Proceedings for the 2nd Current Status of Lamprey Research in the Columbia River Basin Workshop

Organized by the Columbia River Basin Lamprey Technical Workgroup
Tim Cummings, Workgroup Coordinator
August 7, 2007
Vancouver Water Resources Center
Vancouver, Washington

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Workshop Introduction

One function of the Columbia River Basin Lamprey Technical Workgroup is to host workshops (ideally every other year) to allow lamprey researchers to present their data for dissemination and review. The first workshop, *Current Status of Lamprey Research in the Pacific Northwest* was held March 8, 2004 in Vancouver, Washington. The workshop included 14 presentations and an attendance of 86

The second workshop, *Current Status of Lamprey Research in the Columbia River Basin*, held August 7, 2007, was more limited and focused in scope. Seven presentations were given, ranging from general ecology of lamprey in freshwater, to research on specific passage impediments and solutions. The workshop included 7 presentations and an attendance of 79. Most presentations can be viewed at **http://columbiariver.fws.gov/lamprey.htm.**

Workshop Agenda

1:00 Introduction and Overview
Tim Cummings (U.S. Fish and Wildlife Service), and Dave Ward (Columbia Basin Fish and Wildlife Authority)

1:10 The Physiological Ecology and Life History of Adult Pacific Lamprey During Freshwater Residency
Ben Clemens and Carl Schreck (Oregon State University)

1:30 Assessing Larval Lampreys
C*hristina Luzier (U.S. Fish and Wildlife Service)*

1:50 Deschutes River Pacific Lamprey: Past, Present and Future
Jennifer Graham (Confederated Tribes of the Warm Springs Reservation)

2:10 Passage of Adult Pacific Lamprey at Low-Elevation Obstacles in the Umatilla River
Mary Moser (NOAA Fisheries)

2:30 Break

2:50 Passage and behavior of adult Pacific lampreys at Willamette Falls dam, Oregon
Matt Mesa (U.S. Geological Survey)

3:10 Development of Lamprey-Specific Passage Structures at Bonneville Dam
Mary Moser (NOAA Fisheries)

3:30 Preliminary Results of Testing Lowered Nighttime Velocities on Entrance Success to Fishways by Pacific Lamprey at Bonneville Dam.
Chris Peery (University of Idaho)

3:50 Preliminary Results on Correlation Between Night and Day Counts for Pacific Lamprey at Bonneville Dam.
Chris Peery (University of Idaho)

4:10 Group Discussion and Wrap-Up
All

Abstracts

The physiological ecology and life history of adult Pacific lamprey during freshwater residency

Benjamin J. Clemens and Carl B. Schreck, Oregon State University.

Status of Pacific lamprey has become a huge concern, yet surprisingly little is known about their life history. This information will be crucial if fisheries managers are to determine whether passage problems exist *or* more general problems such as high river temperature is dictating migratory characteristics. Here we present data from three collaborative studies to suggest that high summertime river temperatures play a crucial role in migratory behavior, and may function as a strong selective factor for run timing and maturation. Using aircraft to track radio-tagged adult lamprey above Willamette Falls, we have noted holding behavior once river temperatures exceeded 20 ºC. In the laboratory, we subjected fish to a similar > 20 ºC during July-September 2006, and in comparison to fish raised at 12-13 ºC, we observed significant mortalities *months after* the elevated temperature was employed, during the spring maturation period (May 2007).

Preliminary evidence suggests that these treatment fish were smaller and died as a combined result of reproductive maturation and infection with *Aeromonas salmonicida*, the causative agent of furunculosis. Periodic, physiological monitoring of adult lamprey at Willamette Falls suggests reproductive maturation occurs in June, prior to river temperature exceeding 20 ºC. Fish collected after this period had ovary weight : body weight proportions (GSI) more similar to recent migrants captured at the mouth of the Klamath River, in the Pacific Ocean. In summary, we have presented evidence to suggest that river temperatures > 20 ºC are correlated with 1) holding behavior, 2) significant delayed mortality, and 3) reproductive immaturity of Pacific lamprey. We will be continuing with monitoring efforts through the fall and into 2008, and anticipate that our data will be published in greater detail and available soon. We encourage anyone interested in the findings of these studies or in collaborating on similar research ventures to contact us directly.

