Pacific Lamprey Subgroup Meeting

1 Introduction

The PRFF and RRFF Pacific Lamprey Subgroups met on 4 August 2016 to (1) identify lamprey passage metrics, (2) describe methods to estimate passage metrics, and (3) describe methods for assessing unavoidable effects (NNI). The Subgroups first reviewed regional notes and documents to assess the applicability of lamprey passage metrics and methods used in the Columbia River Basin. In short, the region has not identified passage metrics or described methods to assess passage metrics or applied them for lamprey. Therefore, the PRFF and RRFF will identify and develop their own metrics (measurements; not standards or targets) and methods with respect to their Pacific Lamprey Management Plans. What follows is a summary of discussions and recommendations from the Subgroups.

2 Lamprey Passage Metrics

The Subgroups identified the following fish passage metrics that may be measurable for adult lamprey.

- ***Within-Fishway Passage Efficiency*** = Fraction of adult lamprey that successfully egress a fishway.
- ***Entrance Efficiency*** = Proportion of adult lamprey being detected at a fishway entrance at least once after release.
- ***Adjusted Inter-Dam Conversion Rates*** = Ratio of adult lamprey counted at an upstream dam to the number counted at a downstream dam, adjusted for overwintering, tributary escapement, predation, fallback/re-ascension, and reservoir/tailrace spawning.

The Subgroup did not identify travel time (within the fishway, to the fishway entrance, or from one dam or counting station to the next) as a passage metric, because lamprey tend to wander widely, may hold within certain areas (e.g., reservoirs, fishways, etc.) for extended time periods, and may overwinter for one or more years in the project area. On the other hand, travel time can be used as a covariate that may explain passage success. For example, delays within a segment or segments of the fishway may indicate a potential passage problem. Thus, although travel time is not a specific passage metric, it should be measured and used to help explain variation in passage metrics.

3 Lamprey Passage Metrics Methods and Assumptions

The Subgroups described methods and assumptions associated with each passage metric.

3.1 Within-Fishway Passage Efficiency

Within-Fishway Passage Efficiency is a measurement of adult lamprey passage success through the fish ladder. This is the metric that is often referred to when biologists speak of dam passage. Mark-recapture techniques are used to estimate Within-Fishway Passage Efficiency. Given that PIT-tag

interrogation systems have been installed throughout the fishways, PIT tags are appropriate for marking fish and estimating Within-Fishway Passage Efficiency. Active tags can also be used provided they do not affect fish behavior or negatively affect swimming ability. In general, the approach includes capturing adult lamprey within the fishway being tested (assumes the fish intends to pass the project), tagging them, releasing them in the lower fishway or below the fishway, and recording the number of adult lamprey that exit the upstream end of the fishway. It is necessary to track the number of tagged fish that successfully egress the fishway, fallback, and re-ascend the fishway; track tagged fish that leave the fishway downstream and are detected at downstream dams or tributaries; and track fish that overwinter within the fishway if the fishway is not taken out of service during off-season. These data can be used to adjust Within-Fishway Passage Efficiency estimates.

Key assumptions associated with this approach include (1) tagged fish have the same probability of survival and passage through the fishway as untagged fish, (2) behavior of tagged fish is the same as untagged fish, (3) tagged fish intend to pass upstream of the dam through the fishway, (4) tags are not shed or lost, (5) tagging effects do not affect subsequent detections, and (6) enough fish are tagged, or detection efficiencies are high enough to estimate passage success accurately. An important assumption is that adult lamprey captured and tagged within the fishway desire to pass the project. Results from recent tagging studies indicate that adult lamprey can move through various projects multiple times before entering a downstream tributary, reservoir, or tailrace to spawn. This means that not all adult lamprey that enter a fishway intend to pass the dam. Rather, these fish may interact with the fishway but ultimately move downstream of the dam and reproduce successfully. Thus, it is important to track these fish for at least two years to determine their final location if they spawn downstream from the project. Within-Fishway Passage Efficiency can then be adjusted based on these results.

