 MANAGEMENT BRIEF

Use of Night Video to Enumerate Adult Pacific Lamprey Passage at Hydroelectric Dams: Challenges and Opportunities to Improve Escapement Estimates

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Abstract

Reliable estimates of adult Pacific lamprey Entosphenus tridentatus escapement are critically needed to improve management of this declining and ecologically important species. The longest time series of Pacific lamprey counts are from count stations at Columbia River basin dams designed to enumerate adult salmonids during the day, but many Pacific lamprey pass at night. To estimate their total escapement, we used video to monitor nighttime lamprey passage in combination with daytime counts at two count stations at Bonneville Dam and two at The Dalles Dam in 2007–2008. We examined relationships among day and night counts and evaluated the potential for using expansion factors to estimate total escapement from past and future daytime count data. As expected, daytime counts systematically underestimated total lamprey passage, and day and night counts were positively correlated in most comparisons. Unexpectedly, ratios of night : day counts varied widely among sites and years because patterns of upstream and downstream movements past count stations varied. We highlight challenges associated with enumerating cryptic and nocturnal species, such as Pacific lamprey, the potential impact of species-specific behaviors on enumeration efforts, and the importance of appropriate count station location and structure for video monitoring of fish passage.

Obtaining accurate fish counts is essential for effective fisheries management. Passage constrictions such as fish weirs, natural obstructions, and fishways at dams have long been used to count upstream migrating fishes. In some cases, the site is continuously monitored such that counts represent nearly complete censuses of all fish passing the constriction, as at some dam fishways (e.g., Hatch et al. 1994; Hiebert et al. 2000), counting weirs or fences (e.g., Labelle 1994; Clay 1995), and automatic counters (e.g., Welton et al. 1999; Moser et al. 2011). Population estimates have also been generated by enumerating fish during predetermined sampling periods followed by count expansion (e.g., USACE 2008). When a reliable expansion (i.e., estimate based on extrapolation) is not possible, partial or periodic counts have been used as a relative index, although there is often a need to prospectively and retrospectively convert index counts to population estimates (e.g., Davies et al. 2007).

Pacific Lamprey Entosphenus tridentatus is one such species where a decades-long time series of index counts are available at multiple hydroelectric dams in the Columbia River basin, but there is a need for accurate population abundance estimates. The number of adults counted returning to the interior Columbia River basin (defined here as upstream from Bonneville Dam, river kilometer [rkm] 235) has decreased precipitously in recent years (Close et al. 2002; Moser and Close 2003), resulting in a petition for listing under the U.S. Endangered Species Act (USFWS 2004) and reduced harvest in tribal fisheries. The species had not been listed, in part due to uncertainty about population structure and population size. Existing information on Pacific lamprey population estimates in the Columbia River has been based primarily on daytime counts (0500–2100 hours) at main-stem dams. However, adult Pacific lampreys are predominantly nocturnal when during their migration (2100–0500 hours; Moser et al. 2002; Keefer et al. 2012), and daytime counts are known to substantially underestimate total dam passage.

A complete census at any location requires that all fish pass the counting site and that each individual is enumerated exactly once. Passage through unmonitored routes such as dam navigation locks or fishway weirs during periods of high discharge can bias counts low. High passage rates or complex behaviors

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