

## VIII. FOCUSED STUDY: JUVENILE SALMONID HABITAT USE STUDY

Many uncertainties were identified related to juvenile salmonid habitat use, distribution and abundance, some of which may be key to the success of the Battle Creek Salmon and Steelhead Restoration Project (Restoration Project). Testing some of these uncertainties may result in improvements in Restoration Project flows as well as aid in design of similar projects in other watersheds. The study will have three goals.

### Goals

- 1) to verify the juvenile salmonid microhabitat suitability indices upon which the restoration project flows are based;
- 2) to document the distribution of juvenile salmonids in the restoration project area to verify successful passage, habitat occurrence and juvenile production; and
- 3) to estimate the relative abundance of juvenile salmonids in reaches of the restoration project to determine if they are using the reaches as predicted in conceptual and PHABSIM flow models.

### Background

The restoration Project is a relatively high-cost project, designed using widely accepted processes such as limiting factor analysis, limiting life stage modeling, PHABSIM, SNTEMP, and barrier analysis. The restoration Project will implement widely accepted techniques of dam removal, fish ladder and fish screen construction and increased minimum flows. If these design processes and restoration actions or techniques do not work, other restoration efforts may also fail and waste money.

Many of the uncertainties associated with these processes and techniques are identified in the Restoration Project Adaptive Management Plan (AMP). The proposed study would address many of the key uncertainties. One of the primary features of the Restoration Project is increased minimum stream flows to provide salmonid spawning and rearing habitat. Habitat suitability indices used in prescribing flows for the Restoration Project were based on studies outside of the Restoration Project Area and may not be completely appropriate to each of the target species.

Battle Creek-specific juvenile habitat suitability criteria will be developed when there are sufficient numbers of juvenile salmonids. These Battle Creek specific criteria will be compared to those used in developing the Restoration Project. If considerable differences in criteria exist, model results using both criteria would be compared. Criteria will be developed using state-of-the-art techniques which take into consideration habitat availability, appropriate precision in measurement, and consideration of adjacent velocity. Spawning habitat suitability criteria are currently being developed for spring Chinook and steelhead in Battle Creek.

Many of the questions in the proposed study may be better addressed by estimating fish abundance rather than just fish distribution. It is uncertain if standard techniques for estimating abundance would be effective in Battle Creek. During a 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 is not adequate for detecting the entire Battle Creek fish community or estimating abundance. The TRPA (1990) 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 the study sites were sampled by direct observation” which tended to favor the salmonid species.

### **Conceptual Model**

The fundamental question addressed in this study is will Chinook and Steelhead successfully use Battle Creek as predicted in the conceptual models upon which the Restoration Project is based? The general approach is to verify the expected fish distribution and habitat use patterns by direct observation.

### **Uncertainties**

The AMP includes an extensive list of uncertainties, many of which can potentially be evaluated by the proposed study. Uncertainties are arranged by study Goal. The uncertainty numbering system refers to nodes in Conceptual Models in the AMP (e.g. 2A = node A in Conceptual Model 2). Key uncertainties are indicated in bold.

Goal 1) to verify the juvenile salmonid microhabitat suitability indices upon which the restoration project flows are based;

**2A – Uncertainties are inherent in the IFIM and PHABSIM models (Instream Flow Council (2002 and Castleberry 1996) including: 1) sampling and measurement problems associated with representing 42 miles of stream; 2) sampling and measurement problems associated with developing habitat suitability curves; and 3) problems with assigning biological meaning to weighted usable area; especially without presenting confidence intervals.**

**2A – Habitat suitability criteria curves developed in 1989 in TRPA 1998a, which were based on studies outside of the Restoration Project Area and were applied in the PHABSIM flow-habitat simulation for the three species targeted by the Restoration Project, may not be completely appropriate to each of the target species.**

**2H – IFIM results (WUA curves) cannot be confidently converted to estimates of fish production without validating the 1989 IFIM model for Battle Creek salmon and steelhead (e.g. establishing confidence limits and examining transects for significant changes in channel morphology and applying more appropriate habitat suitability curves, etc).**

Goal 2) to document the distribution of juvenile salmonids in the restoration project area to verify successful passage, habitat occurrence and juvenile production;

**3J-3Q, 2C How will juvenile production (growth, survival, distribution, outmigration) be affected by water temperature regime in warm season?**

**3K-3O Food production, predation risk, growth, competition, disease, and other factors of natural mortality. Low juvenile production threatens project success. Predictions of distribution and estimates of carrying capacity may be confounded. Rather than addressing the mortality factors, the proposed study would document the resulting distribution pattern.**

**2G To what extent will steelhead and four races of Chinook use the “A” and “B” grade habitats as predicted?**

In addition, many of the key adult fish passage uncertainties will be tested indirectly by documenting juvenile fish distribution.

