

Challenges to the San Joaquin River Restoration Program in Times of Drought

CHINOOK



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www.nrdc.org

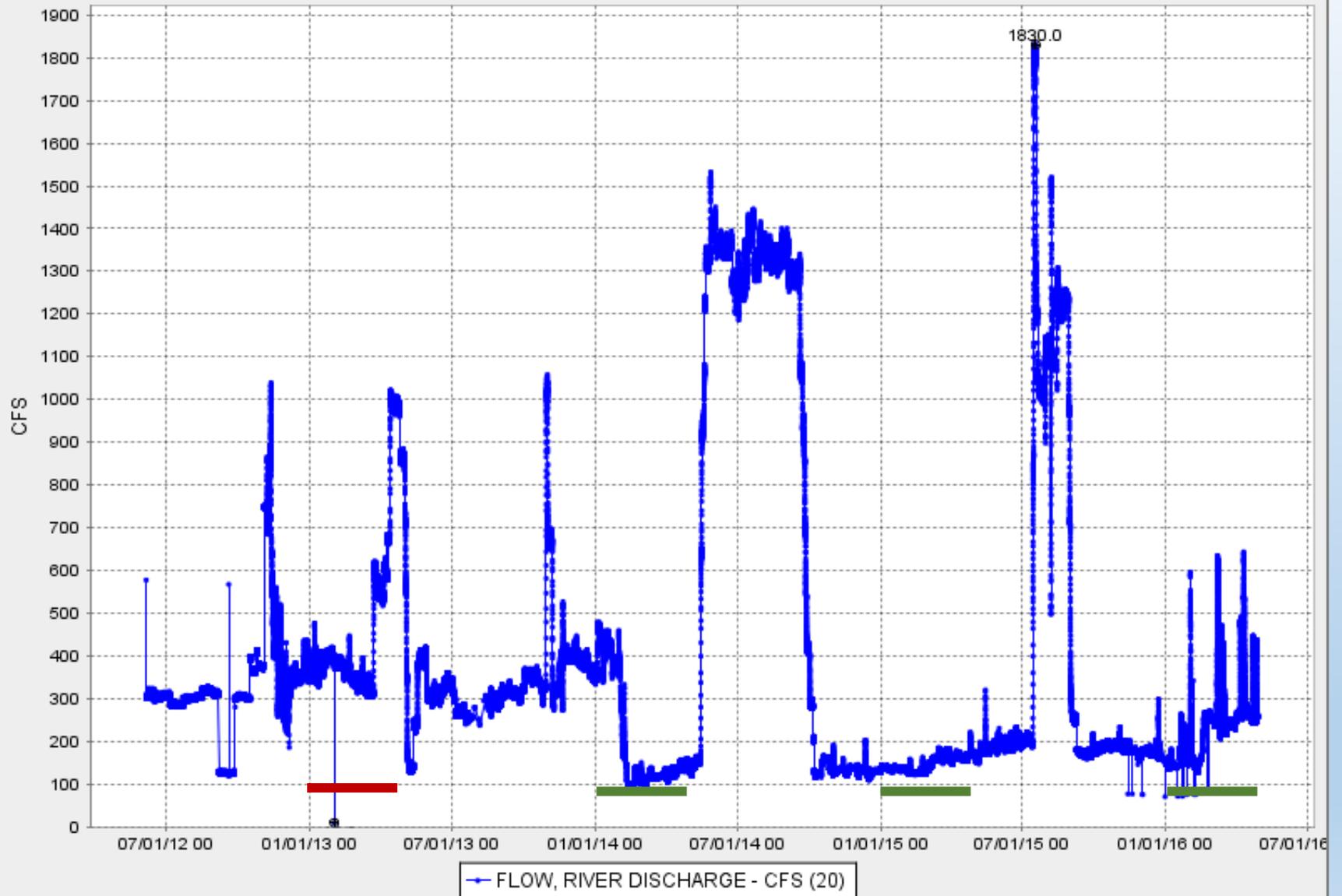
The San Joaquin River Restoration Program (SJRRP) is a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and **restore a self-sustaining Chinook Salmon fishery** in the river while reducing or avoiding adverse water supply impacts from restoration flows.



