Pacific Lamprey

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Contents

Abundance and Distribution

Anlauf-Dunn, K. J., B. J. Clemens, M. R. Falcy, and C. Zambory. 2024. Spatio-temporal distribution of adult Pacific lamprey *Entosphenus tridentatus* relative to habitat fragmentation. River Research and Applications 40(10):1940–1953. https://doi.org/10.1002/rra.4344

Uses counts of Pacific lamprey redds to model the probability of occurrence and abundance of Pacific lamprey based on environmental covariates including artificial barriers, assuming higher predicted lamprey redds translates to more suitable spawning habitats.

Beals, T., and R. Lampman. 2016. White Salmon subbasin larval lamprey distribution, occupancy, and index site monitoring report (2012-2015). Report to Bonneville

Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P149603

Reports on lamprey distribution and site occupancy throughout the White Salmon subbasin and establishes index site monitoring using data from repeat surveys.

Blanchard, M. R., J. E. Harris, J. Skalicky, G. S. Silver, and J. C. Jolley. 2023. Patterns in distribution and density of larval lampreys in the main-stem Columbia River, Washington–Oregon. North American Journal of Fisheries Management 43(6):1458–1474. https://doi.org/10.1002/nafm.10940

Analyzes data sets from multiple research efforts from 2010 to 2018 to describe patterns in the presence and density of larval lampreys in deep water habitats across 430 river kilometers of the lower and middle main-stem Columbia River.

Carim, K. J., J. C. Dysthe, M. K. Young, K. S. McKelvey, and M. K. Schwartz. 2017. A noninvasive tool to assess the distribution of Pacific Lamprey (*Entosphenus tridentatus*) in the Columbia River Basin. PLoS ONE 12(1):e0169334. https://doi.org/10.1371/journal.pone.0169334

Describes the development of an environmental DNA assay to detect Pacific lamprey in the Columbia River basin.

Clemens, B. J., and C. B. Schreck. 2021. Microhabitat use by pre-spawning Pacific Lamprey *Entosphenus tridentatus* in a large, regulated river differs by year, river segment, and availability. Environmental Biology of Fishes 104(3):325–340. https://doi.org/10.1007/s10641-021-01079-7

Utilizes boat surveys to track individuals and document their microhabitat use in the mainstem Willamette River.

Clemens, B. J., M. A. Weeber, M. Lewis, and M. Jones. 2021. Abundance trends for adult Pacific lamprey in western Oregon (USA): Historic declines, recent increases, and relative contributions from coastal rivers. Transactions of the American Fisheries Society 150(6):761-776. https://doi.org/10.1002/tafs.10326

Analyzes abundance trends of adult Pacific Lamprey using dam counts and redd surveys in western Oregon.

Confederated Tribes of the Warm Springs Reservation of Oregon. 2004-2005. Willamette Falls lamprey study. Report to Bonneville Power Administration, Project 20008-308-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=39847

Estimates Pacific lamprey abundance, escapement, and harvest at Willamette Falls.

Confederated Tribes of the Warm Springs Reservation, Oregon. 2008-2009. Determining adult Pacific lamprey abundance and spawning habitat in the lower Deschutes River sub-basin, Oregon. Report to Bonneville Power Administration, Project 2002-016-00, Portland, Oregon. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=40862

Reports on a mark-recapture study and a tribal creel survey to determine a Pacific lamprey escapement estimate for the Deschutes River.

Confederated Tribes and Bands of the Yakama Nation. 2009-2017. Klickitat subbasin larval lamprey monitoring report. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45043

Reports on Pacific lamprey and *Lampetra* spp. distribution and site occupancy in the Klickitat River subbasin.

Confederated Tribes and Bands of the Yakama Nation. 2009-2019. Distribution and occupancy of Pacific lamprey in nine major Columbia subbasins within the Yakama Nation ceded lands. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45023

Reports on Pacific Lamprey and *Lampetra* spp. distribution and site occupancy in the Rock, Wind, White Salmon, Klickitat, Yakima, Crab, Wenatchee, Entiat, and Methow river subbasins.

Confederated Tribes and Bands of the Yakama Nation. 2009-2019. Yakima subbasin lamprey monitoring report. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45044

Reports on Pacific lamprey and *Lampetra* spp. distribution and site occupancy in the Yakima River subbasin.

Confederated Tribes of the Warm Springs Reservation of Oregon. 2010-2020. Willamette Falls lamprey escapement estimate. Annual Report to Bonneville Power Administration, Project 2008-308-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45016

Provides escapement estimates for Pacific lamprey in Willamette Falls.

Confederated Tribes and Bands of the Yakama Nation. 2013-2019. Methow subbasin larval lamprey monitoring report. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45027

Reports on Pacific lamprey and *Lampetra* spp. distribution and site occupancy in the Methow River subbasin.

Confederated Tribes and Bands of the Yakama Nation. 2016-2017. Lower Yakima subbasin larval lamprey monitoring report. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45050

Reports on Pacific lamprey and *Lampetra* spp. distribution and site occupancy in the lower Yakima River subbasin.

Confederated Tribes and Bands of the Yakama Nation. 2016-2017. Naches subbasin larval lamprey monitoring report. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45051

Reports on Pacific lamprey and *Lampetra* spp. distribution and site occupancy in the Naches River subbasin.

Confederated Tribes and Bands of the Yakama Nation. 2016-2017. Upper Yakima Subbasin larval lamprey monitoring report. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45049

Reports on Pacific lamprey and *Lampetra* spp. distribution and site occupancy in the upper Yakima River subbasin.

Farlinger, S. P., and R. J. Beamish. 1984. Recent colonization of a major salmon-producing lake in British Columbia by Pacific Lamprey (*Lampetra tridentata*). Canadian Journal of Fisheries and Aquatic Sciences 41(2):278–285. https://doi.org/10.1139/f84-032

Discusses the colonization of Babine Lake, British Columbia by Pacific lamprey.

Harris, J. E., and J. C. Jolley. 2017. Estimation of occupancy, density, and abundance of larval lampreys in tributary river mouths upstream of dams on the Columbia River, Washington and Oregon. Canadian Journal of Fisheries and Aquatic Sciences 74(6):843–852. https://doi.org/10.1139/cjfas-2016-0212

Estimates occupancy, density, and abundance of larval Pacific lamprey and *Lampetra* spp. in tributary river mouths to impounded portions of the Columbia River.

Harris, J. E., G. S. Silver, J. C. Jolley, R. D. Nelle, and T. A. Whitesel. 2020. A stepwise approach to assess the occupancy state of larval lampreys in streams. Journal of Fish and Wildlife Management 11(1):226–237. https://doi.org/10.3996/112018-JFWM-107

Describes a stepwise approach that incorporates the potential for nondetection and a preselected expected maximum probability of stream occupancy if field crews do not document larval Pacific Lamprey during sampling.

Hayes, M. C., R. Hays, S. P. Rubin, D. M. Chase, M. Hallock, C. Cook-Tabor, C. W. Luzier, and M. L. Moser. 2013. Distribution of Pacific Lamprey *Entosphenus tridentatus* in watersheds of Puget Sound based on smolt monitoring data. Northwest Science 87(2):95–105. https://doi.org/10.3955/046.087.0202

Assesses the current distribution of Pacific lamprey in major watersheds flowing into Puget Sound, Washington.

Hess, J. E., R. L. Paradis, M. L. Moser, L. A. Weitkamp, T. A. Delomas, and S. R. Narum. 2021. Robust recolonization of Pacific lamprey following dam removals. Transactions of the American Fisheries Society 150(1):56-74. https://doi.org/10.1002/tafs.10273

Used genetic monitoring of Elwha River Pacific lamprey to determine the origins of Pacific lamprey larvae and juveniles collected in the Elwha River, determine whether the current N_b has reached levels observed in neighboring undammed basins, and determine the relative productivity of streams within the Elwha River basin.

Idaho Department of Fish and Game. 2000-2009. Evaluate status of Pacific lamprey in the Clearwater River and Salmon River drainages, Idaho. Annual Report to Bonneville Power Administration, Project 2000-028-00, Portland, Oregon. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=33964

Investigates the status of Pacific lamprey populations in Idaho's Clearwater and Salmon River drainages through trapping, electrofishing, and spawning ground redd surveys.

Idaho Department of Fish and Game. 2011. The status of Pacific lamprey (*Entosphenus tridentatus*) in Idaho. Idaho Department of Fish and Game, Boise. https://www.pacificlamprey.org/wp-content/uploads/2022/03/Pacific-Lamprey-Conservation-and-Management-Plan-for-Idaho.pdf

Summarizes the current available knowledge concerning the status of the Pacific lamprey in the state of Idaho.

Jolley, J. C., G. S. Silver, J. E. Harris, E. C. Butts, and C. Cook-Tabor. 2016. Occupancy and distribution of larval Pacific lamprey and *Lampetra* spp. in wadeable streams of the Pacific Northwest. U.S. Fish and Wildlife Service, Vancouver, Washington. https://purl.fdlp.gov/GPO/gpo172719

Utilizes an occupancy-based sampling approach to determine larval lamprey occurrence in several areas with different habiats.

Jolley J. C., G. S. Silver, J. E. Harris, and T. A. Whitesel. 2018. Pacific lamprey recolonization of a Pacific Northwest river following dam removal. River Research and Applications. 34(1): 44–51. https://doi.org/10.1002/rra.3221

Evaluates recolonization of Pacific lampreys into historically used freshwater habitats in the White Salmon River basin after removal of Condit Dam.

Jolley, J. C., G. S. Silver, and T. A. Whitesel. 2012. Occupancy and detection of larval Pacific lampreys and Lampetra spp. in a large river: the Lower Willamette River. Transactions of the American Fisheries Society 141(2):305-312. https://doi.org/10.1080/00028487.2012.662201

Employs a deepwater electrofisher to explore occupancy, detection, and habitat use of larval Pacific lampreys and larval *Lampetra* spp. in the lower Willamette River.

Jung, P. 2024. Description, comparison, and prediction of Pacific lamprey (*Entosphenus tridentatus*) and western brook lamprey (*Lampetra ayresii*) habitat in the southern Oregon coastal range. Master's Thesis. University of Oregon, Eugene. https://hdl.handle.net/1794/30050

Characterizes and compares Pacific lamprey and western brook lamprey habitats using presence/absence data produced by an eDNA sampling effort conducted by South Slough National Estuarine Research Reserve.

Lampman, R., and D. Lumley. 2020. Using environmental DNA to detect and assess Pacific lamprey (*Entosphenus tridentatus*) and *lampetra* species in the upper Columbia River and at two major hydroelectric dams in the lower/middle Columbia River in 2018. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P176743

Analyzes 31 samples of eDNA collected from 14 areas for the detection of Pacific Lamprey and *Lampetra* spp.

Lamprey Technical Workgroup. 2021. Overview of eDNA and applications for lamprey research and monitoring. https://www.pacificlamprey.org/wp-content/uploads/2022/02/Overview_of_eDNA_Applications_for_Lampreys.pdf

Provides a reference for fisheries managers, biologists, and other stakeholders interested in learning more about eDNA and applying this technique to lamprey research and monitoring projects.

Larson, D. C., M. Helstab, M. F. Docker, B. Bangs, and B. J. Clemens. 2020. Landlocked Pacific Lamprey *Entosphenus tridentatus* in the Middle Fork Willamette River,

Oregon. Environmental Biology of Fishes 103(3):291–298. https://doi.org/10.1007/s10641-020-00958-9

Reports on evidence of landlocked Pacific lamprey surviving for over 40 years after the construction of two high-head flood control dams (Dexter and Lookout Point) in the Middle Fork Willamette River.

Lumley, D., T. Beals, and R. Lampman. 2020. Using environmental DNA to detect Pacific lamprey (*Entosphenus tridentatus*) within Yakama Nation ceded lands rivers and streams in 2018. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P176737

Utilized coarse-scale eDNA collection to determine the presence of Pacific lamprey in subbasins and fine-scale eDNA collection to gain an understanding of detection of larval Pacific lamprey in relationship to abundance.

Mayfield, M. P., L. D. Schultz, L. A. Wyss, B. J. Clemens, and C. B. Schreck. 2014. Spawning patterns of Pacific lamprey in tributaries to the Willamette River, Oregon. Transactions of the American Fisheries Society 143(6):1544–1554. https://doi.org/10.1080/00028487.2014.949013

Assesses temporal spawning trends, redd abundance, habitat use, and spatial patterns of spawning at multiple spatial scales for Pacific Lamprey in the Willamette River basin, Oregon.

Mayfield, M. P., L. D. Schultz, L. A. Wyss, M. E. Colvin, and C. B. Schreck. 2014. Using spatial resampling to assess redd count survey length requirements for Pacific lamprey. North American Journal of Fisheries Management, 34(5):923-931. https://doi.org/10.1080/02755947.2014.932867

Assesses the minimum spawning survey distance required to detect the presence of Pacific lamprey redds and obtains precise redd density estimates from these data.

Mueller, R. Larval lamprey assessment at the Roza Dam forebay and Yakima River Delta region, 2015. Report to Bonneville Power Administration, Project 2008-470-00, Portland, Oregon. https://www.cbfish.org/Document.mvc/Viewer/P154981

Reports on deep water larval lamprey surveys near the Roza Dam Diversion Fish Screening Facility and the Yakima River delta region to determine lamprey occurrence and provide a general assessment of substrate composition.

Orlov, A. M., V. F. Savinyh, and D. V. Pelenev. 2008. Features of the spatial distribution and size structure of the Pacific Lamprey *Lampetra tridentata* in the North Pacific. Russian Journal of Marine Biology 34(5):276–287. https://doi.org/10.1134/S1063074008050039

Presents results of long-term research on the spatial and vertical distribution of the Pacific lamprey in the North Pacific, and data on its size structure.

Ostberg C. O., D. M. Chase, M. C. Hayes, and J. J. Duda. 2018. Distribution and seasonal differences in Pacific lamprey and *Lampetra* spp. eDNA across 18 Puget Sound watersheds. PeerJ 6:e4496 https://doi.org/10.7717/peerj.4496

Uses two quantitative PCR-based, aquatic environmental DNA assays to characterize the spatial distribution of lamprey in 18 watersheds of Puget Sound, Washington.

