Pacific Northwest NATIONAL LABORATORY

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Sampling Device to Determine Juvenile Pacific Lamprey Presence/Absence in Deep Water Habitats

Pacific lamprey populations, once abundant throughout the Pacific Northwest, have declined significantly over the past decade; the species is now designated as a federal Species of Concern by the U.S. Fish and Wildlife Service. Little information exists about the distribution, abundance, and habitat use of juvenile lamprey during their early life history when they spend up to seven years burrowed in riverbed substrates. Methods of locating juvenile lamprey and identifying suitable rearing habitat have traditionally involved the use of backpack shocking in shallow water or, in deep water (>1 m), displacing and transporting the lamprey to the surface for identification. Pacific Northwest National Laboratory (PNNL) has developed a new, cost-effective method for locating juvenile lamprey in deep water and characterizing their habitat without transporting them to the surface. The deep water electroshocking platform (DEP) was developed to address this need so hydroelectric system managers can determine if water elevation fluctuations and dredging operations could adversely affect lamprey populations.

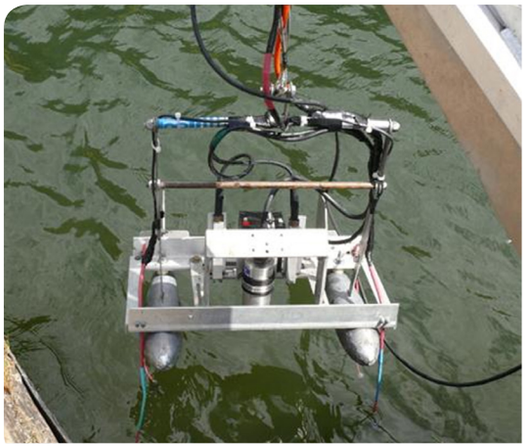
EXPERTISE

The Ecology Group at PNNL has more than 20 years of experience in the operation of a video-based boat-deployed diving platform to locate and assess fish spawning regions and observe fish behavior. The weighted diving platform can be outfitted with various types of sensors and equipment to monitor water quality and characterize habitats of riverine fish and invertebrates. Its capability was recently enhanced with the addition of the DEP, which was specifically designed to sample for juvenile Pacific lamprey that are known to inhabit tributary mouths and deeper sections of the Columbia River.

DEP System Components:

- Integrated sled for use in large rivers at depths up to 75 feet
- Ultra low light color optical cameras
- Paired lasers for scaled measurements
- High-definition multi-format recording system
- Onboard remote electroshocking controller with customized settings
- Infrared/white-light modules
- Water velocity meter

Deep water electroshocking platform.



Juvenile Pacific lamprey.

U.S. DEPARTMENT OF ENERGY

CAPABILITIES

The DEP has the capability to do the following:

- Classify riverbed grain size distribution, near-bed water velocity, temperature, dissolved oxygen, and specific conductance.
- Determine the lengths and estimate age class of the lamprey sampled.
- Estimate lamprey distribution and density within the sampling region.
- Produce geographic information system-based habitat suitability and lamprey distribution maps.

Field Study: Juvenile Lamprey Survey

Ecology Group staff conducted a warm and cold water survey using the DEP at the confluence of the Wind and Columbia rivers in Washington to field test the system in a region juvenile lamprey are known to inhabit. The electroshocking system was found to be very effective to stimulate lamprey to evacuate their burrows within the electroshocked region. Post-processing of the video data using image analysis software allowed us to determine substrate sizes and lamprey lengths using the lasers for scaling. The general findings included the following:

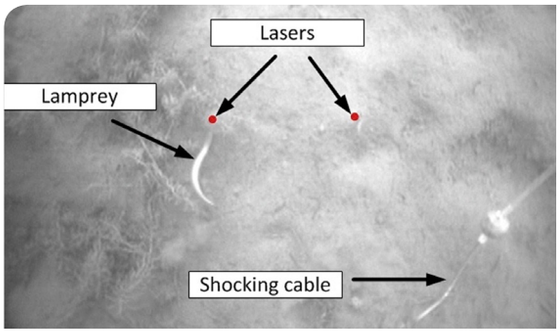
- Lamprey were found at 23 of the 36 sites sampled.
- Lamprey lengths ranged from <50 to 150 mm.
- Water depths of 1.2 to 5.6 m were surveyed.
- Up to seven lamprey were found at a specific site (area = 0.85 m^2).

In addition to conducting deep-water lamprey surveys in the field, the Ecology Group is capable of studying ammocoete and macrophthalmia stages of Pacific lamprey at its Aquatic Research Laboratory in Richland, Washington. These capabilities include the ability to determine the impacts of barotrauma, elevated dissolved gas, shear forces, swimming ability, screen impingement, behavior deterrents using sound and light, tagging effects, and contamination uptake on Pacific lamprey.

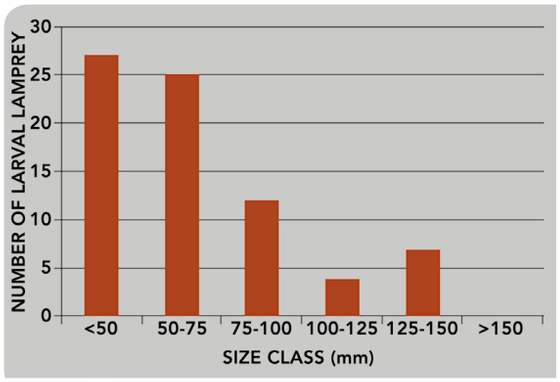
ABOUT PNNL

Pacific Northwest National Laboratory is a U.S. Department of Energy laboratory, reporting to the Office of Science. PNNL advances the fundamental understanding of complex chemical, physical and biological systems and provides science-based solutions to some of the nation's most pressing challenges in national security, energy and the environment. We accomplish this mission through the outstanding research and development activities of our staff, excellence in operations, and high-value partnerships. PNNL has approximately 5,000 researchers and staff located at the main campus in Richland, Washington Battelle, a global science and technology enterprise headquartered in Columbus, Ohio, manages the laboratory for DOE.

Digitized video image illustrates lamprey emergence and detection.



Numbers and lengths of lamprey derived from the field study.



Information on Juvenile Lamprey Studies

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Ecology Group

The primary goal of the Ecology Group is to develop and deploy science and technology to help governmental agencies and corporate land managers accomplish their primary missions while protecting and enhancing ecological resources. Our research and technology development activities address a broad range of land and water resources issues. We offer scientific knowledge of ecosystem management that balances operational demands with effective stewardship of natural resources.

To learn more about the Ecology Group, please contact **David Geist**, Ecology Group Manager, at (509) 371-7165 or visit our website at http://ecology.pnnl.gov/.

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