Distribution and Abundance of Amphipods in the Water Column of the Upper San Francisco Estuary

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Introduction

Zooplankton are an important food source to various pelagic fish in the upper San Francisco Estuary (SFE) [1]. Several studies shed light on the changing trophic structure and altered food webs of the SFE[2,3,4], yet little is known about the availability of amphipods to pelagic fishes as food[5,6,7]. The objective of this study was to create a baseline analysis of amphipod distribution and abundance compared regionally throughout the SFE. Using a pelagic macrozooplankton mysid net, a total of eight groups of amphipods were detected, 5 of which were identifiable to the species level and 2 were identified to genus. An 8th group was comprised of unidentifiable organisms . Average CPUE for these groups was compared across geographic regions from 2013 to 2014.

Methods

- A ten minute, stepped-oblique tow was conducted at each of the 32 mysid stations using a 0.505 mm mesh mysid net mounted on a rigid frame (Figures 1 & 2).
- Sampling was conducted monthly by Fall Midwater Trawl from September through December. Data collected in 2013 and 2014 are presented here.
- Catch Per Unit Effort (CPUE) = Individuals/Volume (m^3) Sampled
- Specific conductance (µS/cm), water temperature (°C), and turbidity (NTU) were measured at the time of sampling and compared to amphipod distribution and abundance.

Figure 1. Fall Midwater Trawl Mysid Sled

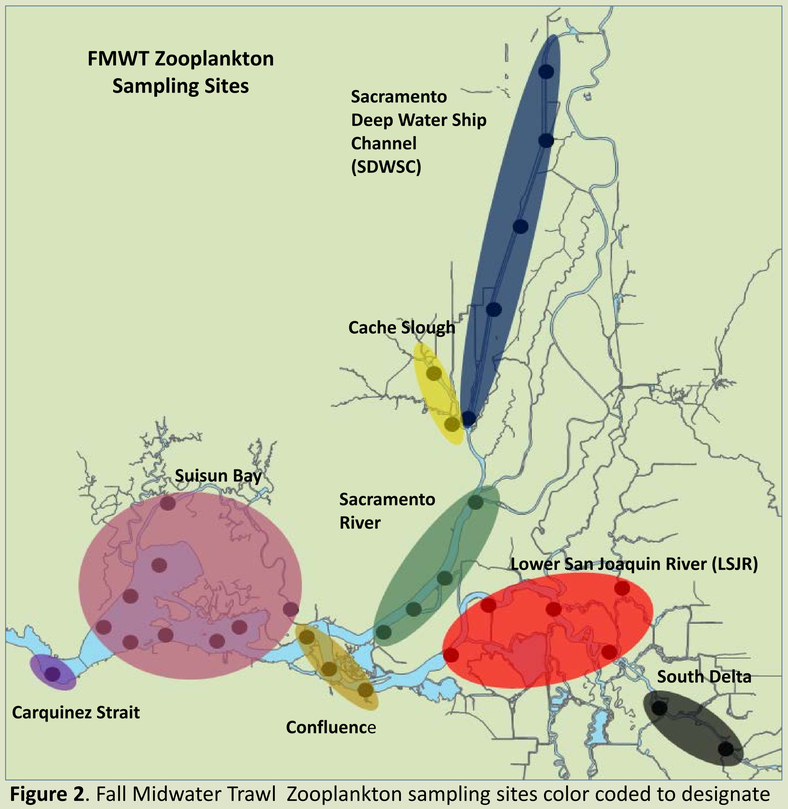

Figure 2. Fall Midwater Trawl Zooplankton sampling sites color coded to designate regions

Results

Table 1. Mean specific conductance , water temperature, and turbidity 2013 to 2014. Mean was calculated for 4 surveys (September-December) by region. Darker cells indicate higher values.

Regions By Survey	Specific Conductance (µS/cm)		Water Temperature (°C)		Turbidity (NTU)	
	2013	2014	2013	2014	2013	2014
Carquinez Strait	25021	26322	15.9	17.7	36.4	26.2
Suisun Bay	15201	19327	16.7	18.4	24.3	21.7
Confluence	6749	9112	17.5	18.9	14.2	11.8
Sacramento River	1565	2273	15.4	18.2	18.9	24.1
Cache Slough	203	233	16.3	17.8	12.2	27.4
SDWSC	637	618	15.6	18.2	25.7	31.6
Lower San Joaquin River	575	701	15.9	18.0	6.4	7.5
South Delta	667	862	16.8	19.3	5.5	6.4

- Water temperature and specific conductance increased from 2013 to 2014, except for in SDWSC. From 2013 to 2014 turbidity decreased slightly (Table 1)

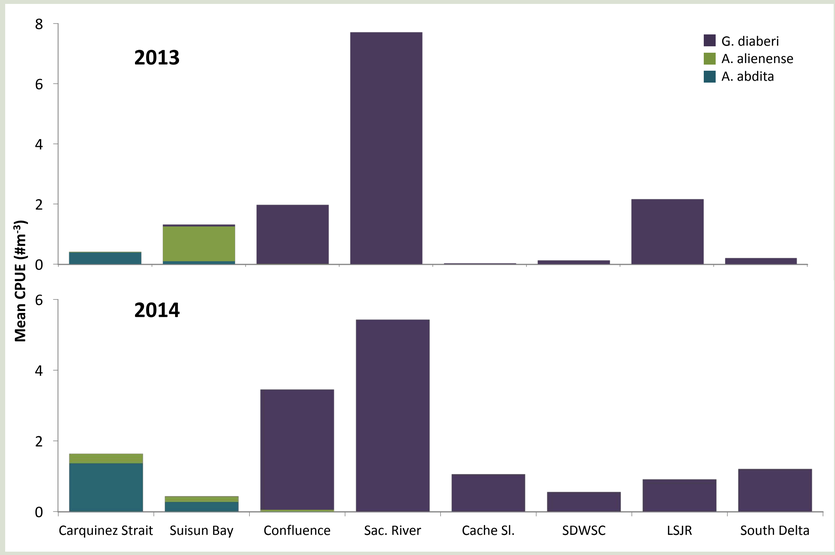

Figure 3. Mean CPUE for 3 most abundant species compared regionally from 2013 to 2014

