSE-2) and two south powerhouse entrances (SPE-1 and SPE-2). The south shore lower fish ladder has two entrances (SSE-1 and SSE-2). Auxiliary water is supplied by three turbine-driven pumps (fish pumps) located in the north side of the powerhouse. The water is pumped into a supply conduit that extends under the north and south shore lower ladders, distributing water to the lower ladder diffusers. Excess water from the juvenile fish bypass system (approximately 180-200 cfs) additionally contributes to the auxiliary water supply during the juvenile fish bypass/collection season.

Facility Modifications

No modifications were made to the adult fish passage system in 2020.

Operations and Maintenance

Fish Ladders and Collection Channels

The adult fishways were in service throughout 2020 with the exception of the winter maintenance season. Inspection and maintenance on the north and south shore fishways occurred from January 6 to January 30 and February 5 to February 26, respectively.

The upper fish ladders are dewatered annually for maintenance activities including: debris removal, diffuser grating and structural support inspections, cleaning of picketed leads, staff gauges and fish counting windows, maintenance of count station window cleaning mechanisms, and repairing 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 ladders. The fish exit is then bulkheaded off, any fish in the exit pool are removed and released to the forebay, and the upper ladders are partially dewatered, leaving about 4 inches running through ladder weir orifices. This flow is maintained to move any remaining fish to tailwater. Approximately twenty-four hours later, the flow is reduced to two inches and maintenance personnel go down the ladder through the orifices to remove debris, move remaining fish to tailwater, and inspect the full length of the channel.

The lower ladders are 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 and exposed diffuser gate operating equipment. Staff gauges are then cleaned and debris is removed. The north shore water is lowered to 0.50 ft for visual inspection of grating. When dewatering for repair is necessary, fish are crowded to the entrance pools, netted, and placed in a 600 gallon container (or 32 gallon containers if fish numbers are very low). The large container is manipulated with the crane to release fish to tailwater and refill the tank if needed. The need for replacement of the diffuser grates and clasps has been an issue for years and will be fully addressed when funding is available. This rehabilitation work began during the 2020 winter maintenance period when the gratings on north ladder diffusers 3, 4, 5 and 6 were replaced. No other problems were observed during the inspection of the lower north shore channel and the lower south shore ladder.

Auxiliary Water Supply

Fish pumps 1, 2, and 3 were out of service (OOS) from January 1 to February 27 for annual maintenance. Annual maintenance consists of changing oil in pedestals, adjusting or replacing packing and shaft seals, inspecting and cleaning heat exchangers, inspecting and replacing broken shear pins on the wicket gates, adjusting brakes, removing trash and debris from the fish pump turbine, and a general mechanical and electrical inspection. The more significant pump outages are summarized in Table 1.

Table 1. Fish pump outages at Lower Monumental Dam, 2020

Affected Pump(s)	Dates	Reason for Outage/Comments
1, 2, 3	Jan 1 – Feb 27	Annual 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 within the fishways. The automated fishway control system is based on a GE Fanuc Series 90 control program. The computer is used to change the control parameters of the terminal units and provide datum acquisition and storage. The remote terminal units control the fishway entrance weir gates according to set points that either regulate the gate depths below tailwater or channel-to-tailwater entrance head differentials. The computer printout contains the following information: dates; times (hour, minute, and second); channel temperatures; channel and tailwater elevations (feet above mean sea level) for the north shore, south powerhouse, and south shore; gate elevations; gate depths; entrance heads; and set points for the gate depths and entrance heads. The automated control system was operating throughout the 2020 operating season.

Operating criteria involve normal and special operating conditions. Under normal operating conditions, NSE-1, NSE-2, SPE-1, SPE-2, and SSE-1 weir gates are operated to meet criteria of at least 8 foot depths (depth criteria) or be on sill if less than 8 foot depths occur (sill criteria). SSE-2 weir gate is operated with a 6-foot opening. Normal operating criteria for the rest of the ladder includes maximums of 0.5 foot heads at the exits, maximums of 0.4 foot and 0.3 foot heads at the north and south shore picketed leads, respectively, 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.

Adult fishway inspections consist of observing facility operating conditions and recording visual readings from staff gauges, weir gate selsyns, and electronic meters. Wave action and impact from large debris have consistently resulted in loss of the south ladder tailwater staff gauge. Readings of the lower south ladder and tailwater are therefore taken from an electronic panel in the service gallery.

Inspections by fisheries staff and QC personnel are normally conducted three or more times per reporting week with times randomized. An average of 3.6 inspections per week were performed (158 inspections /44 weeks) in 2020. Depths and head differentials that were out of criteria, as well as other problems, were reported to powerhouse shift operators and/or maintenance staff for correction. Powerhouse operators conduct shift inspections in addition to the inspections performed by fisheries staff.