**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?**

Goal 3) to estimate the relative abundance of juvenile salmonids in reaches of the restoration project to determine if they are using the reaches as predicted in conceptual and PHABSIM flow models.

Goal 3 also addresses the uncertainties listed under goal 2.

### **Monitoring Goals and Objectives**

Goal 1 is to verify the juvenile salmonid microhabitat suitability indices (rearing criteria) upon which the restoration project flows are based;

Objective 1 A- Develop Battle Creek-specific rearing criteria within 3 years of Restoration Project construction using observations from at least 250 juveniles of each species (MC 1; MC refers to monitoring components described in subsequent section)

Objective 1 B- Within three years of project construction qualitatively compare new spawning and rearing criteria to old criteria (MC 3). If sufficiently different proceed with Objective 1 C.

Objective 1 C- Determine if Weighted usable Area (WUA) calculated from the new spawning and rearing criteria are within 5% of the WUA used as the basis for RP flows. (MC 2)

Goal 2 is to document the distribution of juvenile salmonids in the restoration project area as an indication of successful passage, occurrence of habitat and juvenile production;

Objective 2 A- Estimate juvenile salmonid distribution in the anadromous reaches of Battle Creek in the year after implementation of the Restoration Project. Presence or absence of species within a reach will be estimated by direct observation at one or two sampling sites (MC 4) and incidental observations (MC 5).

Goal 3 is to estimate the relative abundance of juvenile salmonids in the anadromous reaches of Battle Creek for comparison to the relative habitat values as predicted by the conceptual models and PHABSIM flow-habitat simulation.

Objective 3 A- Estimate variability in juvenile salmonid density and calculate the number of observations required to have sufficient statistical power to distinguish (MC 6).

Objective 3B- Estimate juvenile salmonid density after the Restoration Project.

Objective 3C- Develop relative habitat values from the conceptual models and PHABSIM flow-habitat simulation and compare with juvenile salmonid densities observed in 3B.

#### **Monitoring Components- under development**

MC 1. *Develop new Battle Creek-specific juvenile habitat suitability criteria*

MC 2 *Compare new and old spawning and rearing criteria*

MC 3 *Compare PHABSIM runs using new and old criteria*

MC 4 *Distribution surveys.*

Juvenile salmonid distribution in the watershed will be compared to conceptual models of fish distribution, actual spawner distribution, water temperature and geographic features such as springs, and fish passage barriers.

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. Note the similarity of this study to the proposed Fish Community Distribution Survey Focused Study which could be conducted in conjunction with the proposed study resulting in cost savings.

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.

*MC 6 Estimate feasibility and minimum population size for juvenile abundance study.*

This study will develop methods for abundance estimates especially considering questions of sample size, statistical power and timeline. One year of funding will be sought for the first year after the restoration project is completed and adult fish have been allowed access to the project area. Juvenile salmonid densities may be too low to achieve study objectives and may remain so for many years. Conducting the juvenile studies in the first year will aid in determining the feasibility and logistics of the study, as well as provide baseline data to track the projects' progress over time. During the pilot year, statistical analysis may be able to predict the juvenile population size and number of observations required to detect significant differences. Determining the statistical power of the study may aid in determining when there will be sufficient numbers of fish to begin the rest of the juvenile study. This trigger will be used to determine when to pursue funding for the rest of the study under MC 7.

The Restoration Project area will be habitat typed, and divided into reaches. Sites approximately 100 m in length, which include all major meso-habitat types, will be selected within each reach. Juvenile abundance will be determined at the sites by direct counts, by species and by size class. Relative abundance and distribution in the watershed will be compared to conceptual models of fish distribution, actual spawner distribution, water temperature and geographic features such as springs, and fish passage barriers.

*MC 7. Juvenile abundance study*

Components of this study to be determined by the feasibility study in MC 6.

**Monitoring cost estimates**

Sub Total Cost during Restoration Project (2005 – 2007) = \$100,000 for pilot study in year three. Approximately \$200,000 per year for 2 years in future after sufficient numbers of fish have recolonized the habitat.

**Possible Adaptive Responses**

Adjust flows if warranted by improved flow model (MC 3) in conjunction with other elements such as temperature and barrier analysis. The WAF provides up to \$3M to acquire additional flows in Battle Creek if needed.

**References**

TRPA (Thomas R. Payne and Associates). 1990. Draft Species Abundance Report Battle Creek. Prepared for California Department of Fish and Game.