Because of variation in passage efficiency estimates, the Subgroups agreed that at least three valid study estimates would be best to estimate Within-Fishway Passage Efficiency.

3.2 Entrance Efficiency

Entrance Efficiency evaluates how successful adult lamprey are at entering the fishway through existing entrances, assuming the fish desire to move upstream. Mark-recapture techniques with active and/or PIT tags are needed to estimate entrance efficiency. In general, the approach includes capturing adult lamprey within the fishway (assumes the fish intends to pass the project), tagging them, releasing them downstream from the dam, and recording the number of adult lamprey that enter the fishway and are detected at two or more different interrogation stations within the fishway.

Assumptions associated with this approach include (1) tagged fish have the same probability of survival and entering the fishway as untagged fish, (2) behavior of tagged fish is the same as untagged fish, (3) tags are not shed or lost, (4) tagging effects do not affect subsequent detections, and (5) enough fish are tagged, or detection efficiencies are high enough to estimate entrance success accurately. An important assumption is that adult lamprey captured within the fishway desire to pass the project. Because this may not be the case, it is important to track these fish after they are released downstream from the project to determine if fish subsequently move downstream or are consumed by a predator. Entrance efficiency can then be adjusted based on these results.

3.3 Adjusted Inter-Dam Conversion Rates

Adjusted Inter-Dam Conversion Rates estimate the loss of adult lamprey between dams (exit from one dam to the exit of another). In general, window counts at one dam are compared to window counts at another downstream dam. These rates are "adjusted" using results from active and passive tag studies to correct for overwintering, tributary escapement, predation, fallback, re-ascension, and reservoir/tailrace spawning. Some of these "adjustments" are not measurable at this time.

Because this approach relies on dam (window) counts, a major assumption is the dam counts are accurate (i.e., no fish are missed at the dams). Adjustments to dam counts are made using mark-recapture techniques. As before, mark-recapture assumptions include (1) tagged fish have the same probability of survival as untagged fish, (2) behavior of tagged fish is the same as untagged fish, (3) tags are not shed or lost, (4) tagging effects do not affect subsequent detections, and (5) enough fish are tagged, or detection efficiencies are high enough to estimate conversion rates accurately. The mark-recapture estimates must be precise enough to estimate overwintering, tributary escapement, predation, fallback, re-ascension, and reservoir/tailrace spawning. These estimates are then used to adjust dam counts.

4 Assessment of Unavoidable Effects (NNI)

The Subgroup concluded that Within-Fishway Passage Efficiency is the passage metric most likely to be measured accurately. The other passage metrics have assumptions that are difficult to accept or measure. For example, predation and reservoir/tailrace spawning are difficult to measure at this time. In addition, Within-Fishway Passage Efficiency can be estimated with PIT tags and other less preferable technologies. Thus, the Subgroups recommend Within-Fish Passage Efficiency as the primary metric for assessing adult lamprey passage success. The Subgroup believes this is the most appropriate metric are assessing unavoidable effects.

Once an adequate estimate of Within-Fishway Passage Efficiency is generated (based on at least three valid study estimates with study assumptions achieved), one can then estimate unavoidable effects (NNI). However, at this time, the Subgroups were unable to define NNI in terms of passage success. That is, does 100% passage efficiency define passage success, or is it defined as something less than 100% assuming that some level of mortality – like predation – occurs under natural conditions? In addition, the Subgroups were unable to determine at this time what NNI tools (actions) would be used to address unavoidable effects. The Subgroups did note that a greater effort would be needed to address a 70% passage efficiency than, say, a 95% passage efficiency. These are issues that may need to be determined using a model or by consensus of the policy representatives.

5 Juvenile Passage Success

The Subgroups evaluated the current status of methods and tags needed to evaluate juvenile survival and concluded that evaluation of juvenile passage success is not possible at this time.