SAN JOAQUIN R AT HWY 41 (H41)

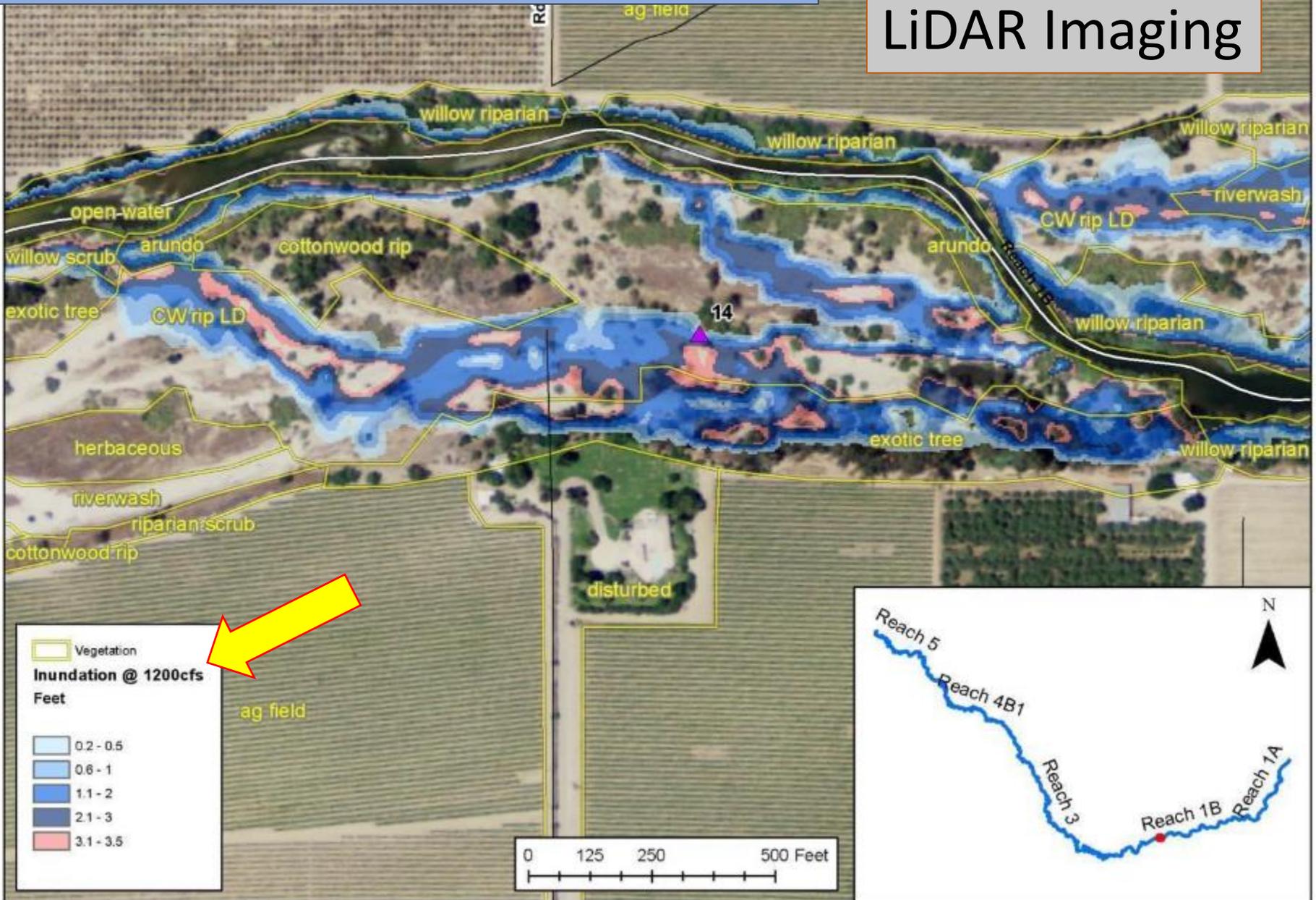
Date from 01/27/2011 00:00 through 04/27/2016 10:34 Duration : 1917 days

Max of period : (07/17/2015 17:30, 1830.0) Min of period : (01/31/2013 12:15, 10.9)