Inspection Results

Visual readings are normally recorded and compared with automated control system readings to check for calibration problems. Data from fishway inspections was entered into an Excel spreadsheet (Appendix 1). The average compliance of all criteria points in 2020 was 98.6%. A summary of fish ladder performance and variability is provided in Table 2.

Ladder exits: North shore ladder exit head differentials were in criteria during all inspections. South shore ladder exit head differentials were in criteria during all inspections. North and south shore exits were operated without debris booms again this season. Changing designs of debris

booms which will be able to withstand high winds and wave action have delayed debris boom replacement.

Ladder weirs: The depths over the weirs of the north shore ladder were within criteria during all inspections. The depths over the weirs of the south shore ladder were within criteria during all inspections.

Counting stations: The head differential across the north shore counting station picketed leads was in criteria on 98.7% of inspections. The out of criteria readings were on August 5 and 14 with readings of 0.6 and 0.5 feet respectively. This was due to debris, adult American shad mortalities and fibrous algae accumulation on the picketed leads. The south shore counting station met criteria on all inspections.

Entrance heads: North shore entrance head differential was in criteria during 98.7% of the inspections. Readings out of criteria were caused by failure of the automated control system due to the high level of the tailwater during elevated river flows and high spring spill levels.

South powerhouse entrance head was in criteria during 99.4% of the inspections. Readings out of criteria were caused by failure of the automated control system due to the high level of the tailwater during elevated river flows and high spring spill levels.

South shore entrance head differential was in criteria during 96.2% of the inspections. Readings out of criteria were caused by failure of the automated control system due to the high level of the tailwater during elevated river flows and high spring spill levels.

North shore entrance (NSE-1 & 2) depths: NSE-1 weir gate was in depth criteria during 94.9% of the inspections. Readings out of criteria were due to calibration issues within the automated control system.

NSE-2 weir gate was in depth criteria during 94.9% of the inspections. Readings out of criteria were due to calibration issues within the automated control system.

South powerhouse entrance (SPE-1 & 2) depths: SPE-1 weir gate was in depth or sill criteria during 100% of the inspections (12.7% depth, 87.3% sill).

SPE-2 weir gate was in depth or sill criteria during 100% of the inspections (12.7% depth, 87.3% sill).

South shore entrances (SSE-1 & 2): SSE-1 weir gate was in depth or sill criteria during 96.2% of the inspections (41.1% depth, 55.1% sill). Readings out of criteria were due to calibration issues within the automated control system

SSE-2 weir gate was in criteria during 98.7% of the inspections. Readings out of criteria were due to the weir operation being defaulted to automatic mode which moved the weir gate off of its set opening height.

North shore collection channel velocity: The velocity unit is located in the north shore collection channel in the transition area between main units 1 and 2. The sending unit is positioned in the channel to avoid non-characteristic high or low readings that are not representative of overall velocity conditions. Accurate velocity readings require the inspector to wait for the digital display to warm up and achieve a duplication of its peak reading.

Velocities were in criteria during 99.4% of the inspections (criteria: 1.5-4.0 ft/s). The North shore collection channel velocity meter would not operate during the December 16 inspection, most likely due to debris hanging on the sensor.

Recommendations

1. Design and install ladder exit debris booms capable of withstanding turbulent waters.
2. Remove sand and debris from the supply conduits and replace all original ladder diffuser grates, support structures, and mud valves.
3. Repair north and south shore fish ladder joint leakage.
4. Replace staff gauges with fiberglass reinforced plastic staff gauges.

Table 2. Summary of adult fishway inspections at Lower Monumental Dam, 2020 [1]

