Drought Zooplankton Paper

# Introduction

## Background

* Review of Drought Synthesis project and how zooplankton ties in.
* Review of Estuary Zooplankton (summarizing FLOAT white paper)
  + Community changes over time
  + Correlation of abundance and distribution with outflow
* Review of initial Zooplankton results in Drought MAST

## Target Taxa background

* Brief summaries of target taxa knowledge, similar to our three zooplankton paper intro
  + H longirostris – Rosie

Hyperacanthomysis longirostris (formerly Acanthomysis bowmani), is a mysid shrimp native to the Ariake sea in Japan (Suzuki et al. 2009). It was first documented in the SFE in 1993, where it was most likely introduced in ballast water (Modlin and Orsi 1997). After its introduction, H. longirostris quickly became the most abundant mysid in the estuary, dominated catches of the CDFW Zooplankton Survey and Fall Midwater Trawl mysid trawls (Barros 2021; Avila and Hartman 2020). It is found throughout the upper estuary, and it appears to have higher temperature and salinity than the native mysid, Neomysis mercedis (Avila and Hartman 2020). H. longirostris is also smaller at maturity than N. mercedis (Avila and Hartman 2020). Abundance is usually highest in the summer (June-August), with lower abundances in fall, winter and spring (Barros 2021). This species has not been studied very frequently in the Estuary, but as the dominant mysid it most likely plays an important role in fish diets.

* + Daphnia - Sam
  + L tetraspina – Christina
  + P forbesi - Arthur

## Questions:

* Do we see regional changes in taxa BPUE?
* Are there env parameters correlated with higher BPUE?
* Does Drought impact the env parameters correlated with higher BPUE?
  + Are the env parameters for taxa changing, or moving?

# Methods

## BPUE calculations

## Regional Drought Changes

* Regional designations (Figure?)
* Grouping and averages
* AOV of taxa regional differences

## GAMS

* BPUE ~ Salinity and month
  + Presence/absence binomial model (glm)
  + Count for just presence negative binomial model (gam)

## Salinity Zones

* Calculating taxa “preferred” salinity zones
* AOV of drought vs wet year BPUE within salinity zone
* Salinity zone distribution between drought and wet years

# Results

## Regional Drought Changes

* Figure: Regional BPUE changes heatmap

## GAMS

* Model decision making (AIC?)
* Model outputs for four target taxa

## Salinity Zones

* Figure: Salinity Bins (could also just be a table)
* Figure: Within Salinity Zone BPUE drought/wet changes
* Figure: Target Salinity Zone distributions

# Discussion

* Regional changes in zooplankton abundance between drought years is likely due to changes in the distribution of their “preferred” salinity zones
* Figure: art/conceptual model of drought > flows > salinity zone distribution > Zooplankton distribution
* Tie this in to the “Zooplankton and Management”
  + How understanding this process can impact management decisions
    - Flow actions – changing flow may not be enough to alter zooplankton abundance. It is important to understand how the change in flow will impact salinity if you want to see changes to zooplankton abundance.
    - Location matters – Flow actions may increase zooplankton abundance in some regions, while decreasing abundance in other regions, so it is important to be specific about what outcome you are looking for.
    - Salinity may trump flow – actions that can alter salinity, such as flooding of islands due to accidental levee breaks or restoration, or installation of barriers, may alter zooplankton distribution and abundance as much as flow actions.
  + Prey vs predator spatial overlap

# References

Barros, A. 2021. Zooplankton Trends in the Upper SFE, 1974-2018. IEP Newsletter 40(1):5-14.

Avila, M., and R. Hartman. 2020. San Francisco Estuary mysid abundance in the fall, and the potential for competitive advantage of Hyperacanthomysis longirostris over Neomysis mercedis. California Fish and Wildlife 106(1):19-38.

Suzuki, K., K. Nakayama, and M. Tanaka. 2009. Horizontal distribution and population dynamics of the dominant mysid Hyperacanthomysis longirostris along a temperate macrotidal estuary (Chikugo River estuary, Japan). Estuarine, Coastal and Shelf Science 83(4):516–528

Modlin, R. F., and J. J. Orsi. 1997. Acanthomysis bowmani, a new species, and A. aspera Ii, Mysidacea newly reported from the Sacramento-San Joaquin Estuary, California (Crustacea: Mysidae). Proceedings of the Biological Society of Washington, 1 10(3):439–446.