Example SJR Floodplain Habitat

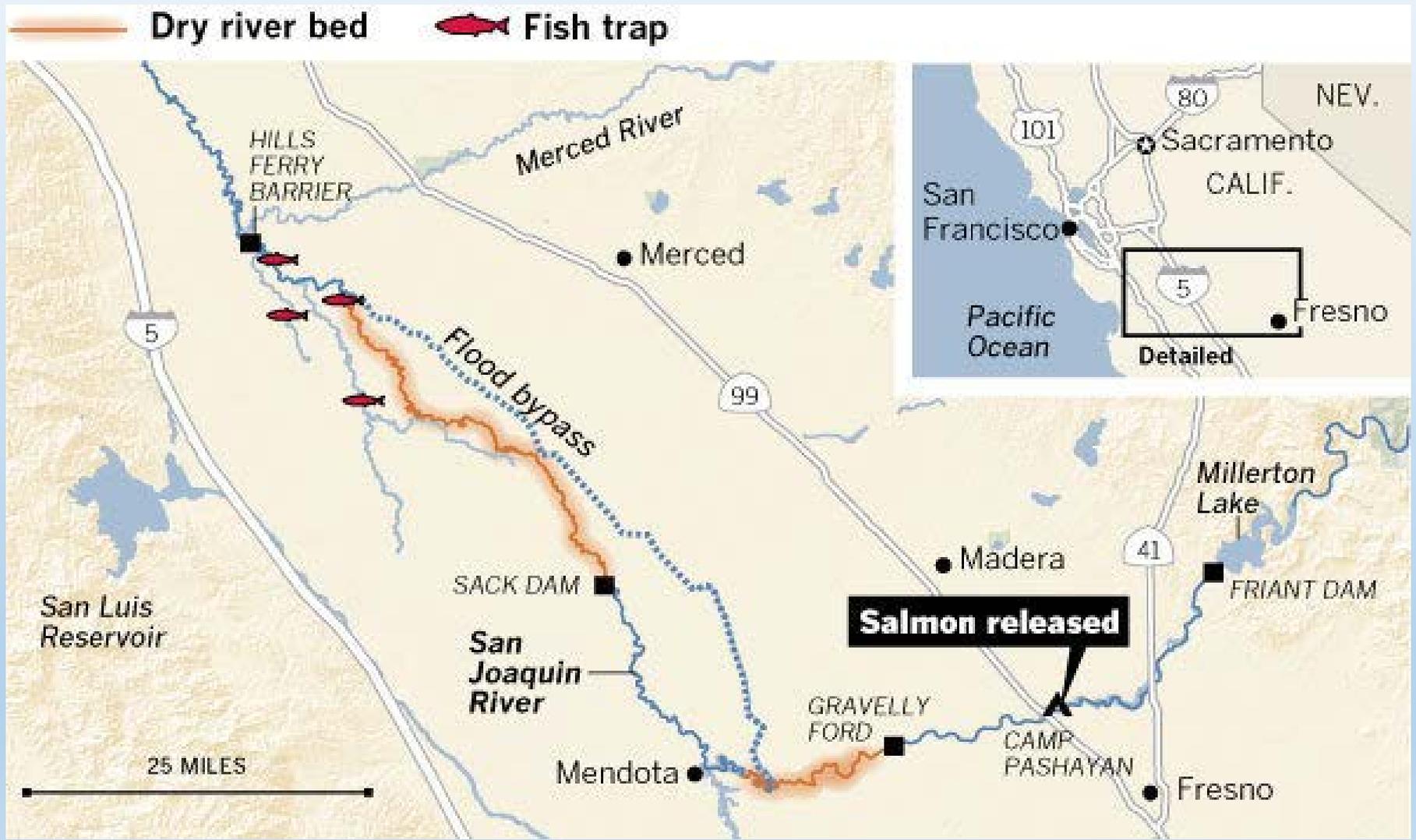
LiDAR Imaging



Critical Low Flow Conditions: April 5, 2014
Friant Dam: 140 CFS This location: 4 CFS

