May 8th, 9:00 AM - 11:00 AM

The Influence of a Ubiquitous Filter Feeder on Coastal Microbial Communities.

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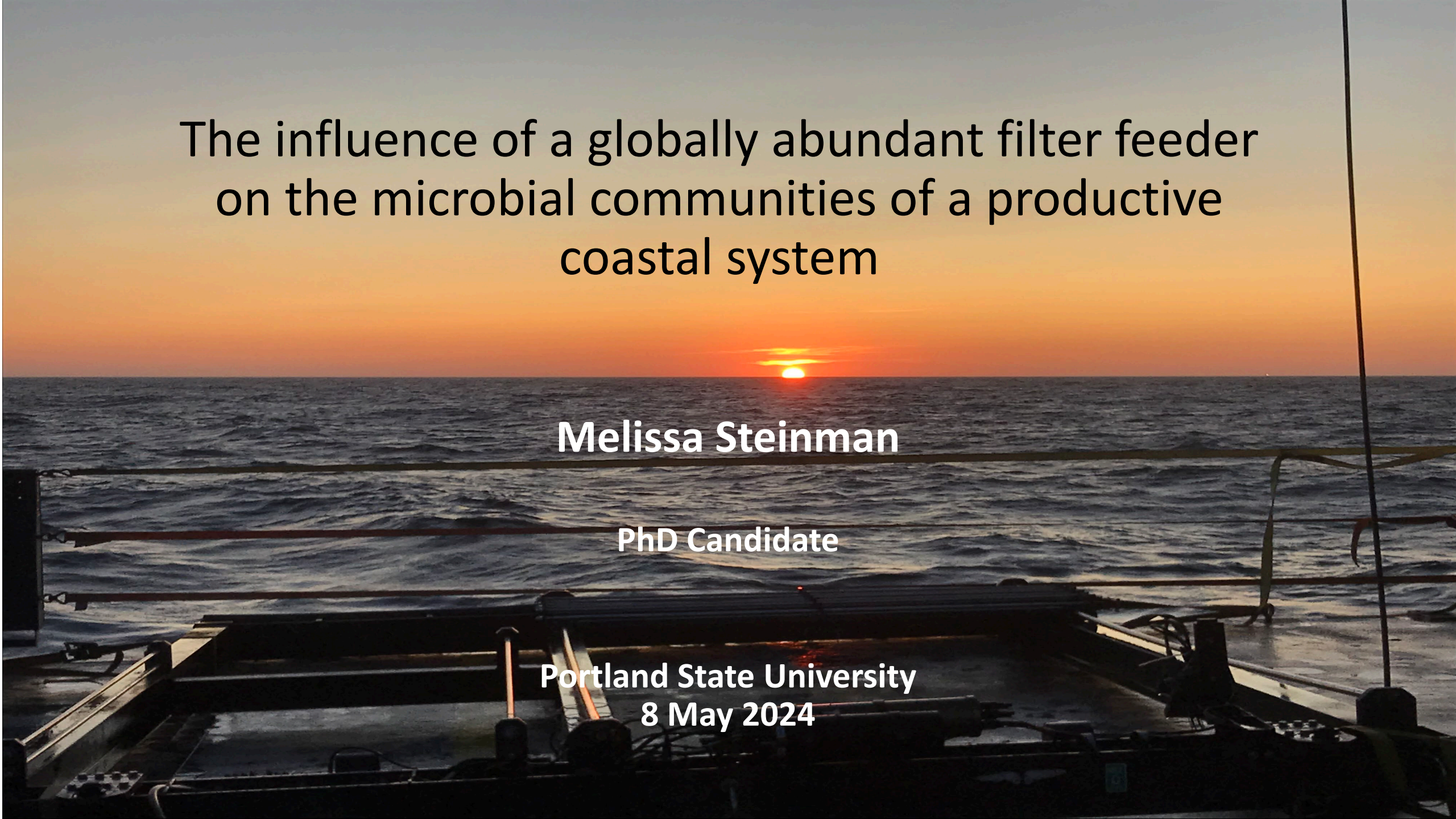
See next page for additional authors

Presenter Information

Melissa Steinman, Moritz S. Schmid, Robert K. Cowen, Su Sponaugle, Kelly R. Sutherland, and Anne W. Thompson



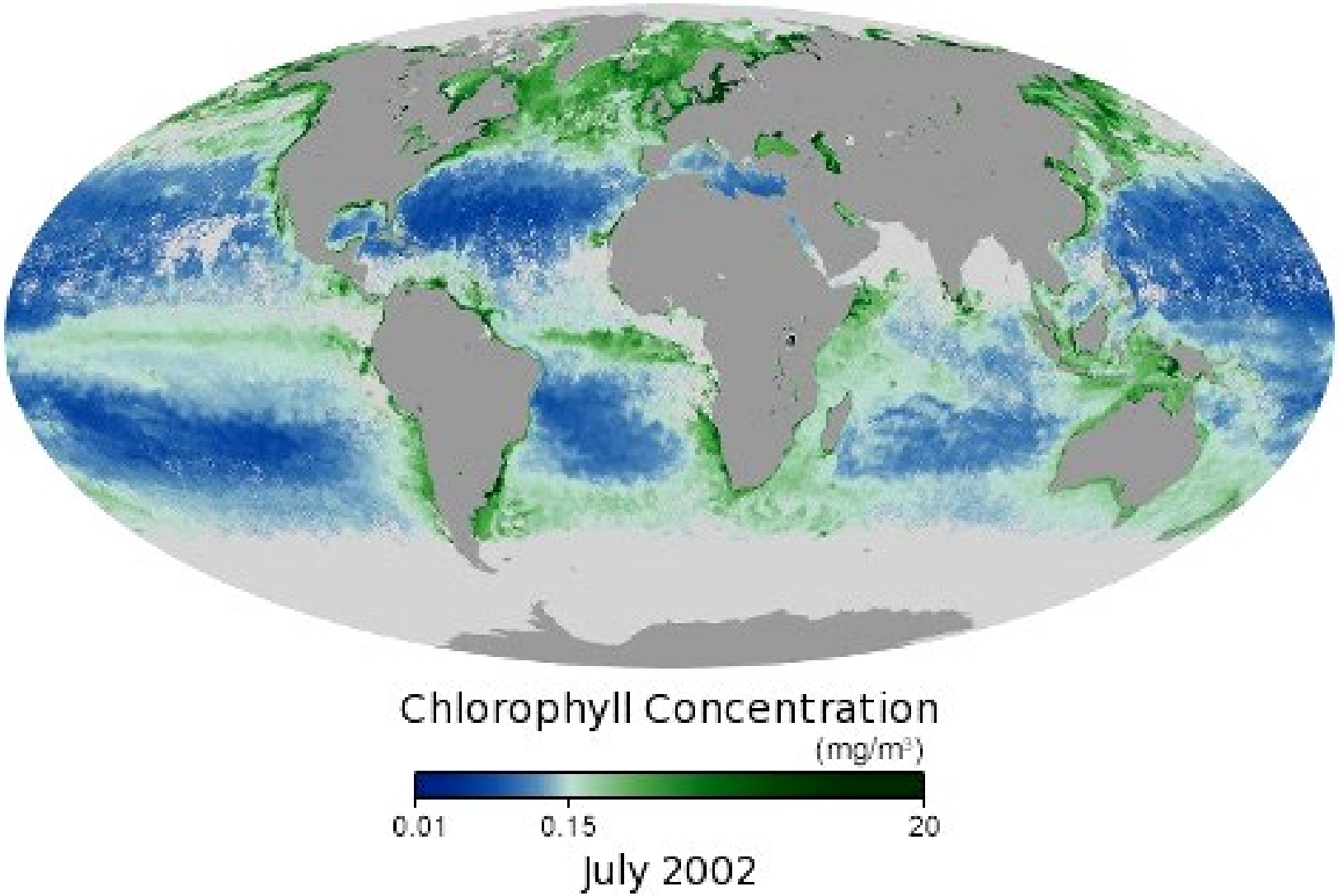
The influence of a globally abundant filter feeder on the microbial communities of a productive coastal system

