Proceedings for the 1st Current Status of Lamprey Research in the Pacific Northwest Workshop


USFWS

Organized by the Columbia River Basin Lamprey Technical Workgroup

Jen Stone, Workgroup Coordinator

March 8, 2004
Vancouver Water Resources Center
Vancouver, Washington

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About the Columbia River Basin Lamprey Technical Workgroup

Structure

The Northwest Power Act directs the Northwest Power and Conservation Council (Council) to develop a program to protect, mitigate, and enhance fish and wildlife of the Columbia River basin that have been affected by construction and operation of hydroelectric dams. Through the fish and wildlife program, the Council makes funding recommendations to Bonneville Power Administration (BPA) for projects to implement the program. As part of a 1995 Council action, the Columbia River Basin Pacific Lamprey Technical Workgroup was established to serve and guide coordination activities for new and existing lamprey projects funded, or proposed for funding, through BPA.

Currently, the need for guided and coordinated lamprey research extends beyond the scope of the existing workgroup. The U. S. Fish and Wildlife Service (Service) encourages the coordination of lamprey research through the Columbia Basin Fish and Wildlife Authority (CBFWA), whose mission is coordinating and promoting effective protection and restoration of fish, wildlife, and their habitat in the Columbia River basin. This effort will be accomplished by re-instating the Lamprey Technical Workgroup to function under the authority of CBFWA. The Columbia River Basin Lamprey Technical Workgroup (Workgroup) will serve as a subcommittee of the Anadromous Fish Committee of CBFWA. The Service will coordinate Workgroup activities by organizing meetings and workshops to facilitate Workgroup function.

Purpose

The purpose of the Workgroup is to provide technical review, guidance, and recommendations for activities related to lamprey conservation and restoration. The Workgroup will accomplish this by:

1. Identifying and prioritizing critical uncertainties regarding lamprey conservation;
    a. Members of the Workgroup will maintain a prioritized list of lamprey research, monitoring, evaluation, and restoration needs. The Workgroup will provide a written summary of the prioritization process that integrates existing projects, new proposals, and research needs (requests for proposals). This will ensure that research is proceeding in a systematic and logical progression that will benefit the rehabilitation of lamprey in a coordinated and cost effective way.
    b. The Workgroup will update the Columbia River Lamprey Program Summary, as needed.

2. Providing a forum for discussion regarding lamprey-related concerns;
    a. Members of the Workgroup will host a workshop every-other year to allow lamprey researchers to present their data for dissemination and review purposes.
    b. Members of the Workgroup will meet twice per year, and more frequently as needed.

3. Disseminating technical information;
    a. The Workgroup will act as a focal point for disseminating and evaluating technical information and providing guidance on lamprey issues (i.e. providing guidance for subbasin planning).
    b. Members of the Workgroup will establish a website dedicated to Workgroup activities that can be used to identify, locate, and track lamprey-related projects.

Workgroup Composition

Members serving on the Workgroup should include scientists having lamprey technical expertise from the federal, state, and tribal governments, academia, and the private sector. Additionally, the Workgroup will include support staff such as contract officers, members of CBFWA, and the Council, as well as a liaison from the Oregon Coastal Lamprey Interest Group.

Funding

The Service, whose mission is to conserve, protect and enhance fish, wildlife, plants, and their habitats, will contribute ¼ FTE to support the coordination of the Workgroup and workshop. Members of the Workgroup will use existing budgetary infrastructure to support their participation. For members with Bonneville Power Administration contracts, costs incurred during participation in these meetings may be charged to existing travel budgets. CBFWA member's travel is reimbursable through their CBFWA membership.

