

2025 LAMPREY INFORMATION EXCHANGE – PRESENTATION ABSTRACTS

DAY 1: CRITFC TRIBAL PACIFIC LAMPREY RESTORATION PLAN

Laurie Porter, Columbia River Inter-Tribal Fish Commission

The Columbia River Inter-Tribal Fish Commission (Yakama, Nez Perce, Umatilla, and Warm Springs Tribes) has recently completed an updated Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin (2025 TPLRP Policy and Technical Plan). The 2025 update is a blueprint for the region and emphasizes tribal leadership, restoring harvest, tribal knowledge and science, accountability, and urgency by all parties/entities under rapidly changing baseline conditions. In addition, the Plan calls out the need for funding - which includes long term, reliable, funding to support conservation and restoration efforts. The update includes both a policy document and a technical document. The Plan includes updates to the Vision, Goals, Numeric Goals, Objectives, and includes tables with timelines and responsible parties. CRITFC will present a brief summary of both documents and their contents. The main focus will be on the technical document in order to review together the objectives, timelines, responsible parties, actions, etc. in order to facilitate awareness of and commitment to implementation of the actions outlined in the plan for the benefit of Pacific lamprey throughout their range. The document is meant to be a roadmap to be used by our federal, state, tribal partners and other agencies to provide guidance on actions needed for restoration of Pacific lamprey. Commitment from agencies to support and implement actions identified in the Plan will be required for the restoration of Pacific lamprey.

DAY 1: LAMPREY PASSAGE

JUVENILE PACIFIC LAMPREY PASSAGE BEHAVIOR AND SURVIVAL IN THE LOWER COLUMBIA AND LOWER SNAKE RIVERS

Kate Deters, Pacific Northwest National Laboratory

Run-of-the-river juvenile Pacific lamprey were collected at juvenile fish facilities at mainstem dams located on the lower Snake and Columbia rivers from 2022 to 2025, and implanted with PNNL-developed Juvenile Eel/Lamprey Acoustic Transmitters. Tagged fish were released approximately 15-40 km upstream of Lower Granite, McNary, John Day, The Dalles, and Bonneville dams. Their reach survival, migration rates, routes of passage past dams, and overall survival were determined using cabled or autonomous receivers. Dam passage survival for the acoustic-tagged lamprey detected passing the dams was estimated using the Virtual Release/Dead Fish Correction (ViRDCT) release/recapture model.

Passage survival ranged from 0.85 to 0.91 at Lower Granite Dam in 2022 and 2023 and was 0.84 at Lower Monumental Dam in 2023. In 2022 and 2023, the majority (54%) of juvenile lamprey at Lower Granite Dam passed through the powerhouse, and 33-34% passed through conventional spill bays. At Lower Monumental Dam in 2023, a higher proportion of tagged juveniles passed through conventional spill bays (54%) compared to the combined powerhouse routes (turbines and juvenile bypass system, 39%).

In 2024, passage survival at McNary and John Day dams ranged from 0.71 to 0.74, which was lower than that observed at the Snake River dams in 2022 and 2023. At McNary Dam, survival was similar for powerhouse and spillway routes, while at John Day Dam, survival was higher through the spillway compared to the powerhouse.

In 2025, 1121 acoustic tagged juvenile lamprey were released from February through June to evaluate passage survival at The Dalles Dam and Bonneville Dam. Early-season fish releases in February and

March provided an opportunity to evaluate passage route survival over a wider range of project operations and environmental conditions (i.e., prior to the spring spill season).

ADULT PACIFIC LAMPREY PASSAGE AND MIGRATION BEHAVIOR AT LOWER COLUMBIA RIVER DAMS

Daniel Deng, Pacific Northwest National Laboratory

The goal of this study is to evaluate recent fishway modifications to ensure they benefit Pacific lamprey passage without detriment to salmon passage and to determine the final fate of adult lamprey in the Bonneville Dam (BON) tailrace, BON fishways, BON pool, and The Dalles Dam (TDA) tailrace.

Approximately 700 adult Pacific lamprey, collected from BON, were implanted with high-power acoustic tags (Sturgeon tags) and passive integrated transponders (PIT) before being released at two locations below the dam: Half were released at the Hamilton Island boat ramp on the Washington shore, and the other half at the mouth of Tanner Creek on the Oregon shore.