Ostberg, C. O., D. M. Chase, M. S. Hoy, J. J. Duda, M. C. Hayes, J. C. Jolley, G. S. Silver, and C. Cook-Tabor. 2019. Evaluation of environmental DNA surveys for identifying occupancy and spatial distribution of Pacific Lamprey (E*ntosphenus tridentatus*) & *lampetra* spp. in a Washington Coast watershed. Environmental DNA 1(2):131–143. https://doi.org/10.1002/edn3.15

Uses eDNA and electrofishing to survey 10 sites in 3 tributaries of the Chehalis River, Washington, to infer distribution and occupancy of Pacific lamprey and *Lampetra* spp.

Reid, S. B. 2018. Distribution of Pacific lamprey in the Rogue River drainage of southern Oregon. Report to Applegate Partnership & Watershed Council and Rogue River Watershed Council. https://docs.cbfwl.org/StreamNet_References/ORsn53699.pdf

Establishes a basin-wide distribution for presence/absence of Pacific Lamprey in 3rd order and higher drainages tributary to the mainstem Rogue River and its principal tributaries.

Reid, S. B., and D. H. Goodman. 2015. Detectability of Pacific lamprey occupancy in western drainages: implications for distribution surveys. Transactions of the American Fisheries Society 144(2):315-322. https://doi.org/10.1080/00028487.2014.991448

Evaluates detection and occupancy probabilities for Pacific lamprey over a broad region encompassing a wide range of landscapes and drainage sizes.

Romer, J. D., B. J. Clemens, J. S. Ziller, and E. Garner. 2024. Detection efficiency of adult Pacific lamprey passage counts at Leaburg Dam and upstream distribution in the McKenzie River (Oregon, USA). Ecology of Freshwater Fish 33(2):e12751. https://doi.org/10.1111/eff.12751

Evaluates the detection efficiency of a video monitoring system and upstream distribution of Pacific lamprey using video counts of lamprey, passive integrated transponder tags, and radio telemetry.

Sankovich, P. M., and T.A. Whitesel. 2022. Bull trout and Pacific lamprey occupancy in the Imnaha River subbasin: 2016 final report. U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, Washington. https://www.fws.gov/sites/default/files/documents/FY%2016%20annual%20report%20Imnaha%20occupancy%20.pdf

Describes eDNA collection at the mouths of the Imnaha River and Horse, Lightning, and Cow creeks to test for the presence of Pacific Lamprey eDNA.

Silver, G. S., J. C. Jolley, and T. A. Whitesel. 2014. Random, spatially-balanced subsample frameworks can be used to estimate Pacific lamprey *Entosphenus tridentatus* nest abundance. U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, Washington. https://www.cbfish.org/Document.mvc/Viewer/P139123

Evaluates the utility of a probabilistic survey design to estimate abundance of Pacific lamprey nests in Cedar Creek (Clark County, Washington) and compares it to census survey and index survey designs.

Siwicke, K. A., and A. C. Seitz. 2018. Spatial differences in the distributions of Arctic and Pacific lampreys in the eastern Bering Sea. Transactions of the American Fisheries Society 147(1):111–127. https://doi.org/10.1002/tafs.10018

Tests the hypothesis that distributions and catches of lampreys would be positively associated with those of their presumed hosts: Arctic Lampreys with small-bodied fishes, and Pacific lampreys with large-bodied fishes.

Skalicky, J. J., and T. A. Whitesel. 2020. Evaluation of larval Pacific lamprey occupancy of habitat restoration sites in the Portland Harbor Superfund area: 2019 annual report. U.S. Fish & Wildlife Service, Columbia River Fish & Wildlife Conservation Office, Vancouver, Washington. https://pub-data.diver.orr.noaa.gov/portland-harbor/20200609_LampreyMntrng_2019AnnualReportFinal_5127.pdf

Studies the occupancy of larval Pacific Lamprey and *Lampetra* spp. in habitats at five restoration sites being constructed to provide compensation for injuries to natural resources as part of the Portland Harbor Natural Resource Damage Assessment.

Torgersen, C. E., and D. A. Close. 2004. Influence of habitat heterogeneity on the distribution of larval Pacific lamprey (*Lampetra tridentata*) at two spatial scales. Freshwater Biology 49(5):614-630. https://doi.org/10.1111/j.1365-2427.2004.01215.x

Utilizes a nested sampling design and multiple logistic regression to evaluate spatial heterogeneity in the abundance of larval Pacific lamprey and habitat in 30 sites on the middle fork John Day River.

Weitkamp, L. A., S. A. Hinton, and P. J. Bentley. 2015. Seasonal abundance, size, and host selection of western river (*Lampetra ayresii*) and Pacific (*Entosphenus tridentatus*) lampreys in the Columbia River estuary. Fishery Bulletin 113(2):213-226. https://doi.org/10.7755/FB.113.2.9

Provides an analysis of anadromous western river and Pacific lampreys in the Columbia River estuary, using data from 2 fish assemblage studies that span 3 decades.

Young, M. K., D. J. Isaak, D. Nagel, D. L. Horan, K. J. Carim, T. W. Franklin, V. A. Zeller, B. Roper, and M. K. Schwartz. 2022. Broad-scale eDNA sampling for describing aquatic species distributions in running waters: Pacific lamprey *Entosphenus tridentatus* in the upper Snake River, USA. Journal of Fish Biology, 101(5):1312–1325. https://doi.org/10.1111/jfb.15202

Utilizes a model-driven spatial sampling template and an eDNA-based sampling campaign to establish a benchmark for understanding the current range of Pacific lamprey across a large portion of its range in the interior Columbia River basin.

Aquaculture

Barron, J. M., K. C. Hanson, R. R. Headley, K. A. Hawke, R. G. Twibell, and A. L. Gannam. 2020. Evaluation of effluent waste water from salmonid culture as a potential food and water supply for culturing larval Pacific lamprey *Entosphenus tridentatus*. Aquaculture 517:734791. https://doi.org/10.1016/j.aquaculture.2019.734791.

Investigates the effects of rearing in effluent water from salmonid culture on the growth, survival, proximate composition, and fatty acid profile of larval lamprey.

Barron, J. M., R. G. Twibell, H. A. Hill, K. C. Hanson, and A. L. Gannam. 2016. Development of diets for the intensive culture of Pacific lamprey. Aquaculture Research 47:3899-3906. https://doi.org/10.1111/are.12840

Tests the effects of seven diet treatments on the survival, growth, fatty acid profile and whole body lipid content of Pacific lamprey ammocoetes.

Evans, T. M., and R. T. Lampman. 2019. Comparison of stable isotope ratios in larval Pacific lamprey tissues and their nutritional sources when reared on a mixed diet. Aquaculture 503:499-507. https://doi.org/10.1016/j.aquaculture.2019.01.012

Investigates which food sources supported Pacific lamprey ammocoetes when reared on a mixed diet and how different tissue stable isotope signatures relate to muscle tissue.

Frick, K., M. L. Moser, T. Liedtke, L. Weiland, A. N. Maine, and A. D. Jackson. 2025. Performance comparisons for artificially propagated and wild Pacific lamprey juveniles and larvae. Aquaculture, Fish and Fisheries 5(3):e70070. https://doi.org/10.1002/aff2.70070

Compares artificially propagated and wild fish in laboratory tests under no-flow conditions to examine light avoidance, burrowing speed, burst swim speed, volitional routine swim speed and time to come to rest.

Jolley, J. C., C. T. Uh, G. S. Silver, and T. A. Whitesel. 2015. Feeding and growth of larval Pacific lamprey reared in captivity. North American Journal of Aquaculture 77(4):449-459. https://doi.org/10.1080/15222055.2015.1044630

Describes a series of experiments using captive larval Pacific to investigate the effect of different food types and different food concentrations on the growth of larvae.

Kalan, P., J. Steinbeck, F. Otte, S. C. Lema, and C. White. 2023. Filter-feeding Pacific lamprey (*Entosphenus tridentatus*) ammocetes can reduce suspended concentrations of E. Coli bacteria. Fishes 8(2):101. https://doi.org/10.3390/fishes8020101

Tests whether the presence of the filter-feeding larval ammocoete life-stage of Pacific lamprey (*Entosphenus tridentatus*) can reduce suspended concentrations of Escherichia coli bacteria.

Lampman, R. 2019. Development of artificial propagation methods for production of juvenile Pacific lamprey (*Entosphenus tridentatus*): for the use in research associated with section 4.2.3 of the Rocky Reach Pacific Lamprey Management Plan. https://www.cbfish.org/Document.mvc/Viewer/P176733

Evaluates the effect of feeding frequency, the effect of sediment depth and its relationship to larval density, and the effect of new additive/supplemental feeds on larval lamprey.

Liedtke, T., L. Weiland, M. Moser, K. Frick, R. Lampman, A. Jackson, A. Gannam, J. Baron, and B. Ekstrom. 2023. Influence of lamprey rearing type on measures of

performance. Report to Bonneville Power Administration, Project 2017-005-00. https://www.cbfish.org/Document.mvc/Viewer/P199260

Evaluates the swimming ability of artificially propagated and wild juvenile lamprey, and compares the performance of artificially propagated and wild larval lamprey by evaluating night activity levels, burrowing ability, and photokinetic response to tail illumination.

Maine, A. N., M. L. Moser, A. D. Jackson, and F. Wilhelm. 2023. Probiotics improve survival and growth of larval Pacific lamprey in laboratory culture. North American Journal of Fisheries Management 43(6):1648–1663. https://doi.org/10.1002/nafm.10923

Tests the hypothesis that the addition of a commercially available probiotic to the feed used in Pacific lamprey cultures would increase both the survival and the growth of first-feeding larvae.

McGree, M., T. A. Whitesel, and J. Stone. 2008. Larval metamorphosis of individual Pacific lampreys reared in captivity. Transactions of the American Fisheries Society 137(6):1866-1878. https://doi.org/10.1577/T07-206.1

Examines the process of metamorphosis in Pacific lampreys by following the development of individuals under controlled conditions.

Collection and Tagging

Beals, T., and R. Lampman. 2016. Entiat subbasin lamprey monitoring report, 2016. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P154964

Reports on electrofishing surveys for larval Pacific lamprey in the Entiat subbasin.

Beals, T., and R. Lampman. 2016. Lower Columbia tributary larval lamprey monitoring report, 2016. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P154966

Reports on electrofishing surveys for larval Pacific lamprey in the Rock, Wind, and White Salmon watersheds.

Beals, T., and R. Lampman. 2019. Summary of Yakama Nation Fisheries larval lamprey electrofishing surveys in the Wenatchee subbasin (2012-2018). Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P165206

Summarizes key information related to the distribution, occupancy and biological trends of larval Pacific lamprey within the Wenatchee Subbasin using survey data collected between 2012 and 2018.

Beals, T., R. Lampman, and T. Liedtke. 2019. Survival assessment of juvenile Pacific lamprey implanted with a dummy acoustic tag for a Yakima basin acoustic telemetry study. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P165204

Studies juvenile Pacific lamprey migration from the lower Yakima River to the lower Columbia River using lamprey tagged with a prototype acoustic transmitter.

Beals, T., D. Lumley, and R. Lampman. 2020. Summary assessment of juvenile/larval lamprey trapping and pit tagging in the Yakima basin, 2018-2019 water year. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P176731

Summarizes lamprey collection, PIT tagging, and migration monitoring in the Yakima River basin.

Close, D. A. 2001. Effects of acute stress and tagging on the swimming performance and physiology of Pacific lampreys (*Lampetra tridentata*). Master's Thesis. Oregon State University, Corvallis. http://hdl.handle.net/1957/32781

Assesses the stress placed on Pacific lamprey under various methods of tagging.

Close, D. A., M. S. Fitzpatrick, C. M. Lorion, H. W. Li, and C. B. Schreck. 2003. Effects of intraperitoneally implanted radio transmitters on the swimming performance and physiology of Pacific lamprey. North American Journal of Fisheries Management 23(4): 1184-1192. https://doi.org/10.1577/MO2-057

Assesses the swimming performance and physiological effects of surgical implantation of radio transmitters into the peritoneal cavities of Pacific lamprey.

Christiansen, H. E., L. P. Gee, and M. G. Mesa. 2013. Anesthesia of juvenile Pacific lampreys with MS-222, BENZOAK, AQUI-S 20E, and Aquacalm. North American Journal of Fisheries Management 33(2):269-276. https://doi.org/10.1080/02755947.2012.754807

Tests three concentrations each of four anesthetics - Finquel , BENZOAK , AQUI-S 20E, and Aquacalm - for efficacy and safety in metamorphosed, outmigrating juvenile Pacific lampreys.

Columbia River Basin Lamprey Technical Workgroup. 2011. Translocating adult Pacific lamprey within the Columbia River basin: state of the science. https://docs.cbfwl.org/StreamNet_References/sn53092.pdf

Provides a review of Pacific lamprey translocation programs in the Columbia River basin.

Confederated Tribes and Bands of the Yakama Nation. 2014-2017. Translocation of adult Pacific lamprey within the Yakima subbasin. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45052

Describes translocation and migration monitoring of Pacific lamprey in the Yakima River subbasin.

Dunham, J. B., N. D. Chelgren, M. P. Heck, and S. M. Clark. 2013. Comparison of electrofishing techniques to detect larval lampreys in wadeable streams in the Pacific Northwest. North American Journal of Fisheries Management 33(6):1149-1155. https://doi.org/10.1080/02755947.2013.826758

Compares capture of lampreys using electrofishing with standard settings for salmon and trout to settings specifically adapted for capture of lampreys.

Hanson, K. C., and J. M. Barron. 2017. Evaluation of the effects of marking Pacific lamprey ammocoetes with visual implant elastomer, coded wire tags, and passive integrated transponders. Transactions of the American Fisheries Society 146(4) 626-633. https://doi.org/10.1080/00028487.2017.1290681

Examines mortality and tag retention of Pacific lamprey marked with visible implant elastomer, coded wire tags, or passive integrated transponders.

