Physical Variables Influencing Near-shore Habitat Use of Juvenile Chinook Salmon in the Sacramento River

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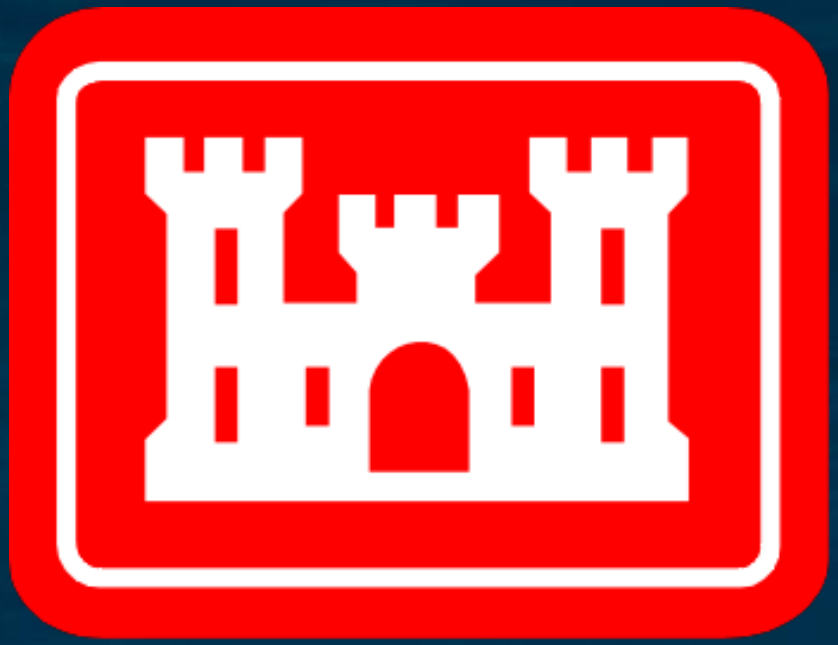
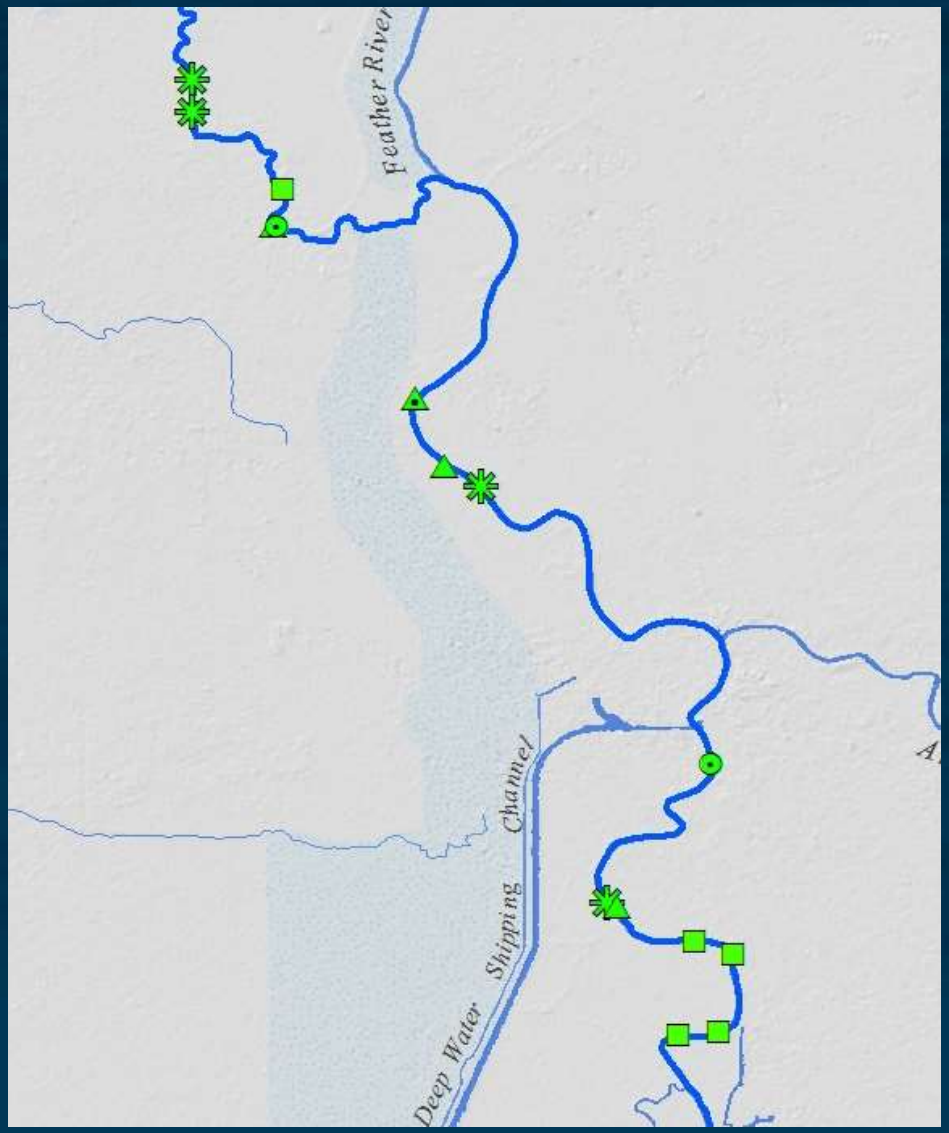