The acoustic tags transmit signals every 5 seconds for half of the tagged fish and every 15 seconds for the other half, providing tag lifespans of four months and one year, respectively. This strategy ensures effective monitoring within the BON fishway and helps assess the fate of lamprey that delay their migration.

The tagged lamprey were detected using a combination of autonomous and cabled acoustic telemetry receivers strategically deployed to evaluate lamprey passage and survival within the BON tailrace, fishways, BON pool, and tributaries between BON and TDA. Receivers were also placed in the TDA tailrace, fish ladders, and forebay.

Data from acoustic and PIT detections at the entrances, within, and at the exits of the BON fishways are being analyzed to assess dam-wide and route-specific passage efficiencies and identify any bottlenecks, following the metrics established by Keefer et al. (2013a) for comparison with previous studies. Acoustic detections upstream and downstream of BON will provide insights into the survival and fate of the tagged adult lamprey for up to one year after tagging.

The findings will provide evaluations of completed lamprey passage projects, guide prioritization of future fishway modifications at BON, and contribute to the overall strategy for conveyance of adult lamprey past Lower Columbia River dams, including BON, TDA and John Day Dam.

DEVELOPMENT OF THE FLOATING ADULT LAMPREY COLLECTOR (OPERATION NOCTURNAL) PHASE II

Ralph Lampman, Yakama Nation Fisheries

The novel floating elver trap (originally designed for true eels) was successfully fabricated with key lamprey modifications and deployed inside a large circular tank at Bonneville Hatchery and underwent several weeks of testing and refinement in 2024 as a result of FY23 PLCI BPA funding. Using FY25 PLCI BPA funding, we implemented modifications to the trap in spring 2025 based on the 2024 study and we conducted additional lab testing at Bonneville Hatchery between June and August to fine tune some additional key design elements to maximize efficiency. We set up a modified collection box and with various minor modifications, we were successful in increasing the collection efficiency within the tank from 26% (the maximum collection efficiency in 2024) to 55% (as of July 2025). In addition to investigating the effects of 1) ramp flow angle and rates, 2) ramp guides, 3) attraction flow configuration with some

splashing water, and 4) bottom plate with 2 inch gaps vs. flush, we also evaluated the impacts of adult lamprey pheromone in the destination tank and creek vs. well water.

We plan to deploy the Floating Adult Lamprey Collector [Operation Nocturnal] (FALCON) at Bonneville Dam WA Shore South Fish Ladder tailwater area in June 2026 (just downstream of the ladder concrete structure) and test efficacy of FALCON during the peak of the migration period (3.5 weeks). Additional recommendations will be made for modification based on this site testing. Finally, this project will create opportunities for additional FALCON to be fabricated and deployed at many other locations using additional funding,

including key bottlenecks at mainstem Columbia River hydroelectric dams. These traps are novel in that they provide access to adult lamprey even before they enter the fish ladder. Given that lamprey (especially weak swimmers) in large numbers turn around at the entrance of many dams, this collector provides additional opportunities for lamprey to effectively bypass passage barriers within the Columbia River Basin and species range wide.

DAY 1: ALASKA REGIONAL MANAGEMENT UNIT

THE 2025 REPORT ON LAMPREY RESEARCH IN ALASKA

Nate Cathcart, Alaska Dept. of Fish & Game

Arctic lamprey (*Lethenteron camtschaticum*) and Pacific lamprey (*Entosphenus tridentatus*) are species of greater conservation need in Alaska. However, we lack natural history information (e.g., distributions, life stage phenology, genetic baselines) about lampreys here despite them often sharing similar habitats and life histories with Pacific salmon or other anadromous fishes. Remedying problematic natural history knowledge gaps is needed to conserve Alaska's lamprey species and their habitats that are affected by climate change and development. Since 2022, collaborations among the Alaska Department of Fish & Game, Knik Tribe, and University of Alaska Fairbanks (and others) have intensified lamprey research, enhancing the quantity and quality of lamprey research in Alaska. Collectively, we aim to identify the distribution of Arctic and Pacific lampreys and describe critical parts of their life-histories, such as larval rearing strategies and spawning migrations. In this presentation, we share our progress, challenges, and plans. Establishing where, when, and how lampreys use Alaskan waters are the first steps toward protecting these cryptic, understudied anadromous fishes.