			------Not Enough Depth------			-------Too Much Depth-------		
Criteria and Locations	**No. in Depth Criteria/ No. in Sill Criteria/ No. of Inspections**	**% In Depth Criteria/ % In Sill Criteria**	**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**
North Channel Water Velocities	157 *** 158	99.4 ***	*** ***	*** ***	*** ***	*** ***	*** ***	*** ***
Differentials								
North Ladder								
Ladder Exit	158 *** 158	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Ladder Weirs	158 *** 158	100.0 ***	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Counting Station	156 *** 158	98.7 ***	*** ***	*** ***	*** ***	1 0.6	1 0.6	0 0.0
South Ladder								
Ladder Exit	158 *** 158	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Ladder Weirs	158 *** 158	100.0 ***	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Counting Station	158 *** 158	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Coll. Channels								
North Shore Entrance	156 *** 158	98.7 ***	0 0.0	0 0.0	2 1.3	0 0.0	0 0.0	0 0.0
South Powerhouse Entrance	157 *** 158	99.4 ***	1 0.6	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
South Shore Entrance	152 *** 158	96.2 ***	2 1.3	0 0.0	3 1.9	0 0.0	0 0.0	1 0.6
Weir Depths								
NSE-1[2]	150 0 158	94.9 0.0	0 0.0	4 2.5	4 2.5	*** ***	*** ***	*** ***
NSE-2[2]	150 0 158	94.9 0.0	0 0.0	4 2.5	4 2.5	*** ***	*** ***	*** ***
SPE-1[2]	20 138 158	12.7 87.3	0 0.0	0 0.0	0 0.0	*** ***	*** ***	*** ***
SPE-2[2]	20 138 158	12.7 87.3	0 0.0	0 0.0	0 0.0	*** ***	*** ***	*** ***
SSE-1[2]	65 87 158	41.1 55.1	0 0.0	1 0.6	5 3.2	*** ***	*** ***	*** ***
SSE-2	156 N/A. 158	98.7 ***	0 0.0	0 0.0	0 0.0	*** ***	*** ***	*** ***

[1] Data from Appendix 1.

[2] "On sill" means the weir gate 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 Monumental Dam consist of: vertical barrier screens (VBS), standard length submersible traveling screens (STS), twelve inch orifices, collection channel that terminates in a dewatering structure, transport flume, separator, and fish distribution system. The distribution system includes: Passive Integrated Transponder (PIT) tag bypass, sampling facilities, holding facilities, and barge and truck loading capabilities.

Each of the 18 bulkhead slots contains two orifices for diverting fish into the collection channel. Eighteen to 21 orifices are open at any one time with a minimum of one orifice open in all bulkhead slots of operating units. Lights are directed at each open orifice to enhance fish movement into the collection channel. The collection channel terminates at the primary dewatering structure where all but 30 cfs flow is removed. The remaining 30 cfs flow and fish are routed through the transport flume to the 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. The distribution system directs the fish to their target locations.

Facility Modifications

The pneumatic cylinder actuator system for the PIT tag bypass slide gates was changed over to a high-speed electro-mechanical actuator system during winter maintenance. A prototype electro-mechanical actuator was installed to operate the PIT tag slide gate on the B side of the facility before the 2019 season. The maintenance cost is much lower and reliability is much higher with the electric system compared to the original pneumatic system. The new cylinder performed well and after some slights modifications, was operating more efficiently than the historic system. The A side pneumatic cylinder actuator system was replaced with an electro-mechanical actuator system prior to the 2020 season. This new system allows Pacific States Marine Fisheries Commission personnel to remotely control and adjust the system as needed and decreases annual maintenance required by Army Corps personnel.

Operation and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within one percent of 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 causes from March 1 through December 31.

Table 3. Summary of unit outages and cause at Lower Monumental Dam, 2020.

Unit	Dates out of service	Reason out of service
All Units	March 23 - 25	STS installation
All Units	Monthly(2-3 days)	STS/VBS inspection/hub tapping on fixed blade units
All Units	March 16 - 17	Trash rack raking (6-8 hrs/day alternating units)
All Units	July 27 – July 31	Doble Testing (Units 5 & 6 on service during none day shift working hours)
Units 1-4	April 20 June 15	Trash rack raking (6-8 hrs/day alternating units)
Units 3-6	December 16	STS removal
Unit 1	December 18, 2019 – March 10	Annual maintenance
	October 7 -13 October 21 - 22	Digital governor control issue
	October 29	Oil accountability investigation
	December 7 – 2021	Annual maintenance
Unit 2	OOS all of 2020	Annual/Draft tube liner rehab
Unit 3	July 6 – August 6	Annual maintenance
	August 19	AC/DC oil pump issue
Unit 4	February 12 May 27 June 24	Hub tapping
	August 10 – October 1	Annual maintenance
Unit 5	February 11	Hub tapping
	February 12	Index testing
	August 3 - 5	XJ02 new break installation
	October 19–November 10	Annual maintenance
Unit 6	February 3	STS Brush Cleaning and Creep Adjustment
	March 3 – 4 July 31 – August 1	Field ground faults
	September 28 – October 16	Annual maintenance

Debris/Trash Racks

In 2020, trash rack raking occurred March 16 – 17, April 20 and June 15. Debris was exceptionally light this season.

Submersible Traveling Screens

The STS's were inspected and tested on March 19, 2020. STS's for units 1 and 3 were installed March 23, 2020, units 5 and 6 were installed March 24, 2020 and unit 4 was installed on March 25, 2020. STS in gatewell 1A was found with a tear in the screen during the July 8 inspection and was immediately replaced with a spare screen before the unit returned to service.