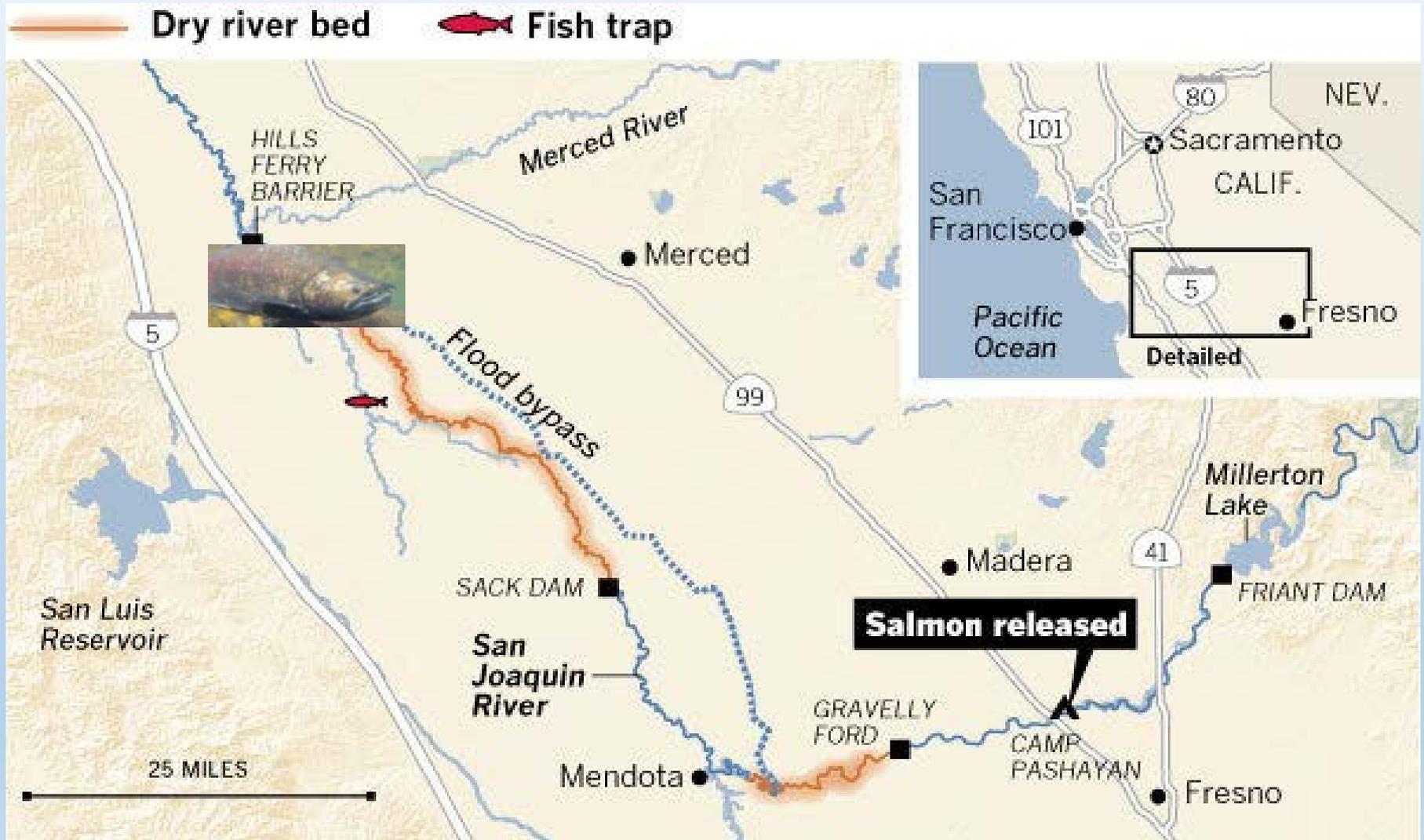


Chinook Salmon Restoration: San Joaquin River, CA



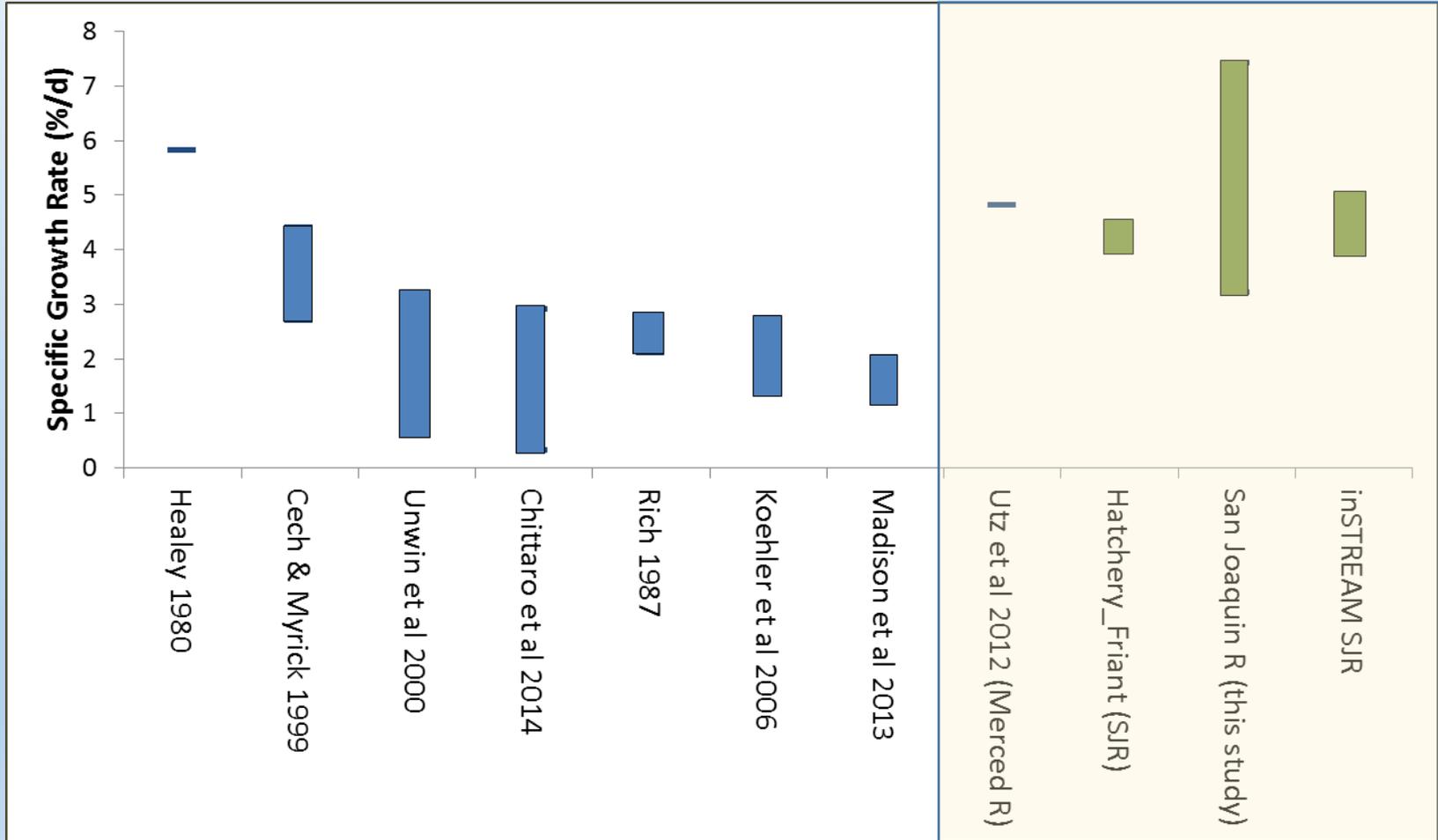
Drought Implications:

How to get adult fish to spawn in the restoration area?



JCS Growth Rates: Building Meta-Analysis

Merced & San Joaquin Rivers



Factors Affecting Salmon Foraging Efficiency

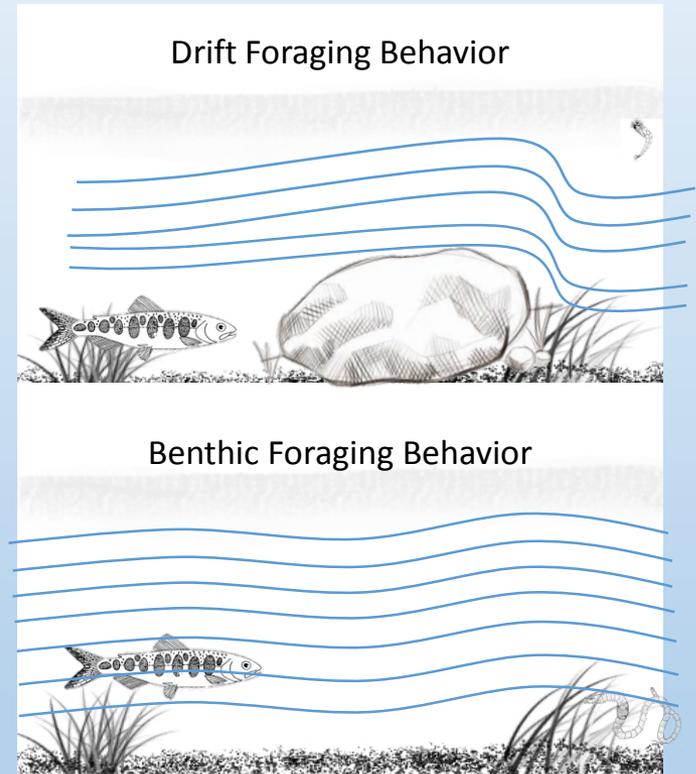
- **Water temperature**
 - Affects metabolism and physiological stress of fish
- **Water velocity**
 - Determines rate of prey delivery
 - Affects water column prey density
- **Water Quality**
 - Affects invertebrate and fish physiology
- **Turbidity**
 - Determines reactive distance for fish
 - Plays a role in invertebrate assemblage
- **Habitat Characteristics**
 - Role in determining invertebrate assemblage
 - Affects fish habitat use and foraging behavior