TRACKING PACIFIC LAMPREY: INTEGRATING TRADITIONAL KNOWLEDGE AND FIELD SURVEYS IN ALASKA

Meghan Montagne, Knik Tribe

Pacific lamprey are an ecologically and culturally significant species in Alaska, but little is known about their distribution and abundance. Traditional Ecological Knowledge (TEK) has indicated a decrease in abundance of lamprey in waters of Southcentral Alaska, impacting traditional uses of the species. The purpose of this project seeks to integrate indigenous and local knowledge with scientific data to better understand pacific lamprey distribution in the Cook Inlet watershed. We are conducting interviews with tribal members, sportfishermen, fishing guides and other community members to document possible lamprey habitat and guide areas for specific sampling. Over two to three field seasons, we are conducting fish surveys using electrofishing and environmental DNA (eDNA) collection in waterways throughout southcentral Alaska. This approach blends TEK, local knowledge, and biological data to better inform future management and conservation practices of the pacific lamprey in Alaska.

REPRODUCTIVE BIOLOGY OF LETHENTERON SPP. IN ALASKAN RIVER DRAINAGES

Amber Perk, University of Alaska Fairbanks

Anadromous Arctic Lamprey (*Lethenteron camtschaticum*) and freshwater-resident Alaskan Brook Lamprey (*L. alaskense*) are paired species with differing life history strategies. Alaskan populations of lampreys remain generally understudied. To increase our understanding of Alaskan lampreys, we characterized the reproductive condition and bioenergetic cost of the life-history strategies of Arctic and Alaskan Brook Lampreys in the Yukon and Susitna River drainages by examining size at maturity, fecundity, gonadosomatic index (GSI), hepatosomatic index (HSI), and proximate composition of lampreys at various stages during their spawning migration. A sample of 180 (74 female) lamprey from Emmonak (lower Yukon River) in September 2022, 103 (43 female) lamprey from Grayling (500 km upriver in Yukon River) in December 2022, and 52 (27 female) lamprey from Susitna River tributaries from June-August 2023 were collected for laboratory analyses. For Arctic Lamprey, moisture content declined in female gonads (62.0 to 57.7%) and increased in female muscle tissue (52.0 to 56.7%) and liver tissue (60.2 to 66.9%). For somatic indices of Arctic Lamprey, HSI declined in males (1.7 to 1.6%) and females (2.5 to 2.2%), while GSI increased in males (4.1 to 5.3%) and females (6.7 to 7.9%). For somatic indices of Alaskan Brook Lamprey, HSI declined in females (1.9 to 1.7%) and increased in males (1.6 to 1.7%), while GSI increased in males (2.8 to 3.4%). With these data, we examined the seasonal shifts in proximate composition following a juvenile stage of feeding versus non-feeding in migratory and resident lamprey, respectively. The current paucity of information on Alaskan lampreys obstructs our understanding of the species but the results of this study provide critical insights into the distinction between variants at the adult stage and reference values for parameters that could be useful for more effective fishery management and population monitoring.

DAY 2: RESTORATION & REINTRODUCTION

REINTRODUCTION OF PACIFIC LAMPREY TO UPPER WILLAMETTE TRIBUTARIES FOLLOWING DECADES OF HABITAT INACCESSIBILITY

Jon Hess, Columbia River Inter-Tribal Fish Commission

Pacific Lamprey (*Entosphenus tridentatus*), once numbered in the millions at Willamette Falls, but declined this past century due to many factors – including dams that blocked 2/3 of their upstream habitat. Hundreds of thousands of these lamprey were commercially harvested each year in the mid-1900s, but abundance has reached levels where even tribal subsistence harvest of a few hundred is challenging. As key contributors to aquatic ecosystem health—larvae serve as natural stream filters and adults return marine-derived nutrients to freshwater systems—lamprey loss has had cascading effects on biodiversity and water quality.