Melissa Steinman

PhD Candidate

Portland State University
8 May 2024

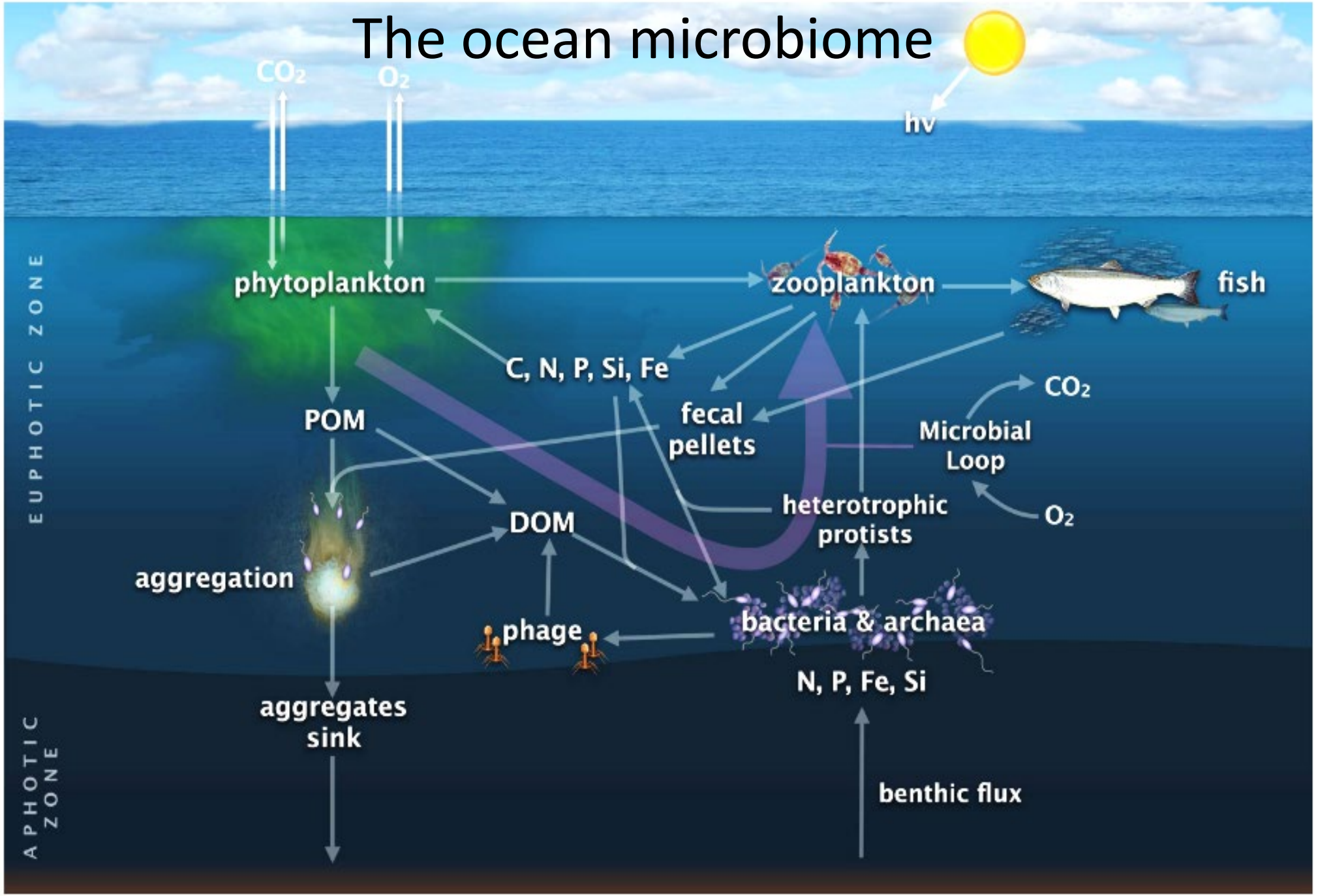
Photosynthetic microbes have a global impact



Worden et al., 2015
Kujawinski et al., 2023

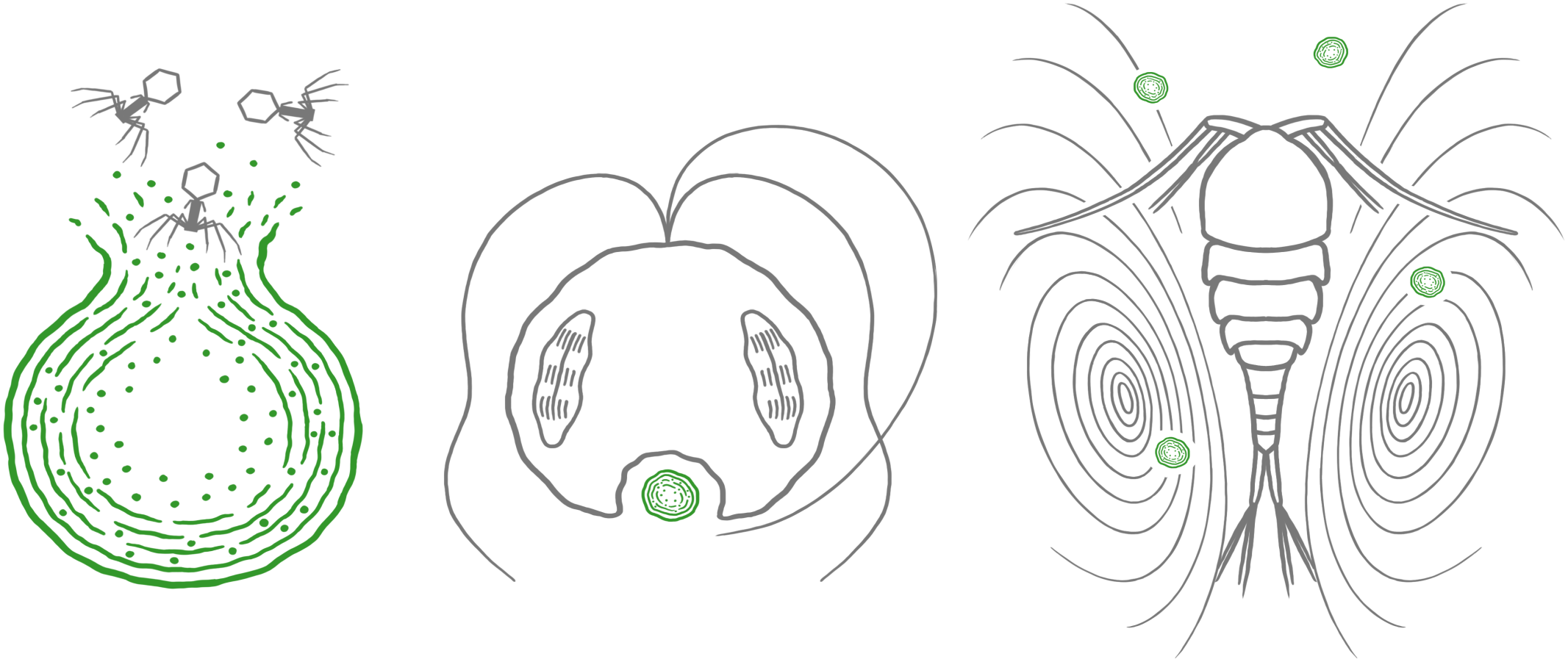
NASA, *Chlorophyll* 2021

The ocean microbiome



Worden et al., 2015

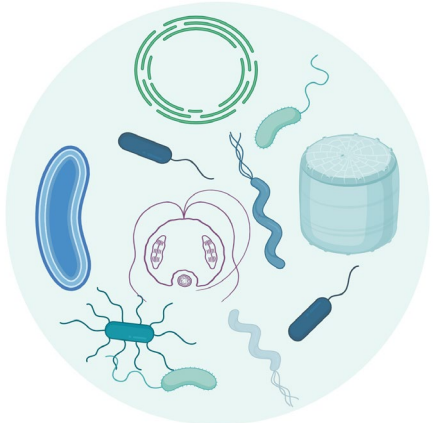
Microbial mortality is not fully understood



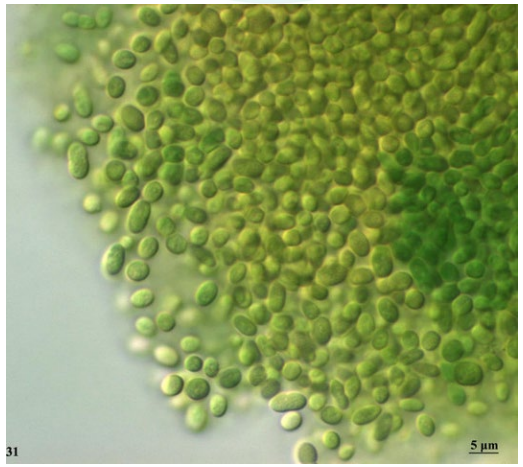
26% of microbial mortality is unaccounted for

