

**PACIFIC LAMPREY MIGRATION BEHAVIOR**

**IN A COMPLEX ENVIRONMENT:**

**OBSTACLES TO PASSAGE**

**AT COLUMBIA RIVER DAMS**

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**EXTENDED ABSTRACT ONLY – DO NOT CITE**

**Introduction**

Pacific lamprey, *Lampetra tridentata*, are parasitic, anadromous petromyzontiforms endemic to the Columbia River drainage in the northwestern United States. After entering freshwater, the adults cease parasitic behavior and move upstream via free-swimming anguilliform locomotion to reach spawning habitats. Recent counts of adult Pacific lamprey passing hydroelectric dams on the Columbia River indicate a decline in lamprey abundance (Starke and Dalen 1995). This may be attributed to obstruction of adult lamprey migration by the dams and subsequent reductions in recruitment. We used radio tracking to assess passage efficiency and migration behavior of Pacific lamprey at Bonneville Dam, the hydroelectric dam located furthest downstream in this drainage.

**Methods**

We captured adult lamprey at night in a trap located in the Bonneville Dam fish ladder during their upstream migration in May - September of 1998 and 1999. Each fish was measured and a small radio transmitter (< 2% of lamprey body weight) was surgically implanted in the body cavity. All fish were released 3

km downstream from the dam. They were relocated via both mobile surveys with a portable receiver, and an array of 32 fixed site receivers that logged the time and date of individual fish passage at key positions in and around the fish ladders at Bonneville Dam (Figure 1). Passage efficiency was defined as the number of lamprey that successfully negotiated an area of interest divided by the number that entered that area.

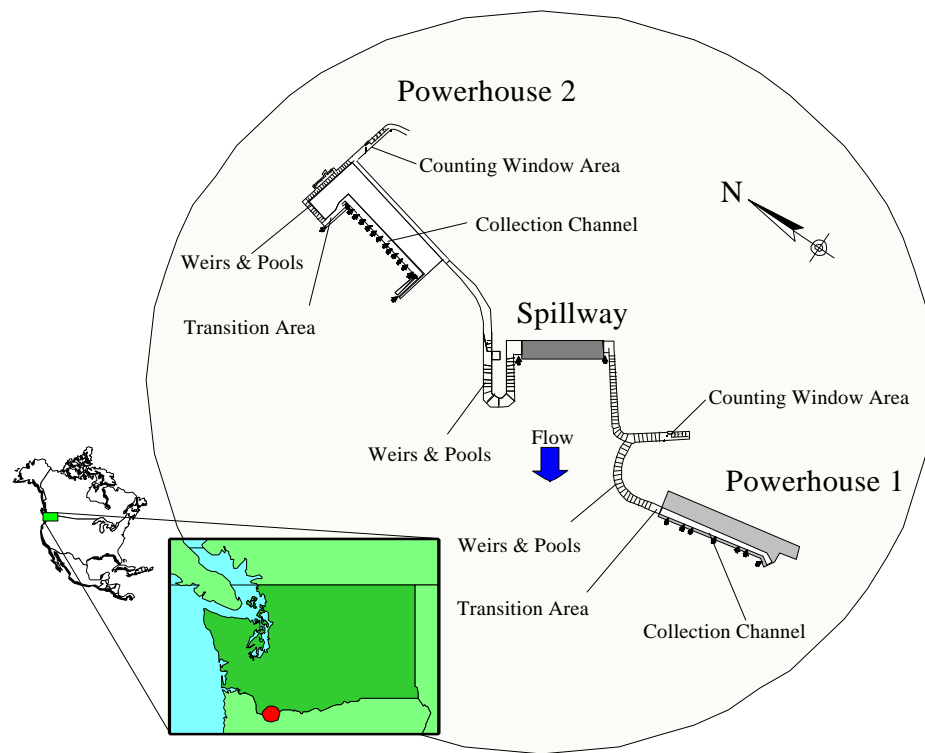


Figure 1. Study area at Bonneville Dam in the Columbia River drainage. Small black arrows represent fish ladder entrances along the base of the dam.

## Results

We tagged 205 lamprey in 1998, and 199 lamprey in 1999. In both years, approximately 90% of the fish migrated upstream after surgical implantation of radio transmitters, indicating that tag effects were low. Less than half of the lamprey that approached Bonneville Dam successfully negotiated the fish ladders: 39% in 1998 and 45% in 1999. In both years, passage efficiency was lowest through collection channels, transition areas, and past counting windows (Table 1).

Table 1. The number of lamprey that negotiated an area of interest divided by the number that entered that area (passage efficiency) in 1998 and 1999 at the Bonneville Dam fish ladder system.

Area of Interest	Passage Efficiency	
	1998	1999
Fish ladder entrances	154÷182 (85%)	161÷183 (88%)
Collection channels and transition areas	105÷154 (68%)	103÷161 (64%)
Weirs and pools	99÷ 105 (94%)	102÷103 (99%)
Counting window area	71÷ 99 (72%)	81÷102 (80%)

## Discussion

The fish ladders at hydropower dams on the Columbia River were constructed to facilitate salmonid passage, but were not designed to pass lamprey. Contrary to expectation, lamprey successfully negotiated high current velocity areas at the fish ladder entrances and in the weir and pool sections of the fishway. This, in spite of the relatively low burst speed and reduced swimming performance of lamprey relative to other fishes (Beamish 1974, Mesa et al. 1999). However, collection channels, transition areas, and the counting windows represented obstacles to upstream movement of Pacific lamprey. We hypothesize that the lack of attachment sites and turbulent currents in the collection channels and transition areas deterred or delayed lamprey. Unlike salmonids, lamprey moved through the fishways primarily at night. Our results suggest that intense lighting at the counting stations, particularly during the night, can also repulse lamprey. Other lamprey species exhibit negative phototaxis and dark-adapted lamprey may be particularly sensitive to light (Protosav 1968, Ullen 1996). Future studies will investigate both the spectral sensitivity and phototactic responses of

migrating Pacific lamprey in an effort to ameliorate their passage at counting stations.

### **Acknowledgements**

John Vella, Northwest Fisheries Science Center (NWFSC), and members of the Idaho Cooperative Fish and Wildlife Research Unit (ICFWRU) contributed to the field tracking effort. Ben Sanford (NWFSC) assisted with statistical analysis and Ken Tolotti (ICFWRU) provided receiver maintenance and transferred data collected at fixed sites. Ted Bjornn (ICFWRU) contributed to proposal development, administration and oversight of the fixed site array. This work was funded by the U.S. Army Corps of Engineers.

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