In 2025, Pacific Lamprey were reintroduced to five Willamette River tributaries blocked by major dams: Detroit (North Santiam), Green Peter (South Santiam), Cougar (McKenzie), Hills Creek (Middle Fork Willamette), and Fern Ridge (Upper Willamette). These dams were prioritized based on inter-agency technical discussions and were confirmed extirpated via eDNA. Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes and Bands of Warm Springs, Nez Perce Tribe, and the Columbia River Inter-Tribal Fish Commission, translocated 50 adult lamprey to each site. The primary goal was to reestablish larvae within their native range where they have been extirpated over 70 years, potentially yielding as many as 2.5 million offspring per site. Next steps for monitoring include eDNA water sampling to test whether habitat models predict where spawning actually occurred, and in future years we will test downstream passage success of larvae and juveniles and eventual return of adult offspring to Willamette Falls. However, monitoring infrastructure is currently lacking and will need to be addressed.

This tribal-led restoration was aided by logistical support and partnership from entities including Confederate Tribes of Grand Ronde and Confederated Tribes of Siletz Indians, USDA, USFWS, ODFW, Oregon Zoo, PGE, ACOE, McKenzie River Trust, and Boy Scouts of America. In parallel, a captive cohort of 25 adults housed at the Oregon Zoo will inform future strategies through survival comparisons of two treatments (overwintered versus direct release) via DNA fingerprinting. This project and the inter-agency collaborations provide a model to build upon for a comprehensive restoration of Pacific Lamprey in dam-fragmented river systems.

REINTRODUCING THE MILLER LAKE LAMPREY TO MILLER LAKE FOLLOWING EXTIRPATION

Benjamin Clemens, Oregon Dept. of Fish & Wildlife

Miller Lake is home to the Miller Lake Lamprey (*Entosphenus minimus*), a native species that occurs only in the upper Klamath Basin in Oregon. The smallest predatory species of lamprey in the world, Miller Lake Lamprey average 76 to 152 mm in body length. In the 1940s and 1950s, Miller Lake Lamprey were observed parasitizing introduced fishes. The Oregon Game Commission (Commission) was therefore concerned that Miller Lake Lamprey compromised trout fisheries in the lake. In 1949, the Commission installed log dams and screens on tributaries to Miller Lake to prevent Miller Lake Lamprey from spawning. In 1958 the Commission applied the chemical toxaphene to the lake and tributaries to eradicate this species. In 1959, the Commission constructed a barrier in Miller Creek approximately 0.8 km downstream of the lake outflow to prevent lamprey from moving back into the lake. Miller Lake Lamprey was believed to have been eradicated entirely until it was rediscovered in the Miller Creek, upper Williamson, and Sycan river drainages in the 1990s. From this point forward the Oregon Department of Fish and Wildlife focused on conservation of the Miller Lake Lamprey. In 2005, the Miller Lake Lamprey Conservation Plan was adopted, and the Miller Lake Lamprey Technical Management Team (TMT) removed the barrier in Miller Creek. Since 2010, the two primary goals of the TMT have been to reintroduce Miller Lake Lamprey back into Miller Lake and its tributaries, and to monitor the success of these reintroductions. Reintroductions have been successful, with evidence of persistence and successful reproduction, and as of 2021 – 2024, reports from anglers of lamprey wounds on and/or lamprey attached to introduced Brown Trout *Salmo trutta*. Thus, 62 years after the Miller Lake Lamprey was believed to have been extirpated from Miller Lake, it is now back in the lake and showing evidence of completing its life cycle in the upper Miller Lake Basin.

ALAKAZAM - BRINGING PACIFIC LAMPREY BACK TO THE TUCANNON RIVER WITH ARTIFICIALLY-PROPAGATED LARVAE

Zach Seilo, Confederated Tribes of the Umatilla Indian Reservation

The Confederated Tribes of the Umatilla Indian Reservation have implemented a reintroduction program for Pacific Lamprey (*Entosphenus tridentatus*) in the Columbia River Basin due to population declines throughout their historic range. Artificial propagation, a new frontier in restoration research for Pacific Lamprey, is one method that is supporting CTUIR reintroduction efforts.

