

XI. FOCUSED STUDY: FISH COMMUNITY STRUCTURE EVALUATION

The proposed focused study will estimate changes in the distribution of fish species in anadromous reaches of Battle Creek and estimate the feasibility of making abundance estimates for a few species. Cost estimates are provided for a year of baseline data from pre-project conditions and a year of sampling 3 to 5 years after the restoration project is complete.

Background

The goals of the Battle Creek Salmon and Steelhead Restoration Project (Restoration Project) include restoring about 48 miles of anadromous fish habitat in Battle Creek and its tributaries and minimizing the loss of renewable energy produced by the Battle Creek Hydroelectric Project. The Restoration Project includes removal of dams; construction of fish screens, fish ladders, stream gages, and other facilities; and changes to stream flow (Jones & Stokes 2003).

Many of these Restoration Project elements may impact the distribution of non-target fish species.

Changes in the Battle Creek fish community may impact the target salmon and steelhead populations through competition or predation. These interspecific interactions are currently not considered key to the success of the Restoration Project nor important in choosing between adaptive management alternatives. However, there is enough uncertainty in our understanding of the ecological role of these interspecific interactions, to warrant baseline studies to evaluate the impact of the Restoration Project on fish distribution.

The footprint of the Restoration Project includes the expected range of the pikeminnow-hardhead-sucker fish assemblage (Moyle 2002) referred to here as the foothills assemblage. For instance, in Deer Creek which like Battle Creek also drains Mount Lassen, the assemblage ranges from 91 m (300 feet) to 550 m (1805 feet). Based solely on elevation the foothills assemblage could therefore range in Battle Creek from the confluence with the Sacramento River almost to the North Battle Feeder Dam on the North Fork (2060 feet) and South Diversion Dam on the South Fork (2030 feet) which are the upstream-most project features of the Restoration Project. However, at these elevations, water temperatures are lower in Battle Creek than in Deer Creek (Ward and Kier 1999). Battle Creeks high base flow and cool water temperature may reduce the upstream range of some species.

In a 1989 study of fish abundance in Battle Creek, most of the species of the foothills assemblage were not found upstream of Eagle Canyon Dam (1420 feet) and Inskip Diversion Dam (1410 feet) (TRPA 1990). The TRPA study noted that non-game species were more abundant in downstream reaches and bass were limited to the mainstem. The foothills assemblage also includes tule perch, speckled dace, California roach riffle sculpin, and rainbow trout, as well as introduced species such as smallmouth bass and green sunfish (Moyle 2002) .

The Restoration Project may also change the distribution or abundance of four watch-list species: hardhead (*Mylopharodon conocephalus*), river lamprey (*Lampetra ayresi*), western brook lamprey (*L. richardsoni*), Pacific lamprey (*L. tridentata*). A Watch-list species “appears to be declining but is not yet in serious trouble. Its populations needs to be monitored to see if special protective action is necessary” (Moyle 2002). Positive or negative impacts to these species may be detected by relatively simple presence absence surveys.

Abundance estimates of these species would also be very useful in understanding the issues involving competition and rare species, but it is uncertain if standard techniques would be effective. During the TRPA fish abundance study, it was concluded that electrofishing was not feasible as a calibration technique for the entire suite of fishes (TRPA 1990). Direct observation alone is not adequate for detecting the entire Battle Creek fish community or estimating abundance. The TRPA study stated “Results of initial field applications dictated that electrofishing effort be severely restricted and increased reliance placed on the direct observation technique”. Other than one study site on the South Fork, “the remainder of all study sites were sampled by direct observation” which “tended to favor the salmonid species” (TRPA 1990).

However, electrofishing may be effective for estimating abundance of a single guild such as lampreys. The feasibility of developing abundance estimates for the lamprey species will be investigated. It is uncertain if the three lamprey species all inhabit Battle Creek. There is little information on lamprey species in Battle Creek as these cryptic species reside in silt or sand substrate, identification procedures for their larval stages require sacrificing the animals to count meristic characteristics, and they are not retained by the Coleman National Fish Hatchery barrier weir fish trap.

