

EFFECTS OF LIGHT ON MIGRATING ADULT PACIFIC LAMPREY

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EXTENDED ABSTRACT ONLY – DO NOT CITE

Introduction

Abundance of anadromous Pacific lamprey (*Lampetra tridentata*) in the Columbia River drainage has declined dramatically in the past two decades (Close, 2001). Hydropower dams on the lower Columbia River may have contributed to this decline by preventing some upstream migrating adults from reaching historical spawning grounds. Recent radiotelemetry data indicate that adult Pacific lamprey have relatively poor passage efficiency at the lower Columbia River hydropower dams (Moser et al., In Press). At Bonneville Dam (the first dam they encounter at Rkm 235) adult lamprey were delayed and/or obstructed at specific parts of the fishways, including fish count stations (Moser et al., In Press). Unlike adult salmonids, adult lamprey are most active at night and some species exhibit negative phototaxis (Ullen et al., 1997). We tested the hypothesis that bright lighting at the fishway count stations elicits an avoidance response in migrating adult Pacific lamprey.

Methods

We trapped lamprey from a fishway at Bonneville Dam (Figure 1). Uniquely-coded transmitters were surgically implanted in the body cavity of selected fish following the methods of Moser et al. (In Press). The radio-tagged lamprey were released below the dam and their approach to and progress through the two count stations (Figure 1) was monitored via an array of underwater antennas.

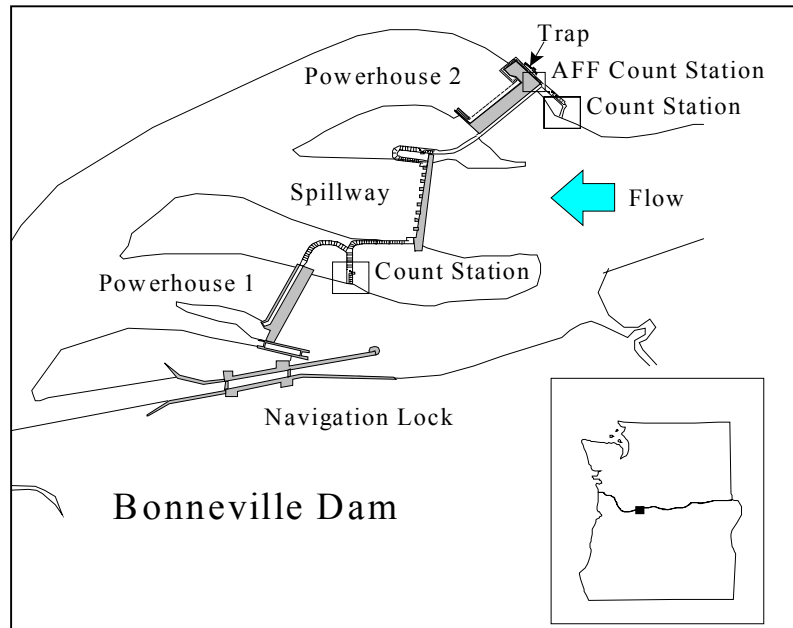


Figure 1. Study area at Bonneville Dam and locations of the count stations, experimental count station at the Adult Fish Facility (AFF), and lamprey trap.

We also conducted controlled experiments of lamprey responses to lighting in a 1.2 m × 13.4 m × 3 m chamber with flowing water (0.8 m s^{-1}). The chamber was partitioned along its axis so that lamprey could choose to move up either a brightly lighted side (simulated count station lighting) or a dark side. For each test, we introduced 10 lamprey into the downstream end of the chamber and recorded the number that had passed through each side after 1 hr. Each group of fish was tested in during day and night.

We also manipulated lighting at an experimental count station in the fishway to test the effects of white lighting (simulated count station lighting), red lighting, and no lighting on catch per unit effort (CPUE) at a trap located approximately 20 m upstream from the light treatment. On consecutive nights we alternated the dark treatment with each of the two light treatments and compared CPUE between treatments using a paired t-test (Zar, 1984).

Results

We radio tagged 299 lamprey in 2000 and 298 in 2001. Of these fish, 141 in 2000 and 147 in 2001 entered Bonneville Dam fishways and approached the count station areas at the top of the fish ladders. In 2000, 106 (75%) of these fish passed the brightly lit count window, negotiated the serpentine weir section, and exited out the top of the ladder and into the forebay of the dam (Figure 2). Most of the remaining fish either passed into the makeup water channel adjacent to the count station or fell back downstream after entering the serpentine weir section (Figure 2). Only 5 fish did not pass upstream from the count window. Similarly, 77% of the lamprey passed successfully through the count station in 2001, but only 2 did not move upstream from the count window (Figure 2).

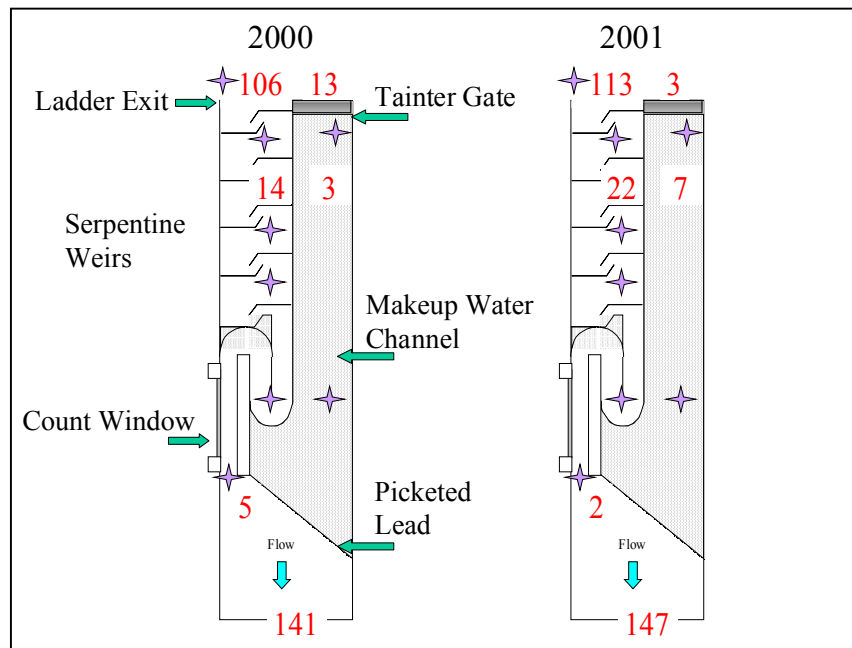


Figure 2. Count stations at Bonneville Dam and the number of lamprey that failed to pass through each area in 2000 and 2001. Stars indicate antenna sites.

We conducted 7 replicates of the laboratory experiments. Lamprey did not avoid the lighted side of the chamber during either day or night ($P > 0.05$). Moreover, there was no significant difference in mean CPUE (lamprey night⁻¹) during white light

(5.2) or red light (4.6) treatments and dark (5.0) treatments in the fishway ($P > 0.05$).

Discussion

Radiotelemetry and laboratory studies indicated that adult Pacific lamprey do not avoid the lighting (1 – 3 lux) at Bonneville Dam count stations. Experiments in the fishway further indicated that light quality had no effect on lamprey passage. We recommend future investigation of adult lamprey passage through the serpentine weir sections of the fishways, as radiotelemetry indicated that more lamprey were obstructed in this area than by the brightly-lit count windows.

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