Harris, J. E., T. L. Liedtke, J. J. Skalicky, and L. K. Weiland. 2023. Salvage using electrofishing methods caused minimal mortality of burrowed and emerged larval lampreys in dewatered habitats. North American Journal of Fisheries Management 43(6):1553–1566. https://doi.org/10.1002/nafm.10894

Estimates mortality of larval lampreys salvaged by electrofishing in wet and dry conditions during three dewatering events with different environmental conditions, and compares mortality of salvaged larval lampreys to mortality of burrowed and emerged larval lampreys.

Johnson, E. L., T. S. Clabough, M. L. Keefer, C. C. Caudill, P. N. Johnson, W. T. Nagy, and M. A. Jepson. 2012. Evaluation of dual frequency identification sonar (DIDSON) for monitoring Pacific lamprey passage behavior at fishways of Bonneville Dam, 2011. Report to U.S. Army Corps of Engineers, Portland, Oregon. https://usace.contentdm.oclc.org/digital/collection/p16021coll3/id/80

Evaluates using dual frequency identification sonar passively observing Pacific lamprey behavior and passage at fine scales.

Jolley, J. C., C. T. Uh, G. S. Silver, and T. A. Whitesel. 2017. Low mortality of larval lampreys from electrofishing, suction-pumping, anesthesia, and handling. Journal of Fish and Wildlife Management 8 (2):640–647. https://doi.org/10.3996/052017-JFWM-046

Monitors the survival of larval Pacific lamprey after backpack electrofishing, deepwater electrofishing and suction-pumping, anesthesia, and handling.

Kelley, K. L., T. J. Blubaugh, W. G. Simpson, and J. E. Harris. 2024. An evaluation of batch marking techniques for larval lampreys. U.S. Fish and Wildlife Service Columbia River Fish & Wildlife Conservation Office, Vancouver, Washington. https://www.fws.gov/sites/default/files/documents/Kelly_2024_Batch%20Marking%20TechniquesProgressReportLampreyMark_Final.pdf

Investigates several simple batch marking techniques to assess mortality and effectiveness for larval lampreys.

Lampman, R. 2017. Translocation of adult Pacific lamprey within the Methow subbasin, 2015-2016 broodstock. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P154975

Reports on Pacific lamprey translocation and migration monitoring in the Methow River subbasin.

Lampman, R. 2018. Translocation of adult Pacific Lamprey within the upper Columbia, 2017-2018 broodstock. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P165203

Reports on Pacific lamprey translocation and migration monitoring in the upper Columbia River.

Liedtke, T. L., J. E. Harris, J. J. Skalicky, and L. K. Weiland. 2021. Evaluation of larval lamprey survival following salvage: a pilot study. Report to Bonneville Power Administration, Project 2017-005-00. https://www.cbfish.org/Document.mvc/Viewer/P196865

Assesses the efficacy of lamprey salvage efforts by evaluating the survival and performance of larval lamprey following various salvage techniques.

Litts, R., B. J. Clemens, G. Vonderohe, and J. Schaefer. 2023. Backpack electrofishing can be used to collect adult lamprey. North American Journal of Fisheries Management 43(6), 1623–1630. https://doi.org/10.1002/nafm.10900

Describes a new method for collecting adult Pacific lamprey in wadeable streams using a backpack electrofisher.

Lumley, D., and R. Lampman. 2020. Yakama Nation Pacific Lamprey Project adult Pacific lamprey (*Entosphenus tridentatus*) collection in the lower Columbia River, 2019. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P176736

Summarizes adult Pacific Lamprey trapping and transporting from Bonneville, The Dalles, and John Day dams.

Meeuwig, M. H., A. L. Puls, and J. M. Bayer. 2007. Survival and tag retention of Pacific lamprey larvae and macrophthalmia marked with coded wire tags. North American Journal of Fisheries Management 27(1):96-102. https://doi.org/10.1577/M06-074.1

Examines the survival, tag retention, and growth of Pacific lamprey larvae and macrophthalmia marked with standard-length decimal coded wire tags and exposed to two levels of handling stress.

Mesa, M. G., J. M. Bayer, and J. G. Seelye. 2003. Swimming performance and physiological responses to exhaustive exercise in radio-tagged and untagged Pacific lampreys. Transactions of the American Fisheries Society 132(3):483-492. https://doi.org/10.1577/1548-8659(2003)132<0483:SPAPRT>2.0.CO;2

Estimates the critical swimming speed (U_{crit}) and documented physiological responses of radio-tagged and untagged adult lampreys exercised to exhaustion.

Mesa, M. G., E. S. Copeland, H. E. Christiansen, J. L. Gregg, S. R. Roon, and P. K. Hershberger. 2012. Survival and growth of juvenile Pacific lampreys tagged with passive integrated transponders (PIT) in freshwater and seawater. Transactions of the American Fisheries Society 141(5):1260-1268. https://doi.org/10.1080/00028487.2012.686951

Examines a novel technique for tagging juvenile Pacific lampreys with passive integrated transponder tags.

Mesa, M. G., R. J. Magie, E. S. Copeland, and H. E. Christiansen. 2011. Surgical wound healing in radio-tagged adult Pacific lamprey *Entosphenus tridentatus* held on different substrata. Journal of Fish Biology, 79(4):1068-1075. https://doi.org/10.1111/j.1095-8649.2011.03071.x

Examines healing and mortality of radio-tagged Pacific lamprey held in different holding structures post-surgery.

Moser, M. L., A. D. Jackson, R. P. Mueller, A. N. Maine, and M. Davisson. 2017. Effects of passive integrated transponder (PIT) implantation on Pacific lamprey ammocoetes. Animal Biotelemetry 5:1. https://doi.org/10.1186/s40317-016-0118-3

Examines survival, tag retention, growth, and swimming performance of Pacific lamprey ammocoetes tagged with uniquely coded 8.4-mm PIT tags and controls marked with visible implant elastomer.

Moser, M. L., A. D. Jackson, T. Tsuzaki, and P. S. Kemp. 2012. Do surgically implanted radio transmitters alter the climbing ability of adult Pacific lamprey, *Lampetra tridentata*?

Fisheries Management and Ecology 20(4):374–376. https://doi.org/10.1111/fme.12020

Assesses how radio transmitters affect the climbing ability of Pacific lamprey.

Moser, M. L., D. A. Ogden, and B. P. Sandford. 2007. Effects of surgically implanted transmitters on anguilliform fishes: lessons from lamprey. Journal of Fish Biology 71(6): 1847-1852. https://doi.org/10.1111/j.1095-8649.2007.01628.x

Examines passage success of adult Pacific lamprey at a large, hydropower dam and finds a negative correlation with the size of surgically implanted transmitters.

Mueller, R., S. Liss, and Z. D. Deng, Z. D. 2019. Implantation of a new micro acoustic tag in juvenile Pacific lamprey and American eel. Journal of Visual Experiments. 145:e59274. https://doi.org/10.3791/59274

Describes the procedure for implanting a micro acoustic tag in juvenile Pacific lamprey and American eel.

Mueller, R. P., R. A. Moursund, and M. D. Bleich. 2006. Tagging juvenile Pacific lamprey with passive integrated transponders: methodology, short-term mortality, and influence on swimming performance. North American Journal of Fisheries Management 26(2):361-366. https://doi.org/10.1577/M05-017.1

Examines the feasibility of tagging juvenile Pacific lampreys with passive integrated transponder tags and investigates any associated impacts on survivorship and swimming ability.

Silver, G. S., C. W. Luzier, and T. A. Whitesel. 2009. Detection and longevity of uncured and cured visible implant elastomer tags in larval Pacific lampreys. North American Journal of Fisheries Management 29(5):1496-1501. https://doi.org/10.1577/M08-199.1

Evaluates the performance of visible implant elastomer tags in larval Pacific lampreys, specifically testing the effects of elastomer and inspection light source on tag detection in 40 larvae.

Stone, J., M. McGree, and T. A. Whitesel. 2006. Detection of uncured visible implant elastomer tags in larval Pacific lampreys. North American Journal of Fisheries Management 26(1):142-146. https://doi.org/10.1577/M05-046.1

Evaluates the performance of uncured visible implant elastomer tags on ammocoetes of Pacific lampreys to determine tag detection and the influences of color and tag position on detection.

Conservation and Restoration

Arakawa H., and R. T. Lampman. 2020. An experimental study to evaluate predation threats on two native larval lampreys in the Columbia River Basin, USA. Ecology of Freshwater Fish 29(4):611–622. https://doi.org/10.1111/eff.12537

Reports on experimental predation studies conducted to evaluate and compare the predation threats of 10 species of native and non-native fishes on larvae of Pacific Lamprey and Western Brook Lamprey.

Beamish, R. J., and T. G. Northcote. 1989. Extinction of a population of anadromous parasitic lamprey, *Lampetra tridentata*, upstream of an impassable dam. Canadian Journal of Fisheries and Aquatic Sciences 46(3):420–425. https://doi.org/10.1139/f89-056

Reports on Pacific lamprey being unable to colonize a lake formed by the construction of a dam.

Clemens, B. J. 2022. Warmwater temperatures (≥ 20°C) as a threat to Pacific lamprey: Implications of climate change. Journal of Fish and Wildlife Management 13(2):591–598. https://doi.org/10.3996/JFWM-21-087

Provides information supporting the hypothesis that rivers with warm water temperatures and low river flows may select against Pacific lamprey migrating and spawning in the upper reaches of some watersheds.

Clemens, B., K. Anlauf-Dunn, M. Weeber, and T. Stahl. 2020. Coastal, Columbia, and Snake conservation plan for lampreys in Oregon. Oregon Department of Fish and Wildlife. https://docs.cbfwl.org/biblio40004.pdf

Identifies management strategies to address factors limiting lampreys, and research, monitoring, and evaluation needed to fill data gaps and inform future status assessments for them.

Clemens, B. J., R. J. Beamish, K. C. Coates, M. F. Docker, J. B. Dunham, A. E. Gray, J. E. Hess, J. C. Jolley, R. T. Lampman, B. J. McIlraith, M. L. Moser, J. G. Murauskas, D. L. Noakes, H. A. Schaller, C. B. Schreck, S. J. Starcevich, B. Streif, S. J. Wetering, J. Wade, L. A. Weitkamp, and L. A. Wyss. 2017. Conservation challenges and research needs for Pacific lamprey in the Columbia River Basin. Fisheries 42(5):268–280. https://doi.org/10.1080/03632415.2017.1305857

Discusses research needs for Pacific lamprey conservation, including range-wide trends in status, population dynamics, population delineation, limiting factors, and marine influences.

Clemens, B. J., T. R. Binder, M. F. Docker, M. L. Moser, and S. A. Sower. 2010. Similarities, differences, and unknowns in biology and management of three parasitic lampreys of North America. Fisheries 35(12):580–594. https://doi.org/10.1577/1548-8446-35.12.580

Identifies areas in which key information is missing for the juvenile phase and adult freshwater spawning migrations, and compares and contrasts information for sea and Pacific lampreys.

Clemens, B. J., and C. J. Wang. 2021. Dispelling misperceptions of native lampreys (*Entosphenus* and *Lampetra* spp.) in the Pacific Northwest (USA). Conservation Science and Practice 3(6):e402. https://doi.org/10.1111/csp2.402

Recommends a multi-pronged approach to dispel the misperceptions of native lampreys.

Clemens, B. J., T. A. Friesen, S. V. Gregory, and C. L. Zambory. 2023. The case for basinwide passage and habitat restoration for Pacific lamprey in the Willamette

River basin (Oregon, USA). North American Journal of Fisheries Management 43(6):1567-1583. https://doi.org/10.1002/nafm.10891

Provides an up-to-date history of lamprey harvest and management at Willamette Falls, recommends addressing the lack of basinwide, lamprey-specific passage and habitat restoration to improve the quantity and quality of lamprey spawning and rearing habitats, and identifies research needs for monitoring the population(s) of lamprey at Willamette Falls.

Close, D. A, K. P. Currens, A. Jackson, A. J. Wildbill, J. Hansen, P. Bronson, and K. Aronsuu. 2009. Lessons from the reintroduction of a noncharismatic, migratory fish: Pacific lamprey in the upper Umatilla River, Oregon. Pages 233-253 *in* L. Brown, S. Chase, M. Mesa, R. Beamish, and P. Moyle, editors. Biology, management, and conservation of lampreys in North America. American Fisheries Society Symposium 72, Bethesda, Maryland. https://doi.org/10.47886/9781934874134.ch14

Reports on the spawning success, growth, and abundance of reintroduced Pacific lamprey in the Umatilla River.

Close, D. A., M. S. Fitzpatrick, and H. W. Li. 2011. The ecological and cultural importance of a species at risk of extinction, Pacific lamprey. Fisheries 27(7):19-25. https://doi.org/10.1577/1548-8446(2002)027%3C0019:TEACIO%3E2.0.CO;2

Assesses the cultural and ecological value of Pacific lamprey, suggests they play an important role in the food web and that cultural biases affect management policies.

Columbia River Inter-Tribal Fish Commission. 2011. Tribal Pacific lamprey restoration plan for the Columbia River basin. Columbia River Inter-Tribal Fish Commission, Portland, Oregon. https://critfc.org/wp-content/uploads/2012/12/lamprey_plan.pdf

Presents a plan to halt Pacific lamprey population declines, reestablish them as a fundamental component of the ecosystem and restore them to sustainable, harvestable levels throughout the historical range and in all tribal usual and accustomed areas.

Columbia River Inter-Tribal Fish Commission. 2025. 2025 Tribal Pacific lamprey Restoration plan for the Columbia River basin: policy document. Columbia River

Inter-Tribal Fish Commission, Portland, Oregon. https://docs.cbfwl.org/biblio38415_2025P.pdf

Provides an update of vision, goals, and objectives for lamprey restoration based on the 2011 Restoration Plan.

Columbia River Inter-Tribal Fish Commission. 2025. 2025 Tribal Pacific lamprey Restoration plan for the Columbia River basin: technical document. Columbia River Inter-Tribal Fish Commission, Portland, Oregon. https://docs.cbfwl.org/biblio38415_2025T.pdf

Highlights progress and shortcomings in Pacific lamprey restoration since the 2011 Restoration Plan was implemented.