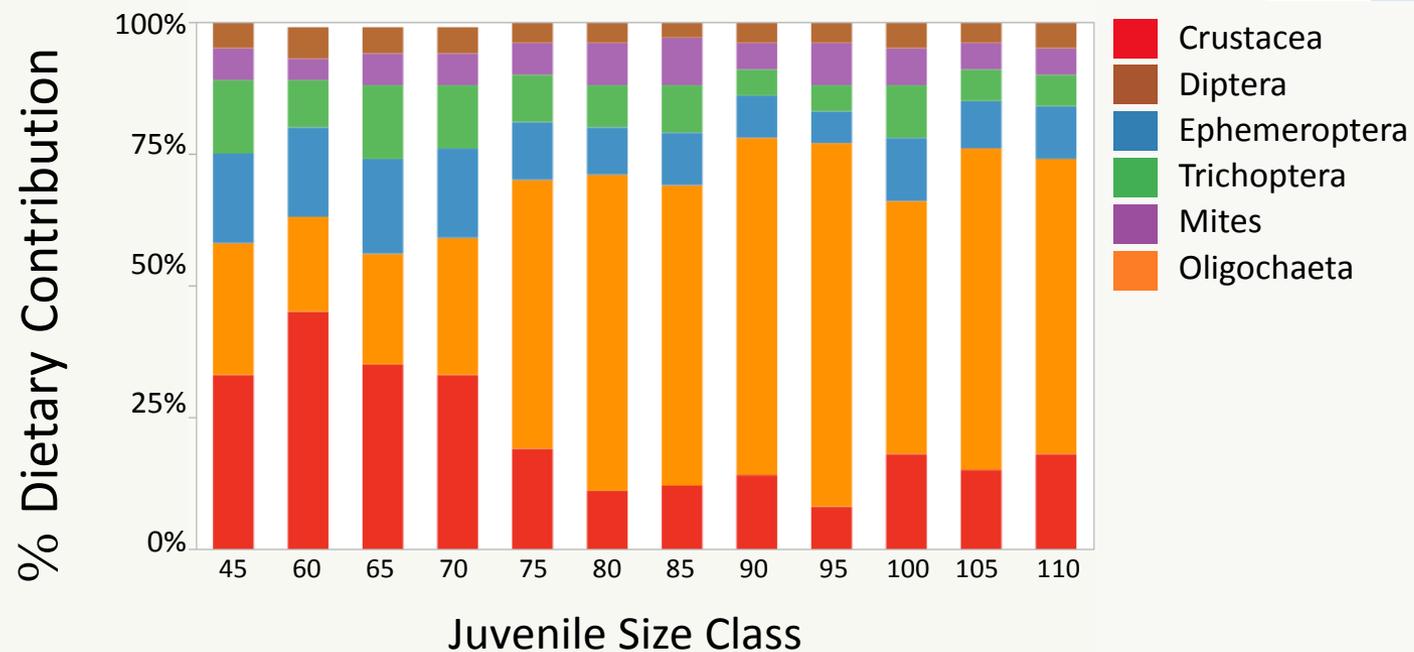
Main Effect of foraging efficiency = Survival & Growth

Foraging Behaviors of Salmonids

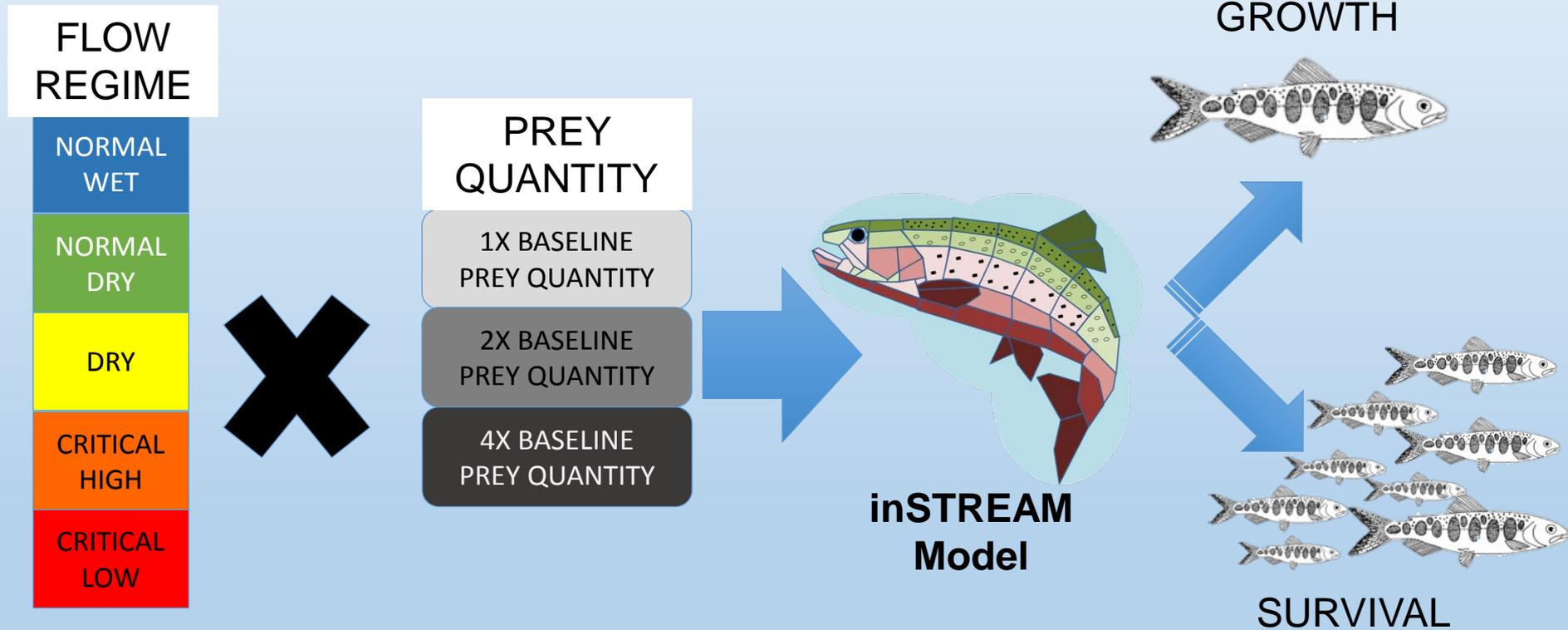
- Most salmon foraging models assume drift foraging only
- Drought conditions in rivers may lessen the efficiency of drift foraging
 - Increased temperatures
 - Decreased prey availability/quality
 - Increased competition and predation risk due to habitat loss
- **Drift = ambush**
 - Usually more efficient, allowing energy to be conserved and net energy intake optimized
- **Search = searching**
 - Usually less efficient, requires actively swimming and searching for prey