STS's are usually operated in "cycle" mode when the average fork length of subyearling Chinook and/or sockeye salmon is greater than 120 mm, and in continuous "run" mode when either is less than 120 mm. In 2020, the STS's were placed in continuous run mode when first deployed on March 25; they were changed to cycle-run mode on April 8 when average lengths of collected fish were greater than 120mm. The STS's were changed to continuous-run mode on May 20 due to average sub-yearling Chinook and sockeye lengths being less than 120 mm. They were changed back to cycle-run mode on June 28 when the average lengths of collected fish were greater than 120mm.

Vertical Barrier Screens

The VBS in gatewell 1B was inspected on December 30, 2020 and found to be in good working order. The VBS in gatewell 3B was inspected on July 14, 2020 and south side bolts were found missing on top section and the screen was hanging out about 6 inches. The VBS framework was re-aligned and welded in place. The VBS in gatewell 5B was inspected on October 29, 2020 and found to be in good working order. The VBS in gatewell 6B was inspected on August 6, 2020 and found to be in good working order. All visual VBS inspections were conducted via biologist using a man basket.

Gatewells

During the 2020 season, gatewells did not exceed 50% debris coverage criteria on any inspections.

Orifices/Collection Channel

During the 2020 season, the number of open orifices varied from 17 to 20 according to forebay level. With the Lower Monumental reservoir at minimum operating pool, water discharge through an orifice is reduced. During this period, extra orifices were opened to supply additional water to the adult fishway. Orifices were cycled and backflushed with air daily to remove debris. Orifice lights were also checked daily. If a light was not working, flow was directed to the other orifice in the slot until repairs could be made.

Primary Dewatering Structure

The Primary Dewatering system operated from March 23 to December 16. The compressed air screen cleaner functioned well throughout the 2020 season. The Primary Dewaterer mechanical screen cleaner brush automated systems were upgraded during winter maintenance and had intermittent malfunctions from March 23 to April 6. Electricians identified the problem and adjusted the system. This problem had little impact on keeping debris off of the incline screen, as the bubbler was still operating, and technicians were able to run the brush manually during their shifts. The Primary Dewaterer mechanical screen cleaner brush system was taken out of service on May 28, after the brush head assembly fell off the brush arm. The axle holding the assembly on the arm was broken. The mechanical brush could not be repaired until the collection channel was dewatered. This problem had little impact on keeping debris off of the incline screen, as the bubbler was still operating and debris load remained light throughout the

season.

Wet Separator/Distribution and Sampling Systems

Sudden water level drops at the separator were not a problem this year. Water level remained fairly consistent at the separator with manual operation of the automated weirs of the primary dewaterer. As has been the case for the last few years, the separator was operated at a higher water level to assure no problem with exposed separator bars would occur.

Barge Loading Operations

Fish were transported by barge from April 24 through June 21. Barge loading at Lower Monumental occurred without any issues during the 2020 transport season.

Truck Loading Operations

Juvenile fish were scheduled to be transported by truck from August 1 to October 1. Per 2020 Fish Operations Plan, the Lower Monumental trucking schedule is contingent upon the Technical Management Team (TMT) approval; the TMT decision was that no truck transport would take place from Lower Monumental Dam during the 2020 transport season.

AVIAN PREDATOR MONITORING

Areas of avian predation monitoring included: forebay, turbine discharge, spillway discharge and JFF bypass outfall. Deterrent measures included: bird wires across the tailrace of the powerhouse, water cannon sprinklers at the exit of the bypass outfall pipe, bird deterrent spikes at common perching areas, and hazing (April 1 through June 2) under the animal control contract with USDA Wildlife Services (WS). Two shift hazing coverage (daylight to dusk) occurred from May 3 to June 2.

Avian predators tend to rest in the forebay and chase juvenile fish as they jump. They also spend time perched on the lock wall facing the tailrace. At the downstream navlock guidewall, bird wires were added along the top rail of the handrail during winter 08-09 which effectively reduced the perching previously seen there, however, to a great extent the perching only relocated to the deck in front of the handrails.

The following data is based on bird counts taken in two separate procedures (limited to April 1 through October 1). The first procedure takes place during fish ladder inspections with supplemental counts by WS on days with no ladder inspection. The second procedure is from daily observations of the tailrace area taken at approximately 11:00 hours each day as specified in the Avian Action Plan.