Columbia River Inter-Tribal Fish Commission, Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, and Nez Perce Tribe. 2016-2018. Master plan: Pacific lamprey artificial propagation, translocation, restoration, and research. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45029

Describes plans for Pacific lamprey artificial propagation, translocation, restoration, and research designed to make progress towards supplementation and aquaculture research goals and biological objectives.

Confederated Tribes of the Umatilla Indian Reservation, Columbia River Inter-Tribal Fish Commission, and Oregon Cooperative Fishery Research Unit. 1996-2019. Pacific lamprey research and restoration. Annual Report to Bonneville Power Administration, Project 1994-026-00, Portland, Oregon. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=40800

Summarizes Pacific lamprey restoration efforts including reintroduction, genetic assessment, abundance estimates, and impacts of dams and other barriers.

Lamprey Technical Workgroup. 2021. Monitoring and minimizing effects of dredging on lampreys. https://www.pacificlamprey.org/wp-content/uploads/2022/02/Dredging_-and_Lampreys_03.19.21.pdf

Summarizes the effects of human-caused substrate disturbances on juvenile lampreys, provides best management guidelines to protect them from human-caused substrate disturbances, and describes research and data needs.

Liedtke, T. L., J. E. Harris, C. J. Wang, and T. M. Sutton. 2023. Bringing partners together: A symposium on native lampreys and the Pacific Lamprey Conservation Initiative. North American Journal of Fisheries Management 43(6)1449–1457. https://doi.org/10.1002/nafm.10970

Reports on a symposium at the 2022 American Fisheries Society meeting that highlighted collaborations among biologists, policymakers, and Native American tribes addressing conservation for native lampreys.

McIlraith, B., A. Jackson, G. James, C. Baker, R. Lampman, and B. Rose. 2017. Synthesis of threats, critical uncertainties, and limiting factors in relation to past, present, and future priority restoration actions for Pacific lamprey in the Columbia River basin. https://www.critfc.org/wp-content/uploads/2018/04/Synth-Threats-LAMPREY-ISAB-response-2017.pdf

Provides a summary of documents and review of research of Pacific lamprey in the Columbia River basin.

Moser, M. L., and D. A. Close. 2003. Assessing Pacific lamprey status in the Columbia River basin. Northwest Science 77(2):116-125. https://hdl.handle.net/2376/802

Offers a comparison of adult lamprey counts at hydropower dams to recent radiotelemetry results and found that the counts underestimated losses between some dams and overestimated passage times through reservoirs.

Mueller, R. P., C. L. Rakowski, W. A. Perkins, and M. C. Richmond. 2014. Assessment of fluctuating reservoir elevations using hydraulic models and impacts on larval Pacific lamprey rearing habitat in the Bonneville Pool. Report to U.S. Army Corps of Engineers, Contract DE-AC05-76RL01830, Portland, Oregon. https://www.osti.gov/servlets/purl/1208782/

Presents the results of a modeling assessment of potential Pacific lamprey larval habitat that may be impacted by dewatering of the major tributary delta regions in the Bonneville pool of the Columbia River.

Petersen, R. S. 2006. The role of traditional ecological knowledge in understanding a species and river system at risk: Pacific lamprey in the Lower Klamath Basin. Master's Thesis. Oregon State University, Corvallis. http://hdl.handle.net/1957/8966

Compiles traditional ecological knowledge from the Karuk and Yurok tribal communities related to Pacific lamprey.

Sheoships, G. 2014. Pacific lamprey *Entosphenus tridentatus*: integrating traditional ecological knowledge and contemporary values into conservation planning, and stream substrate associations with larval abundance in the Willamette River Basin, Oregon, U.S.A. Master's Thesis. Oregon State University, Corvallis, Oregon. http://hdl.handle.net/1957/54846

Compiles traditional ecological knowledge and the cultural values of Pacific lamprey to provide guidance for future conservation planning and evaluates the fine scale habitat characteristics of larval Pacific lamprey.

U.S. Fish and Wildlife Service. 2011. Pacific lamprey (*Entosphenus tridentatus*) assessment and template for conservation measures. U S. Fish and Wildlife Service, Portland, Oregon. https://purl.fdlp.gov/GPO/gpo172916

Assesses risks to Pacific lamprey populations using a NatureServe ranking approach.

U.S. Fish and Wildlife Service. 2019. Pacific lamprey *Entosphenus tridentatus* assessment. https://purl.fdlp.gov/GPO/gpo173012

Presents a revision of the 2011 Pacific lamprey assessment.

Ward, D. L., B. J. Clemens, D. Clugston, A. D. Jackson, M. L. Moser, C. Peery, and D. P. Statler. 2012. Translocating adult Pacific lamprey within the Columbia River Basin: State of the science. Fisheries 37(8):351–361. https://doi.org/10.1080/03632415.2012.704818

Reports results from two current translocation programs for Pacific lamprey, provide context for use of translocation, and discusses potential benefits, risks, and uncertainties.

Wang, C., and H. Schaller, H. 2015. Conserving Pacific lamprey through collaborative efforts. Fisheries 40(2):72-79. https://doi.org/10.1080/03632415.2014.996871

Describes a Pacific lamprey conservation initiative composed of three parts: assessment, conservation agreement, and regional implementation plans.

Williams, S., C. Wang, B, McIlraith, J. Weybright, P. Monk, D. Statler, and T. Sween. 2019. Pacific Lamprey Conservation Initiative Columbia River basin projects. Annual Report to Bonneville Power Administration, Project 2017-005-00, Portland, Oregon. https://www.cbfish.org/Document.mvc/Viewer/P165844

Reports on three projects that address priority restoration in the Columbia and Snake River basins and reduce overall risk to lamprey populations.

Yakama Nation Fisheries. 2010-2021. Yakama Nation Pacific lamprey project. Annual Report to Bonneville Power Administration, Project 2008-470-00, Portland, Oregon. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45022

Reports on activities undertaken by the Yakama Nation Pacific Lamprey Project to conserve and restore Pacific lamprey.

Endocrinology and Physiology

Beamish, R. J. 1980. Adult biology of the river lamprey (*Lampetra ayresi*) and the Pacific Lamprey (*Lampetra tridentate*) from the Pacific coast of Canada. Canadian Journal of Fisheries and Aquatic Sciences 37(11):1906–1923. https://doi.org/10.1139/f80-232

Reports on the life cycles and biology of river lamprey and Pacific lamprey in Western Canada.

Clarke, W. C., and R. J. Beamish. 1988. Response of recently metamorphosed anadromous parasitic lamprey (*Lampetra tridentata*) to confinement in fresh water. Canadian Journal of Fisheries and Aquatic Sciences 45(1):42–47. https://doi.org/10.1139/f88-006

Assesses the ability of recently metamorphosed Pacific lamprey to survive in freshwater environments.

Clemens, B. J., S. A. Sower, S. van de Wetering, and C. B. Schreck. 2012. Incidence of male intersex in adult Pacific lamprey (*Entosphenus tridentatus*), with a brief discussion of intersex vs. Hermaphroditism in lampreys (*Petromyzontiformes*). Canadian Journal of Zoology 90(9):1201–1206. https://doi.org/10.1139/z2012-085

Reports the incidence of male intersex in adult Pacific lamprey during their pre-spawning migration in fresh water.

Clemens, B. J., S. van de Wetering, J. Kaufman, R. A. Holt, and C. B. Schreck. 2009. Do summer temperatures trigger spring maturation in Pacific lamprey, *Entosphenus tridentatus*? Ecology of Freshwater Fish 18(3):418–426. https://doi.org/10.1111/j.1600-0633.2009.00358.x

Compares fish reared in the laboratory at diel fluctuating temperatures of 20–24°C with fish reared at cooler temperatures (13.6°C).

Clemens, B. J., S. van de Wetering, S. A. Sower, and C. B. Schreck. 2013. Maturation characteristics and life-history strategies of the Pacific Lamprey, *Entosphenus tridentatus*. Canadian Journal of Zoology 91(11):775–788. https://doi.org/10.1139/cjz-2013-0114

Describes the maturation timing and associated characteristics of adult Pacific lamprey, and to test the null hypothesis that different life histories do not exist.

Clemens, B. J., L. Weitkamp, K. Siwicke, J. Wade, J. Harris, J. Hess, L. Porter, K. Parker, T. Sutton, and A. M. Orlov. 2019. Marine biology of the Pacific lamprey *Entosphenus tridentatus*. Reviews in Fish Biology and Fisheries 29(4):767–788. https://doi.org/10.1007/s11160-019-09578-8

Synthesizes the literature to identify patterns in the marine biology of Pacific lamprey, develops hypotheses to explain these patterns, and identifies limiting factors, threats, and research needs.

Colotelo, A. H., B. D. Pflugrath, R. S. Brown, C. J. Brauner, R. P. Mueller, T. J. Carlson, Z. D. Deng, M. L. Ahmann, and B. A. Trumbo. 2012. The effect of rapid and sustained decompression on barotrauma in juvenile brook lamprey and Pacific lamprey:

Implications for passage at hydroelectric facilities. Fisheries Research 129-130:17-20. https://doi.org/10.1016/j.fishres.2012.06.001

Analyzes how juvenile lamprey are affected by exposure to low pressures.

Falcon, J. 2021. Examination of exhaustion in larval Pacific lamprey (*Entosphenus tridentatus*) through variations of temperature, flow, and cover. Master's Thesis. Portland State University, Oregon. https://doi.org/10.15760/honors.1173

Observes how lamprey may become exhausted by analyzing the burrowing behavior of 63 larval Pacific lamprey after exposure to treatment combinations of temperature, flow, and burrowing ability.

Goodman, D. H., and S. B. Reid. 2022. Rapid development of larval Pacific lamprey *Entosphenus tridentatus* in southern populations provides adaptive benefits for uncertain flow regimes. Environmental Biology of Fishes 105(3):403–411. https://doi.org/10.1007/s10641-022-01236-6

Studies the development of anadromous Pacific lamprey from hatchling to transformation into macrophthalmia near the southern extent of their range, San Luis Obispo drainage, California.

Hayes, M. C., M. L. Moser, B. J. Burke, A. D. Jackson, and N. S. Johnson. 2022. Behavior of female adult Pacific lamprey exposed to natural and synthesized odors. Journal of Fish and Wildlife Management. 13 (1):94–105. https://doi.org/10.3996/JFWM-21-014

Conducts bioassays with Pacific Lamprey in a two-choice maze to evaluate the behavioral response of preovulatory adult females to introduced chemical cues and changes in flow.

Leis, E., M. Moser, A. Maine, A. Jackson, and S. Gee. 2024. Developing a cell line for Pacific lamprey disease research. Report to Bonneville Power Administration, Project 2017-005-00. https://www.cbfish.org/Document.mvc/Viewer/P205960

Describes attempts to produce a primary cell line for Pacific lamprey that can be used for viral assays and other disease research to identify pathogen risks.

Lemons, D. E., and L. I. Crawshaw. 1985. Responses to rapid temperature change in the Pacific lamprey (*Lampetra tridentata*). Canadian Journal of Zoology 63(5):1027–1032. https://doi.org/10.1139/z85-154

Studies aspects of the thermal biology of the Pacific lamprey by making rapid changes in the ambient water temperature.

Meeuwig, M. H., and J. M. Bayer. 2005. Morphology and aging precision of statoliths from larvae of Columbia River basin lampreys. North American Journal of Fisheries Management 25(1):38-48. https://doi.org/10.1577/M03-184.1

Examines the general morphology and precision associated with age determination of statoliths from larval Pacific lampreys and western brook lampreys found within the Columbia River basin.

Meeuwig, M. H., J. M. Bayer, and R. A. Reiche. 2006. Morphometric discrimination of early life stage *Lampetra tridentata* and *L. richardsoni* (Petromyzonidae) from the Columbia River Basin. Journal of Morphology 267(5):623–633. https://doi.org/10.1002/jmor.10427

Examines the effectiveness of morphometric and meristic characteristics for taxonomic discrimination of *Lampetra tridentata* and *L. richardsoni* (Petromyzonidae) during embryological, prolarval, and early larval stages.

Mesa, M. G., J. M. Bayer, and J. G. Seelye. 2003. Swimming performance and physiological responses to exhaustive exercise in radio-tagged and untagged Pacific lampreys. Transactions of the American Fisheries Society 132(3):483-492. https://doi.org/10.1577/1548-8659(2003)132<0483:SPAPRT>2.0.CO;2

Estimates the critical swimming speed (U_{crit}) and documented physiological responses of radio-tagged and untagged adult lampreys exercised to exhaustion.

Mesa, M. G., J. M. Bayer, M. B. Bryan, and S. A. Sower. 2010. Annual sex steroid and other physiological profiles of Pacific Lampreys (*Entosphenus tridentatus*). Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology 155(1):56–63. https://doi.org/10.1016/j.cbpa.2009.09.019

Documents changes in plasma levels of estradiol 17-β, progesterone, 15α-hydroxytestosterone, thyroxine, triiodothyronine, protein, triglycerides, and glucose in adult Pacific lampreys.

Moser, M., A. Maine, T. Shonat, and A. Jackson. 2023. Oxygen consumption of sexually mature adult, first-feeding larval, and yearling Pacific lampreys. North American Journal of Fisheries Management 43(6):1664–1672. https://doi.org/10.1002/nafm.10938

Studies the oxygen requirements of both sexually mature adults and larvae.

Nika, N., and T. Virbickas. 2010. Brown trout *Salmo trutta* redd superimposition by spawning *Lampetra* species in a lowland stream. Journal of Fish Biology 77(10):2358–2372. https://doi.org/10.1111/j.1095-8649.2010.02818.x

Studies reproductive interaction between sympatric Pacific lampreys and salmonids.

Nozaki, M., and A. Gorbman. 1984. Distribution of immunoreactive sites for several components of pro-opiocortin in the pituitary and brain of adult lampreys, Petromyzon Marinus and *Entosphenus tridentatus*. General and Comparative Endocrinology 53(3):335–352. https://doi.org/10.1016/0016-6480(84)90261-2

Studies the occurrence and localization of molecular components of pro-opiocortin in the pituitary and brain of two species of adult lamprey.