Physical setting

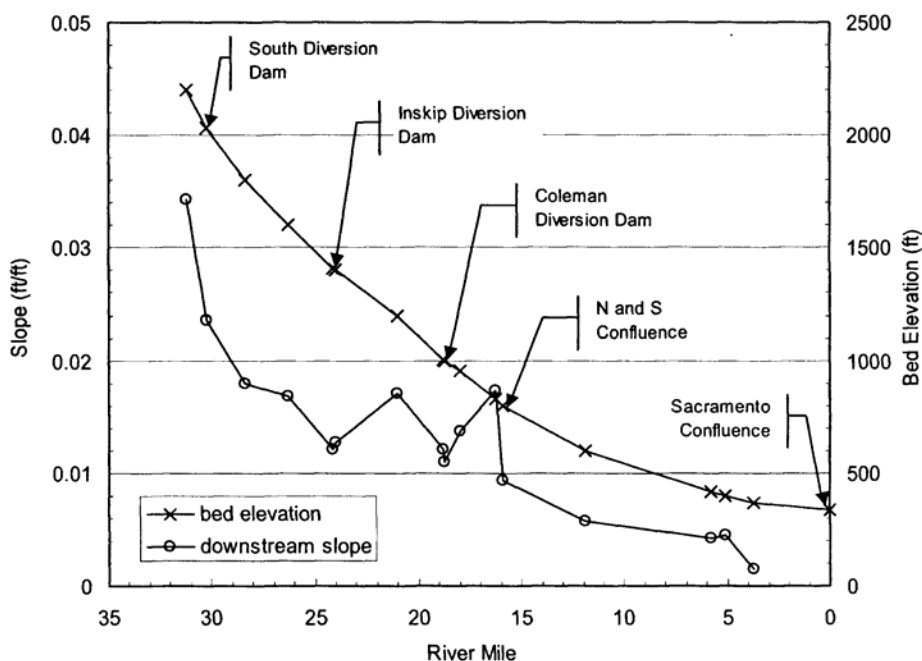


Figure 1. Bed profile of South Battle and Battle Creeks. Modified from Greimann 2001b.

Uncertainties

Uncertainties and learning opportunities pertaining to possible changes in fish community structure will arise from Restoration Project implementation, especially from Dam removal and changes in flow and water temperature regime

- How will fish species distribution change?
- How will these changes relate to changes in water flow and temperature?
- Will populations of potential predators of RP target species increase?
- Will populations of watch species increase?

Conceptual Model

Dams, diversions and natural barriers in Battle Creek may restrict the distribution of the foothills stream assemblage by blocking fish passage, entrainment of fish into the canal system, and alterations of the thermal regime. Removal of the dams may increase the range of many species including predators or competitors which could have an impact on restoration Project target salmonids. An important assumption is that dams and water diversions have restricted the distribution of fishes in Battle Creek.

There is uncertainty in how the fish species distribution will change in response to the Restoration Project. Increased fish passage may allow the upstream extension of the range of non-target anadromous species and predator species. The restoration project will produce complex changes in water temperature. Water temperatures may be higher or lower than pre-project conditions depending on time of year and location. These changes in water temperature may favor some species resulting in changes in fish species distribution.

Hypotheses

- The distribution of the foothills assemblage will increase upstream following the Restoration Project.
- The distribution of predatory species will increase upstream following the Restoration Project.
- Watch-list species will increase in abundance and distribution following dam removal.
- Changes in fish distribution will be related to changes in water temperature.
- Changes in fish distribution will be related to improvements in fish passage.

Monitoring Goals and Objectives

Goal- Estimate changes in fish community distribution or abundance which may affect the success of the restoration project or which may result from the Restoration Project.

Objectives (MC refers to monitoring components described in subsequent section)-

1) Estimate fish species distribution in the anadromous reaches of battle creek immediately before and a few years after implementation of the Restoration Project. Presence or absence of species within a reach will be estimated using one or two sampling sites (MC 2) and incidental observations (MC 5).

2) Estimate feasibility of estimating abundance of a few target species such as predators or lamprey immediately before and a few years after implementation of the Restoration Project. Population of predators and hardhead will be indexed (MC 1). Population abundance of lamprey will be estimated (MC 3). Juvenile abundance estimates (MC 4) will also be evaluated.

Monitoring components

MC 1. Snorkel surveys of entire project area for large bodied fishes.

Snorkel surveys of Battle Creek would be conducted to obtain population indexes for large bodied species, including pikeminnow, hardhead, Sacramento sucker, and smallmouth bass. Counts of rainbow trout are currently conducted during existing salmonid snorkel surveys and are not included as part of this survey. Snorkel counts would be used to index populations of pikeminnow and bass that could be predators of the Restoration Project target salmonids.

The large bodied fish surveys would be conducted separately from the salmonid surveys, to insure more complete counts and because methods differ slightly between the two surveys. Centrarchids larger than 9 inches and cyprinids larger than 12 inches will be counted by 3 snorkelers using standard direct observation techniques. Four surveys would be conducted during approximately one year to capture seasonal variability and determine the best time of year to base the index.