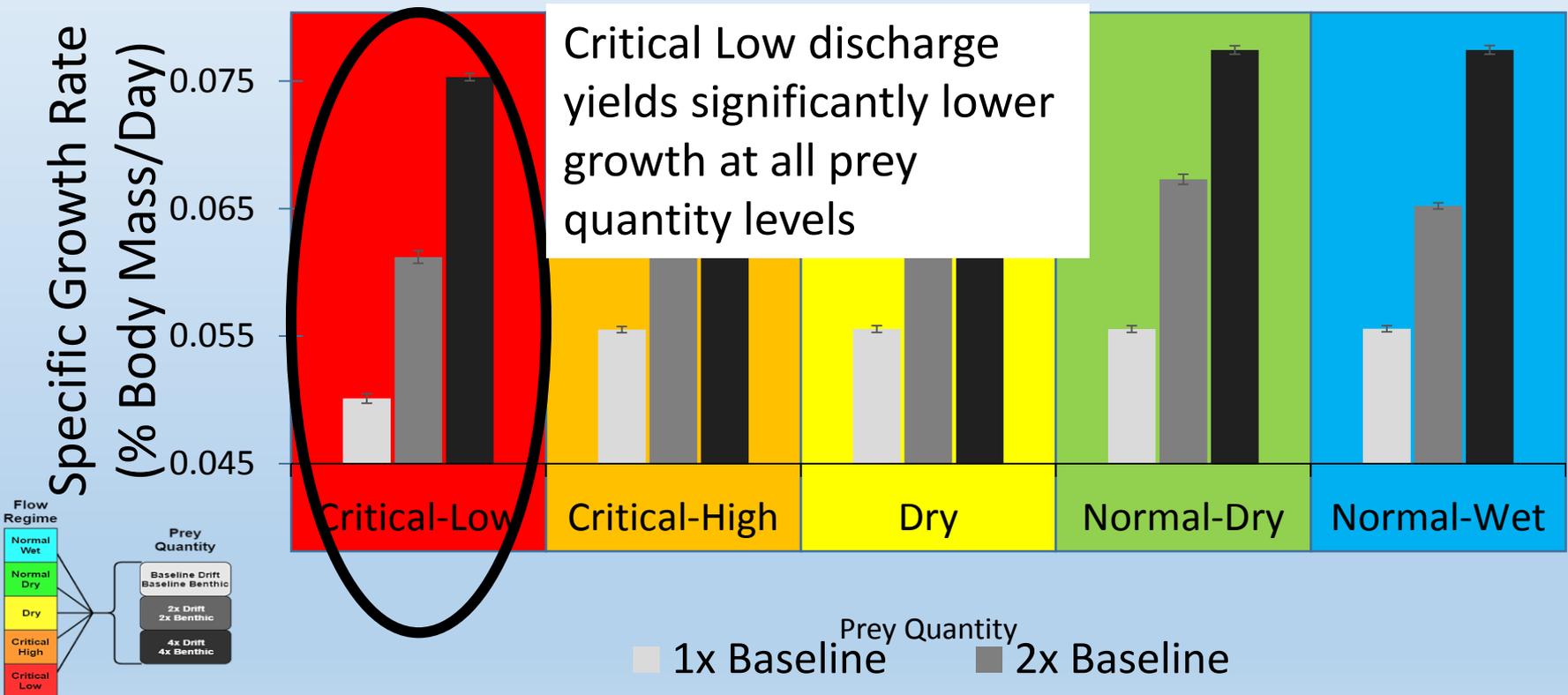
$\delta^{15}\text{N}$, $\delta^{13}\text{C}$ & MixSIAR suggest that during the 2014 drought oligochaetes were a primary food source