Pelekai, K. N. 2021. Evaluation of Pacific lamprey *Entosphenus tridentatus* anatomical structures as records of age and isotope histories. Master's Thesis. Oregon State University, Corvallis, Oregon. https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/b2774327w

Evaluates if two lamprey anatomical structures have potential for biological and ecological inference: the statolith and eye lens.

Pelekai, K. N., J. E. Hess, L. A. Weitkamp, R. T. Lampman, and J. A. Miller. 2023. Evaluation of Pacific Lamprey statoliths for age estimation across their life cycle. North American Journal of Fisheries Management 43(6):1610–1622. https://doi.org/10.1002/nafm.10920

Uses known-age hatchery and wild Pacific lamprey to evaluate the potential of statoliths to provide estimates of individual size and age throughout ontogeny.

Porter, L. L., P. F. Galbreath, B. J. McIlraith, and J. E. Hess. 2017. Sex ratio and maturation characteristics of adult Pacific lamprey at Willamette Falls, Oregon. Columbia River Inter-Tribal Fish Commission Technical Report 17-01, Portland, Oregon. https://docs.cbfwl.org/CRITFC/17-01.pdf

Examines sex ratio and maturation characteristics of in-migrating adult Pacific lamprey at Willamette Falls.

Rai, S., A. Szeitz, B. W. Roberts, Q. Christie, W. Didier, J. Eom, S.-S. Yun, and D. A. Close. 2015. A putative corticosteroid hormone in Pacific lamprey, *Entosphenus tridentatus*. General and Comparative Endocrinology 212:178-184. https://doi.org/10.1016/j.ygcen.2014.06.019

Demonstrates that 11-deoxycortisol, a steroid precursor to cortisol in the steroidogenic pathway, may be a functional corticosteroid in Pacific lamprey.

Richards, J. E., and F. W. Beamish. 1981. Initiation of feeding and salinity tolerance in the Pacific lamprey *Lampetra tridentata*. Marine Biology 63:73–77. https://doi.org/10.1007/BF00394664

Studies how changes in salinity tolerance are determined during metamorphosis in Pacific lamprey.

Robinson, T. C., P. W. Sorensen, J. M. Bayer, and J. G. Seelye. 2009. Olfactory sensitivity of Pacific lampreys to lamprey bile acids. Transactions of the American Fisheries Society 138(1):144-152. https://doi.org/10.1577/T07-233.1

Tests whether larval and adult lamprey bile acids serve as migratory and spawning pheromones in adult Pacific lampreys.

Simpson, W. G., T. J. Blubaugh, and T. A. Whitesel. 2025. Laboratory evaluation of potential climate change impacts on the larval metamorphosis of Pacific lamprey (*Entosphenus tridentatus*). Environmental Biology of Fishes 108:1401-1411. https://doi.org/10.1007/s10641-025-01732-5

Describes a laboratory study that compares the incidence of metamorphosis between larval Pacific lamprey reared at natural winter river temperatures and those reared at water temperatures prevented from falling below 9 °C over 2 years.

Smith, C. D., S. E. Payne, J. L. Morace, and E. B. Nilsen. 2023. Organohalogenated contaminants in multiple life stages of the Pacific Lamprey (*Entosphenus tridentatus*), Oregon, USA. Environmental Pollution 335:122363. https://doi.org/10.1016/j.envpol.2023.122363

Reports on analysis of tissue and sediment samples for 56 organohalogenated compounds to understand the impacts of these compounds on Pacific lamprey.

Tsuneki, K., and A. Gorbman. 1975. Ultrastructure of the anterior neurohypophysis and the pars distalis of the lamprey, *Lampetra tridentata*. General and Comparative Endocrinology 25(4):487–508. https://doi.org/10.1016/0016-6480(75)90160-4

Biological study of the anterior neurohypophysis and the pars distalis of Pacific lamprey.

Tsuneki, K., and A. Gorbman. 1975. Ultrastructure of pars nervosa and pars intermedia of the lamprey, Lampetra tridentata. Cell And Tissue Research 157:165–184 https://doi.org/10.1007/BF00222064

Biological study of the pars nervosa and pars intermedia of Pacific lamprey.

Van de Wetering, S. J. 1998. Aspects of life history characteristics and physiological processes in smolting Pacific lamprey, *Lampetra tridentata*, in a central Oregon coast stream. Master's Thesis. Oregon State University, Corvallis. http://hdl.handle.net/1957/15823

Utilizes rotary screw traps to estimate Pacific lamprey smolt yield, outmigration timing, age structure and sex ratio for Tenmile Creek basin, Lane County, Oregon.

Whitesel T. A., M. McGree, and G. S. Silver. 2020. Predicting larval metamorphosis of Pacific lamprey *Entosphenus tridentatus* through measurements of length and mass. Journal of Fish Biology. 97(3):804–816. https://doi.org/10.1111/jfb.14436

Evaluates the utility of length and mass measurements to predict the larval metamorphosis of Pacific lamprey.

Yamazaki, Y., N. Fukutomi, K. Takeda, and A. Iwata. 2003. Embryonic development of the Pacific Lamprey, *Entosphenus tridentatus*. Zoological Science 20(9):1095–1098.https://doi.org/10.2108/zsj.20.1095

Describes the embryonic development of Pacific lamprey.

Yun, S.-S., A. P. Scott, J. M. Bayer, J. G. Seelye, D. A. Close, and W. Li. 2003. HPLC and ELISA analyses of larval bile acids from Pacific and western brook lampreys. Steroids 68(6):515-523. https://doi.org/10.1016/S0039-128X(03)00088-6

Investigates bile acid production of Pacific and western brook lampreys.

Yun, S.-S., A. Szeitz, A. Wildbill, M. Siefkes, and D. Close. 2014. Sulfated bile acids as putative sex pheromone components in Pacific lamprey. Transactions of the American Fisheries Society 143(6):1455-1459. https://doi.org/10.1080/00028487.2014.946090

Examines whether mature Pacific lampreys use sulfated bile acid compounds for their reproductive function.

Yun, S.-S., A. J. Wildbill, M. J. Siefkes, M. L. Moser, A. H. Dittman, S. C. Corbett, W. Li, and D. A. Close. 2011. Identification of putative migratory pheromones from Pacific lamprey (*Lampetra tridentata*). Canadian Journal of Fisheries and Aquatic Sciences. 68(12):2194-2203. https://doi.org/10.1139/f2011-140

Describes the results from a series of experiments examining whether adult Pacific lamprey behavior is mediated by chemical cues from larval conspecifics and whether the Pacific lamprey olfactory system responds to putative bile acid chemical cues that were released by the larval Pacific lamprey.

Genetics

Arakawa, H., R. T. Lampman, and J. E. Hess. 2021. Whose kids did you eat? Genetic identification of species and parents of larval lampreys in fish predator guts.

Transactions of the American Fisheries Society 150(5):551-559. https://doi.org/10.1002/tafs.10307

Describes an experimental predation study and analysis of larval Pacific Lampreys in the gut contents of predators' digestive tracts via both morphological and molecular methods.

Clemens, B. J., L. Wyss, R. McCoun, I. Courter, L. Schwabe, C. Peery, C. B. Schreck, E. K. Spice, and M. F. Docker. 2017. Temporal genetic population structure and interannual variation in migration behavior of Pacific Lamprey *Entosphenus Tridentatus*. Hydrobiologia 794:223–240. https://doi.org/10.1007/s10750-017-3096-4

Tests whether adult Pacific lamprey show temporal genetic population structure and migrate different distances between years.

Docker, M. F., G. R. Haas, D. H. Goodman, S. B. REID, And D. D. Heath. 2006. PCR-RFLP markers detect 29 mitochondrial haplotypes in Pacific lamprey (*Entosphenus tridentatus*). Molecular Ecology Notes 7(2):350–353. https://doi.org/10.1111/j.1471-8286.2006.01605.x

Develops five polymerase chain reaction-based markers that detect variation in the mitochondrial genome of the Pacific lamprey across most of its range.

Docker, M. F., G. S. Silver, J. C. Jolley, and E. K. Spice. 2016. Simple genetic assay distinguishes lamprey genera *Entosphenus* and *Lampetra*: Comparison with existing genetic and morphological identification methods. North American Journal of Fisheries Management 36(4):780-787. https://doi.org/10.1080/02755947.2016.1167146

Describes a genetic assay using the Pacific lamprey microsatellite locus *Etr-1* to distinguish *Entosphenus* from *Lampetra*.

Goodman, D. H. 2006. Evidence for high levels of gene flow among populations of a widely distributed anadromous lamprey *Entosphenus tridentatus* (Petromyzontidae). Master's Thesis. Cal Poly Humboldt, Arcata, California. http://hdl.handle.net/2148/121

Assesses genetic population structure in *Entosphenus tridentatus* to evaluate whether this lamprey exhibits fidelity to natal streams or regions.

Goodman, D. H., S. B. Reid, M. F. Docker, G. R. Haas, and A. P. Kinziger. 2008. Mitochondrial DNA evidence for high levels of gene flow among populations of a widely distributed anadromous lamprey *Entosphenus tridentatus* (Petromyzontidae). Journal of Fish Biology 72(2):400-417. https://doi.org/10.1111/j.1095-8649.2007.01731.x

Surveys mitochondrial DNA variation among 1246 individuals of Pacific lamprey from 81 populations spanning from the Skeena River, British Columbia, to the Ventura River, California using five restriction enzymes.

Hess, J. E., N. R. Campbell, D. A. Close, M. F. Docker, and S. R. Narum. 2013. Population genomics of Pacific lamprey: adaptive variation in a highly dispersive species. Molecular Ecology 22(11):2898-2916. https://doi.org/10.1111/mec.12150

Uses restriction site–associated DNA sequencing to genotype 4439 quality filtered single nucleotide polymorphism loci for 518 individuals collected across a broad geographical area including British Columbia, Washington, Oregon and California.

Hess, J. E., N. R. Campbell, M. F. Docker, C. Baker, A. Jackson, R. Lampman, B. McIlraith, M. L. Moser, D. P. Statler, W. P. Young, A. J. Wildbill, and S. R. Narum. 2015. Use of genotyping by sequencing data to develop a high-throughput and multifunctional SNP panel for conservation applications in Pacific lamprey. Molecular Ecology Resources 15(1):187-202. https://doi.org/10.1111/1755-0998.12283

Describes the development of an optimal combination of 96 high-throughput SNP assays from a total of 4439 SNPs and the use of them to address parentage analysis, species identification and characterization of neutral and adaptive variation.

Hess, J. E., C. C. Caudill, M. L. Keefer, B. J. McIlraith, M. L. Moser, and S. R. Narum. 2014. Genes predict long distance migration and large body size in a migratory fish, Pacific lamprey. Evolutionary Applications 7(10):1192-1208. https://doi.org/10.1111/eva.12203

Tests for SNPs associated with migration distance, migration timing, and morphology using individual-based data gathered from Pacific lamprey captured at Bonneville Dam.

Hess, J. E., T. A. Delomas, A. D. Jackson, M. J. Kosinski, M. L. Moser, L. L. Porter, G. Silver, T. Sween, L. A. Weitkamp, and S. R. Narum. 2022. Pacific lamprey translocations to the Snake River boost abundance of all life stages. Transactions of the American Fisheries Society 151(3):263-296. https://doi.org/10.1002/tafs.10359

Describes parentage and sibship analyses with 260 single-nucleotide polymorphism loci to monitor productivity of translocated lamprey over a decade (2007–2018).

Hess J. E., J. J. Smith, N. Timoshevskaya, C Baker, C. C. Caudill, D. Graves, M. L. Keefer, A. P. Kinziger, M. L. Moser, L. L. Porter, G. Silver, S. L. Whitlock, and S. R. Narum. 2020. Genomic islands of divergence infer a phenotypic landscape in Pacific lamprey. Molecular Ecology 29(20):3841–3856. https://doi.org/10.1111/mec.15605

Addresses whether concentrated genomic architecture could influence local adaptation for Pacific lamprey.

Khan, A. 2017. Investigation of candidate sex determination and sex differentiation genes in sea lamprey, Petromyzon marinus, and Pacific lamprey, *Entosphenus tridentatus*. Master's Thesis. University of Manitoba, Winnipeg. http://hdl.handle.net/1993/32547

Tests whether 19 candidate sex determination genes identified from other vertebrates showed sex specific sequence differences in sea lamprey and Pacific lamprey.

Lin, B., Z. Zhang, Y. Wang, K. P. Currens, A. Spidle, Y. Yamazaki, and D. A. Close. 2008. Amplified fragment length polymorphism assessment of genetic diversity in Pacific lampreys. North American Journal of Fisheries Management 28(4):1182-1193. https://doi.org/10.1577/M07-035.1

Investigates the use of amplified fragment length polymorphisms to assess genetic population structure of Pacific lampreys.

Parker, K. A. 2018. Evidence for the genetic basis and inheritance of ocean and river-maturing ecotypes of Pacific lamprey (*Entosphenus tridentatus*) in the Klamath River, California. Master's Thesis. Cal Poly Humboldt, Arcata, California. https://digitalcommons.humboldt.edu/etd/179

Combines genetic sequencing with traditional ecological knowledge to evaluate imperiled anadromous Pacific lamprey and applies the findings to conservation in the context of resolving Native American traditional food security issues.

Parker K. A., J. E. Hess, S. R. Narum, and A. P. Kinziger. 2019. Evidence for the genetic basis and epistatic interactions underlying ocean- and river-maturing ecotypes of Pacific lamprey (*Entosphenus tridentatus*) returning to the Klamath River, California. Molecular Ecology 28(13):3171–3185. https://doi.org/10.1111/mec.15136

Investigates the genetic basis of the ocean- and river-maturing ecotypes in anadromous Pacific lamprey.

Spice, E.K., D. H. Goodman, S. B. Reid, and M. F. Docker. 2012, Neither philopatric nor panmictic: microsatellite and mtDNA evidence suggests lack of natal homing but limits to dispersal in Pacific lamprey. Molecular Ecology 21(12):2916-2930. https://doi.org/10.1111/j.1365-294X.2012.05585.x

Uses nine microsatellite loci to examine the population structure in 965 Pacific lamprey from 20 locations from central British Columbia to southern California and supplements this analysis with mitochondrial DNA restriction fragment length polymorphism analysis on a subset of 530 lamprey.