Assessing electrofishing as a tool to detect presence and determine capture efficiency of larval lampreys

Christina W. Luzier, Greg Silver, and Timothy A. Whitesel, U.S. Fish and Wildlife Service.

Understanding the status of anadromous and resident lampreys in the Columbia River Basin has been identified as the most important factor for conserving these native species. The development of standardized sampling protocols is critical for determining the distribution and abundance of adult and juvenile lampreys. Electrofishing is commonly used for determining distribution and abundance of juvenile fishes; however, little work has been done to assess the effectiveness of electrofishing for larval lampreys. We performed controlled electrofishing trials and evaluated the results relative to several factors, such as larval density, size and electrofishing effort. This study provides insights into the utility of electrofishing for predicting the probability of detection and in estimating capture efficiency for larval lampreys. The probability of detection increased as density increased for all sizes of ammocoetes. Smaller ammocoetes were more easily detected than larger ones when distributed at low densities. Cumulative capture efficiency increased as density increased for all sizes. Cumulative capture efficiency was highest for small ammocoetes. A mark-recapture study in the field showed lower capture efficiencies than those observed in the controlled trials. The ultimate intent of this work is to evaluate electrofishing and develop approaches to assist in determining larval lamprey distribution and abundance for the purpose of understanding lamprey status. The results of the analyses could also aid in the development of measures of confidence for existing larval lamprey electrofishing data.

Deschutes River Pacific lamprey: past, present and future

Jennifer Graham, Confederated Tribes of the Warm Springs Reservation.

Since 2002, The Confederated Tribes of the Warm Springs Reservation of Oregon, Department of Natural Resources, has built a lamprey program addressing gaps in Pacific lamprey life history information for the Deschutes River Subbasin, Oregon. To date, we have completed

objectives to determine species identification, outmigration timing, ammocoete distribution and ammocoete-habitat relationships. Pacific lampreys were the only species positively identified during field surveys. Outmigrant timing in the Warm Springs River and Shitike Creek, tributaries to the Deschutes River, was highly correlated ($P < 0.001$) with stream discharge. A backpack electrofisher was used to determine ammocoete distribution and habitat relationships. Ammocoetes were present in five westside perennial streams to the Deschutes River as well as the mainstem Deschutes River from Rkm 0 – 156. Many habitat characteristics were highly correlated ($P < 0.001$) with ammocoete presence including average water depth at which ammocoetes were captured, water velocity, depth of fine substrate, presence of wood and depositional area. Currently, we are conducting a radio telemetry project to determine over-wintering locations, spawning habitat and timing for adult Pacific lamprey. Other projects underway include stream temperature monitoring, an ammocoete backpack electrofisher efficiency study, and adult Pacific lamprey escapement estimates. In the future, we'd like to experiment with multiple methodologies to estimate tributary production and escapement as well as re-establish Pacific lamprey populations to sustainable, harvestable levels in all Warm Springs Tribal usual and accustom harvest locations.

Identification of low-elevation impediments to adult Pacific lamprey (*Lampetra tridentata*) migration in the Umatilla River, Oregon

Mary L. Moser, NOAA Fisheries, and Aaron Jackson and Jeanette Howard, Confederated Tribes of the Umatilla Indian Reservation.