Talmy, et al. 2019

Art: Dr. Anne W. Thompson and Franz Anthony

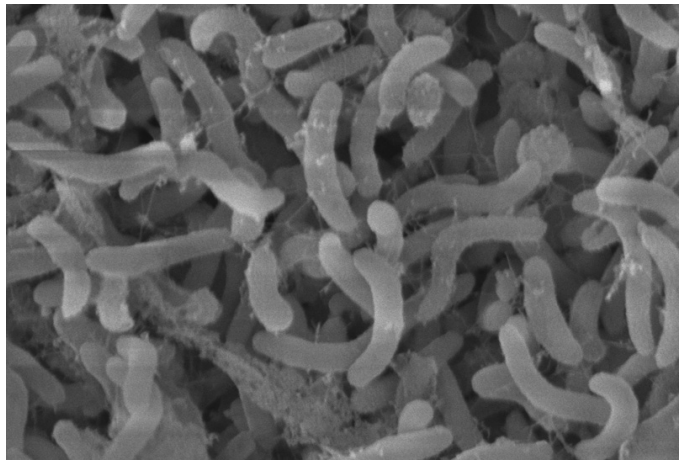


Dominant oceanic microorganisms



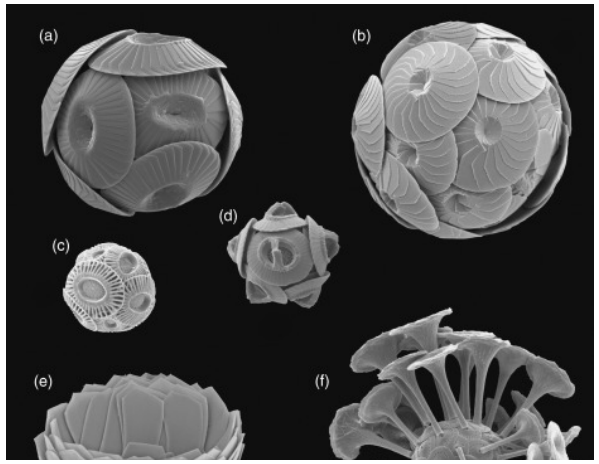
Synechococcus

Critical to global oxygen production

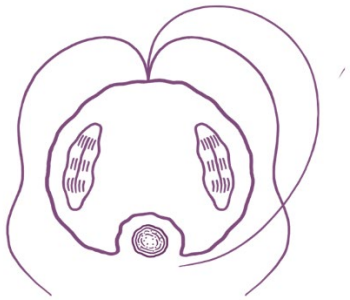


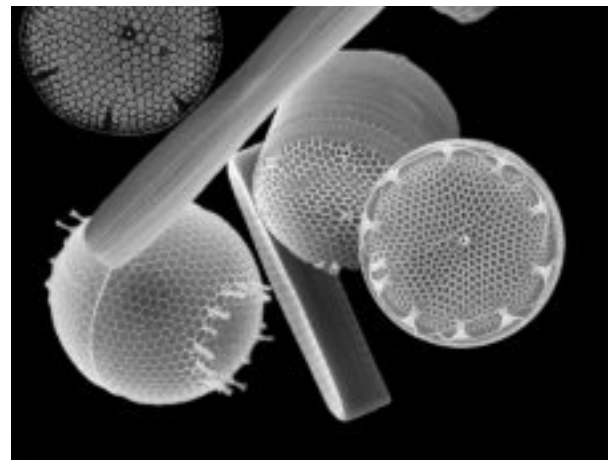
SAR11

Most abundant cell in the ocean



Prymnesiophytes



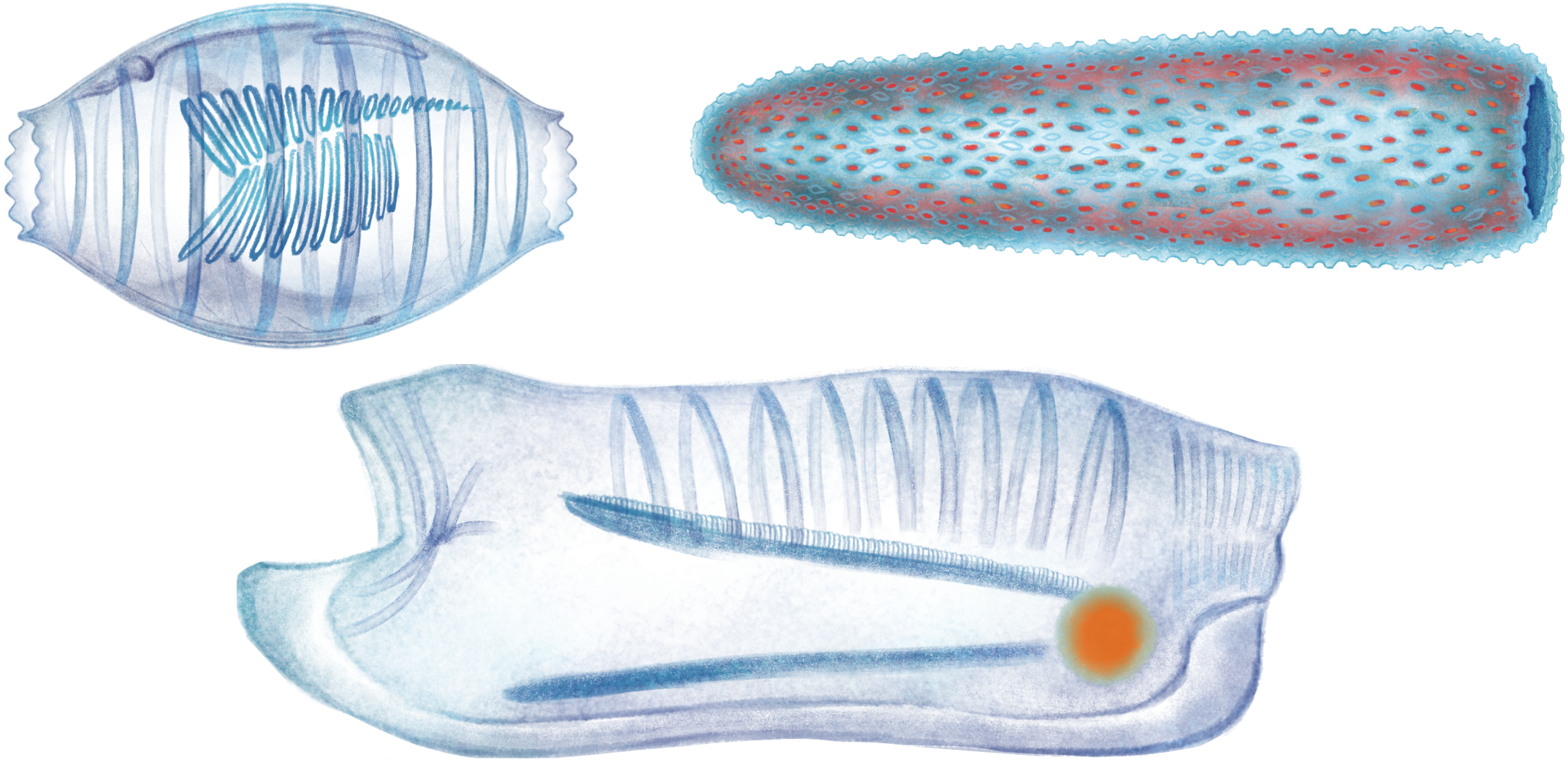


Diatoms

Maximum size

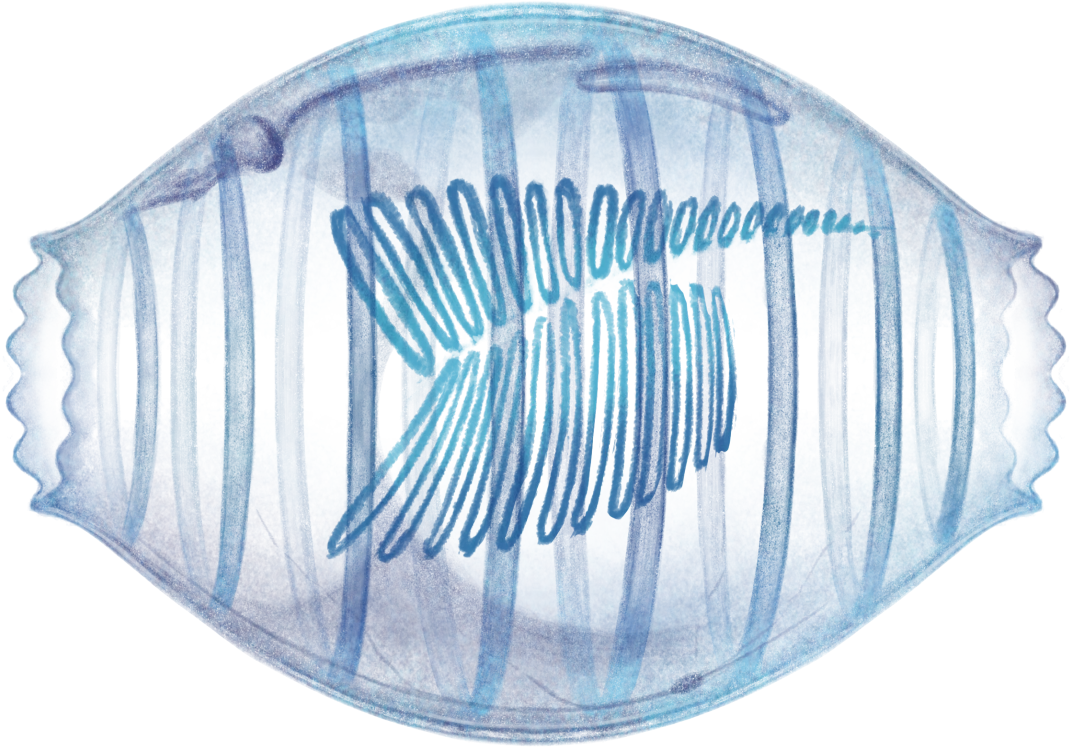
Art: Dr. Anne W. Thompson and Franz Anthony

Thaliaceans – powerful but poorly understood

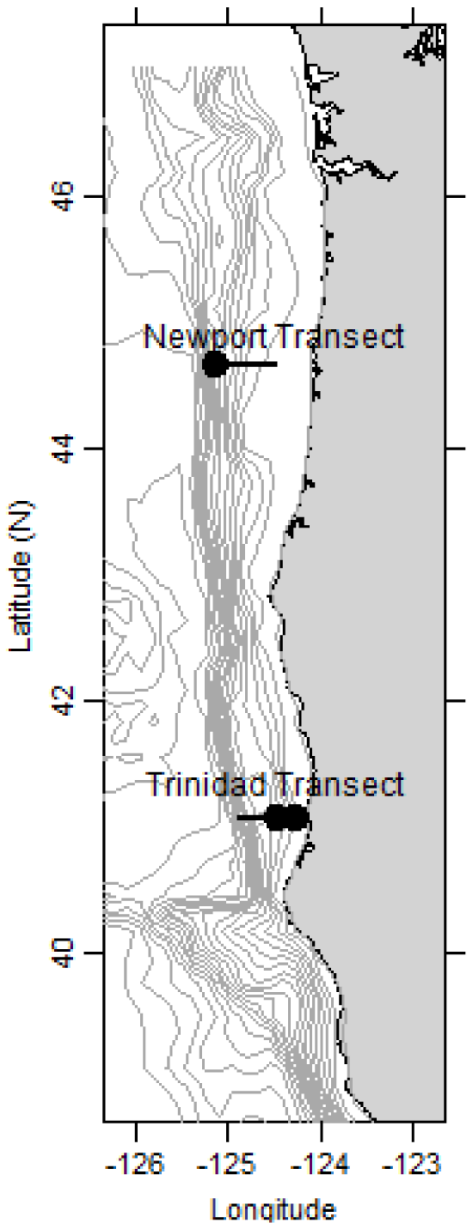


Art: Anne Thompson and Franz Anthony

How do doliolids impact the microbial community?