1. Fish Ladder Inspection/APHIS supplemented Bird Monitoring

Fish ladder inspections were conducted three to six times per week at Lower Monumental Dam to ensure ladders were operating within criteria and for training purposes. These inspections were conducted at random times and contain counts during active bird hazing as well as in its absence. On Mondays and Thursdays (April 1 through June 2) WS contracted employees collected bird information in the same format as the ladder inspection data and this information was added to the spreadsheet for inclusion in this report. During daylight hours, gulls were present if hazing was not occurring. High juvenile fish numbers passing the dam via spill related to higher gull numbers. In the absence of hazing, gulls appeared to be fairly effective at feeding in the tailrace areas. Each ladder inspection included an avian predator count section for five areas that included: forebay (FB), spillway (SWT1), under the bird wires of the turbine discharge (PHT1), downstream of the birdwires below the turbine discharge (PHT2), and lastly the juvenile bypass outfall (JFOF). Each area included counts of both foraging and resting birds. The following summarizes the data collected from April 1 through October 1 of the 2020 operating year. The averages offered in each category include all data through the time period; it is an average of all the Fish Ladder Inspection/WS supplemented Bird Monitoring Inspections for that condition (feeding/resting) in each zone.

Gulls

Gull numbers were highest from April 6 to May 31 with a second wave of activity from June 28 to September 6 after the end of barge transport. In all areas, gull numbers dropped after May 31 as juvenile salmonid numbers became increasingly sparse. Gull numbers increased again later in the year in response to increasing numbers of out-migrating juvenile American shad.

Gull numbers feeding in the forebay (**FB**) ranged from 0 to 15 (May 20) and averaged 0.51. Gull numbers resting in the FB ranged from 0 to 69 (May 10) and averaged 8.13. FB gulls are typically seen resting on the navigation lock guide wall.

Gull numbers feeding in the spillway (**SWT1**) ranged from 0 to 75 (May 4) and averaged 9.5. Gull numbers resting in SWT1 ranged from 0 to 45 (August 7) and averaged 1.37. SWT1 gulls are typically seen avoiding the pyrotechnics of the hazers firing over the spillway discharge from the navigation lock deck (elevation 536).

Gull numbers feeding in the powerhouse tailrace under the bird wires (**PHT1**) ranged from 0 to 40 (July 29) and averaged 1.66. Gull numbers resting in PHT1 ranged from 0 to 6 (August 26) and averaged 0.13. PHT1 gulls are only typically seen when the hazer is not present.

Gull numbers feeding in the powerhouse tailrace downstream of the bird wires (**PHT2**) ranged from 0 to 45 (May 19) and averaged 4.62. Gull numbers resting in PHT2 ranged from 0 to 30 (July 24) and averaged 0.56. PHT2 gulls are also only typically seen when the hazer is not present.

Gull numbers feeding at the juvenile bypass outfall (**JFOF**) ranged from 0 to 25 (May 20) and averaged 2.66. Gull numbers resting at JFOF ranged from 0 to 20 (July 25) and averaged 0.31. JFOF gulls are typically seen when large numbers of juvenile salmonids were bypassed.

Hazing was effective at moving gulls out of the area. Two shifts were used to provide daylight to dusk coverage throughout the historic peak of salmonid outmigration. The second shift of hazing was equally as effective as the morning shift. On days when hazing did not occur but fish passage numbers were high, the birds returned and resumed normal feeding behaviors. Gull numbers correlated well with the peak of the juvenile fish outmigration this season, as has been the rule in the past. Observers noticed that during higher spring spill volume, large numbers of feeding gulls were seen just below SWT1, so were not included in the tailrace observation numbers. This newly observed feeding location also decreased the effectiveness of hazing efforts.

Cormorants

Cormorant numbers were fairly consistent throughout the season. Fall and winter cormorant numbers tend to be higher than those during the juvenile salmonid outmigration.

Cormorant numbers feeding in the forebay (**FB**) ranged from 0 to 11 (April 16), and averaged 0.21. Cormorant numbers resting in the FB ranged from 0 to 11 (April 30 and May 4) and averaged 0.82. FB cormorants are commonly seen foraging and are impervious to hazing.

Cormorant numbers feeding in the spillway (**SWT1**) ranged from 0 to 14 (September 4) and averaged 0.53. Cormorant numbers resting in SWT1 ranged from 0 to 10 (July 17), and averaged 0.42. SWT1 cormorants are not effectively prevented from foraging by the pyrotechnics of the hazers.

Cormorant numbers feeding in the powerhouse tailrace under the bird wires (**PHT1**) ranged from 0 to 7 (September 5), and averaged 0.18. Cormorant numbers resting in PHT1 ranged from 0 to 4 (September 30), and averaged 0.05. PHT1 cormorants come and go and are impervious to hazing.

Cormorant numbers feeding in the powerhouse tailrace downstream of the bird wires (**PHT2**) ranged from 0 to 16 (September 12) and averaged 0.75. Cormorant numbers resting in PHT2 ranged from 0 to 6 (July 22), and averaged 0.10. PHT2 cormorants also come and go and are impervious to hazing.

