Independent Scientific Review Panel
for the Northwest Power & Conservation Council
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Memorandum (ISRP 2012-11) **August 22, 2012**

To: Rhonda Whiting, Chair, Northwest Power and Conservation Council

From: Rich Alldredge, ISRP Chair

Subject: Follow-up Review of Accord Proposal, Willamette Falls Lamprey Escapement Estimate (2008-308-00)

Background

At the Council's July 18, 2012 request, the ISRP reviewed a progress report and a response for the Confederated Tribes of the Warm Springs Reservation of Oregon's Columbia River Basin Fish Accord proposal, *Willamette Falls Lamprey Escapement Estimate,* BPA project #2008-308-00. The project is developing quantitative measures for indices of abundance and escapement estimates for adult Pacific lamprey at Willamette Falls. Proposed objectives address the lack of population information in the Willamette River and address how lamprey behavior and vulnerability to predation may affect abundance estimates.

This is a follow-up review to two earlier reviews of the project (ISRP 2011-6 and ISRP 2009-23). In the most recent review from 2011, the ISRP found that the proposal met scientific review criteria and recommended two qualifications:

> The first qualification is that upon completion the full-scale project design be reviewed. The project design should demonstrate clear evidence of the effectiveness of the technologies to meet project objectives: the long-term monitoring protocol(s) and an index of abundance for adult Pacific lamprey at Willamette Falls. This should include a statistical estimate of how many lampreys would have to be tagged to obtain valid abundance estimates.
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> The second qualification is that the ISRP review a progress report at the end of 2011 or early 2012 on two key uncertainties that have not been completely resolved: can PIT-tagged lamprey be successfully detected at passage locations and can lamprey be reliably counted by underwater cameras. The sponsors expect to make significant progress toward addressing these uncertainties in 2011.

The Tribes' response describes that they are still working on a full-scale project design and they expect this design to be developed in the next few years. Consequently, the Tribes' response submittal and thus the ISRP's review focuses on the second qualification regarding the ability to detect PIT-tagged lamprey and to count lamprey with underwater cameras.

Recommendation

Qualification #2: The qualification is partially met.

The sponsors have made progress on developing indices of abundance and escapement estimates for adult lamprey, but the uncertainties noted in the 2011 ISRP review have not been completely resolved.

Specifically, the 2011 annual progress report was completed and submitted to BPA and one of the key uncertainties was addressed – PIT tagged lamprey can be detected with reasonable efficiency at fixed sites in fishways/ladders at Willamette Falls. The other key uncertainty was not resolved – "can lamprey be reliably counted with underwater video cameras?" The problems of having no reliable motion detection system, a lack of an automated video tape review system, and technical difficulties with the hard drive have not been overcome. It appears that the uncertainties associated with all methods can be reduced if diligently pursued with attention to quality assurance/quality control. However, if not significantly improved in the next field season, the current procedure should probably be dropped. Alternate underwater video camera systems may be more appropriate (see below).

Careful investigation of the associations among multiple indicators of abundance should provide insights into lamprey abundance over time. In this manner the project can provide information about lamprey at Willamette Falls as well as sharing lessons learned with other managers in the region.

Qualification #1: The qualification is not met and, as noted by the sponsor, was not intended to be met with this submittal.

The ISRP requests a review of the full-scale project design in the very near future, and certainly before the start of the 2014 field season. The sponsors are encouraged to get some assistance because of the complexity of passage monitoring, recent modifications to the old fishway, and the various problems encountered with monitoring systems. The ISRP recommends that the sponsors partner with an agency or firm to develop the technical aspects of passage monitoring in such a complex system as Willamette Falls. Some possibilities are NOAA Fisheries, Pacific Marine Fisheries Commission, ODFW, the Oregon State COOP Research Unit, or private consultants. Technology from the USACE studies on lamprey at the Columbia River mainstem dams may also be applicable to the Willamette. Finally, the ISRP suggests that the sponsors hold a workshop focused specifically on Willamette Falls lamprey monitoring issues.

Clear evidence of the limitations of the technologies was presented candidly. The sponsors have not been able to develop a scientifically defensible full-scale design. As experience is gained completion of the project design should be possible. An important advance is that the sponsors can obtain sufficient tagged fish to get reasonable estimates of abundance. However, the ISRP does have some concerns about statistical aspects of the estimation methodology, as described below. The full-scale project design should include justification of sample design including sample sizes for all estimation methods.

Comments

PIT-Tag Detection

The sponsors are making progress despite numerous technical and procedural difficulties. Association between PIT tag detections and other abundance estimates, such as stratified camera counts and creel surveys should continue.

The sponsors should explain why half-duplex PIT tags are being used rather than full-duplex tags. The tradeoffs between the two tag types are relatively well known, but information should be presented on how these tradeoffs, such as size, ease of injection, and range of detection, apply to this project.

