Using Stable Isotope Analysis of Zooplankton to Document Trophic and Biogeochemical Changes in the San Francisco Estuary

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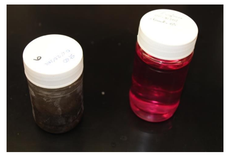
1 Introduction and Objectives

Zooplankton are an important food source for fish, like the endangered delta smelt. We use stable isotope analysis to improve our knowledge of the planktonic food web in the San Francisco Estuary (SFE) and gain insights into its evolution over the past 4 decades.

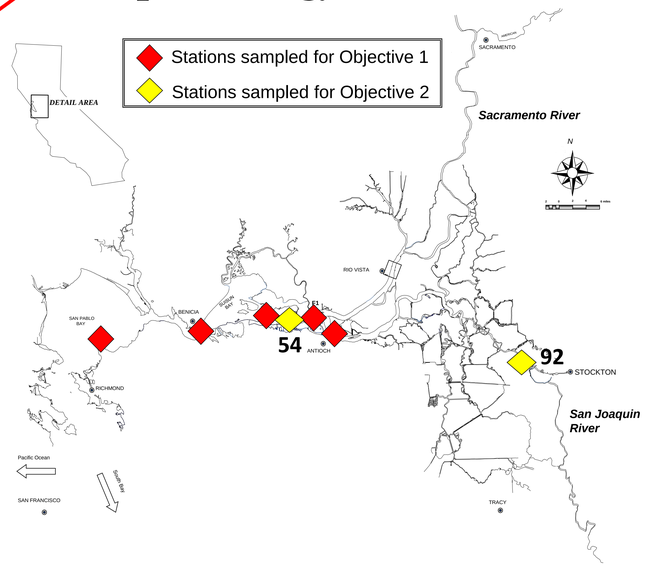
2 main objectives:



Objective 1: Analyze effect of preservation method on zooplankton stable isotope composition.

Objective 2: Use historical zooplankton samples to characterize trends in their trophic ecology and/or biogeochemistry of the SFE ecosystem.

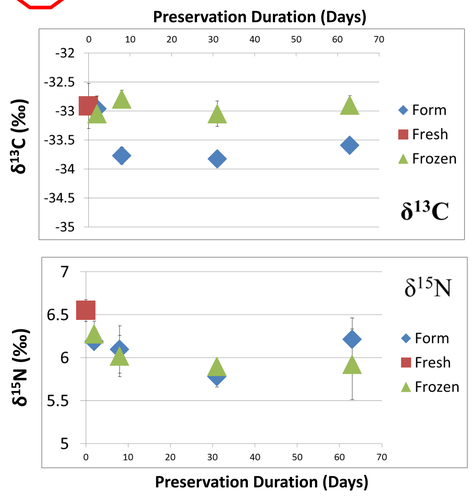
2 Sample Strategy and Methods



A. Zooplankton identification, sorting , and picking up of 8 different species (from 30 to 400 individuals/ sample depending on species). Two stations for the historical study: 54 (Low Salinity Zone), 92 (freshwater, San Joaquin river)

B. Stable Isotope Analysis by EA-IRMS (Elemental Analyzer- isotopic ratio mass spectrometer)

3 Impact of Preservation Methods and Duration:



Daphnia

- Initial Formalin depletion for $\delta^{13}C$*
- Initial depletion in formalin and frozen for $\delta^{15}N$*

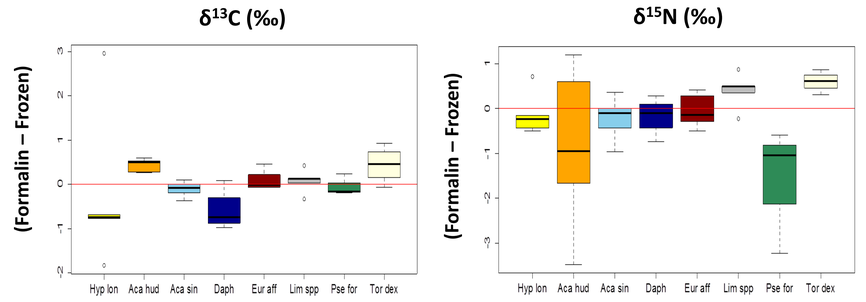
*remained constant over time

***Correction factor of .6 for Carbon and .5 for Nitrogen**

All Species:

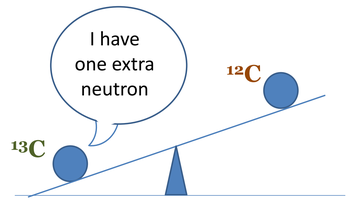
(difference between formalin preserved & frozen samples)

- $\delta^{15}N$: Limited to no impact for 6 of 8 species
- $\delta^{13}C$: < 1‰ difference for all species

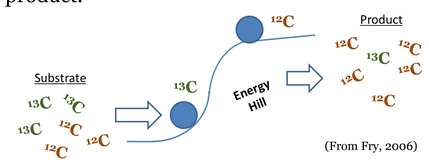


Stable Isotope Analysis

What are Stable Isotopes?