In 2021 and 2022, twelve female and eighteen male lampreys were cross-fertilized in the lab. The resulting larval lampreys were reared to a minimum of 30 days post-fertilization. Approximately 800,000 artificially propagated larval lampreys were released into the Tucannon River in 2021 and 2022. Crosses were isolated into two release treatments (staggered release and direct release) that were released at two sites in the Tucannon River. Electro-fishing surveys were conducted at multiple index sites along the river to assess presence and distribution of larval lampreys. Genetic analysis was conducted on all sampled larvae to determine whether they were from artificial propagation efforts.

Larval lampreys (n=262) collected during electrofishing surveys in 2023, were submitted for genetic analysis. Four of the larval lampreys collected during surveys were not successfully genotyped. Larval lampreys were only found at four index sites (river kilometer 0, 10.1, 50.1, and 60.1). There were no artificially propagated larval lampreys identified at the lower river index sites (river kilometers 0 and 10.1). The two index sites in the upper Tucannon (river kilometers 50.1 and 60.1) were located near larval lamprey release locations. At river kilometer 50.1, 53% of the larvae collected were from artificial propagation, and at river kilometer 60.1, 96% of the larvae were from artificial propagation. Moreover, most of the fish were assigned to both parents, increasing the credibility of the assignment.

DEVELOPING METHODS TO OUTPLANT LARVAL PACIFIC LAMPREY IN THE TUCANNON RIVER

Mary Moser, Moserworks LLC

Starting in 2012, The Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) developed methods for artificial propagation of Pacific Lamprey (*Entosphenus tridentatus*) for research and restoration. One of the key objectives of this work was to successfully release artificially-propagated larvae into the Tucannon River following a regionally-established supplementation framework. Over the past five years we have focused on identification of release techniques that result in the greatest larval survival after outplanting. Two methods were used to assess survival: 1) observed presence of larvae during the first five days after outplanting in artificial redds, and 2) use of parentage analysis to identify survivors from specific outplanting treatments. All larvae outplanted were near first feeding (23 – 40 d post fertilization). Outplanting treatments included control and pre-acclimation in Tucannon River water, volitional (artificial redd) vs direct bucket dumps, and release in swift vs calm receiving waters. Survival during the first five days after outplanting in artificial redds was uniformly high (>90%), except in 2023 when high siltation and larval density resulted in complete mortality when water circulation ceased (day 3), resulting in hypoxia. Pre-acclimation in Tucannon River water did not convey any immediate survival advantage. Parentage analysis provided the first evidence that artificially-propagated larvae released from artificial redds and via less labor-intensive bucket dumps can continue surviving in nature for more than two years. This result is supported by increased occurrence in recent years of larvae and juveniles at a screw trap in the lower Tucannon River. Trapping and genetic monitoring will continue and the results will direct future Pacific Lamprey release methods in the Tucannon River and other receiving waters.

ROAD LAMPREY: GUIDELINES FOR TRAP & HAUL OF PACIFIC LAMPREY

Ann Gray, US Fish & Wildlife Service, Retired

Anadromous lampreys are of conservation concern worldwide. One of the primary sources of lost production is due to the inability of pre-spawning adult lamprey to get past man-made barriers (both physical and environmental). The use of methods to trap and haul adult lamprey past these obstacles, or to remove them from unsafe areas, is increasingly being used to reduce losses from these sources. However, it is critical to evaluate the costs of expensive trap and haul operations relative to fishway retrofits and other methods to increase volitional passage.

We reviewed methods developed over more than 25 years of Pacific Lamprey trap and haul operations in the Columbia River drainage. An even longer history of this technique has been employed by managers in the Laurentian Great Lakes to control invasive sea lamprey. While lampreys are generally resilient and can endure longer times out of water, greater temperature changes and more handling than finfish, there are methods specific to handling of lampreys that can reduce stress and promote fish health and ultimately, production.