Visit the Workgroup web site, hosted by the U. S. Fish and Wildlife Service, for more information at:
http://columbiariver.fws.gov/lamprey.htm

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Workshop Introduction

Lampreys are widely distributed in the Pacific Northwest, particularly the Columbia River basin. Until recently, conserving native lampreys was not a management priority, despite their commercial, ecological, economic, and cultural values. Biological and ecological information for these species is limited and few studies have been conducted within the Columbia River basin. Current information suggests that lamprey populations are declining, and in January 2003, four species of lamprey (*Lampetra tridentata, L. richardsoni, L. ayresi,* and *L. hubbsi*) were petitioned for listing under the Endangered Species Act.

The Columbia River Basin Lamprey Technical Workgroup convened a workshop at the Vancouver Water Resources Center on March 8th, 2004 to continue discussion on the population status of lampreys within the region. The workshop was attended by 86 participants from federal, state, tribal, and academic institutions and agencies throughout the Pacific Northwest and Canada. The workshop is summarized in this document and presentations can be viewed at **http://columbiariver.fws.gov/lamprey.htm.**

Workshop Agenda

8:30am – 9:00am	Sign-in, coffee
9:05am – 9:25 am	"*Introduction to technical workgroup and to lamprey species"* Jen Stone, U. S. Fish and Wildlife Service
9:25am – 9:40am	"*Lamprey species petition and opportunities"* Doug Young, U. S. Fish and Wildlife Service
9:40am – 10:00am	*"Genetic markers to distinguish among west coast lamprey species and the population structure of these species"* Margaret Docker, Great Lakes Institute for Environmental Research
10:00am – 10:20am	*"Progress of the CTUIR's lamprey research and restoration project"* Dave Close, the Confederated Tribe of the Umatilla Indian Reservation
10:20am – 10:40am	Refreshments
10:40am – 11:00am	"*Distribution of lamprey in the Portland metropolitan area"* Dave Ward, OR Department of Fish and Wildlife
11:00am – 11:20am	*"Habitat use and population dynamics of lampreys in Cedar Creek, WA"* Bao Lê, U. S. Fish and Wildlife Service

11:20am – 11:40pm	*"Determining lamprey species composition, larval distribution, and adult abundance in the Deschutes River sub-basin"* Jennifer Graham, the Confederated Tribes of the Warm Springs Reservation of OR
11:40pm – 12:00pm	*"Status of Pacific lamprey in the Clearwater River drainage, Idaho"* Christopher W. Claire, ID Fish and Game
12:00pm – 1:00pm	Lunch
1:00pm – 1:20pm	*"Egg predation in lampreys and the role of adult behavior"* Doug Markle, Oregon State University
1:20pm – 1:40pm	"*Lamprey early life history: Thermal ecology and morphometrics"* Mike Meeuwig, U. S. Geological Survey
1:40pm – 2:00pm	*"Annual physiological profiles of Pacific lampreys: implications for migration past dams"* Matt Mesa, U. S. Geological Survey
2:00pm – 2:20pm	Refreshments
2:20pm – 2:40pm	*"Structural and operational modifications to improve adult lamprey passage at lower Columbia River dams"* Mary Moser, NOAA-Fisheries
2:40pm – 3:00pm	"*Assessment of the Eicher screen and fish bypass on migrating juvenile Pacific lamprey at the T.W. Sullivan Plant, Willamette Falls, Oregon"* Dan Domina, Portland General Electric
3:00pm – 3:20pm	*"Video Monitoring of Juvenile Lamprey on Guidance Screens"* Kenneth Ham, Pacific Northwest National Laboratory
3:20pm – 4:00pm	General Discussion

Adjourn

Abstracts

"Introduction to technical workgroup and to lamprey species"
Jen Stone, U. S. Fish and Wildlife Service