The estimate of the number of lamprey passing the fish ladder relies heavily on two assumptions that should be examined. First, extracting subsets of tagged lamprey that are known to have passed over the ladder assumes that there is a 100% detection probability of a PIT-tagged lamprey being detected if it ascends the ladder. The report mentions "marker tags" being deployed to ensure that the array were in continuous operation, but this is not the same as ensuring a 100% detection rate of tagged lamprey. Placing a known number of pre-tagged lamprey below the arrays would allow estimating the fraction being detected to confirm the detection rate. Second, the project assumes that PIT-tagged fish have the same behavior as untagged fish. But the tagged sample is derived from lamprey that have already started up the fish ladder and were holding in the lamprey trap. It is conceivable that these fish are "predestined" to migrate, and so the fraction of fish that choose to migrate over the ladders would be overestimated. Note that this problem has no effect on the estimate of fish moving up the ladders, but rather on the expansion factor for fish that do not migrate. It is not clear how to test if this effect is occurring – perhaps some sampling and tagging of lamprey from the horseshoe area before they move up the ladder would provide some information about this potential problem.

Detection in the new fishway after the three legs merge (pool 48) is fairly good, but the two detectors on the ramps at the falls appeared to fail. Modifications for 2012 may work for the ramps but this needs to be checked. The sponsors will also need to set up detectors and check detection efficiency in the old fishway, which was modified in October 2011.

Additional problems appear to be related to databases for PIT tags, with tags being detected that are not in the database. Coordination of tagging and database sharing are essential for successful interpretation of results.

Underwater Camera Counts

Despite difficulties it may be worthwhile to continue using the underwater camera video as a source of lamprey abundance information if substantial improvements can be demonstrated in the next field season. Perhaps time stratification can be used to extract counts for a subset of the time that can be related to counts from other detection methods. There are prospects for future application, pending further technical development and staff training. However, unless

efforts to identify an effective way to integrate the mark-recapture data with the video counts are successful this methodology should be dropped.

Alternate methods may be available. The sponsors may find it useful to review methods used by the Department of Fisheries and Oceans (DFO), Canada, to estimate outgoing juvenile smolt abundance in Chilko Lake BC.[1] Smolts are directed through a trap that is built underneath a counting shack. The counting shack has a digital camera mounted overhead that can photograph the entire trap floor board. Photos are taken every five minutes to capture smolt abundance. Counts of fish in these photos are used in conjunction with hand-tallied travel times of smolts across the floor board to calculate estimates of total fish passage for each five minute interval. The method may be applicable, with modification, to reduce the amount of video examination required for counting lamprey.

Other

Estimation of the number of lamprey going over the ladders uses a simple-Petersen estimator that assumes equal catchability over the entire season. More recent methods for analyzing capture-recapture data that can deal with problems such as changing catchability over time, travel time between release and recapture, and missing data by extrapolating for periods where no sampling occurred should be reviewed for applicability to this project (Schwarz et al. 2009, Bonner and Schwarz 2011). In addition, the sponsors should consider more recent methods for confidence intervals (Equation 3) that used profile intervals and related likelihood methods (Steinhorst et al. 2004).

The two annual progress reports are welcome, but the usefulness of the reports is limited because data in tables or appendices are lacking. This includes: detection efficiencies by day, week, or month; fallback data; ramp passage data; and detailed reporting regarding the video data. Appendix D does provide actual data.

Creel census for abundance estimates is promising as participation is high. However, more consistency is required because sometimes the data are weights and sometimes they are counts. Also, currently only total data are given but specific data would be more useful.

References

Bonner, S. B. and C.J. Schwarz. 2011. Smoothed estimates for time-stratified mark-recapture experiments using Bayesian p-splines. Biometrics 67, 1498-1507. DOI: 10.1111/j.1541-0420.2011.01599.x.

Schwarz, C.J., D. Pickard, K. Marine and S.J. Bonner. 2009. Juvenile Salmonid Outmigrant Monitoring Evaluation, Phase II– December 2009. Final Technical Memorandum for the Trinity River Restoration Program, Weaverville, CA. 155 pp. + appendices. Available at: www.fws.gov/arcata/fisheries/reports/technical/TR_Final_Report.pdf

[1] See www.sfu.ca/grow/science/resources/1289336126.pdf (page 13). A contact for this work is David Willis, Stock Assessment Biologist, Department of Fisheries and Ocean, Canada, David.Willis@dfo-mpo.gc.ca, 250-851-4953.

Steinhorst, K., Y. Wu, B. Dennis and P. Kline (2004). Confidence Intervals for Fish Out-Migration Estimates Using Stratified Trap Efficiency Methods, Journal of Agricultural, Biological, and Environmental Statistics Vol. 9, No. 3 (Sep., 2004), pp. 284-299.