Gammarus diaberi

Ampelisca abdita

Corophium alienense

- The 3 most abundant species roughly followed a salinity gradient with *A. abdita* and *C. alienense* occurring downstream and *G. diaberi* occurring upstream (Figure 3).
- *G. diaberi* was vastly more abundant in the water column than other species and was mostly concentrated in the Lower San Joaquin River and Sacramento River regions including the Confluence (Figure 3) .
- In 2014 relative abundance of *G. diaberi* decreased in every region it occurred at in 2013 except for Cache Slough (Figure 3).

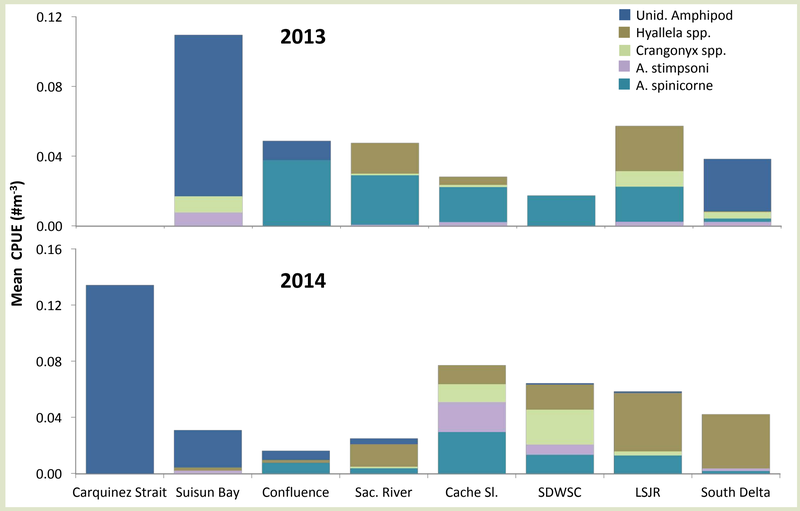

Figure 4. Mean CPUE by region for 5 species from 2013 to 2014

Hyalella spp.

Crangonyx spp.

Americorophium spinicorne

Americorophium stimpsoni

- Overall abundance of *G. diaberi*, *A. spinicorne*, and *C. alienense* decreased from 2013 to 2014, whereas *A. stimpsoni*, *A. abdita*, *Crangonyx*, and *Hyalella* increased (Figure 4).
- In 2013 Cache Slough had a low population of amphipods but in 2014 population sizes of *Hyalella spp.*, *A. spinicorne, A. stimpsoni*, and *Crangonyx spp.* increased(Figure 4).

Discussion

- Many of these amphipods are epibenthic; they may have been collected during pelagic sampling for a variety of reasons including vertical migrations, submerged aquatic vegetation floating to the surface, or mixing in the water column.
- *G. diaberi* dominated upstream locations of the SFE; we postulate that this is due to their preference for brackish to freshwater environments.
- Distribution is affected by the location of the freshwater-saltwater interface which is in turn affected by freshwater outflow.
- The overall CPUE was lower in 2014 due to the decrease in *G. diaberi*.
- The increase in *A. abdita* and *A. stimpsoni* in 2014 may be due to their affinity for more marine water and warmer temperatures, respectively.
- These shifts in amphipod abundance, monitored over several years, could potentially begin to reveal a shift in diet for pelagic species of fishes in SFE given their importance as a food source.
- The 2013 to 2014 data provided by FMWT is a seasonal snapshot of amphipods present in the water column.

Acknowledgements

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[1] Cummins, K. W. 1971. Energy relations in Cladoceran populations. Trans. Amer. Micros. Soc. 90: 101-102. Davis, N. D. 1993.[2] Caloric content of oceanic zooplankton and fishes for studies of salmonid food habits and their ecologically related species. (NPAFC Doc.) FRI-UW-9312. Fisheries Research Institute, University of Washington, Seattle. 10 pp. [3]Durand, J. R. 2015. A Conceptual Model of the Aquatic Food Web of the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science, 13(3).[4]Hennessy, A., Contreras, D. 2014. IEP FMWT Zooplankton Monitoring Program Protocol. California Department of Fish and Wildlife, Bay-Delta Region. [5]Interagency Ecological Program Management, Analysis, and Synthesis Team. 2015. An updated conceptual model of Delta Smelt biology: our evolving understanding of an estuarine fish. Technical Report.[6]Miller, L. 1999. Spring abundance and distribution of amphipods, Gammarus diaberi, and corophium spp. in the San Francisco Bay Estuary. California Department of Fish and Game. Central Valley-Bay Delta Branch. [7]Slater, S., Baxter, R. 2014. Diet, Prey Selection, and Body Condition of Age-0 Delta Smelt, Hypomesus transpacificus, in the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science, 12(3).