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Seasonal changes in trophic interactions in the plankton community in the Strait of Georgia

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Seasonal changes in trophic interactions in the plankton community in the Strait of Georgia

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1 Problem

The plankton community composition and trophic interactions vary greatly throughout a year, but these details aren't often represented well in numerical simulations.

Understanding the seasonal food web dynamics within the plankton community can lend insights into energy transfer to higher trophic levels.

Research Question

What does the plankton food web structure look like in the SoG and how does it change seasonally?

Implementation

Built 3 detailed, seasonal food web models for the plankton community in the SoG in spring, summer, and winter

2 Methods

Biomass Data

Phytoplankton: based on pigment data derived from HPLC from 2015 – 2017 and 2019 – 2020, analysed using Chemtax

Zooplankton: net tows from 2006 – 2017, only tows > 200 m

Microzooplankton: cell counts from STRATOGEM, 2002 - 2005

Ecopath Model

Assumes mass balance between and within functional groups (FGs)

$$B_i \cdot (P/B)_i \cdot EE_i - \sum_{j=1}^{n} B_j \cdot (Q/B)_j \cdot DC_{ji} = 0$$

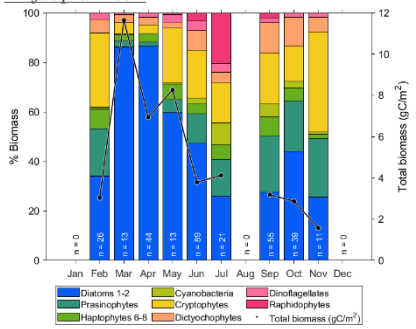
$$Q_i = P_i + R_i + (1 - GS_i) \cdot Q_i$$

3A Results

Plankton community composition

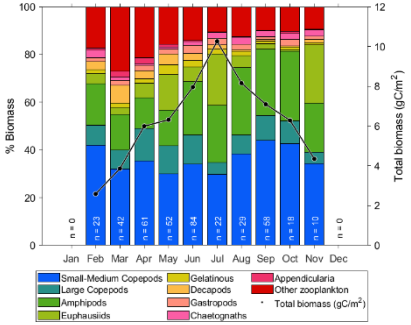
Monthly average over time series

Phytoplankton



- Clear diatom bloom in spring
- Flagellates increase in dominance in remainder of year

Zooplankton

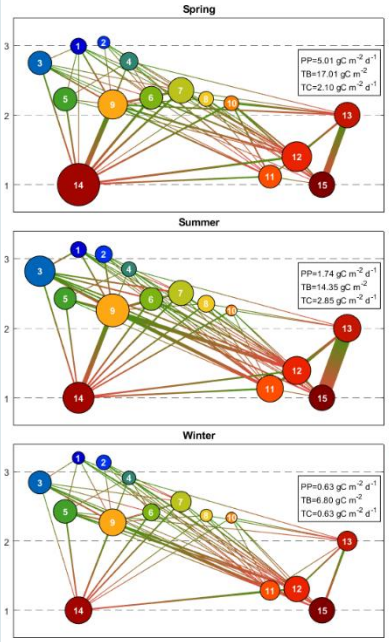


- Copepods are 35-55% of biomass year-round
- Other large crustaceans (amphipods, euphausiids) dominate the rest of the biomass

Defined 3 seasonal periods: spring (March-May), summer (June-October), and winter (November – February)

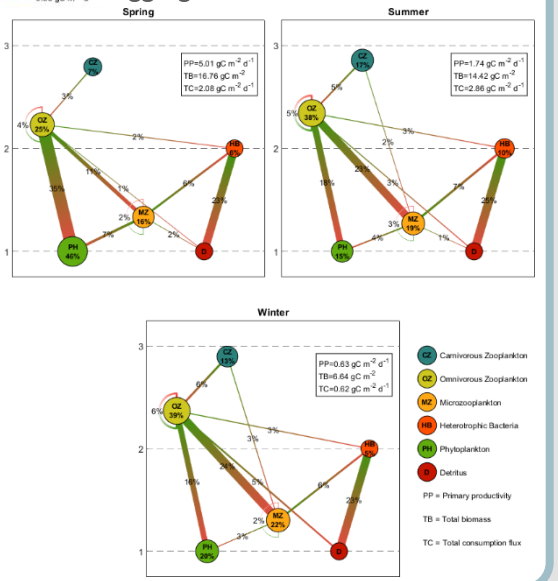
3B Results

Seasonal food web structure



- Plankton community spans 3 TLs
- TLs are highest in winter, then summer, then spring
- In spring, autotrophic phytoplankton (diatoms) contribute 81% of PP in spring, and ~50% in summer and winter, with mixotrophic groups contributing the rest
- ~50% of system flow originates from each of primary producers and detritus
- Over the year, 43% of zooplankton production is unused within the plankton system
- Gives estimates of parameters that are hard to directly measure or that we have limited information about, i.e. bacterial biomass, zooplankton production and respiration
- Microbial loop becomes more important in summer and winter, when primary production is under limiting conditions

Aggregated & relative structure



4 Implications

- Showed the importance of the microbial loop, which is currently understudied
- Can estimate the changes in availability and nutritional quality of food for planktivorous fish
- Understanding the small-scale interactions at the bottom of the food-web is important as the climate continues to vary