Sampling in the California Current System



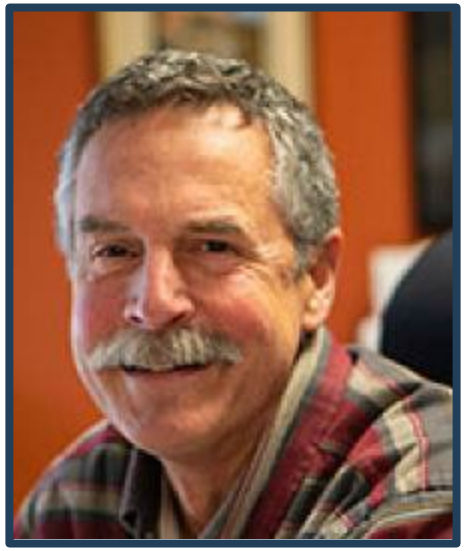
Stations:

- On-shelf
- Shelf Break
- Off-Shelf

Transects:

- Newport Hydrographic Line (NH)
- Trinidad Head Transect (TR)

Su Sponaugle
Oregon State University
Plankton Ecology Lab



Robert Cowen
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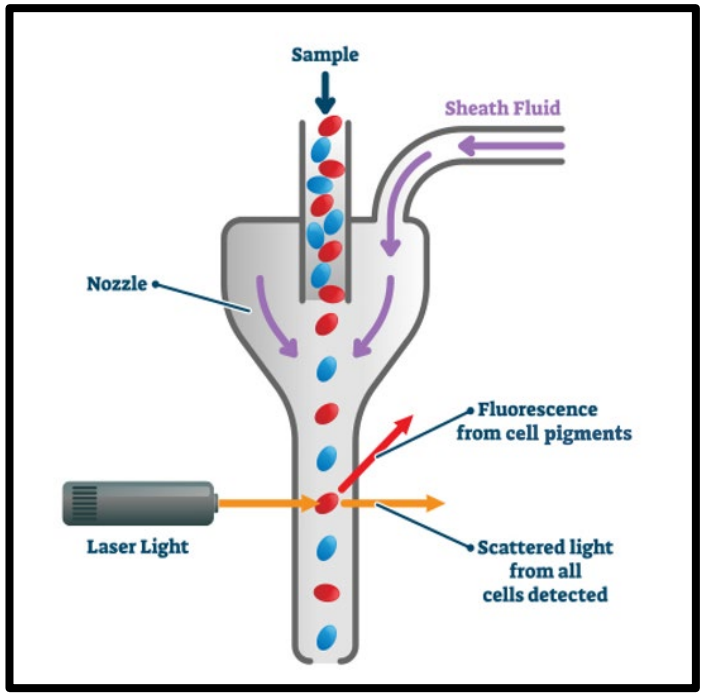
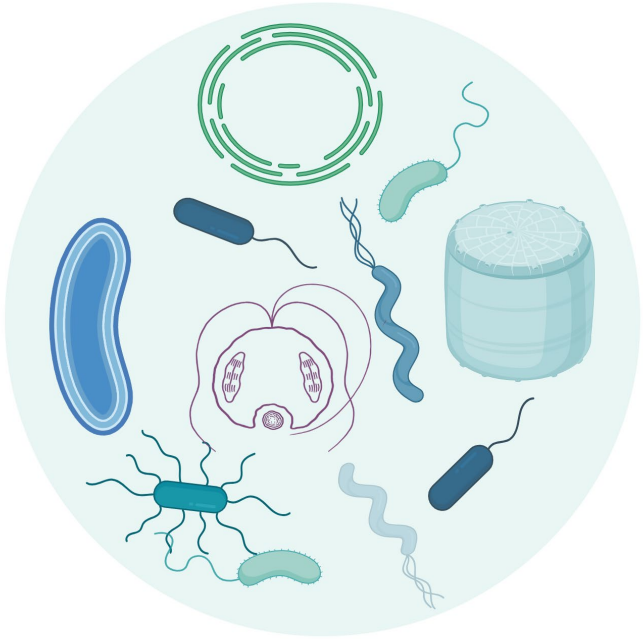
Kelly Sutherland
University of Oregon
Form, Function, Flow of Plankton
https://www.sutherlandlab.org/

Sampling in the California Current System



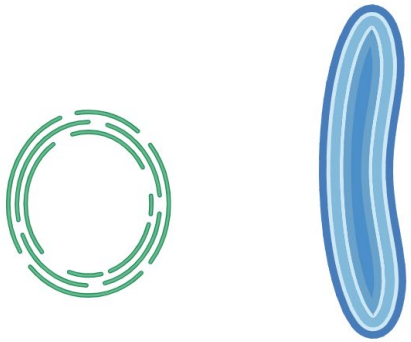
- Size Fractions
- Four Depths
- Fixed for Flow Cytometry

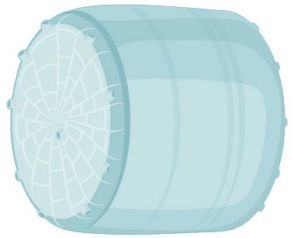
Microbial identification



16S rRNA gene sequencing & identification of ASVs

- Identify amplicon sequence variants using *dada2*
- Taxonomically identify microbial sequences using BLASTn (NCBI)
- Relative abundances using R
- Hypothetical functional roles
  - Free-living (prey), potential symbionts/pathogens/neutral
  - Comparison to published functionality