Taylor, E. B., L. N. Harris, E. K. Spice, and M. F. Docker. 2012. Microsatellite DNA analysis of parapatric lamprey (*Entosphenus* spp.) populations: Implications for evolution, taxonomy, and conservation of a Canadian endemic. Canadian Journal of Zoology 90(3):291–303. https://doi.org/10.1139/z11-135

Tests for genetic differentiation at microsatellite DNA loci between Vancouver Island lamprey and Pacific Lamprey.

Timoshevskiy, V. A., R. T. Lampman, J. E. Hess, L. L. Porter, and J. J. Smith. 2017. Deep ancestry of programmed genome rearrangement in lampreys. Developmental Biology 429(1):31–34. https://doi.org/10.1016/j.ydbio.2017.06.032

Develops probes that allow simultaneous tracking of nearly all sequences eliminated by programmed genome rearrangement in *P. marinus* and *Entosphenus tridentatus*.

Whitlock, S. L., L. D. Schultz, C. B. Schreck, and J. E. Hess. 2017. Using genetic pedigree reconstruction to estimate effective spawner abundance from redd surveys: An example involving Pacific lamprey (*Entosphenus tridentatus*). Canadian Journal of Fisheries and Aquatic Sciences 74(10):1646–1653. https://doi.org/10.1139/cjfas-2016-0154

Describes how genetic pedigree reconstruction can be used to estimate effective spawner abundance in a stream reach using Pacific lamprey.

Yamazaki, Y., N. Fukutomi, N. Oda, K. Shibukawa, Y. Niimura, and A. Iwata. 2005. Occurrence of larval Pacific lamprey *Entosphenus tridentatus* from Japan, detected by random amplified polymorphic DNA (RAPD) analysis. Ichthyological Research 52(3):297–301. https://doi.org/10.1007/s10228-005-0276-4

Reports on species identification of Pacific lamprey from other species of Japanese lampreys.

Migration and Passage

Ackerman, N. K., B. J. Pyper, M. M. David, G. J. Wyatt, D. P. Cramer, and T. M. Shibahara, 2019. Passage effectiveness at a pool-and-weir fishway designed to accommodate Pacific lampreys. North American Journal of Fisheries Management 39(3):426-440. https://doi.org/10.1002/nafm.10281

Evaluates the passage efficiency of Pacific lampreys through a new pool-and-weir fishway at River Mill Dam on the Clackamas River, Oregon, that was designed to facilitate Pacific Lamprey passage.

Bayer, J. M., T. C. Robinson, and J. G. Seelye. 2001. Upstream migration of Pacific lampreys in the John Day River: behavior, timing, and habitat use. Annual Report to Bonneville Power Administration, Project 2000-052, Portland, Oregon. https://docs.cbfwl.org/biblio44434.pdf

Assesses the logistics associated with conducting a radio telemetry study of Pacific lamprey in the John Day River and collect preliminary information on their migration behavior.

Beamish, R. J., and C. D. Levings. 1991. Abundance and freshwater migrations of the anadromous parasitic lamprey, *Lampetra tridentate*, in a tributary of the Fraser River, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 48(7):1250–1263. https://doi.org/10.1139/f91-151

Reports on the outmigration of Pacific lamprey out of the Nicola River during 1984-85 and 1987-1988.

Boggs, C., M. Keefer, C. Caudill, C. A. Peery, and M. Moser. 2009. Evaluation of adult Pacific lamprey migration and behavior at McNary and Ice Harbor dams, 2008. Report to U.S. Army Corps of Engineers, Walla Walla, Washington. https://web.archive.org/web/20200812082055/https://www.webpages.uidaho.edu/uiferl/pdf%20reports/Boggs%20et%20al%202009-5%20MN08%20Lamprey%20Report%20Final.pdf

Calculates passage efficiency and identifies areas of difficult passage for Pacific lamprey at McNary Dam.

Byford, G. J., C. M. Wagner, J. B. Hume, and M. L. Moser. 2016. Do native Pacific lamprey and invasive sea lamprey share an alarm cue? Implications for use of a natural repellent to guide imperiled Pacific lamprey into fishways. North American Journal of Fisheries Management 36(5):1090-1096. https://doi.org/10.1080/02755947.2016.1198286

Reports on an initial test of the hypothesis that the odor produced by dead Pacific lamprey contains one or more natural repulsive compounds that elicit the known alarm response in migratory sea lamprey.

Clabough, T. S., E. L. Johnson, M. L. Keefer, C. C. Caudill, C. J. Noyes, J. Garnett, L. Layng, T. Dick, M. A. Jepson, K. E. Frick, S. C. Corbett, and B. J. Burke. 2015. Evaluation of adult Pacific lamprey passage at lower Columbia River dams and behavior in relation to fishway modifications at Bonneville and John Day dams – 2014. Report to U.S. Army Corps of Engineers, Portland, Oregon. https://usace.contentdm.oclc.org/digital/collection/p16021coll3/id/638

Monitors the passage behavior of radio-tagged adult Pacific lamprey at Bonneville and John Day dams to evaluate the effectiveness of modifications made to improve their passage.

Clabough, T. S., M. L. Keefer, C. C. Caudill, E. L. Johnson, and C. A. Peery. 2012. Use of night video to enumerate adult Pacific lamprey passage at hydroelectric dams: challenges and opportunities to improve escapement estimates. North American Journal of Fisheries Management 32(4):687-695. https://doi.org/10.1080/02755947.2012.690820

Uses video to monitor nighttime lamprey passage in combination with daytime counts at two count stations at Bonneville Dam and two at The Dalles Dam to estimate lamprey escapement.

Clemens, B. J., M. G. Mesa, R. J. Magie, D. A. Young, and C. B. Schreck. 2011. Pre-spawning migration of adult Pacific lamprey, *Entosphenus tridentatus*, in the Willamette River, Oregon, U.S.A. Environmental Biology of Fishes 93(2):245–254. https://doi.org/10.1007/s10641-011-9910-3

Describes the migration distances and timing of adult Pacific lamprey in the Willamette River Basin.

Clemens, B. J., J. D. Romer, J. S. Ziller, and M. Jones. 2023. More flow in a regulated river correlates with more and earlier adult lamprey passage, but peak passage occurs at annual low flows. Ecology of Freshwater Fish 32(3):516–527. https://doi.org/10.1111/eff.12703

Describes the trends in lamprey dam counts during 2005–2020 at Leaburg Dam on the McKenzie River.

Courter, I., S. Duery, J. Vaughan, C. Peery, M. Morasch, R. McCoun, B. Clemens, and C. Schreck. 2012. Migration behavior and distribution of adult Pacific lamprey in the Willamette basin. Report to Columbia River Inter-Tribal Fish Commission, Portland, Oregon. https://www.cbfish.org/Document.mvc/Viewer/P126202

Studies migration behavior, distribution, and habitat use of adult Pacific lamprey in the upper Willamette basin.

Daigle, W. R., M. L. Keefer, C. A. Peery, and M. L. Moser. 2008. Evaluation of adult Pacific lamprey passage rates and survival through the lower Columbia River hydrosystem: 2005-2006 PIT-tag studies. Report to U.S. Army Corps of Engineers Portland and Walla Walla Offices. https://docs.cbfwl.org/biblio40525.pdf

Monitors the passage of Pacific lamprey tagged with half duplex passive integrated transponder tags passing at Bonneville, The Dalles, John Day, McNary, and Ice Harbor dams.

Daigle, W. R., C. A. Peery, S.R. Lee, and M. L. Moser. 2005. Evaluation of adult Pacific lamprey passage and behavior in an experimental fishway at Bonneville Dam. Report to U.S. Army Corps of Engineers and Bonneville Power Administration. https://usace.contentdm.oclc.org/digital/collection/p16021coll3/id/453/

Tests the behavior and swimming performance of Pacific lamprey passing through an experimental fishway.

Goodman, D. H., and S. B. Reid. 2017. Climbing above the competition: Innovative approaches and recommendations for improving Pacific Lamprey passage at fishways. Ecological Engineering 107:224-232. https://doi.org/10.1016/j.ecoleng.2017.07.041

Evaluates the behavior and capabilities of upstream migrating adult Pacific lamprey using a series of experimental trials in relation to existing and novel fishway designs using PIT tags.

Goodman, D. H., S. B. Reid, R. C. Reyes, B. J. Wu, and B. B. Bridges. 2017. Screen efficiency and implications for losses of lamprey macrophthalmia at California's largest water diversions. North American Journal of Fisheries Management 37(1): 30-40. https://doi.org/10.1080/02755947.2016.1235633

Investigates the guidance efficiency of fish screens for the protection of emigrating Pacific lamprey and Western river in a series of experimental trials.

Goodman, D. H., S. B. Reid, N. A. Som, and W. R. Poytress. 2015. The punctuated seaward migration of Pacific Lamprey (*Entosphenus tridentatus*): Environmental cues and implications for streamflow management. Canadian Journal of Fisheries and Aquatic Sciences 72(12):1817–1828. https://doi.org/10.1139/cjfas-2015-0063

Investigates emigration timing of juvenile Pacific lamprey over a 10-year period in the Sacramento River, California.

Hatch, D. R., and J. M. Whiteaker. 2009. A field study to investigate repeat homing in Pacific lampreys. Pages 191-201 *in* L. Brown, S. Chase, M. Mesa, R. Beamish, and P. Moyle, editors. Biology, management, and conservation of lampreys in North America. American Fisheries Society Symposium 72, Bethesda, Maryland. https://www.critfc.org/wp-content/uploads/2012/11/Hatch_AFSS_2009.pdf

Investigates in-season homing of Pacific lampreys in the lower Columbia River using radiotelemetry.

Jackson, A., and M. Moser. 2012. Low-elevation dams are impediments to adult Pacific lamprey spawning migration in the Umatilla River, Oregon. North American Journal of Fisheries Management 32(3):548-556. https://doi.org/10.1080/02755947.2012.675950

Studies whether low-elevation irrigation diversion dams in the main-stem Umatilla River are obstacles to adult lamprey spawning migration.

Johnson, E. L., C. C. Caudill, T. S. Clabough, M. L. Keefer, M. A. Jepson, and M. L. Moser. 2010. Effects of lowered fishway water velocity on fishway entrance success by adult Pacific lamprey at Bonneville Dam, 2007-2009. Report to U.S. Army Corps of Engineers, Portland, Oregon. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=b954e0bb668bd6b256b9b6ddfcb3ffa666b58ce7

Evaluates whether reduced water velocities at the Bonneville Dam Powerhouse 2 fishway openings improved entrance efficiencies and other passage performance metrics for radio-tagged adult lampreys compared to control water velocities.

Johnson, E. L., T. S. Clabough, M. L. Keefer, C. C. Caudill, C. A. Peery, and M. L. Moser. 2008-2009. Effects of lowered nighttime velocities on fishway entrance success by Pacific lamprey at Bonneville Dam and fishway use summaries for lamprey at Bonneville and The Dalles dams, 2008. Report to U.S. Army Corps of Engineers, Portland, Oregon. 2008 2009

Evaluates the effects of very low water velocities at fishway entrances on lamprey behavior and passage efficiency at Bonneville Dam and passage behaviors at Bonneville, The Dalles, and John Day dams.

Johnson, E. L., C. C. Caudill, M. L. Keefer, T. S. Clabough, C. A. Peery, M. A. Jepson, and M. L. Moser. 2012. Movement of radio-tagged adult Pacific lampreys during a large-scale fishway velocity experiment. Transactions of the American Fisheries Society 141(3):571-579. https://doi.org/10.1080/00028487.2012.683468

Tests whether reduced water velocities at Bonneville Dam fishway openings improved entrance efficiency and other passage metrics for radio-tagged Pacific lampreys compared with control velocities and near-zero velocities.

Keefer, M. L., C. T. Boggs, C. A. Peery, and C. C. Caudill. 2013. Factors affecting dam passage and upstream distribution of adult Pacific lamprey in the interior Columbia River basin. Ecology of Freshwater Fish 22(1):1-10. https://doi.org/10.1111/j.1600-0633.2012.00586.x

Utilizes radiotelemetry to evaluate potential predictors of lamprey passage success at McNary Dam.

Keefer, M. L., C. C. Caudill, T. S. Clabough, M. A. Jepson, E. L. Johnson, C. A. Peery, M. D. Higgs, and M. L. Moser. 2013. Fishway passage bottleneck identification and prioritization: a case study of Pacific lamprey at Bonneville Dam. Canadian Journal of Fisheries and Aquatic Sciences 70(10):1551–1565. https://doi.org/10.1139/cjfas-2013-0164

Uses migration histories from 2170 radio-tagged adult Pacific lamprey to identify locations of poor passage at Bonneville Dam.

Keefer, M. L., C. C. Caudill, E. L. Johnson, T. S. Clabough, C. T. Boggs, P. N. Johnson, and W. T. Nagy. 2017. Inter-observer bias in fish classification and enumeration using dual-frequency identification sonar (DIDSON): a Pacific lamprey case study. Northwest Science 91(1):41–53. https://doi.org/10.3955/046.091.0106

Assesses inter-observer differences in the identification and enumeration of adult Pacific lamprey imaged with Dual-frequency Identification Sonar passing a large dam fishway.

Keefer, M. L., C. C. Caudill, E. L. Johnson, T. S. Clabough, M. A. Jepson, and M. L. Moser. 2017-2011. Adult Pacific lamprey migration in the lower Columbia River: radiotelemetry and half duplex pit-tag studies. Report to U.S. Army Corps of Engineers. 2007 2010 2011

Monitors Pacific lamprey passage and migration behaviors at Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Lower Granite, and Priest Rapids dams.

Keefer, M. L., C. C. Caudill, and M. L. Moser. 2014. Fishway bottleneck relief models: a case study using radio-tagged Pacific lampreys. Transactions of the American Fisheries Society, 143(4):1049-1060. https://doi.org/10.1080/00028487.2014.911210

Describes a “bottleneck relief” model using Kaplan–Meier methods to help managers assess where remediation efforts are likely to provide the largest increases in fishway passage.