DAY 2: OUTREACH (DISCUSSION)

PLCI OUTREACH INITIATIVES AND FUTURE DIRECTIONS

Sophia Troeh, US Fish & Wildlife Service

Lack of Awareness is a key range-wide threat identified by PLCI to successful Pacific Lamprey conservation, including in the Upper Columbia Regional Implementation Plan. Increased understanding of native lamprey ecology, cultural significance, declines, and recovery is vital to conservation success with both fisheries professionals and the general public. As the co-leads of the PLCI Outreach Subcommittee, we will present on lamprey outreach successes in 2025. These efforts include the development of a Pacific Lamprey exhibit at Leavenworth National Fish Hatchery, multiple lamprey outreach events, and the distribution of six outreach kits distributed in Oregon. By December, we will have statistics to share. We will also share about upcoming outreach opportunities and provide a platform for feedback from the larger PLCI group.

CHALLENGES TO IMPROVING THE SIGNAL WHILE REDUCING THE NOISE IN COMMUNICATING RECOMMENDATIONS IN LAMPREY MANAGEMENT

Benjamin Clemens, Oregon Dept. of Fish & Wildlife

The purpose of this talk is to spark conversation and deeper reflection among lamprey practitioners regarding information-sharing needs — specifically, the quantity, specificity, and delivery of information. A common theme among participants in the Pacific Lamprey Conservation Initiative is the desire for a more streamlined flow of information: fewer meetings and a manageable number of emails, yet simultaneously, more detailed and prescriptive guidance on implementing specific management practices.

These parallel desires — less communication but more and better information — highlight an inherent tension. How can we amplify the signal (i.e., useful, accurate, and digestible information targeted to the right audience) while minimizing the noise (i.e., excessive frequency, volume, and duration of communications)? This presents a classic “wicked problem”: a challenge without a straightforward solution.

Although information on lamprey biology and management is increasingly more accessible, research shows that attention spans are shrinking, and fewer people engage in deep, critical reading. The traditional educational model — “more is more” — often relied on information overload, or “information dumps,” which we now understand to be ineffective.

Therefore, communicating large volumes of information to broad audiences indiscriminately is neither strategic nor productive. Compounding the issue, many lamprey studies are location- and context-specific, reflecting unique climates, geologies, hydrologies, and lamprey ecotypes across ecoregions. Management practices effective in one watershed may not translate to others.

Ultimately, the “right-sized” amount of information for a given management issue is often elusive and not easily transferable across regions. In some cases, broadly disseminating generalized information may hinder — rather than help — the conservation and understanding of Pacific Lamprey.

DAY 2: STATUS & DISTRIBUTION

DISTRIBUTION OF LAMPREY SPECIES WITHIN THE SALMON RIVER WATERSHED, CALIFORNIA

Sam Stroich and Kim Deniz, Salmon River Restoration Council

This study helps define the distribution and species composition of lamprey species in the Salmon River of northern California. We surveyed the entire Salmon River and major tributaries for the presences of lamprey species from 2024 through 2025. We characterize the habitat where lamprey ammocoetes were found and describe abundance. The Salmon River is a wild, remote watershed of the mid-Klamath river watershed. It is surrounded by wilderness areas, has no dams or agriculture, and provides an excellent study area for natural processes affecting lamprey. Our study aims to identify the distribution limits of lamprey, and to identify species presence other than Pacific Lamprey. We used a lamprey specific electrofisher to survey for lamprey ammocoetes, and also collect tissue samples of ammocoetes for genetic analysis throughout the watershed, including major tributaries. We also measured and collected tissue samples from lamprey captured in 3 rotary screw traps in the watershed. Although indigenous traditional knowledge has much information on adult Pacific lamprey from fishing sites, our study is the first time distribution is documented throughout the watershed. In addition, although Pacific lamprey is well known from the Salmon River, our study attempts to shed light on what other species of lamprey may be present. This study is in direct collaboration with the Karuk Tribe Fisheries Department, and in coordination and support of the USFS (Klamath National Forest) and the CRITFC. Our study was funded by the PLCI and the USFWS.