Efforts to restore Pacific lamprey (*Lampetra tridentata*) populations in the Umatilla River may be constrained by poor lamprey passage success during their pre-spawning migration. We used radiotelemetry to document passage of both spawning-phase (n = 30) and newly-migrating (n = 51) adult lamprey as they moved upstream from the mouth of the Umatilla River in 2005. The first major obstacle lamprey encounter in the Umatilla River is Three Mile Falls Diversion Dam, which is operated by the Bureau of Reclamation at Rkm 6. Only 50% of the spawning-phase and 11% of the newly-migrating lamprey that approached this low-elevation structure (8 m hydraulic height) were able to successfully pass over. The next obstacle to passage is Boyd's Diversion Dam, a privately-operated hydroelectric diversion at Rkm 14 that is less than 1 m high. Of the lamprey that approached this structure, 40% of the spawning-phase fish and 25% of the newly-migrating fish successfully passed over. At both dams, spawning-phase fish were probably more successful because flows during their migration period (late April-May) were higher than those for newly-migrating fish (late June-July). This resulted in both more potential passage routes and cooler water temperatures. Our pilot study indicated that in the first 50 km of the Umatilla River, the combination of low summer flows, high temperature, and a series of five, low-elevation dams conspire to block passage of adult Pacific lamprey.

Passage and behavior of adult Pacific lampreys at Willamette Falls dam, Oregon

Matthew G. Mesa, Robert J. Magie, and Elizabeth S. Copeland, U. S. Geological Survey.

We used radio telemetry to monitor behavior and passage characteristics of adult Pacific lampreys during their upstream migration at Willamette Falls dam on the Willamette River near Portland, Oregon. Our objectives were to document: (1) the specific routes of passage at the dam and the falls; and (2) the duration of passage through different routes and overall passage success. During the spring through fall of each year, fish were captured in a trap located in a fishway of the dam, surgically implanted with a radio tag, and released several km downstream of the dam. In 2005, we radio tagged 116 lampreys and in 2006 we tagged 94 fish. In both years, over 90% of the fish returned to the project with a median travel time of 7 – 9 h. Most fish moved at night from about 2000 – 2300 h. In 2005, 43 fish (35%) successfully passed the project via the fishways, with most fish using fishway number 1. Prior to the installation of flashboards around the perimeter of the falls in early July, lampreys used fishways 1, 2, and 3 to pass the dam. After flashboards were installed, only fishway number 1 was used. The peak of passage occurred in August. No fish passed over the falls, although several fish ascended to the top. In 2006, 24 fish (20%) passed the project, again primarily using fishway number 1. Most fish passed prior to 9 June when the powerhouse was shut down due to construction. Two fish passed via the falls in early July. The time it took for fish to pass through a fishway depended on which one they used—the median passage time ranged from 4 – 5 h in fishways 2 and 3 and from 22 – 74 h in fishway number 1. Fishway number 1, the most commonly used route of passage, had a passage efficiency of around 60%. Many fish resided in various areas of the tailrace for times ranging from a few hours to almost a year and eventually left the project and moved downstream. Collectively, our results indicate that passage of lampreys at Willamette Falls dam is relatively poor. One factor that seems to be important to the passage success of lampreys is sufficient attraction flow at fishway entrances. Work is currently ongoing to identify specific barriers to lamprey passage and implement corrective measures.

A lamprey passage structure at Bonneville Dam: three years old and growing

Mary L. Moser, NOAA Fisheries, Howard Pennington and Jeremy Roos, Pacific States Marine Fisheries Commission, and William Daigle, University of Idaho.

The passage success of upstream migrating adult Pacific lamprey (*Lampetra tridentata*) at Columbia River hydropower dams is poor relative to salmonids. In particular, lamprey are delayed and fall back downstream at the serpentine weirs near the top of the Bonneville Dam fishways. The lamprey also regularly enter auxiliary water supply (AWS) channels which provide no ready outlet to the dam forebay. In 2004-06, we operated a lamprey passage structure (LPS) at the Bradford Island AWS to aid lamprey passage. Lamprey can use this LPS to volitionally move from the AWS, through a series of rest boxes, and into the forebay of the dam. Individual lamprey were counted as they passed through the LPS, and in each year of operation this count increased. In 2006, we added a dual collector system, shortened the lengths of steep ramps, and incorporated a larger resting pool in the LPS. From mid-May to mid-September, 14,975 lamprey used the LPS, and this exceeded the number counted at the count window located in the adjacent Bradford Island fishway (n =14,862). Of the 2,000 lamprey that we

tagged with half-duplex passive integrated transponder tags and released below Bonneville Dam, 146 were detected in the LPS while 197 were detected as they passed through the Bradford Island fishway exit. Both of these sources of data suggest that the LPS contributed significantly to overall passage of lamprey in the Bradford Island fishway system.