Keefer, M. L, T. C. Clabough, M. A. Jepson, E. L. Johnson, C. T. Boggs, and C. C. Caudill. 2012. Adult Pacific lamprey passage: data synthesis and fishway improvement prioritization tools. Final Report to U.S. Army Corps of Engineers, Contract W912EF-08-D-0007, Portland, Oregon. https://usace.contentdm.oclc.org/digital/collection/p16021coll3/id/100

Provides summary information on adult Pacific lamprey migration behavior and passage at dams in the Federal Columbia River Power System (FCRPS).

Keefer, M. L., W. R. Daigle, C. A. Peery, and M. L. Moser. 2008. Adult Pacific lamprey bypass structure development: tests in an experimental fishway, 2004-2006. Report to U.S. Army Corps of Engineers, Portland, Oregon. https://docs.cbfwl.org/biblio40527.pdf

Reports on a series of experiments conducted in an experimental fishway at Bonneville Dam in 2004–2006 to evaluate adult Pacific swimming performance and behaviors.

Keefer, M. L., W. R. Daigle, C. A. Peery, H. T. Pennington, S. R. Lee, and M. L. Moser. 2010. Testing adult pacific lamprey performance at structural challenges in fishways.

North American Journal of Fisheries Management 30(2):376–385. https://doi.org/10.1577/M09-099.1

Uses an experimental fishway to test performance of adult Pacific lampreys when confronted with a series of structural challenges.

Keefer, M. L., Mary. L. Moser, C. T. Boggs, W. R. Daigle, and C. A. Peery. 2009. Variability in migration timing of adult Pacific lamprey (*Lampetra tridentata*) in the Columbia River, U.S.A. Environmental Biology of Fishes 85(3):253–264. https://doi.org/10.1007/s10641-009-9490-7

Examines the effects of river environment on the timing of spawning migrations by Pacific lamprey in the Columbia River.

Keefer, M. L., M. L. Moser, C. T. Boggs, W. R. Daigle, and C. A. Peery. 2009. Effects of body size and river environment on the upstream migration of adult Pacific lampreys. North American Journal of Fisheries Management 29(5):1214–1224. https://doi.org/10.1577/M08-239.1

Describes the development and implementation of a half-duplex passive integrated transponder (PIT) tag monitoring array at five Columbia and Snake River dams to evaluate adult lamprey migrations.

Keefer, M. L., C. J. Noyes, T. S. Clabough, D. C. Joosten, and C. C. Caudill. 2020. Rapid migration and high survival of adult Pacific Lampreys in reservoirs. North American Journal of Fisheries Management 40(2):354–367. https://doi.org/10.1002/nafm.10413

Uses acoustic telemetry to investigate behavior and survival of 784 adult Pacific lampreys in Columbia River reservoirs and turbulent dam tailraces.

Keefer, M. L., C. A. Peery, S. R. Lee, W. R. Daigle, E. L. Johnson, and M. L. Moser. 2010. Behaviour of adult Pacific lamprey in near-field flow and fishway design experiments. Fisheries Management and Ecology 18(3):177–189. https://doi.org/10.1111/j.1365-2400.2010.00772.x

Describes the use of an experimental fishway to examine adult Pacific lamprey behavior in a series of attraction and passage-performance tests.

Kirk, M. A. 2015. Migration behaviors of adult Pacific lamprey (*Entosphenus tridentatus*) at large hydropower dams on the Columbia River. Master's Thesis. University of Idaho, Moscow. https://objects.lib.uidaho.edu/etd/pdf/Kirk_idaho_0089N_10459.pdf

Examines the potential mechanisms at hydropower dams responsible for limiting passage by exploring Pacific lamprey behavior at three different scales.

Kirk, M.A., and C. C. Caudill. 2017. Network analyses reveal intra- and interspecific differences in behaviour when passing a complex migration obstacle. Journal of Applied Ecology 54(3):836-845. https://doi.org/10.1111/1365-2664.12786

Evaluates both interspecific and intraspecific patterns in movement to test hypotheses about the complex set of mechanisms causing differences in passage at a migration obstacle.

Kirk, M. A., C. C. Caudill, E. L. Johnson, M. L. Keefer, and T. S. Clabough. 2015. Characterization of adult Pacific lamprey swimming behavior in relation to environmental conditions within large-dam fishways. Transactions of the American Fisheries Society 144(5):998–1012. https://doi.org/10.1080/00028487.2015.1059368

Discusses observations on the swimming behaviors of Pacific Lampreys at two large Columbia River dams (Bonneville and John Day) and to develop inferences regarding potential mechanisms influencing passage within lower fishway sections.

Kirk, M. A., C. C. Caudill, J. C. Syms, and D. Tonina. 2017. Context-dependent responses to turbulence for an anguilliform swimming fish, Pacific lamprey, during passage of an experimental vertical-slot weir. Ecological Engineering 106:296–307. https://doi.org/10.1016/j.ecoleng.2017.05.046

Analyzes the swimming paths of 90 adult Pacific lamprey in response to hydraulic conditions when passing a vertical-slot weir in an experimental fishway.

Kirk, M. A., C. C. Caudill, D. Tonina, and J. C. Syms. 2016. Effects of water velocity, turbulence and obstacle length on the swimming capabilities of adult Pacific lamprey. Fisheries Management and Ecology 23(5):356–366. https://doi.org/10.1111/fme.12179

Assesses the swimming capabilities of adult Pacific lamprey in an experimental vertical-slot fishway in response to three different fishway features.

Kirk, M. A., M. L. Keefer, and C. C. Caudill. 2014. Evaluating Pacific lamprey behavior in fishways at Bonneville and John Day dams using dual-frequency identification sonar (DIDSON), 2013. Report to U. S. Army Corps of Engineers, Portland, Oregon. https://usace.contentdm.oclc.org/digital/collection/p16021coll3/id/153

Reports on using dual-frequency identification sonar at Bonneville and John Day dams to observe adult Pacific lamprey behaviors.

Lampman, R. T. 2011. Passage, migration behavior, and autoecology of adult Pacific lamprey at Winchester Dam and within the North Umpqua River Basin, Oregon, USA. Master's Thesis. Oregon State University, Corvallis. http://hdl.handle.net/1957/26407

Describes the passage efficiency and migration routes of adult Pacific lamprey at Winchester Dam and evaluates the seasonal movement patterns of adult Pacific lamprey and their use of holding habitat at Winchester Dam in relation to temperature conditions.

Lampman, R. 2020. Evolution of lamprey passage structures within the Yakima basin. Report to Bonneville Power Administration, Project 2008-470-00. https://www.cbfish.org/Document.mvc/Viewer/P176742

Describes the use of 4-inch flexible tube for passing adult Pacific Lamprey at Prosser Dam left fish ladder.

Lamprey Technical Workgroup. 2020. Barriers to adult Pacific lamprey at road crossings: guidelines for evaluating and providing passage. https://www.arlis.org/docs/vol1/F/FishPassage/Lamprey-2020.pdf

Summarizes current understanding of the factors that affect passage of adult Pacific Lamprey at road crossings and offers options for improving passage.

Lamprey Technical Workgroup. 2022. Practical guidelines for incorporating adult Pacific lamprey passage at fishways, Version 2.0. https://www.pacificlamprey.org/wp-content/uploads/2022/08/2022.06.06-Lamprey-Psg-White-Paper.pdf

Summarizes pertinent information on adult Pacific Lamprey passage capabilities from existing literature and provides a technical reference on how to accommodate passage of adult Pacific lamprey.

Lamprey Technical Workgroup. 2022. Review of factors affecting larval and juvenile lamprey entrainment and impingement at fish screen facilities. https://www.pacificlamprey.org/wp-content/uploads/2022/10/Review_of_Factors_Affecting_Lamprey_Entrainment_Impingement__2022.pdf

Reviews existing data and literature on entrainment and impingement of larval and juvenile lampreys at screens and provides recommendations for reducing entrainment and impingement.

Liedtke, T. L., R. T. Lampman, P. Monk, A. C. Hansen, T. J. Kock, T. E. Beals, D. Z. Deng, and M. S. Porter. 2022. Monitoring the movements of juvenile Pacific lamprey (*Entosphenus tridentatus*) in the Yakima River, Washington, using acoustic telemetry, 2019–20. U.S. Geological Survey Open-File Report 2022–1052. https://doi.org/10.3133/ofr20221052

Utilizes prototype transmitters and acoustic monitoring arrays to evaluate juvenile lamprey movements in the Yakima River.

Maenhout, J. 2017. A monitoring study to quantify dam passage and tributary escapement of adult Pacific lamprey in the Rocky Reach project area and the mid-Columbia River. Report to Public Utility District No. 1 of Chelan County, Wenatchee, Washington. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=39415

Studies Pacific lamprey passage rates and behavior, and tributary escapement at Rocky Reach Dam.

McIlraith, B. J., C. C. Caudill, B. P. Kennedy, C. A. Peery, and M. L. Keefer. 2015. Seasonal migration behaviors and distribution of adult Pacific Lampreys in unimpounded reaches of the Snake River Basin. North American Journal of Fisheries Management 35(1):123–134. https://doi.org/10.1080/02755947.2014.986344

Describes the movements of 146 adult Pacific lampreys in the Snake River and its tributaries upstream from Lower Granite Dam.

Mesa, M. G., R. J. Magie, and E. S. Copeland. 2010. Passage and behavior of radio-tagged adult Pacific Lampreys (*Entosphenus tridentatus*) at the Willamette Falls Project, Oregon. Northwest Science 84(3):233–242. https://doi.org/10.3955/046.084.0303

Uses radio telemetry to monitor the passage of adult Pacific lampreys at the Willamette Falls Project on the Willamette River.

Moser, M. L., S. C. Corbett, M. L. Keefer, K. E. Frick, S. Lopez-Johnston, and C. C. Caudill. 2019. Novel fishway entrance modifications for Pacific lamprey. Journal of Ecohydraulics 4(1):71–84. https://doi.org/10.1080/24705357.2019.1604090

Reports on the use of fishway entrance modifications to improve Pacific lamprey passage.

Moser, M. L., M. L. Keefer, S. C. Corbett, K. E. Frick, C. C. Caudill, and S. C. Tackley. 2021. Providing refuges for adult Pacific lamprey *Entosphenus tridentatus* inside fishways. Aquaculture and Fisheries 6(2):144–150. https://doi.org/10.1016/j.aaf.2019.03.003

Examines adult Pacific lamprey use of two specially designed fishway refuges at Bonneville Dam on the Columbia River.

Moser, M. L., M. L. Keefer, H. T. Pennington, D. A. Ogden, And J. E. Simonson. 2010. Development of Pacific lamprey fishways at a hydropower dam. Fisheries Management and Ecology 18(3):190–200. https://doi.org/10.1111/j.1365-2400.2010.00773.x

Reports on the use of a fishway designed specifically for Pacific lamprey at Bonneville Dam on the Columbia River.

Moser, M. L., A. L. Matter, L. C. Stuehrenberg, and T. C. Bjornn. 2002. Use of an extensive radio receiver network to document Pacific lamprey (*Lampetra tridentata*) entrance efficiency at fishways in the lower Columbia River, USA. Hydrobiologia 483:45–53. https://doi.org/10.1023/A:1021394521450

Documents fine-scale passage efficiency of adult anadromous Pacific lamprey at Bonneville and The Dalles Dams in the lower Columbia River.

Moser, M. L., P. A. Ocker, L. C. Stuehrenberg, and T. C. Bjorn. 2002. Passage efficiency of adult Pacific lampreys at hydropower dams on the Lower Columbia River, USA. Transactions of the American Fisheries Society 131(5): 956-965. https://doi.org/10.1577/1548-8659(2002)131%3C0956:PEOAPL%3E2.0.CO;2

Documents the movements of radio-tagged adult Pacific lampreys in specific areas of fishways at the first three dams they encounter as they move upstream.

Moser, M. L., D. A. Ogden, B. J. Burke, and C. A. Peery. 2005. Evaluation of a lamprey collector in the Bradford Island makeup water channel, Bonneville Dam, 2003. Report to U.S. Army Corps of Engineers, Contract E96950021, Portland, Oregon. https://www.webapps.nwfsc.noaa.gov/assets/26/1350_07212010_103051_Moser.et.al.2005b-rev.pdf

Assess the performance of a structure to pass adult lamprey from the makeup water channel to the forebay at Bonneville Dam.

Moser, M. L., D. A. Ogden, H. T. Pennington, W. R. Daigle, and C. A. Peery. 2005-2006. Development of passage structures for adult Pacific lamprey at Bonneville Dam. Report to U.S. Army Corps of Engineers, Contract E96950021, Portland, Oregon. 2005 2006

Evaluates the performance of a lamprey passage structure and develops and evaluates a prototype lamprey collector at a Bonneville Dam fishway entrance.

Moser, M. L., H. T. Pennington, and J. M. Roos. 2008. Grating size needed to protect adult Pacific lampreys in the Columbia River basin. North American Journal of Fisheries Management 28(2):557-562. https://doi.org/10.1577/M07-126.1

Assesses the bar spacing needed to exclude adult lampreys that enter the fishways at Bonneville Dam.

Moursund, R. A., M. D. Bleich, K. D. Ham, and R. P. Mueller. 2003. Evaluation of the effects of extended length submerged bar screens on migrating juvenile Pacific lamprey (*Lampetra tridentata*) at John Day Dam in 2002. Final Report to U.S. Army Corps of Engineers, Contract DE-AC06-76RL01830, Portland, Oregon. https://docs.cbfwl.org/USACE/EvalEffectsExtendedLengthSubmergedBarScreensJuvenileLampreyJohnDayDam-2002.pdf

Studies the effects of the modified extended-length submerged bar screens on juvenile Pacific lamprey at John Day Dam.

Moursund, R. A., R. P. Mueller, T. M. Degernian, and D. D. Dauble. 2001. Effects of dam passage on juvenile Pacific lamprey (*Lampetra tridentata*). Report to U.S. Army Corps of Engineers, Portland, Oregon. https://docs.cbfwl.org/biblio46041.pdf

Studies impingement rates, swimming performance, effects of shear forces, and effects of light and pressure on juvenile Pacific lamprey.