Cormorant numbers feeding at the juvenile bypass outfall (**JFOF**) ranged from 0 to 2 (April 21, April 24, May 4 and May 14) and averaged 0.08. Cormorant numbers resting in JFOF ranged from 0 to 6 (May 25) and averaged 0.14.

Terns

Tern numbers were very low throughout the season. No sightings occurred during ladder inspection observations.

Terns were neither seen feeding nor resting in the forebay (**FB).**

Terns were neither seen feeding nor resting in the spillway (**SWT1**).

Terns were neither seen feeding nor resting in the power house tailrace under the bird wires (**PHT1**).

Terns were neither seen feeding nor resting in the power house tailrace downstream of the bird wires (**PHT2**).

Terns were neither seen feeding nor resting at the juvenile bypass outfall (**JFOF**). JFOF tern observations are also extremely rare.

Grebes

Grebe numbers were very low throughout the season. No sightings occurred during ladder inspection observations

Grebe were neither seen feeding nor resting in the forebay (**FB)**.

Grebes were neither seen feeding nor resting in the spillway (**SWT1**).

Grebes were neither seen feeding nor resting in the powerhouse tailrace under the bird wires (**PHT1**).

Grebes were neither seen feeding nor resting in the power house tailrace downstream of the bird wires (**PHT2**).

Grebes were neither seen feeding nor resting at the juvenile bypass outfall (**JFOF)**. JFOF grebe observations are extremely rare.

Pelicans

Pelicans were first present on April 9 and last seen in all areas on August 22.

Pelican numbers feeding in the forebay (**FB**) ranged from 0 to 8 (May 28) and averaged 0.19. Pelican numbers resting in the FB ranged from 0 to 4 (April 19, April 21 and May 8) and averaged 0.21. FB pelicans are typically seen cruising as a group; generally along the north shoreline.

Pelican numbers feeding in the spillway (**SWT1**) ranged from 0 to 14 (May 11) and averaged 0.65. Pelican numbers resting in SWT1 ranged from 0 to 4 (June 3) and averaged 0.18. SWT1 pelicans typically are not impacted by the pyrotechnics of the hazers firing to prevent gulls and cormorants from feeding.

Pelican numbers feeding in the powerhouse tailrace under the bird wires (**PHT1**) ranged from 0 to 4 (May 17 and July 7) and averaged 0.18. Pelican numbers resting in PHT1 ranged from 0 to 11 (July 24) and averaged 0.2.

Pelican numbers feeding in the powerhouse tailrace downstream of the bird wires (**PHT2**) ranged from 0 to 35 (May 18) and averaged 0.94. Pelican numbers resting in PHT2 ranged from 0 to 9 (May 24 and July 8) and averaged 0.41. PHT2 pelicans typically are not bothered by the pyrotechnics of the hazers firing to prevent gulls and cormorants from feeding.

The number of pelicans feeding at the juvenile bypass outfall (**JFOF**) ranged from 0 to 6 (May 12) and averaged 0.14. Pelican numbers resting at JFOF ranged from 0 to 9 (May 2) and averaged 0.13. JFOF pelicans are typically seen when large numbers of juvenile salmonids are bypassed.

2. Tailrace Bird Monitoring of Lower Monumental Dam (Avian Action Plan)

Single daily counts of gulls, cormorants and terns occurred between the hours of 1100 and 1300 each day from April 1 through June 30 as per the Avian Action Plan. Maximum counts with date of occurrence, average count through the April 1 to June 30 period, and a graph of the daily counts for each species throughout the period are as follows (Figures 1-2).

The maximum number of gulls was 30 (April 17, May 3 and May 20, respectively) with a daily average of 6.1.