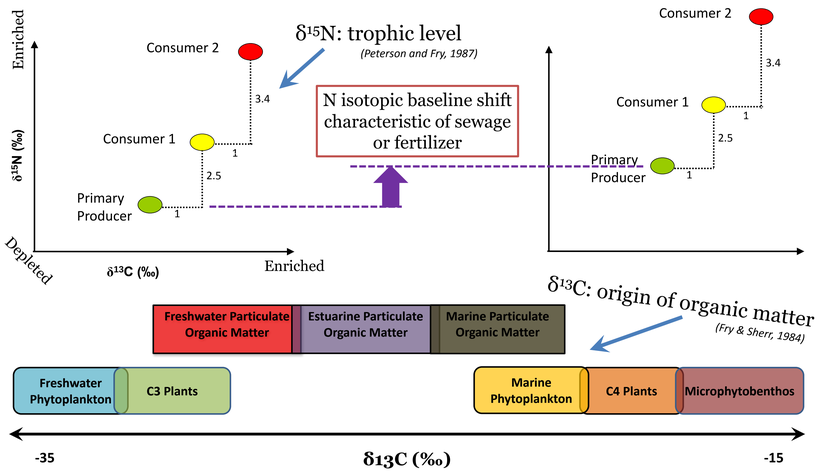


It is harder to push the heavier Carbon 13 up the "energy hill" in some chemical reactions, which means less of the heavier isotope in the product.

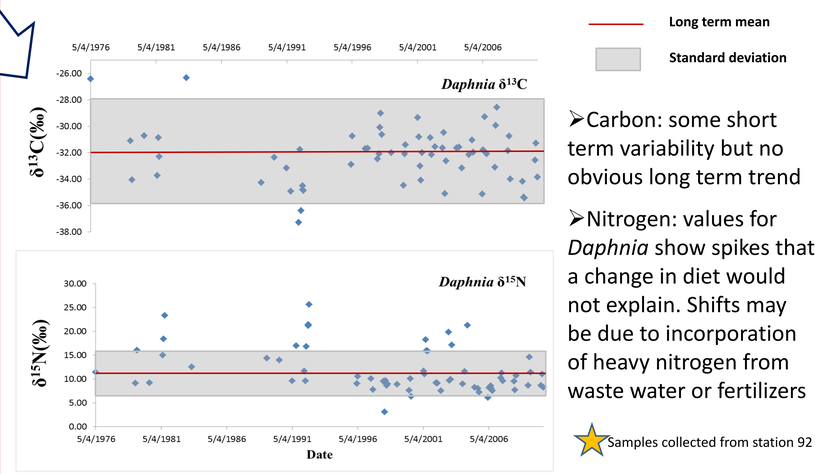


(From Fry, 2006)

What are Stable Isotopes Useful for in Ecology?



4 Long Term Evolution of Stable Isotopes



- Carbon: some short term variability but no obvious long term trend
- Nitrogen: values for *Daphnia* show spikes that a change in diet would not explain. Shifts may be due to incorporation of heavy nitrogen from waste water or fertilizers

★ Samples collected from station 92

5 Conclusion & Perspectives

- **Only slight differences in isotopic signature between preservation methods (formalin - frozen)**
- **Like Daphnia, spikes in d15N detected for most other species (not shown here), likely as a result of anthropogenic N inputs**
- **Due to zooplankton having short life cycles and frequent molts, they are accurate indicators of short term conditions in the estuary**

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2. Peterson, B. J., and B. Fry. 1987. Stable Isotopes in Ecosystem Studies. Annual Review of Ecology and Systematics **18**:293-320.
3. Fry, B., and E. B. Sherr. 1984. δ13C measurements as indicators of carbon flow in marine and freshwater ecosystems. Contributions in Marine Science **27**:13-47.
4. "You gotta fight (deh deh) for your right..... To parrrrrrtaaaay" –Beastie Boys