There are three species of lamprey native to the Columbia River basin, the Pacific lamprey (*Lampetra tridenta*), the western brook lamprey (*L. richardsoni*), and the river lamprey (*L. ayresi*). As larvae (ammocoetes), lampreys are blind filter-feeders, often taking up residence in the silty backwater areas of freshwater environments. Ammocoetes hatch from eggs that are laid during the spring in gravel and reside in the stream for up to six years. Pacific and river lamprey metamorphose into transformers and spend their adult life in the ocean as ecto-parasites, whereas western brook lamprey spend their entire life in freshwater and do not feed as adults. All species die after spawning in freshwater. There is very little known about the river lamprey, and the minimal research conducted in this region has focused on the Pacific and western brook lamprey. There currently is a need for guided and coordinated lamprey research in the basin. The Columbia River Basin Lamprey Technical Workgroup fills this need under the authority of the Columbia Basin Fish and Wildlife Authority, whose mission is coordinating and promoting effective protection and restoration of fish, wildlife, and their habitat in the Columbia River basin. The U. S. Fish and Wildlife Service coordinates Workgroup activities by organizing meetings and workshops to facilitate Workgroup function.

"Lamprey species petition and opportunities"
Doug Young, U. S. Fish and Wildlife Service

The Fish and Wildlife Service (Service) was petitioned to list four species of lamprey under the Endangered Species Act. The petitioners identified 12 main threats to these lamprey species. The Service has reviewed the petition and determined that an emergency listing was not warranted. The Service will address the petition per national Listing Priority Guidance policy, and when funding is available. The standard petition review process includes determination of whether the petition provides sufficient information to warrant further evaluation, and subsequent initiation of a status review. In the interim period, the Service's Oregon Fish and Wildlife Office (OFWO), one of multiple field offices within the range of the four petitioned lamprey species, has funded several research and monitoring activities, and is pursuing additional conservation opportunities. OFWO's lamprey conservation priorities were discussed.

"Genetic markers to distinguish among west coast lamprey species and the population structure of these species"
Margaret Docker, Great Lakes Institute for Environmental Research

Genetic markers in lampreys are useful for species identification (since many species are difficult or impossible to identify as ammocoetes based on morphological differences) and to study population structure within each species. I used inter- and intraspecific differences in mitochondrial DNA sequence to develop several restriction fragment length polymorphism (RFLP) assays in lampreys. RFLP assays can unambiguously

distinguish between anadromous Pacific lamprey (*Lampetra tridentata*) and the Klamath River lamprey (*L. similis*) and between Pacific lamprey and western brook or river lampreys *(L. richardsoni* and *L. ayresi*, respectively). However, there were no genetic differences to distinguish between the western brook and river lampreys. Likewise, there were no species-specific differences among any of the freshwater-resident lampreys in the Klamath Basin (*L. tridentata* ssp., *L. similis*, *L. minima*, and *L. lethophaga*) or between species in the Goose Lake Basin (*L. tridentata* ssp. and *L. lethophaga*). There was, however, considerable intraspecific variation. For example, although the Pit-Klamath brook lamprey, *L. lethophaga*, was genetically indistinguishable from any of the species with which it was sympatric, different populations of *L. lethophaga* differed genetically. In particular, populations in the Klamath Basin were very distinct from those in the Pit River Basin. Further research will need to address the question of whether such genetically different populations should be considered the same species and whether sympatric species that are genetically indistinguishable are indeed species. We are currently using this intraspecific variation and additional RFLPs, however, to study population structure within the Klamath Basin and in the anadromous Pacific lamprey.

"Progress of the CTUIR's lamprey research and restoration project"
Dave Close, the Confederated Tribe of the Umatilla Indian Reservation

Pacific lamprey has declined in the upper Columbia and Snake River basins. In 2000 we initiated adult outplantings in the Umatilla River, a tributary of the Columbia River, in order to re-establish larval abundance. The final goal is to restore natural production of Pacific lamprey to self-sustaining and harvestable levels. The success of adult outplantings has been studied using several measures. Nest and egg viability surveys have been conducted to determine reproductive success of outplanted adult lamprey. To monitor larval abundance before and after outplantings, electrofishing has been conducted along the longitudinal profile of the river since 1998. The number of outmigrating lamprey has been studied since 1997 by collecting larval and metamorphosed lamprey by rotary screw trap. Number of upmigrating lampreys has been studied by capturing lampreys by portable assessment traps in 1999-2002 and by fyke net in 2002. The results have been promising. Adults outplanted to the upper reaches of the river have spawned successfully and produced ammocoetes. Larvae are beginning to disperse to the lower reaches of the Umatilla River. The number of outmigrating lampreys remains low and the number of upmigrating adults is negligible.