MC 2. Distribution surveys.

Standard fisheries sampling using multiple techniques including electrofishing, seining, and direct observation, will be conducted at sites within all naturally anadromous reaches of Battle Creek. While one site will be selected within each of 18 reaches, a few additional sites will be selected to more clearly define the current upper ranges of the fishes.

MC 3. Feasibility-level abundance estimates.

More intensive electrofishing will be conducted in a few sites to determine the feasibility of estimating the abundance of the 3 lamprey species. If feasible and within cost constraints, baseline abundance estimates will be made. Sites would ideally include habitat above and below the current distributions, including sites on both forks and the mainstem. The study would be dependant upon results from distribution surveys to determine the best sites for sampling.

MC 4. Rotary screw trapping.

Two rotary screw traps have been operated on Battle Creek starting in 1998. All non-larval fish are identified and counted, and a subsample is measured. Catch data expressed as fish per acre foot will be compared before and after the Restoration Project to detect large changes in abundance of juvenile fish.

MC 5. Incidental observations.

Observations incidental to other fisheries monitoring, including snorkel surveys, habitat use studies, barrier weir monitoring, radiotelemetry and fish rescue will be incorporated into the analysis of fish species distribution.

Monitoring Cost Estimates**Baseline study**

MC 1	\$28,600
MC 2	\$95,700
MC 3	\$28,050
Total	\$152,350

Post project study

MC 1	\$47,500
MC 2	\$137,500
MC 3	\$31,875
Total	\$216,875

Possible Adaptive Responses

Increases in distribution or abundance or concentrations of predatory fish could suggest a follow-up predator investigation, or changes in facilities that may concentrate predators.

Increases in distribution or abundance of the watch-list species could suggest that dam removal or flow restoration may be a tool for improving populations of these fishes.

Declines in distribution or abundance of the watch-list species could suggest further studies or remedial actions.

Table 1. Fish species observed or suspected to occur in Battle Creek based on monitoring by U.S. Fish and Wildlife Service.

Common Name	Latin Name	Native/ Invasive	Observed/ suspected
Black Bullhead	<i>Ameiurus melas</i>	I	O
White Catfish	<i>Ameiurus catus</i>	I	O
Brown Bullhead	<i>Ameiurus nebulosus</i>	I	S
Sacramento Sucker	<i>Catostomus occidentalis</i>	N	O
Prickly Sculpin	<i>Cottus asper</i>	N	O
Riffle Sculpin	<i>Cottus gulosus</i>	N	O
Western Mosquitofish	<i>Gambusia affinis</i>	I	O
Threespine Stickleback	<i>Gasterosteus aculeatus</i>	N	O
California Roach	<i>Hesperoleucus symmetricus</i>	N	O
Tule Perch	<i>Hysterocarpus traski</i>	N	O
Channel Catfish	<i>Ictalurus punctatus</i>	I	O
River Lamprey	<i>Lampetra ayresi</i>	N	S/O
Western Brook Lamprey	<i>Lampetra richardsoni</i>	N	S/O
Pacific Lamprey	<i>Lampetra tridentata</i>	N	S/O
Hitch	<i>Lavinia exilicauda</i>	N	O
Green Sunfish	<i>Lepomis cyanellus</i>	I	O
Bluegill	<i>Lepomis macrochirus</i>	I	O
Smallmouth Bass	<i>Micropterus dolomieu</i>	I	O
Spotted Bass	<i>Micropterus punctulatus</i>	I	O
Largemouth Bass	<i>Micropterus salmoides</i>	I	O
Hardhead	<i>Mylopharodon conocephalus</i>	N	O
Golden Shinner	<i>Notemigonus crysoleucas</i>	I	O
Rainbow Trout/Steelhead	<i>Oncorhynchus mykiss</i>	N	O
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	N	O
Sacramento Pikeminnow	<i>Ptychocheilus grandis</i>	N	O
Speckled Dace	<i>Rhinichthys osculus</i>	N	O

References

- Moyle, Peter B. 2002. Inland Fishes of California. University of California Press, Berkeley and Los Angeles California.
- TRPA (Thomas R. Payne and Associates). 1990. Draft Species Abundance Report Battle Creek. Prepared for California Department of Fish and Game.
- Ward, M. B., and W. M. Kier. 1999. Battle Creek salmon and steelhead restoration plan. Report by Kier Associates to Battle Creek Working Group.