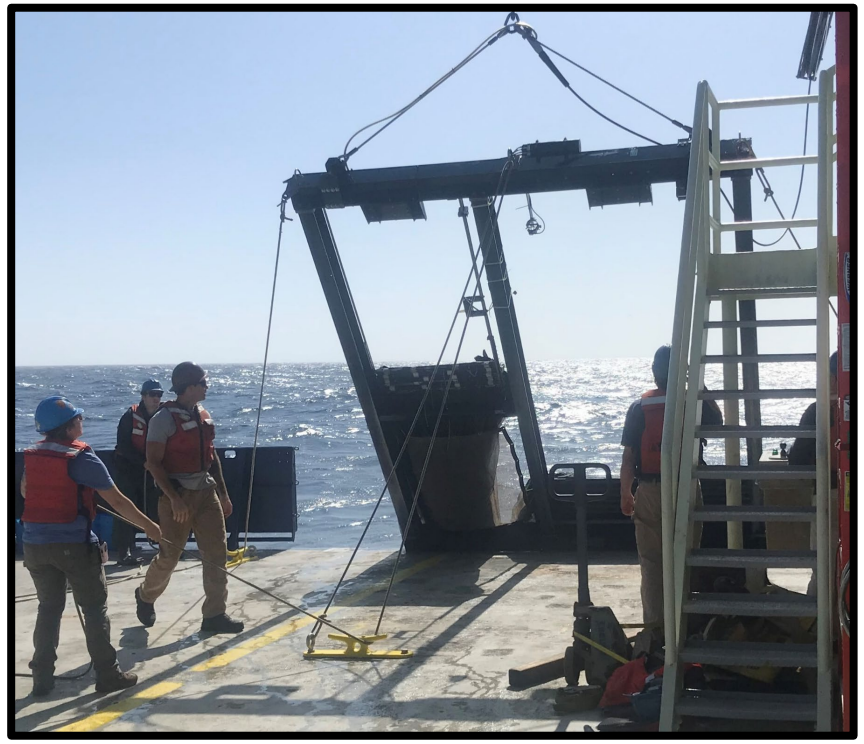




qPCR

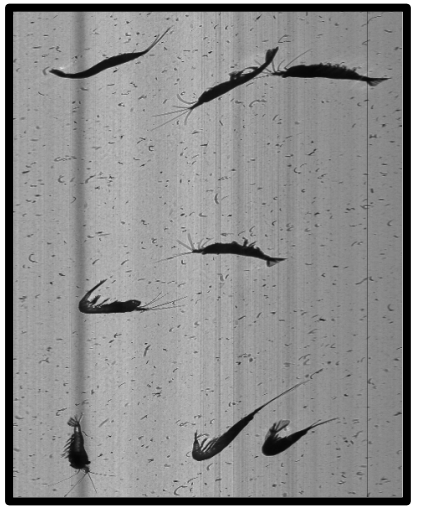
- Quantify specific taxa

Sampling in the California Current System



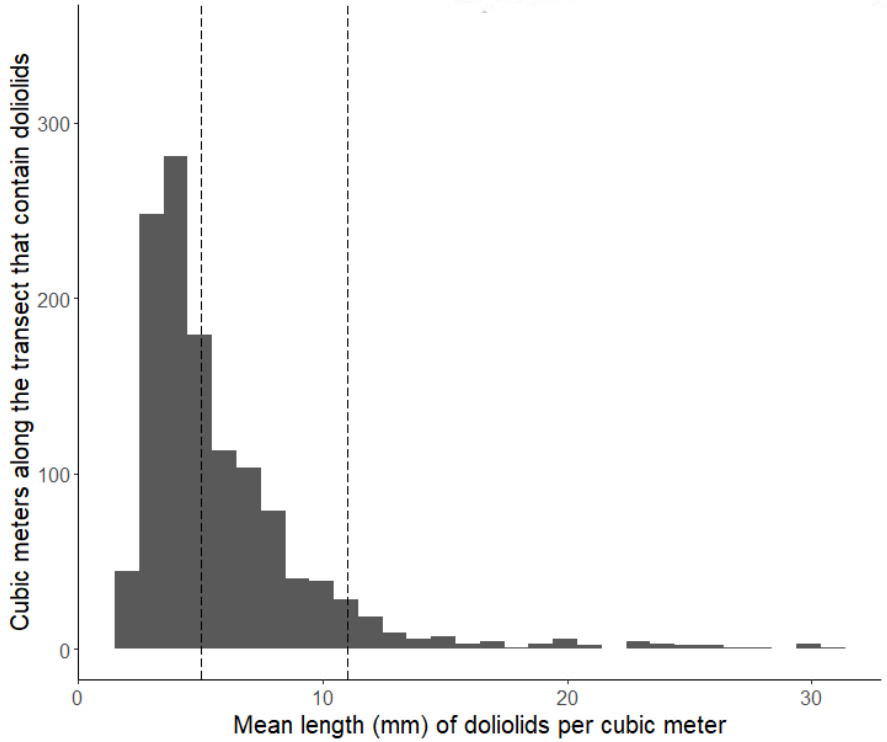
- Multiple Opening Closing Net Environmental Sampling System (MOCNESS)
- Coupled asymmetrical net
- Minimizes damage to gentle bodies

In Situ Ichthyoplankton Imaging System (ISIIS)

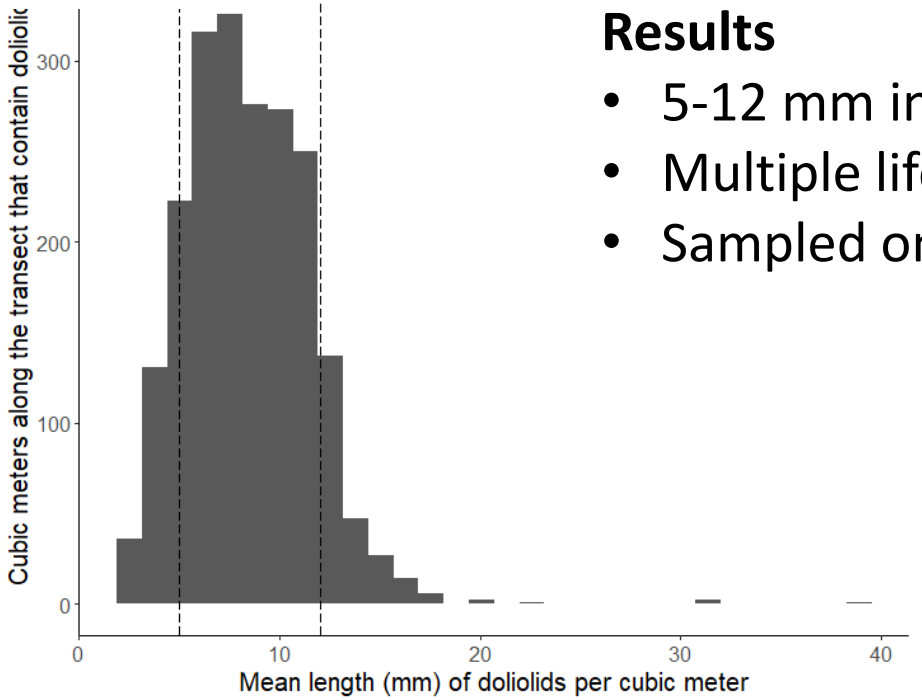


Moritz Schmid
Oregon Department of Fish and Wildlife
Oregon Marine Reserves

Doliolid identification and abundance



Newport Hydrographic (NH) Line Transect

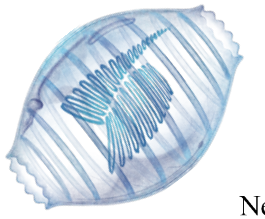


Trinidad Head (TR) Transect

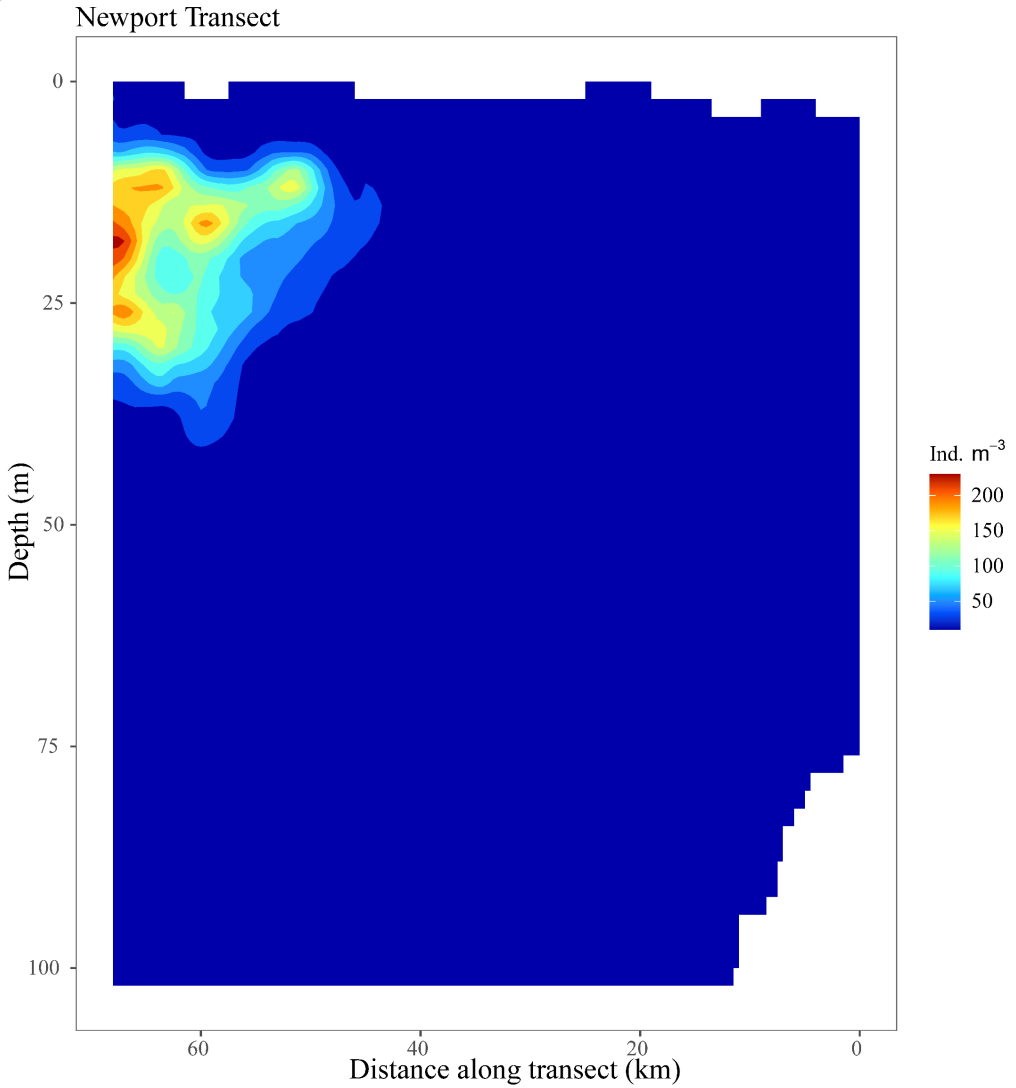
Results

- 5-12 mm in size
- Multiple life stages on transect
- Sampled only gonozooid life stage