EBLIMP MAKES ITS LANDING! UPDATED DISTRIBUTION MAPS AND OCCUPANCY MODELS FOR PACIFIC LAMPREY IN THE 21ST CENTURY

Kellie Carim, US Forest Service

Pacific lamprey were once abundant in Pacific Northwest streams. Like many anadromous species, they have declined over the last century in response to habitat loss and fragmentation throughout their historic range. In response, numerous Tribal, federal, and state and natural resource agencies have initiated conservation projects focused on improving habitat quality and access, as well as reintroductions in previously occupied habitat. Given the breadth of these activities, information on current distributions and suitability of current and future habitat is needed to help prioritize limited conservation resources and increase long-term conservation success. To address this need, we initiated the eDNA Basin-wide Lamprey Inventory and Monitoring Project (eBLIMP) to assess current distributions and develop habitat suitability models for Pacific lamprey throughout the Columbia River basin and coastal subbasins of Oregon and Washington. Over 2,700 unique locations were surveyed with support from over three dozen Tribes, natural resource agencies, local governments, and NGOs to determine current distributions of Pacific lamprey. Early results reveal the furthest inland occurrence of Pacific lamprey in the Salmon River, ID (Young et al. 2022), and increasingly vacant habitat in subbasins that are further inland. Development of updated habitat suitability models is underway. The models will test a series of hypotheses regarding the habitat conditions that affect lamprey occurrence and be used to derive regional estimates of historical, current, and potential future range extents. In this presentation, we will share the results and interpretations of these updated models. Maps showing the range extent of Pacific lamprey under various model scenarios will be formatted as ArcGIS shapefiles and made publicly available for use in prioritizing conservation efforts in the Pacific Northwest.

MODELING LAMPREY DISTRIBUTION USING FLOW, GEOMORPHOLOGY, AND ELEVATION IN A TERMINAL LAKE SYSTEM

Jacob Dickey, Oregon State University

Lampreys are an ecologically important group of fishes. Several species are imperiled and lack key distribution and habitat data. The terminal Goose Lake basin, United States, is home to two such species: the Goose Lake Lamprey *Entosphenus* sp. (formally undescribed) and the Pit-Klamath Brook Lamprey *E. lethophagus*. Species distribution models (SDMs) are useful for identifying key habitats; however, SDMs

are subject to accuracy impairments caused by scale mismatches and spatial autocorrelation, both of which are exacerbated by the hierarchical structure of dendritic stream networks. Our goal was to relate lamprey presence–absence to ecological drivers and predict the distribution of lampreys across the Goose Lake basin.

Using a data set pooling approach, we integrated count and presence–absence data from five surveys and relevant habitat variables from publicly available geospatial data sets to build logistic regression models. To account for potential mismatches of scale, we compared three sample grains for slope and sinuosity (i.e., stream segment lengths of 250, 500, and 1,000 m) and two scales of elevation (site and watershed). We accounted for spatial autocorrelation by incorporating network-based and Euclidean spatial dependencies using a spatial stream network modeling approach. Using the best-fit spatial and nonspatial models, we predicted basinwide lamprey distribution.

We found that flow, sinuosity at our largest sample grain (1,000 m), and watershed-scale elevation were positively associated with lamprey presence, whereas slope was negatively associated with lamprey presence. The nonspatial model predicted lamprey presence among sinuous, low-gradient streams, whereas the spatial model, which identified Euclidean and flow-connected spatial relationships, predicted contiguous patches with a high probability of occurrence near areas with previously observed presences.

Our study revealed ecological relationships and produced an accurate basin wide SDM. Prediction and inference improved after accounting for spatial relationships across multiple scales. Developing accurate and efficient modeling strategies that incorporate the hierarchical structure inherent to stream ecosystems aids in the management and conservation of native fishes such as lampreys.