"Distribution of lamprey in the Portland metropolitan area"
Dave Ward, OR Department of Fish and Wildlife

The Oregon Department of Fish and Wildlife (ODFW) began regular monitoring of fish communities in Portland area streams in 1993. Since then, we have used backpack electrofishing to collect fish throughout 52 streams. We found lamprey *Lampetra* spp. in 32 of the 52 streams surveyed. Although most individuals collected were not identified to species, both Pacific lamprey *Lampetra tridentata* and western brook lamprey *L. richardsoni* were collected. Findings indicate that lamprey are still widely distributed in Portland area streams, and that habitat protection and restoration is warranted. ODFW is

also monitoring movements of radiotagged Pacific lamprey at Willamette Falls. To date, 8 of 16 tagged lamprey have successfully passed the falls. Monitoring is ongoing, and plans for spring 2004 include tagging about 30 more Pacific lamprey.

"Habitat use and population dynamics of lampreys in Cedar Creek, WA"
Bao Lê, U. S. Fish and Wildlife Service

Pacific lamprey (Lampetra tridentata) in the Columbia River basin have declined to a remnant of their pre-1940's populations. Little research has been conducted on this species within the Columbia River basin and identifying the biological and ecological factors limiting lamprey populations is critical to their recovery. This ongoing, multi-year study examines Pacific lamprey populations in Cedar Creek, Washington, a third-order tributary to the Lewis River. Objectives of the study include investigating larval lamprey habitat use, juvenile outmigrant timing, adult return timing, and adult spawning habitat requirements. Lamprey were captured using an adult fish ladder, lamprey pots, a rotary screw trap, and a lamprey electrofisher. In addition, spawning ground surveys were conducted annually during the spawning period. Our results suggest larval lamprey prefer areas of fine sediment and slow moving water. Outmigrant timing of juvenile lamprey occurs in two peaks and is associated with discharge in the winter and when discharge is decreasing in late spring. Adult Pacific lamprey begin returning to Cedar Creek in late spring and another pulse of returning adults are captured in the fall. Spawning occurs throughout the summer months and is associated with pool tail outs, runs, and riffle habitat. Adult lamprey prefer areas with large gravel and flows of 2-3 ft./sec. A gear efficiency study was implemented using net pens in a controlled field setting. Known numbers of ammocoetes, in two size categories (<60mm, >60mm), were acclimated in net pens over a 24-hour period and sampled using 70% depletion electrofishing. Preliminary results suggest the depletion model may overestimate abundance for fish <60mm at high densities. A regression was developed in order to reduce some of the error associated with the 70% depletion model. More gear efficiency trials and fieldwork related to study objectives will continue in 2004.

"Determining lamprey species composition, larval distribution, and adult abundance in the Deschutes River sub-basin"
Jennifer Graham, the Confederated Tribes of the Warm Springs Reservation of OR

The status of lampreys in the Deschutes River sub-basin is unknown. In 2003, we completed larval lamprey distribution and habitat surveys in the perennial streams to the lower Deschutes River. Larval lamprey were collected in four of the thirteen streams we surveys but were only present in the lowest reaches. Habitat associations were relatively weak but we did find a relationship between lamprey presence and wood (P=0.0) and depositional area (P=0.01). We also fished two rotary screw traps, in the Warm Springs River and Shitike Creek, to estimate outmigrant numbers and outmigrantion timing. Outmigrant numbers were not estimated due to a lack in trap efficiency. In 2002, ammocoetes and macropthalmia outmigrated in March while in 2003, peak outmigrant varied by developmental stage and stream. We also conducted a feasibility study to determine if it was possible to mark and recapture adult Pacific lamprey to estimate