Preliminary results on correlating night and day counts for Pacific lamprey at Bonneville Dam – 2007

Chris Peery and Eric Johnson, University of Idaho, and David Clugston, U.S. Army Corps of Engineers.

Accurate escapement estimates are critical in managing declining Pacific lamprey populations in the Columbia River. Daytime counts have been reported at Columbia River dams for a decade, but there is still some uncertainty in what temporal and spatial trends in daytime counts indicate in terms of actual population status for lamprey, primarily because we know that lamprey are most active at night. To evaluate how best to determine actual escapement levels, we are recording nighttime activity at the two count stations at each Bonneville and The Dalles dams, on the lower Columbia River. By viewing recordings we will estimate actual numbers of fish passing dams at night. These values will be combined with daytime counts for a 24 hr count of fish passing count stations. Initial processing of recordings indicates that nighttime passage can be quite variable. For example, during 16-27 May 2007, eight adult lamprey passed the Bradford Island Count station during the day while video records showed ten fish passed at night, for a net change of 18 fish during this period. However, at the Washington shore during a 7 d period (29 May – 4 June) day and night counts were 388 and -1,974, respectively, for a net change of =1,580. We will continue to process nighttime video recording of these for these four count stations. Other potential routes for fish to pass these two dams (as determined from radio telemetry) and fish passed via lamprey passage structures (LPS, Bonneville Dam only) will be used to adjust count data to produce an estimate of actual numbers of fish passing these two projects. Ultimately we hope to determine a practical method to estimate real lamprey escapement levels at Columbia River dams.

Preliminary results of testing lowered nighttime velocities on entrance success to fishways by Pacific Lamprey at Bonneville Dam – 2007

Chris Peery, Eric Johnson, and Mike Jepson, University of Idaho, Mary Moser, National Marine Fisheries Service, and David Clugston, U.S. Army Corps of Engineers.

Previous radio telemetry studies indicated that passage at dams is relatively low (12 to 60%) for adult Pacific lamprey *Lampetra tridentata* and could be a significant factor limiting production in the Columbia River. For example, fishway entrances at dams are difficult for adult lamprey to negotiate, likely because of high water velocities and structural complexity (square bulkheads, raised lips, recessed slots, etc.). We used radio telemetry to evaluate the effectiveness of reduced velocities at night to improve success rates for lamprey attempting to enter the Washington-shore fishway at Bonneville Dam. Nighttime entrance velocities were alternated between normal (at

least 1 ft head, 8 ft/s) and reduced (0.5 ft head, 4 ft/s) velocities at night (2200 to 0400 hrs) in a paired treatment test. As of 30 July, we had released 380 tagged adult lamprey downstream from the dam, of which 90 had first re-approached the dam at the Washington-shore fishway. The resulting entrance success for these 90 fish was less than 2% (1/61) during normal operations and 38% (12/29) during reduced velocity conditions. Overall, looking at all approaches and entries at the Washington-shore, entry success was 2% (10 entrances from 564 approaches) during normal operations and 29% (47 entries from 164 approaches) during reduced entrance velocities. There were also 10 and 26 fish that exited at the Washington shore, resulting in net entrance success of 0 and 21 during normal and reduced nighttime velocities, respectively. Preliminary conclusions from this data summary indicate that lowering nighttime velocities at fishway entrances shows promise to improve success for fish attempting to pass dams. However, getting fish into fishways is only the initial step to passing a dam, and other obstacles must be addressed to improve overall passage success at Columbia River dams.

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