Apr 5th, 11:30 AM - 1:30 PM

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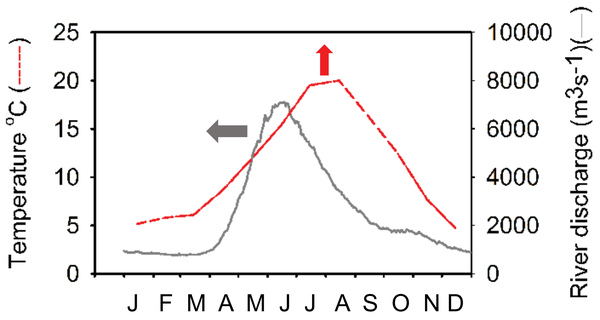
The seasonal delivery of freshwater to estuaries is changing

Zooplankton are central to pelagic estuarine food webs. River discharge, through its effect on salinity and water residence time, strongly influences the presence, composition, and abundance of zooplankton in estuaries[1,2]. Fraser river peak discharges are occurring earlier and temperatures are warming[3] with unknown effects on zooplankton production and dynamics.

Fig 1. River discharge for the Fraser River measured at Hope, B.C. (1912 – 2014) from wateroffice.gc.ca and average temperature measured in the inner estuary of FRE over the course of this study. Arrows indicate direction of predicted change.



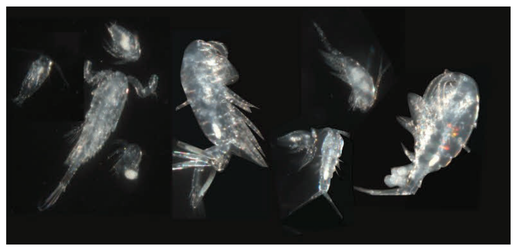
Main Objective: Predict how population dynamics of key zooplankton species in the Fraser River Estuary (FRE) will be influenced by changes to the annual hydrograph and a warming water column.

What species are present? When and where?

Fig 2. The Fraser River Estuary delta, British Columbia, Canada. Locations of twice monthly sampling sites (Δ) and of less frequently sampled sites (●).

- 1-2x month zooplankton monitoring
- August 2013 – May 2016
- Tows of a 0.5 m mouth, 100 µm mesh conical net
- CTD casts, chlorophyll, and nutrients

The zooplankton community included a mix of freshwater, marine, and estuarine endemic taxa. The most abundant taxa were the copepods ***Diacyclops thomasi***, ***Eurytemora affinis***, and ***Pseudobradya* spp**. One nonindigenous species was found, the copepod, *Oithona davisae.*



What limits zooplankton in the FRE?

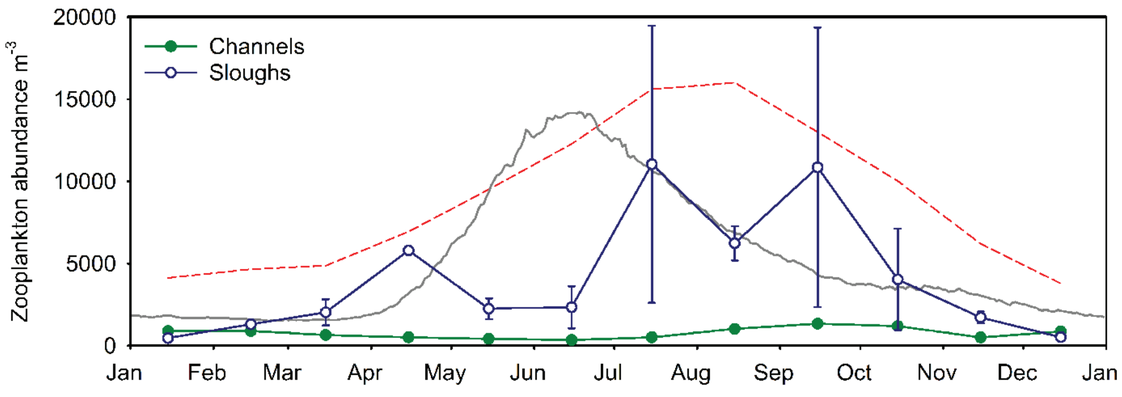


Fig. 3. Average monthly zooplankton abundance (±1 SE) (excluding copepod nauplii and rotifers) was higher at slough stations (Deas and Ladner) than at channel stations (Massey Tunnel, Wellington Point, and Cannery Channel). River discharge (——) and temperature (---) as in fig. 1.

Higher abundances in sloughs suggest that water residence time plays a role in limiting zooplankton abundance during the spring and summer.

This works by a variety of mechanisms, including:

- Higher turbulence may hinder feeding, mate finding, and escape from predators
- Lower food resources (Phytoplankton may also be limited by water residence time)
- Being flushed from habitat (our focus)

How do zooplankton avoid being swept away?