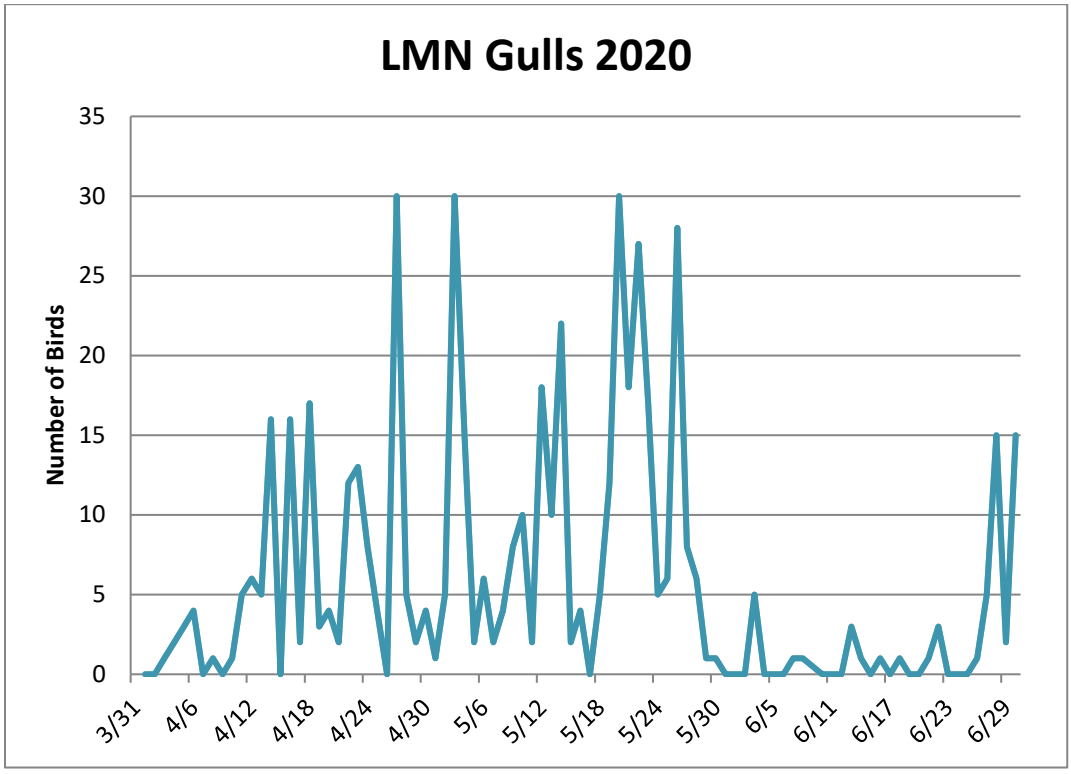

Figure 1. Daily maximum count of gulls in Lower Monumental Tailrace, 2020.

The maximum number of cormorants was 4 (April 16) with a daily average of 0.17.

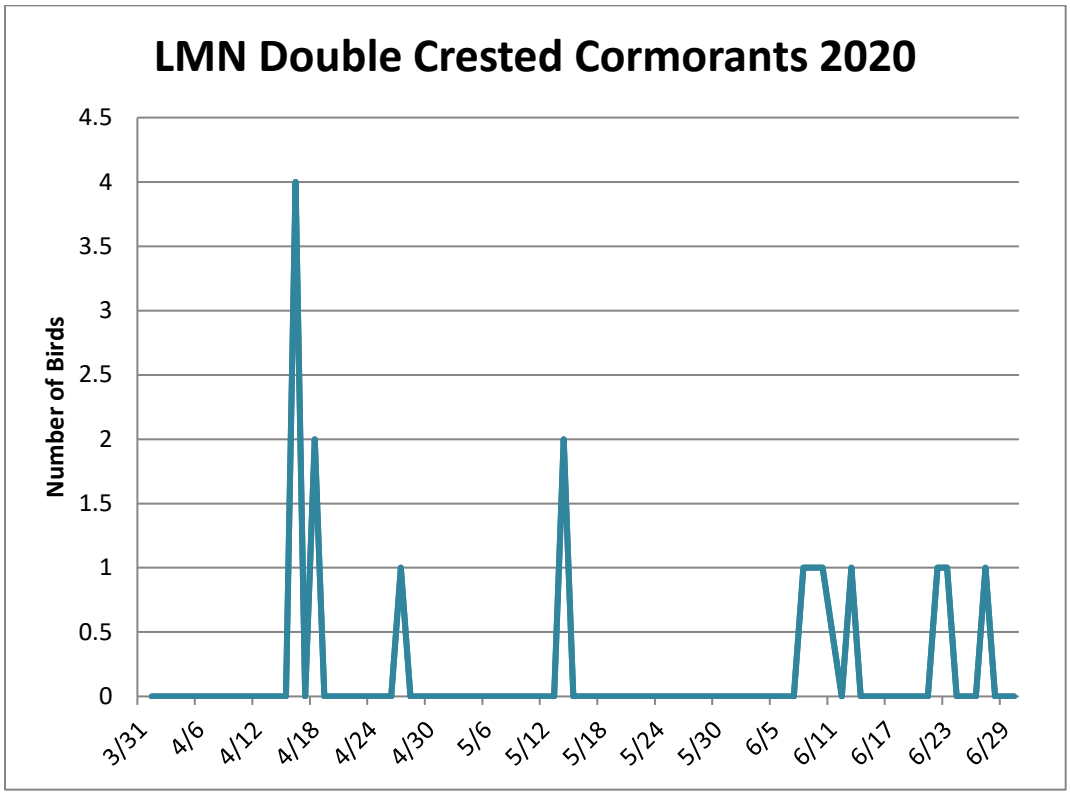

Figure 2. Daily maximum count of cormorants in Lower Monumental Tailrace, 2020.