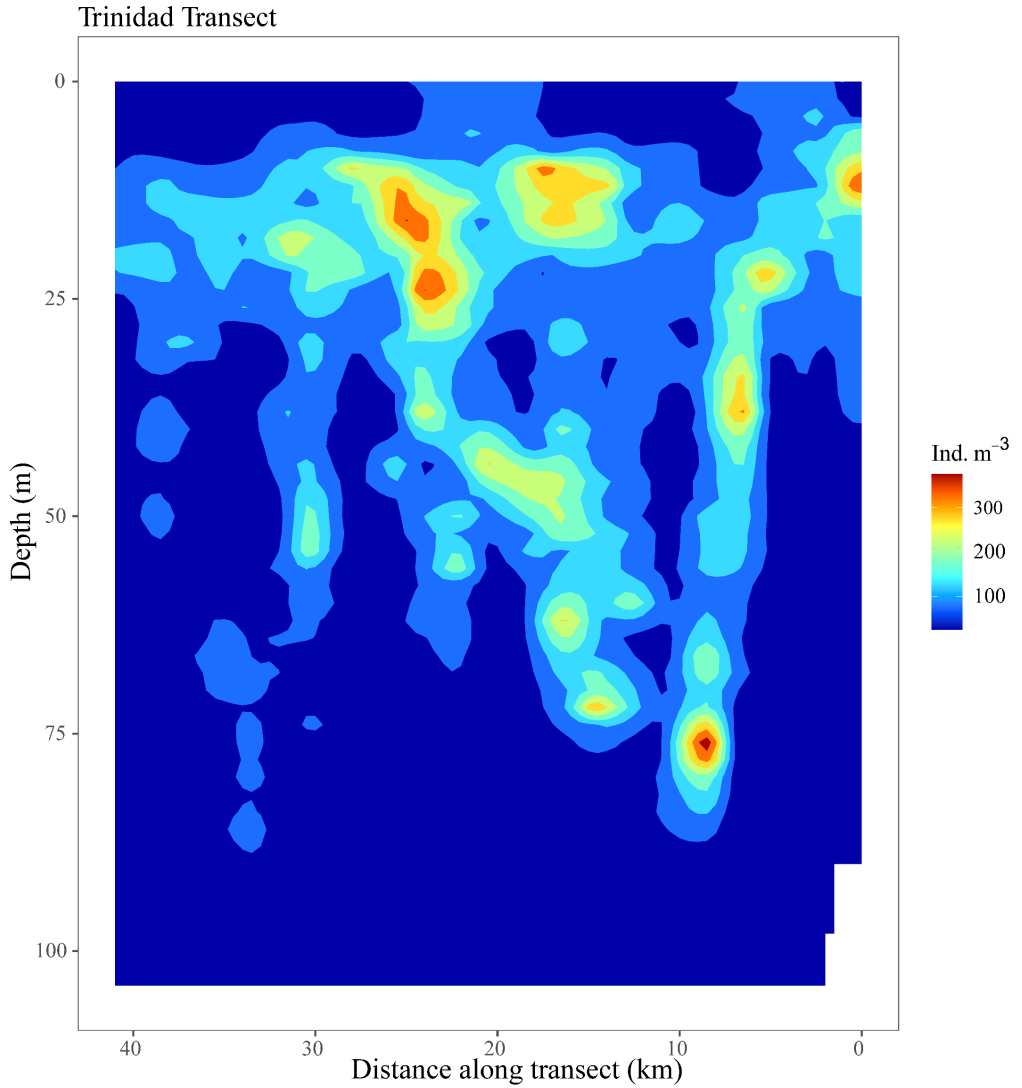
Steinman et al, 2024, *In Revision*



Sometimes very abundant, always patchy!



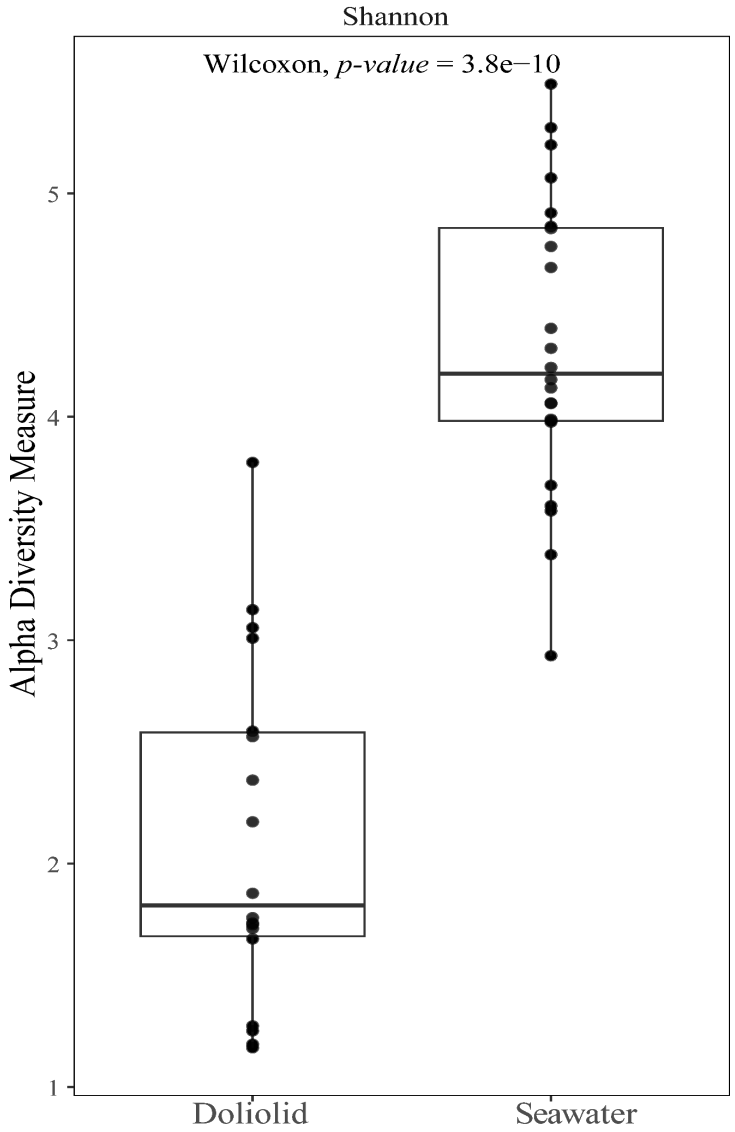
227 individuals per m^3



533 individuals per m^3

Steinman et al, 2024, *In Revision*

Seawater vs doliolid microbial diversity?

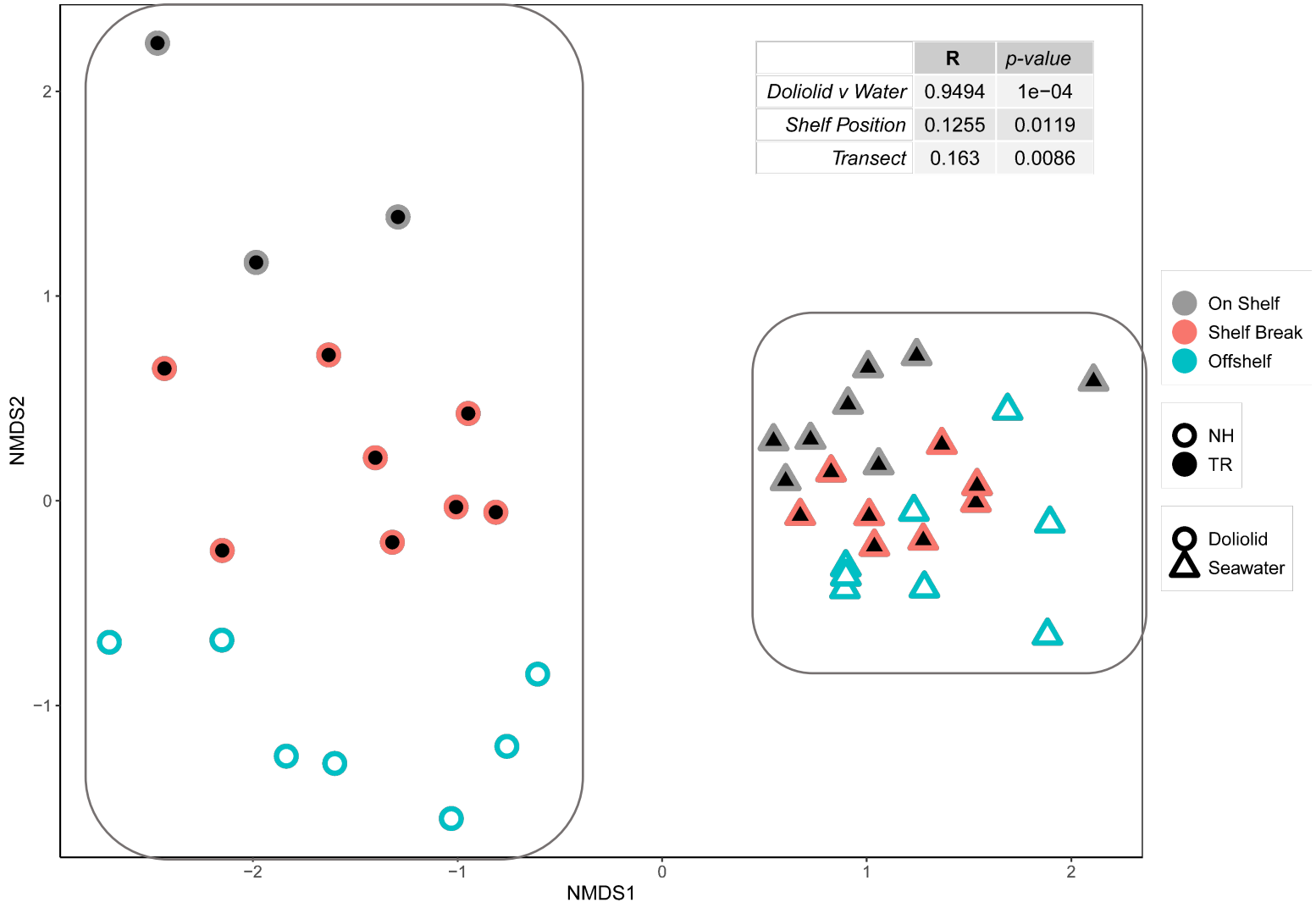


Results

- 6801 unique ASVs
- Doliolid diversity low
- Doliolid microbes are different than seawater
- Consistent with other microbiomes

Steinman et al, 2024, *In Revision*

Seawater vs doliolid microbial diversity?