escapement at Sherar's Falls, located at Rkm 71 in the Deschutes River. Using a long handled dip net, 199 adult lamprey were collected. All lamprey were fitted with a floy tag, fin clipped, total length measured and released downstream 2 Rkm. We recaptured 35 through dipnetting and a tribal lamprey creel. Tag retention was estimated to be to be 71% based on the presence of a tag wound and fin clip. We also conducted a tribal creel to estimate the number of lamprey collected by Confederated Tribes of Warm Springs tribal members. Twenty-one interviews were conducted with tribal members and we estimated harvest at close to 1,000 adult Pacific lamprey.

"Status of Pacific lamprey in the Clearwater River drainage, Idaho"
Tim Cochnauer and Christopher W. Claire*, ID Fish and Game

Pacific lamprey *Lampetra tridentata* are a native Snake River basin species occupying a unique ecological niche. Recent decline of Pacific lamprey adult migrants to the Snake River drainage has focused attention on the species. Adult Pacific lamprey counted passing Ice Harbor Dam fishway averaged 18,158 during 1962-69 and 545 during 1993-2003. Human natural resource manipulations in the Snake, Clearwater, and Salmon River drainages have altered ecosystem habitat in the last 120 years, likely impacting the productive potential of Pacific lamprey habitat. Timber harvest, stream impoundment, road construction, grazing, mining, and community development have dominated habitat alteration in the Clearwater River system and Snake River corridor. Hydroelectric projects in the Snake River corridor impact juvenile and larval Pacific lamprey outmigrants and returning adults. Juvenile and larval Pacific lamprey outmigrants potentially pass through turbines, turbine bypass/collection systems, and over spillway structures at the four lower Snake River hydroelectric dams. Clearwater River drainage hydroelectric facilities, including the Pacific Power and Light dam on the Clearwater River in Lewiston, Idaho (1927-1972), Dworshak Dam on the North Fork Clearwater River (1972-present), and Harpster Dam on the South Fork Clearwater River (1910-1963), severely or completely restricted chinook salmon *Oncorhynchus tshawytscha* passage and altered or obstructed passage routes of outmigrating Pacific lamprey juveniles, larvae, and upstream adult migrants. In 2000-2003 Idaho Department of Fish and Game investigated the status of Pacific lamprey populations in Idaho's Clearwater River drainage and implemented initial foundational sampling in the Salmon River drainage. Trapping, electrofishing, and visual habitat assessment surveys were used to determine Pacific lamprey distribution, life history strategies, habitat requirements, and population abundance in the South Fork Clearwater River, Lochsa River, Selway River, Middle Fork Clearwater River, and lower Salmon River subbasins. Sixteen-hundred fifty-nine ammocoetes were captured electroshocking 158 sites in the South Fork Clearwater River, Lochsa River, Selway River, Middle Fork Clearwater River, Clearwater River, Salmon River, and their tributaries in 2000-2003. Presence-absence survey findings in 2003 augmented 2000, 2001, and 2002 firmly and consistently indicating Pacific lamprey ammocoetes and macrothalmia are not numerous or widely distributed. Pacific lamprey distribution was confined to the lower reaches of Red River below rkm 8.0, the South Fork Clearwater River, Lochsa River (Ginger Creek to mouth), Selway River (Bear Creek to mouth), Middle Fork Clearwater River, and the Clearwater

River (downstream to Potlatch River). Pacific lamprey distribution in the Salmon River reach downstream of the Little Salmon River is restricted to the mainstem Salmon River.