U.S. Army Corps of Engineers

Background & Introduction

- Evaluate habitat use of focal fish species at various post-2006 levee repair sites
- Determine if on-site mitigation features are increasing habitat value to approximate “natural banks”
- Identify which microhabitat features of maximize fish use by focal species



Methods: Locations

Sampling occurred at 16 sites, encompassing 3 site categories:

- Naturalized sites (n=4)
- Unmitigated repair sites (n=3)
- Mitigated repair sites (n=9)

Naturalized

Unmitigated Repair

Mitigated Repair

Methods: Sampling

Sampling by boat electrofishing

Methods: Sampling

Measure associated habitat characteristics at each incursion point

Methods: Sampling

Establish point-specific capture record & habitat parameters

Methods: Variables

Habitat variables:

- Depth / Slope
- Velocity / Gradient
- Substrate
- Temperature difference
- Shade
- Emergent woody material
- Emergent vegetation

Others:

- Event
- Rivermile
- Site/design category

Methods: Habitat Occupancy

- Single-variable logistic regression model to determine if model fit is significantly improved by any one predictor:

$$P_i = \frac{e^{g(x)}}{(1 + e^{g(x)})}$$

- Remove non-significant ($p > 0.25$) predictors from scope for multi-variable model fits
- Use backward model selection to determine the most likely multivariate model

Methods: Habitat Occupancy

- Test fit of the selected model using Hosmer-Lemeshow goodness-of-fit statistic (a high *p*-value indicates a good fit)
- Evaluate classification accuracy with unbiased jackknife estimator
- Determine Cohen's kappa statistic as a chance-corrected measure of prediction

Results: Habitat Value of Mitigated Repair Sites

- Fish densities at mitigated repair sites (all designs) were not significantly different from naturalized sites
- Fish densities at most mitigated repair sites were significantly higher than at non-mitigated sites

Results: Fry Habitat Occupancy

Variables excluded due to non-significance in single model evaluation:

- Shade
- Substrate (at 15 feet)

Multivariate model fitting: Final model

- Vegetation density
- Depths close to shore (5 & 10 feet)
- Velocity close to shore (5 & 10 feet)
- Current gradient
- Substrate close to shore (5 & 10 feet)
- Rivermile

Results: Fry Habitat Occupancy

Occupancy probability key factors

Higher probability at points with:

- Submerged vegetation (sparse, OR = 2.07)

Lower probability at points with:

- Deep water close to shore (OR = 0.63)
- Faster current close to shore (OR = 0.46)

Hosmer-Lemeshow GOF: $p = 0.34$

Jackknife : 88% classified correctly

Cohen's kappa: 0.29 ($Z = 6.54$, $p < 0.01$)

Results: Juvenile Habitat Occupancy

Variables excluded due to non-significance in single model evaluation:

- Shade
- Depth (at 15 feet)

Multivariate model fitting: Final model

- Bank slope
- Density of woody material
- Depths close to shore
- Current gradient
- Temperature difference
- Substrate
- Rivermile

Results: Juvenile Habitat Occupancy

Occupancy probability key factors

Higher probability at points with:

- woody material (sparse OR = 1.78, medium OR = 2.71)
- warmer ambient temperatures (OR = 1.64)

Lower probability at points with:

- Deep water close to shore (> 5ft, OR = 0.06)
- Cooler ambient temperatures (OR = 0.45)

Hosmer-Lemeshow GOF: $p = 0.46$

Jackknife : 81% classified correctly

Cohen's kappa: 0.27 ($Z = 5.96$, $p < 0.01$)

Results: Smallmouth Bass

Variables excluded due to non-significance in single model evaluation:

- Vegetation density
- Depth at 10 and 15 feet
- Velocity gradient
- Substrate

Multivariate model fitting:

- Bank slope
- Density of woody material
- Nearshore current velocity
- Rivermile

Higher chance of occupancy at:

- Steep slopes (OR 2.78)
- Density of woody material (OR, Low: 1.93, Medium: 3.06 , High: 11.11)
- Velocity close to shore (Medium, OR 3.31)
- Abundance decreases with distance upstream (OR 0.98)

FISHBIO

Resident Rearing vs. Migration

- Collect drift samples at select sites
- Gastric lavage of juvenile Chinook
- Dissection of mortalities

Key points:

- Majority of individuals had identifiable gastric contents (>95%)
- Often large number of diet items (~200) suggestive of active feeding
- Seasonally high abundance of larval native fishes in drift and diet
  - Larval fishes can constitute > 60% of drift items
- Typically, copepods and cladocerans constitute > 90% of prey items

Questions?