1. Tidal vertical migration (TVM)

TVM uses tidal currents to alter or maintain horizontal position. By swimming upward during flooding tides, estuarine zooplankton are able to avoid being flushed out to sea. The presence of strong TVM behaviour in *E. affinis* in the FRE suggests that advection has had a large influence on this population.

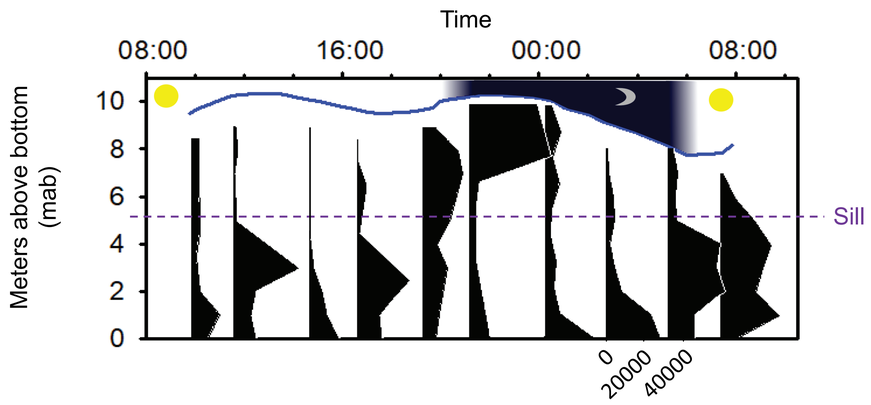


Fig. 4 Area plots indicating depth-specific *E. affinis* abundance estimated using collections from a 30-L Schindler-Patalas trap deployed every 1-m each 2-3 hours over a tidal cycle (Sept. 2014) in a sheltered slough. Placement of abundance profile indicates collection start time. Total water column depth (——). Note that abundance axis repeats; one is shown for scale.

2. Resting egg production

Monthly incubations of field-collected adult female *E. affinis* to estimate egg production rate (data not shown) revealed that this population drops eggs in the spring (fig 5). Resting eggs drop to the sediment where they remain until they are resuspended and conditions are ideal for hatching. **The timing of dropped eggs here suggests resting egg production in the FRE may be a strategy to withstand flushing or periods of low salinity.** To our knowledge, this hasn't been reported before in estuarine species.

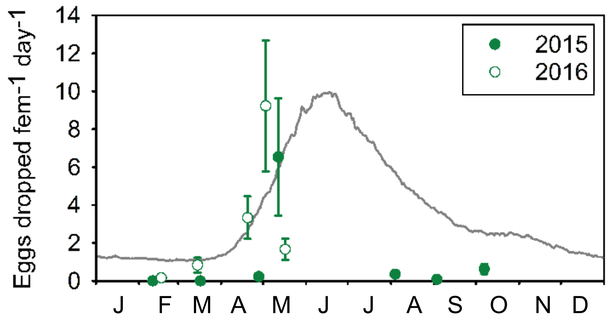


Fig. 5 Average daily number of eggs dropped (± 1 SE) per *Eurytemora affinis* female per day during 24 hr incubations presented with average discharge for the Fraser River from wateroffice.gc.ca

Preliminary conclusions

- Zooplankton appear limited by short water residence time in the estuary
- Backwater areas and sediments may be important to sustaining estuarine zooplankton populations.
- Life history events, such as resting egg production, of estuarine copepods may be timed to coincide with the freshet.
- The freshet interrupts the growing season of abundant estuarine copepods. An earlier freshet will influence temporal patterns of zooplankton production by removing the warmest part of the spring growing season and by increasing the temperature and duration of the post-freshet growing season

Ongoing work & future questions

- Continue to process zooplankton samples
- Continue to gather rate estimates and measure vertical distribution. These will help us model population dynamics under various river discharge and warming scenarios.
- If *Eurytemora* are producing resting eggs during the freshet, what cues the switch from subitaneous egg production? What cues hatching?

Acknowledgements & References

This project would not have been possible without the dedication of our volunteers, Sandra Emry, Nikita Sergeenko, Jaimie Grimm, Matt Madsen and Sachiko Ouchi, and boat operators, Chris Payne and Lora Pakhomova. We thank Olga Kalata for help with taxonomy. This project is funded by NSERC, Environment Canada, and a Discovery grant to EAP.

[1]Ketchum BH (1954) Ecology 35:191
[2]Miller CB (1983) In: Ketchum, B.H. (ed) Estuaries and Enclosed Seas. Elsevier, Amsterdam, p 103–149
[3]Morrison J, Quick MC, Foreman MG (2002) J Hydrol 263:230–244