"Egg predation in lampreys and the role of adult behavior"
Doug Markle, Oregon State University

The high fecundity and huge mortality experienced by eggs and larvae of most teleosts has led to a variety of adult behaviors that appear to reduce mortality. Adult lamprey are usually not considered to show such behavior. However, two behaviors, egg rolling in Coquille River Pacific lamprey and predation in Miller Lake lamprey, may benefit eggs by reducing the probability of predation. Egg rolling behavior may disperse eggs from a vulnerable unprotected nest to crevices while predation by Miller Lake lamprey may simply reduce predator numbers. These and other possible benefits of these behaviors are hypotheses that will be investigated with Leo Grandmontagne and Abel Brumo during 2004.

"Lamprey early life history: Thermal ecology and morphometrics"
Mike Meeuwig* and Jennifer Bayer, U. S. Geological Survey

We examined the effects of temperature (10° C, 14° C, 18° C, and 22° C) on survival and development of Pacific lampreys (*Lampetra tridentata*) and western brook lampreys (*L. richardsoni*) during embryological and early larval stages. The temperature for zero development was estimated for each species and the response to temperature was measured as the proportion of individuals surviving to hatch, surviving to the larval stage, and exhibiting abnormalities at the larval stage (i.e., malformations of the body). The estimated temperature for zero development was 4.85° C for Pacific lampreys and 4.97° C for western brook lampreys. Survival was greatest at 18° C followed by 14° C, 10° C, and 22° C, with significant differences observed between 22° C and other temperatures. Overall survival was significantly greater for western brook lampreys than for Pacific lampreys; however, the difference in proportion of individuals surviving was only 0.02. Similarly, survival to the time of hatch was significantly greater than survival to the time of the larval stage, although this represented a difference in proportion of individuals surviving of only 0.03. The proportion of individuals exhibiting abnormalities at the larval stage was greatest at 22° C followed by 18° C, 10° C, and 14° C, with significant differences observed between 22° C and other temperatures. These data provide baseline information on the thermal requirements of early life stage Pacific and western brook lampreys, and will aid in assessment and prediction of suitable spawning and rearing habitats for these species.

"Annual physiological profiles of Pacific lampreys: implications for migration past dams"
Matt Mesa*, Jennifer M. Bayer, and James G. Seelye; U. S. Geological Survey
Darren Ogden, Pacific States Marine Fisheries Commission

Recent research by the University of Idaho and the National Marine Fisheries Service (NMFS) indicates that a large percentage of upstream migrating adult Pacific lampreys

(*Lampetra tridentata*) have difficulty negotiating fishways at Bonneville Dam, the first dam on the Columbia River. Although such poor performance can be attributed in part to design constraints in the fishways and the relatively poor swimming ability of lampreys, questions remain as to whether there may be any physiological basis for this behavior. We will present results from two years of laboratory studies designed to document some sex steroid and other physiological profiles of Pacific lampreys on an annual basis. In addition, we sampled blood from lampreys migrating through fishways at Bonneville Dam in 2001 and 2002 to assess their physiological status at the time of passage. Our results are being used to explore the possibility of an underlying physiological basis for the disparate migration behavior of Pacific lampreys.

"Structural and operational modifications to improve adult lamprey passage at lower Columbia River dams"
Mary Moser, NOAA-Fisheries

n/a

"Assessment of the Eicher screen and fish bypass on migrating juvenile Pacific lamprey at the T.W. Sullivan Plant, Willamette Falls, Oregon"
Dan Domina, Portland General Electric

n/a

"Video Monitoring of Juvenile Lamprey on Guidance Screens"
Kenneth Ham, Pacific Northwest National Laboratory

Juvenile lamprey were monitored interacting with fish guidance screens at hydroelectric facilities. Behaviors videotaped in the field corroborated lamprey screen interactions seen in laboratory testing, including impingement at high velocities and some individuals becoming stuck between screen bars. Extensive video monitoring quantitatively demonstrated that screen modifications to decrease bar spacing reduced the number of lamprey stuck.

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We would like to thank the Coquille Indian Tribe for providing refreshments during the workshop.