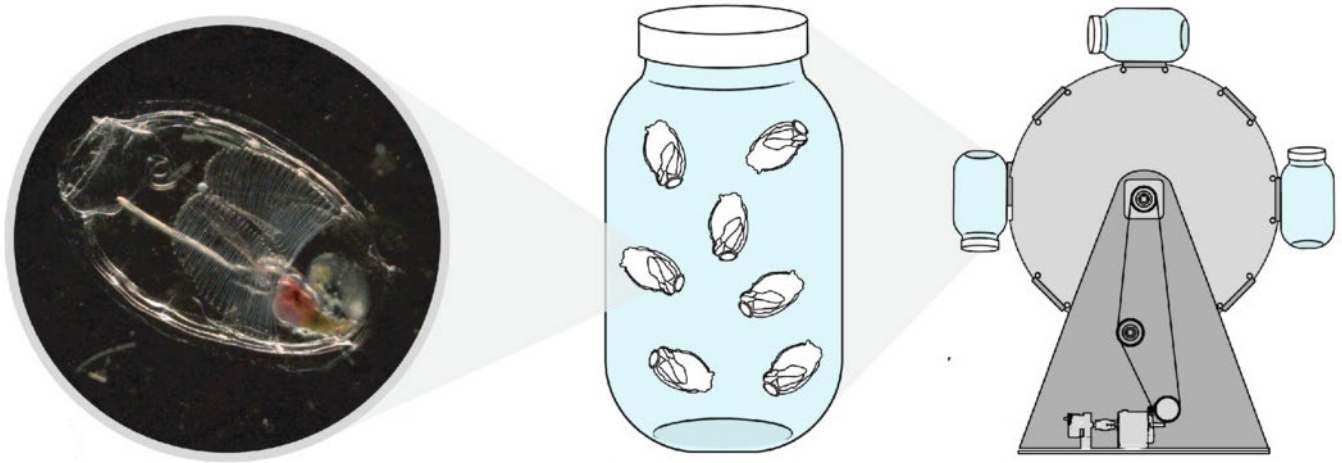
	R	*p-value*
Doliolid v Water	0.9494	1e−04
Shelf Position	0.1255	0.0119
Transect	0.163	0.0086

Results

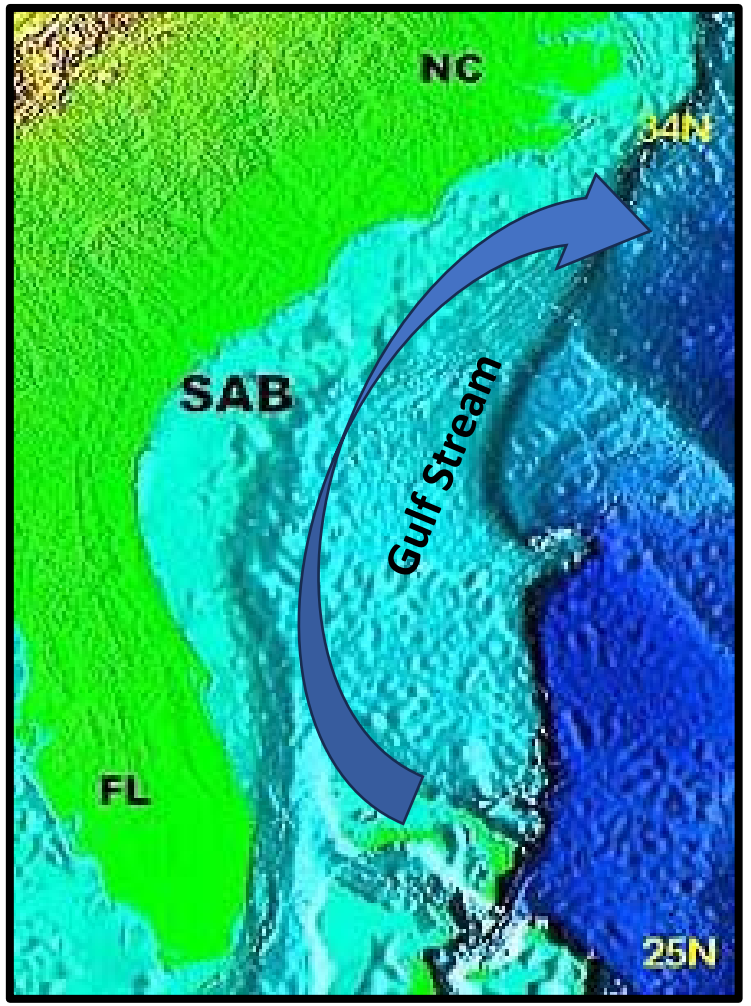
- Microbial communities are distinct
- Differences exist in between locations
- Doliolid microbiome by location

Steinman et al, 2024, *In Revision*

Compare: Atlantic vs Pacific doliolid microbiomes?



Pereira et al., 2022

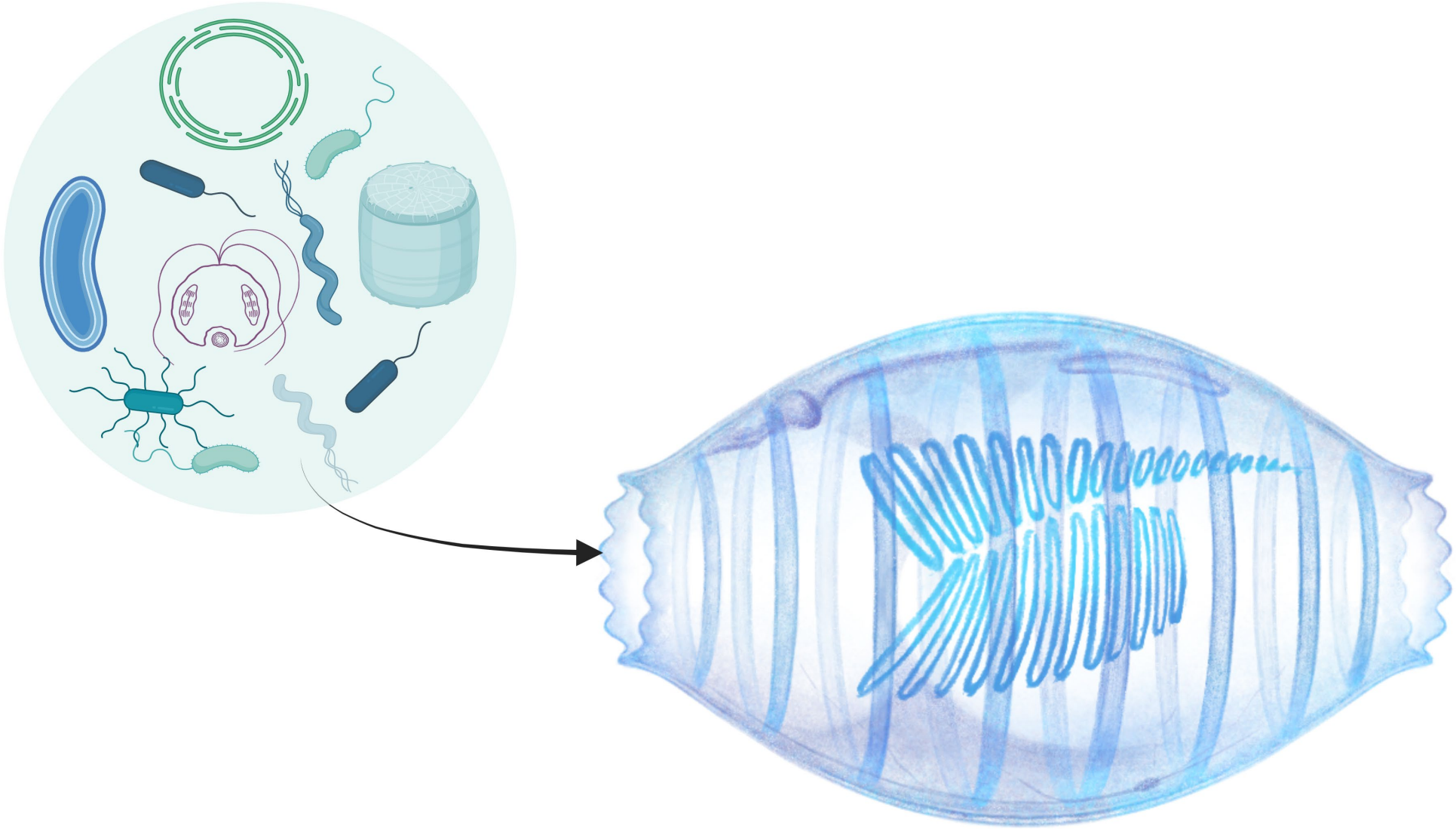


Noaa.gov

Chapter 2 Conclusions – doliolid microbiomes

- Doliolids host a unique microbiome.
- Specific microorganisms not shared Atlantic vs Pacific.
- Four possible reasons:
  - Seawater microbial community?
  - Host genotype?
  - Host factors?
  - Body compartments?
- Hypotheses and targets generated:
  - Identify doliolid symbionts or pathogens?
  - Microbiome could be supporting unique doliolid survival strategies

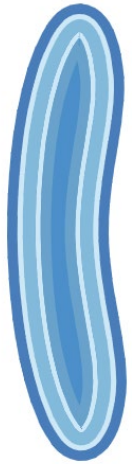
Do doliolids shape the microbial community through feeding?