DAY 2: GENETICS & CONTAMINANTS

ENVIRONMENTAL RNA (ERNA) DISTINGUISHES SEX AND MATURITY IN PACIFIC LAMPREY

Dan Bingham, Cramer Fish Sciences

Unlike environmental DNA (eDNA), which detects organisms at the species level, environmental RNA (eRNA) can detect organisms at the phenotypic level (e.g., sexually mature adults). We designed six qPCR assays to test whether we could detect eRNA from sexually mature male Pacific Lamprey to develop eRNA as a tool for inferring the presence of spawning adults in nature. We targeted genes expected to be upregulated in the gonad of sexually mature males and implemented a “common garden” experiment by placing lamprey of known sex and maturity into tanks of water and sampling for their eRNA. We verified gene expression in a subset of three genes (SPATTA22_1, CDH23_1, CYP17A) across three tissue types: gonad, gill, and liver. As expected, gene expression of all three genes in the gonads of sexually mature males was significantly higher (normalized mean RNA concentration [ng/uL] \pm 95% CI) than all other levels of maturity, life stage, and sex, with an increase ranging from 60 to 182-fold. We detected eRNA in all 15 tanks and from all genes, though not every gene was detected in each tank. A Bayesian model suggested that eRNA concentrations (ng/uL) produced by the SPATTA22_1 gene in tanks containing sexually mature males were associated with posterior gene expression rates ($h^{-1}/g^{-1}/mL^{-1}$), \bar{E} , that were on average 8.41 times higher than all other levels of sex, maturity, and life stage. However, the lower 98% confidence interval (mean \bar{E} = 4.97E-08; 98%CI: 1.43E-08, 1.48E-07) overlapped the upper limits of immature indeterminate larvae and immature adult mixtures (i.e., tanks possibly containing males and females). Notably, the model indicated that both the half-life of eRNA in tanks and the eRNA extraction efficiency were exceptionally low, with a half-life of 12 minutes (3.48 to 31.2 minutes) and a mean efficiency of 29% (SD=25%). To harness the power of eRNA, efforts should

focus on improving extraction efficiency and consider the inherent high degradation rate of RNA in the environment. Secondly, careful gene selection is paramount and should focus on genes expressed in tissues with significant environmental exposure and substantial upregulation.

AN INVESTIGATIVE STUDY INTO MICROPLASTIC ACCUMULATION & ITS CORRELATION WITH MERCURY LEVELS IN A CULTURALLY RELEVANT SPECIES OF THE COLUMBIA RIVER BASIN

Venecia Rollins, Oregon State University

The Pacific lamprey, *Entosphenus tridentatus*, is not classified as a commodity by industry standards. As a result, the health of these fish and those who consume them has often been overlooked. In September 2022, the Oregon Health Authority issued a consumption advisory for Pacific Lamprey due to elevated levels of mercury, polychlorinated biphenyls (PCBs), and dioxins. Given the affinity many pollutants tend to associate with plastics, understanding this interaction may be critical for maintaining ecological health, food safety, and human well-being. An ecologically vital species and a 'First Food' for numerous Tribes in the Pacific Northwest, Pacific Lamprey are essential to the region's ecosystem. Therefore, this study seeks to determine whether the presence of microplastics (MPs) within these fish correlates, corresponds, or contributes to changes in total and methyl-mercury levels. All lampreys examined were collected post-mortem from Bonneville Power Dam during the summer spawning seasons of 2021-2023. Through dissection, digestion, and micron-filtration of muscle tissue samples, followed by counting and FTIR analysis, the presence of MPs was detected. These findings were combined with separate analyses of total mercury and methylmercury performed on the same fish, provided by the Columbia River Inter-Tribal Fish Commission to the USGS. The goal of this research is to determine whether the presence of MPs in the edible tissue of these fish could influence the trophic transfer (biomagnification) of mercury. As this research is ongoing, results have not yet been finalized. We look forward to sharing our findings.

PER- AND POLYFLUOROALKYL SUBSTANCES IN PACIFIC LAMPREY (ENTOSPHEUS TRIDENTATUS) AND OTHER FISH SPECIES IN THE PACIFIC NORTHWEST

Elena Nilsen, US Geological Survey

This study investigated the presence and distribution of per- and polyfluoroalkyl substances (PFAS) in fish in the Pacific Northwest. Several PFAS bioaccumulate in aquatic organisms and fish, posing potential health threats to piscivorous wildlife and humans. Ocean-going parasitic life stage of Pacific lamprey (*Entosphenus tridentatus*) were collected along the Oregon and Washington coastline. Multiple fish species (4 total) including adult Chinook salmon (*Oncorhynchus tshawytscha*) were also collected from the Bonneville Pool on the Columbia River. Our objectives were to: 1) quantify the differences in PFAS composition different fish species, 2) contribute to a fish consumption health advisory based on the PFAS concentrations if warranted, and 3) evaluate potential risk to piscivorous wildlife using the US EPA's draft ambient water quality criteria.