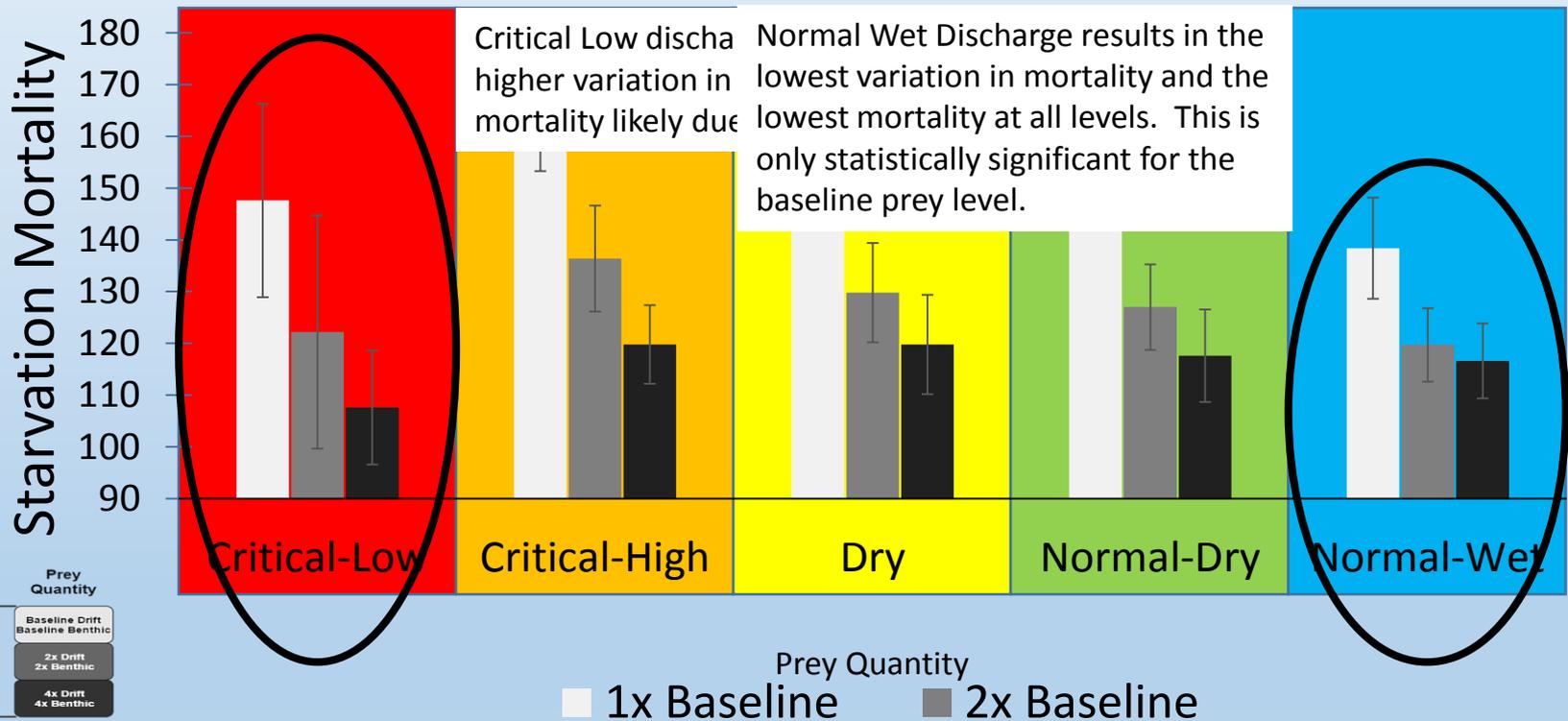
Tests to Examine Effects of Discharge, Prey, and Foraging Strategy



Effect of Discharge Level and Prey Quantity on Growth



Effect of Discharge Level and Prey Quantity on Starvation Mortality



Main Findings



- High growth rates in Central Valley
 - Even in mainstem habitat
 - Not predicted by bioenergetics models
- Agreement across multiple lines of evidence
- Resiliency of species / population?