Murauskas, J. G., A. M. Orlov, L. Keller, O. A. Maznikova, and I. I. Glebov. 2019. Transoceanic migration of Pacific Lamprey, *Entosphenus Tridentatus*. Journal of Ichthyology 59(2):280–282. https://doi.org/10.1134/S0032945219020115

Reports on the first documented instance of transoceanic migration by Pacific lamprey.

National Marine Fisheries Service. 2001-2002. Migration behavior of adult Pacific lamprey in the lower Columbia River and evaluation of Bonneville Dam modifications to improve passage. U.S. Army Corps of Engineers, Contract E96950021, Portland, Oregon. 2001 2002

Assesses behavior, passage success, and migration rates of adult Pacific lamprey at lower Columbia River dams and evaluates effects of modifications to gratings on passage of lamprey at Bonneville Dam.

Normandeau Associates. 2001. Assessment of Willamette Falls Project operational effects on upstream passage of non-salmonid species, in particular, Pacific lamprey. Report to Willamette Falls Project Fisheries/Aquatics/Terrestrial Workgroup. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=6794

Identifies and evaluates the potential for Willamette Falls Project impacts to Pacific lamprey.

Noyes, C. J., C. C. Caudill, T. S. Clabough, D. C. Joosten, E. L. Johnson, M. L. Keefer, and G. P. Naughton. 2012. Adult Pacific lamprey migration behavior and escapement in the Bonneville reservoir and lower Columbia River monitored using the juvenile salmonid acoustic telemetry system (JSATS), 2011. Report to U.S. Army Corps of

Engineers, Portland, Oregon. https://usace.contentdm.oclc.org/digital/collection/p16021coll3/id/78

Studies Pacific lamprey upstream passage and migration behaviors to calculate lamprey travel times, to estimate escapement past monitored sites, and to evaluate Juvenile Salmon Acoustic Telemetry System detection efficiency.

Ocker, P. A., L. C. Stuehrenberg, M. L. Moser, A. L. Matter, J. J. Vella, B. P. Sandford, and T. C. Bjornn. 2001. Monitoring adult Pacific lamprey (*Lampetra tridentata*) migration behavior in the lower Columbia River using radiotelemetry, 1998-1999. Report to U. S. Army Corps of Engineers, Contract E96950021, Portland, Oregon. https://docs.cbfwl.org/biblio121.pdf

Studies tagged Pacific lamprey to determine routes of passage at hydroelectric dams, to identify locations in the fishways where lamprey fail to advance, and to test the effects of spillway entrance modifications on lamprey entry into the fishways at Bonneville Dam.

Reinhardt, U. G., L. Eidietis, S. E. Friedl, and M. L. Moser. 2008. Pacific lamprey climbing behavior. Canadian Journal of Zoology 86(11):1264–1272. https://doi.org/10.1139/Z08-112

Documents lamprey climbing behavior at a lamprey-friendly fishway at Bonneville Dam on the Columbia River.

Rose, B. P., and M. G. Mesa. 2012. Effectiveness of common fish screen materials to protect lamprey ammocoetes. North American Journal of Fisheries Management 32(3): 597-603. https://doi.org/10.1080/02755947.2012.678965

Tests the effectiveness of five common fish screen materials for excluding lamprey ammocoetes: interlock, vertical bar, perforated plate, and 12-gauge and 14-gauge wire cloth.

Starke, G. M., and J. T. Dalen. 1995. Pacific lamprey (*Lampetra tridentata*) passage patterns past Bonneville Dam and incidental observations of lamprey at the Portland District Columbia River dams in 1993. U.S. Army Corps of Engineers, Cascade Locks, Oregon.

https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?pn=ViewFile&att=ODFW/ODFW_12508_2_Lampreypassagepatterns1993.pdf

Determines areas around the Portland District Columbia River dams where lamprey might be delayed or injured and develops baseline data on lamprey passage past Bonneville Dam.

Syms, J. C., M. A. Kirk, C. C. Caudill, and D. Tonina. 2021. A biologically based measure of turbulence intensity for predicting fish passage behaviours. Journal of Ecohydraulics 9(1):55–67. https://doi.org/10.1080/24705357.2020.1856007

Tests the performance of six velocity- and turbulence-derived metrics for predicting passage behaviors of Pacific lamprey under varying hydraulic conditions within an experimental vertical slot.

U.S. Army Corps of Engineers. 2014. Pacific lamprey passage improvements implementation plan, 2008-2018: 2014 revision. http://pweb.crohms.org/tmt/documents/FPOM/2010/Task%20Groups/Task%20Group%20Lamprey/10%20Year%20Lamprey%20Plan%20update%20final%202015.pdf

Presents a plan to identify specific actions that can be taken to improve lamprey passage at USACE dams along the lower Columbia and Snake rivers.

U.S. Army Corps of Engineers. 2015-2023. Use of adult Pacific lamprey passage structures at Bonneville and John Day Dams. U.S. Army Corps of Engineers, Cascade Locks, Oregon. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=46142

Enumerates adult Pacific Lamprey passing Bonneville Dam using conventional and alternative fishways designed to pass these fish.

U.S. Fish and Wildlife Service. 2011-2014. Passage of radio-tagged adult Pacific lamprey at Yakima River diversion dams. Report to U.S. Army Corps of Engineers and U.S. Bureau of Reclamation. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45070

Utilizes radio telemetry to determine approach timing, residence time, passage routes, and migration rates at the diversion dams on the lower Yakima River.

Vella, J. J., L. C. Stuehrenberg, and T. C. Bjornn. 1996-1997. Migration patterns of Pacific lamprey *Lampetra tridentata* in the lower Columbia River. Annual Report of Research to U.S. Army Corps of Engineers, Contract E96950021, Portland, Oregon. 1996 1997

Evaluates passage patterns of upstream-migrating Pacific lamprey in the lower Columbia River to determine return time from the release site back upstream to Bonneville Dam, determine passage routes and behavior, and determine migration rates through reservoirs.

Zobott, H., R. Budwig, C. C. Caudill, M. L. Keefer, and W. Basham. 2020. Pacific lamprey drag force modeling to optimize fishway design. Journal of Ecohydraulics 6(1):69–81. https://doi.org/10.1080/24705357.2020.1768911

Applies a drag force model approach for use in design of Pacific Lamprey (*Entosphenus tridentatus*) passage structures where lamprey may be partially or fully submerged.

Zobott, H., C. C. Caudill, M. L. Keefer, R. Budwig, K. Frick, M. Moser, and S. Corbett. 2015. Design guidelines for Pacific lamprey passage structures. Report to U.S. Army Corps of Engineers, Portland, Oregon. https://usace.contentdm.oclc.org/digital/collection/p16021coll3/id/637

Presents design guidelines for use in the development of lamprey passage structure systems, including hydraulic, structural, and operational considerations.

Other

Bell, G. R., and G. S. Traxler. 1986. Resistance of the Pacific Lamprey, *Lampetra tridentata* (gairdner), to challenge by *Renibacterium salmoninarum*, the causative agent of kidney disease in Salmonids. Journal of Fish Diseases 9(3):277–279. https://doi.org/10.1111/j.1365-2761.1986.tb01014.x

Tests to see if Pacific lamprey are suitable hosts to *Renibacterium salmoninarum* bacterium.

BioAnalysts, Inc. 2000. A status of Pacific lamprey in the mid-Columbia region. Report to Public Utility District No. 1 of Chelan County, Wenatchee, Washington. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=17007

Summarizes information on the biology of Pacific lamprey in the mid-Columbia region.

Close, D. A., A. D. Jackson, B. P. Conner, and H. W. Li. 2004. Traditional knowledge of Pacific lamprey (*Enosphenus tridentatus*) in Northeastern Oregon and Southeastern Washington from indigenous peoples of the Confederated Tribes of the Umatilla Indian Reservation. Journal of Northwest Anthropology 38(2):141-462. https://www.sciencebase.gov/catalog/item/5d3b6e0ce4b01d82ce8d7ae1

Utilizes Traditional Ecological Knowledge to gain natural history insights and baseline life history information for Pacific lamprey.

Confederated Tribes of the Warm Springs Reservation of Oregon. 2009-2019. Evaluate status and limiting factors of Pacific lamprey in the lower Deschutes River, Fifteenmile Creek and Hood River. Report to Bonneville Power Administration, Project 2007-007-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=39954

Reports on a mark-recapture study and a tribal creel survey to determine an escapement estimate for the lower Deschutes River, Fifteenmile Creek and Hood River.

Confederated Tribes and Bands of the Yakama Nation. 2015-2018. Summary assessment of larval/juvenile lamprey entrainment in irrigation diversions within the Yakima subbasin. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45053

Surveys irrigation diversions to salvage as many larval/juvenile lampreys as possible and return them to their respective stream downstream of the diversion.

Confederated Tribes and Bands of the Yakama Nation. 2016-2020. Yakama Nation cultural oral interviews on asum (lamprey eels): summary and review. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45048

Presents and reviews oral interviews with Yakama Nation tribal members on lamprey.

Confederated Tribes and Bands of the Yakama Nation. 2017-2019. Summary assessment of larval/juvenile lamprey entrainment in irrigation canals within the Yakima subbasin. Report to Bonneville Power Administration, Project 2008-470-00. https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=45025

Describes larval lamprey salvage surveys in the Yakima River subbasin.

Dauble, D. D., R. A. Moursund, and M. D. Bleich. 2006. Swimming behaviour of Juvenile Pacific lamprey, *Lampetra tridentata*. Environmental Biology of Fishes 75(2):167–171. https://doi.org/10.1007/s10641-005-4698-7

Studies diel movement patterns and swimming ability of actively migrating Pacific lamprey.

Downey, T., D. Rilatos, A. Sondenaa, and B. Zybach. 1996. Skwakol: the decline of the Siletz Lamprey Eel population during the 20th century. Oregon State University, Corvallis. https://ir.library.oregonstate.edu/concern/technical_reports/br86bb99z

Presents a historical accounting of the abundance and uses of lamprey eels by the peoples and families of the Siletz River Valley during the past 170 years.

Dunkle, M. R., and C. C. Caudill. 2015. The role of Pacific lamprey in Yakima River tributary food webs. Report to Columbia River Inter-Tribal Fish Commission, Portland, Oregon. https://www.cbfish.org/Document.mvc/Viewer/P149680

Assess the effects of nutrient additions to streams by Pacific lamprey.

Dunkle, M. R., R. T. Lampman, A. D. Jackson, and C. C. Caudill. 2020. Factors affecting the fate of Pacific lamprey carcasses and resource transport to riparian and stream macrohabitats. Freshwater Biology 65(8):1429–1439. https://doi.org/10.1111/fwb.13510

Tracks the fate of post-spawn carcasses in two inland Columbia River basin streams to characterize spatial distribution of carcasses and marine-derived nutrient deposition.

Frick K. E., S. C. Corbett, and M. L. Moser. 2017. Climbing success of adult Pacific lamprey on a vertical wetted wall. Fisheries Management and Ecology 24(3):230–239. https://doi.org/10.1111/fme.12225

Tests Pacific lamprey vertical climbing on a vertical wetted wall in relation to flow and three water delivery mechanisms: overflow, upwelling and sidewelling.

Gomes, D. G. E., J. R. Benjamin, B. J. Clemens, R. Lampman, and J. B. Dunham. 2025. New technology for an ancient fish: A lamprey life cycle modeling tool with an R Shiny application. PLoS One 20(5):e0323408. https://doi.org/10.1371/journal.pone.0323408

Uses Pacific lamprey as a case study to highlight the utility of a life cycle model that includes an R Shiny interactive web application interface to simulate abundance by life stage.

Gonzalez, R., J. Dunham, S. Lightcap, and J. McEnroe. 2017. Large wood and instream habitat for juvenile coho salmon and larval lampreys in a Pacific Northwest stream. North American Journal of Fisheries Management 37(4):683-699. https://doi.org/10.1080/02755947.2017.1313794

Evaluates the potential effects of large wood on larval lampreys as well as on juvenile coho salmon in a small, coastal, Oregon stream.

Goodfellow, C., T. Levi, L. Weitkamp, and J. Hess. 2024. Characterization of prey fishes of pacific Lamprey via metabarcoding analysis of gut contents of ocean-caught specimen. Report to Bonneville Power Administration, Project 2017-005-00. https://www.cbfish.org/Document.mvc/Viewer/P210889

Refines and tests a new protocol for metabarcoding lamprey intestinal contents at the 12S mitochondrial region using a novel blocking primer that minimizes lamprey (self) detections.

Hess, J. E., R. T. Lampman, A. D. Jackson, T. Sween, L. Jim, N. McClain, G. Silver, L. Porter, and S. R. Narum. 2023. The return of the adult Pacific lamprey offspring from translocations to the Columbia River. North American Journal of Fisheries Management 43(6):1531-1552. https://doi.org/10.1002/nafm.10922

Addresses whether adult translocation offspring from three programs return to Bonneville Dam in numbers that support previous model predictions and whether Columbia River origin Pacific lamprey contribute to adult production widely across the species range.

Jackson, A. D., M. L. Moser, S. T. Onjukka, S. LaPatra, K. M. Lujan, C. Samson, M. G. White, M. Blair, L. Rhodes, R. Lampman, A. N. Maine, and J. C. Jolley. 2019. Occurrence of pathogens in Pacific Lamprey (*Entosphenus tridentatus*). Reviews in Fish Biology and Fisheries 29(3):653–668. https://doi.org/10.1007/s11160-019-09572-0

Assembles data from regional fish health laboratories to assess pathogen prevalence in Pacific lamprey sampled from various sources.

Jolley, J. C., and K. M. Lujan. 2019. Pathogens of Pacific lamprey detected through routine fish health screenings. Journal of Fish and Wildlife Management 1(2):517–524. https://doi.org/10.3996/122018-JFWM-119

Describes fish health surveys on wild-caught larval and adult Pacific Lamprey from locations that were used as lamprey sources for captive research to determine the occurrence of bacteria, viruses, and parasites that may be pathogens.

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