

XII. DIAGNOSTIC STUDY: FISH LADDER AND NATURAL BARRIER ASSESSMENT USING RADIOTELEMETRY

Introduction. The CALFED Technical Panel Report suggests in Section 3.1.2 that post-construction evaluation of the fish ladders proposed for the Battle Creek Salmon and Steelhead Restoration Project should include a more intensive evaluation of the movement and possible delay of adult salmon through the fish ladders. Because the ladder designs incorporated all appropriate features determined necessary and feasible by a multi-agency design team, the Adaptive Management Team had originally viewed an intensive passage study as unnecessary unless the proposed ladder passage counts and visual operations during other monitoring provided reason to suspect a problem may exist. In response to the Technical Panel suggestions that a radio-tag study should be conducted, the following study concepts are presented to examine Passage Objectives 1 and 3 from the Adaptive Management Plan (upstream passage of adult salmon and steelhead at dams and over natural obstructions).

Steelhead distribution surveys are a required element of the Restoration Project MOU. CALFED has funded a 2 year study to evaluate the feasibility of using kayak-based steelhead redd surveys for to meet long term population monitoring needs in Battle Creek. Although the kayak survey has not been completed, it appears likely that it will not be able to achieve Restoration Project goals. Use of radiotelemetry to monitor the distribution of steelhead may be the only feasible option for the Restoration Project. Therefore, radiotelemetry has become a higher priority.

Measuring or verifying fish passage is important in meeting AMP Fish Passage objectives. Although Restoration Project fish ladders were designed with high standards, using modern procedures, the constructed ladders may not function as intended. The Restoration Project increased minimum flows were prescribed specifically to allow fish passage at barriers identified in a 1989 barrier study (TRPA). The natural barriers in Battle Creek mostly consist of boulder clusters which form small plunges, waterfalls and chutes. The boulder clusters can shift and move over time. For instance, a barrier has evolved on the North Fork since the TRPA study which in 2001 and 2002 blocked spring Chinook passage at flows of 30 cfs (Brown and Newton 2002, Brown et al 2004).

The following are key uncertainties that could be addressed through the proposed radiotelemetry study.

3I-3M How will spawning activity be distributed within the restored habitat that is made accessible by reducing natural obstacles with higher instream flows?

3H-3M How will spawning activity be distributed within the restored habitat that is made accessible by fail-safe fish ladders?

3C-3H Will fail-safe fish ladders insure adequate upstream passage at dams?

3D-3I Will new instream flows provide fish passage at natural obstacles that meets the level predicted using Powers and Orsborn methodology and will that level of passage meet or exceed that required for fish ladders?

Null Hypothesis. After completion of the Battle Creek restoration project, anadromous salmonids will be able to pass fish ladders at North Battle Feeder Diversion Dam, Eagle Canyon Diversion Dam, and Inskip Diversion Dam and potential natural barriers downstream of those fish ladders within three days of encountering each point. Results will have to take into account natural factors that could delay transit time, such as very cold temperatures or very high flows.

Alternative Hypothesis. In the absence of natural factor to delay transit time, passage at natural barriers and dams is delayed longer than three days of encountering each obstruction and may require some sort of remedial action.

Study Period. In order to allow for the evaluation of fish movement in a variety of flow conditions and water year types the AMPT proposed to study the movement of tagged steelhead and spring Chinook salmon for three migration seasons after the ladders are constructed. This proposal details \$210,517 in costs for the first year of such a study, for inclusion in initial funding for the Restoration Project. The estimate assumes that the USFWS to do work with existing gear. The costs to do the work with all new equipment would be \$318,725. Costs for two follow-up years would be similar, approximately \$211,000 per year, to account for equipment replacement and inflation.

Study Concept , Radio Tagging Study

To assess upstream movement of steelhead and salmon in Battle Creek under the modified flows and project configurations, 50 adult steelhead and 50 spring Chinook would be to radio-tagged when collected at the CNFH barrier weir, to track their movement in the watershed. Radio-tags are proposed rather than alternative methods (e.g. half-duplex PIT tags) because they allow the tracking of the movement of individual fish using both fixed and mobile receivers, which will more complete analysis of the upstream movements and distribution of tagged fish. In comparison, PIT-tagged fish can be monitored effectively only as they pass fixed sites. However, radio tags are expensive (\$200/each) and involve greater tagging stress than PIT tags. Thus a relatively small sample size would be needed for a radio tracking study.

Proposed Monitoring Sites:

1. Battle Creek downstream of CNFH counting weir (to assess fallback)
2. Battle Creek upstream of Coleman P.H.
3. N.F Battle Creek at mouth.
4. S.F. Battle Creek at mouth
5. N.F Battle Creek downstream of known natural barrier at river mile 3.05
6. N.F Battle Creek upstream of known natural barrier at river mile 4.5.
7. N.F Battle Creek downstream of Eagle Canyon Diversion.
8. Entrance to Eagle Canyon fish ladder

9. Exit to Eagle Canyon Fish Ladder
10. N.F. Battle Creek downstream of North Battle Creek Feeder Diversion
11. Entrance to North Battle Creek Feeder fish ladder
12. Exit to North Battle Creek Feeder fish ladder
13. S.F. Battle Creek downstream of Inskip Diversion
14. Entrance to Inskip Diversion fish ladder
15. Exit to Inskip Diversion fish ladder

Remote monitoring stations at these points will allow assessment of fish movement after handling and tagging (sites 1 & 2), searching behavior at the confluence of the forks (sites 3 & 4), behavior at natural barriers in the North Fork Battle Creek (sites 5 & 6), and arrival at and passage through each of the three fish ladders (sites 7-15). In addition to fixed tracking sites, mobile tracking will be conducted during the course of other studies including temperature monitoring, juvenile habitat use monitoring, fish community monitoring, and especially snorkel surveys.

Radio Tracking Cost Estimate	# of Units	Unit Price	Total
Receiver/data logger w/DSP & multiple antennas for dams & ladders	1	\$17,000	\$17,000
Receiver/data logger w/ multiple antennas & solar system for remote sites	1	\$11,000	\$11,000
Portable receivers	2	\$4,000	\$8,000
Tagging Equipment			\$200
Radio tags	100	\$200	\$20,000
Vendor Field support			\$5,000
Computer	1		\$2,500
Field supplies			\$6,392
Salary			\$116,206
Indirect costs			\$24,219
Total			\$210,517