The maximum number of terns was 2 (May 26) with a daily average of 0.03.

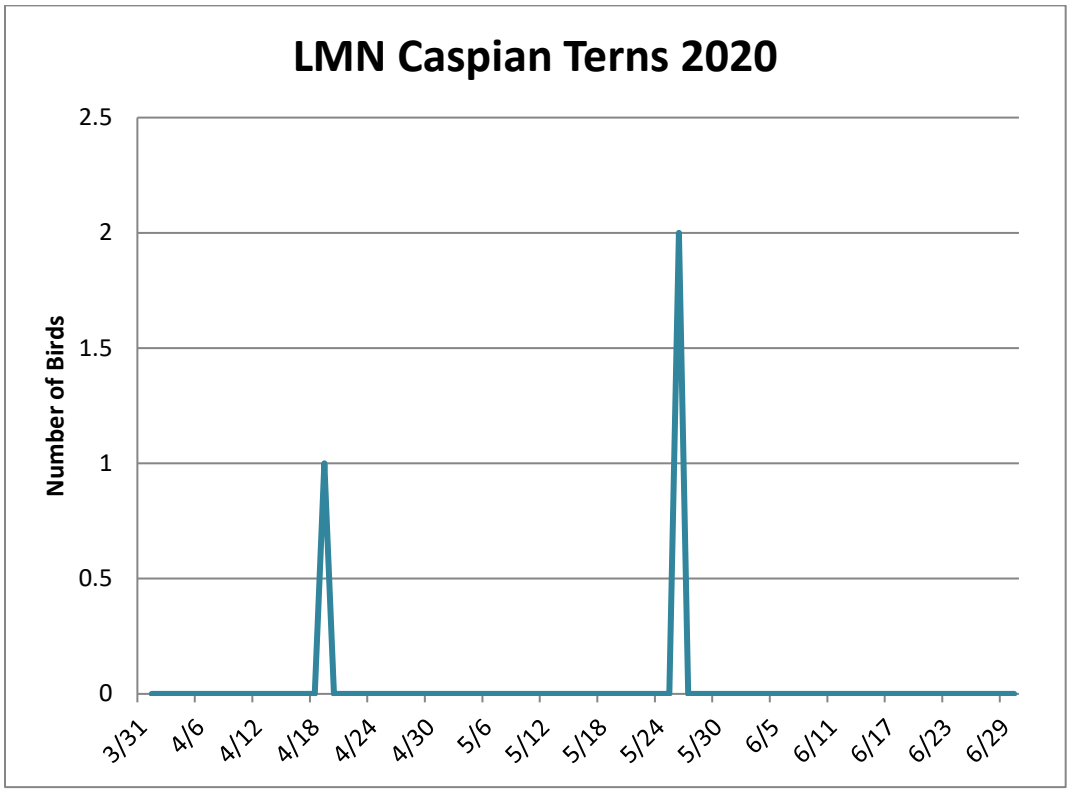

Figure 3. Daily maximum count of terns in Lower Monumental Tailrace, 2020.

Cooling Water Strainer Counts

Turbine unit cooling water strainers were examined for biologic content once per month from January until June 2020. Species content included lamprey, salmon species, steelhead, prawns, and a final category titled "other" which included all other species. The vast majority of other species were American shad. The number of each group and percent of the total of individuals of all groups combined was: juvenile lamprey 2180 (94.45%), salmon species 26 (1.13%), steelhead 0 (0.0%), prawns 2 (0.09%) and other 100 (4.33%).

Timing of the entry of each group into the strainers represents migration timing coupled with susceptibly of being drawn into the cooling water system for each group at that growth stage. Juvenile lamprey were generally present from February through June with numbers peaking at 1290 in February. Salmon species were generally susceptible only in April through June peaking at 11 in April and May. Steelhead were not seen in the strainers the entire year. The vast majority of all groups were no longer living when collected. The percent of each group released alive was: lamprey 12.44%, salmon species 0.0%, steelhead 0.0%, prawns 0.0%, and other 0%. Probability of any individual being alive at the time of strainer cleaning was likely more related to time of entry rather than which unit's strainer it was found in.

Recommendations

1. Install a shear boom across the forebay to direct debris to the spillway during the high flow/high debris period to reduce orifice fouling and associated fish injury.
2. Research converting the pipe system between the PIT facility counter tanks and the PIT facility holding tank exits with an open system that eliminates the need to hold fish in the PIT system holding tanks.

APPENDIX

Appendix 1. Lower Monumental Adult Fishway Inspections, 2020. (spreadsheet)