Known free-living microorganisms as potential prey

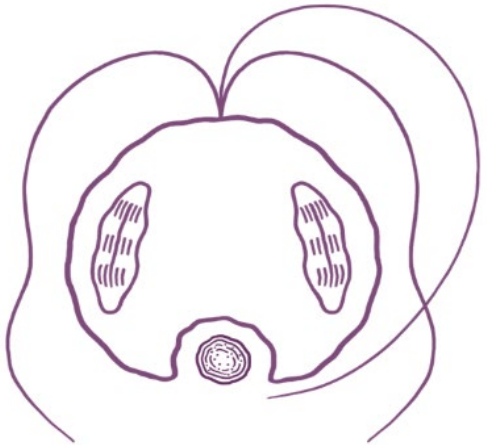
Synechococcus

SAR11



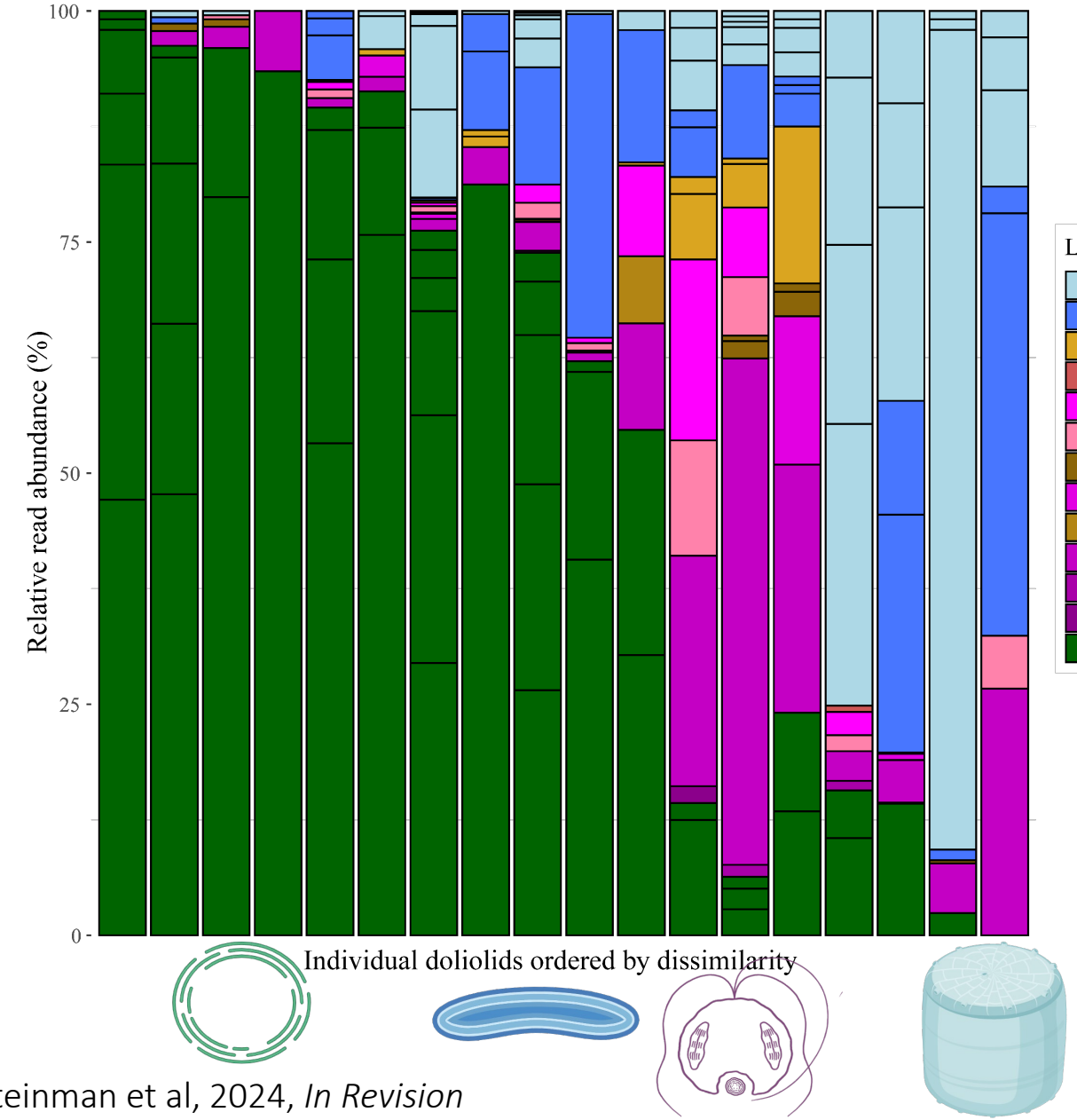
Diatoms

Prymnesiophytes



Rousseau, 2007
Armbrust, 2009
Gionannoni, 2017
Doré et al., 2020

Which microbial prey are found in doliolids?



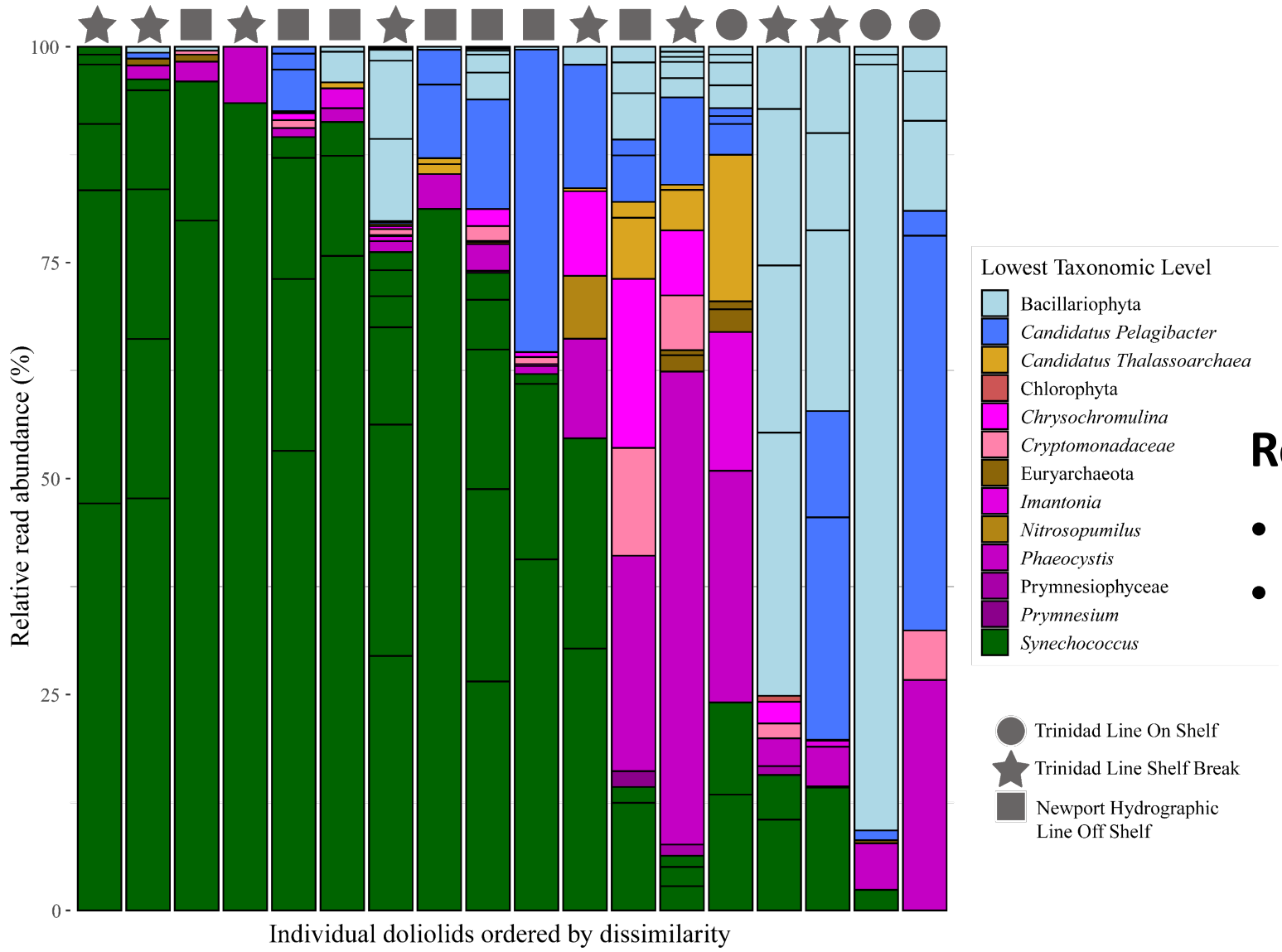
Steinman et al, 2024, *In Revision*

Results

- Effective predator of prokaryotes
- Many microbial functional groups
- Wide range of cell sizes

- *Synechococcus* is present
- Archaeal is present
- SAR11 is present

What is driving the differences in feeding between doliolids?

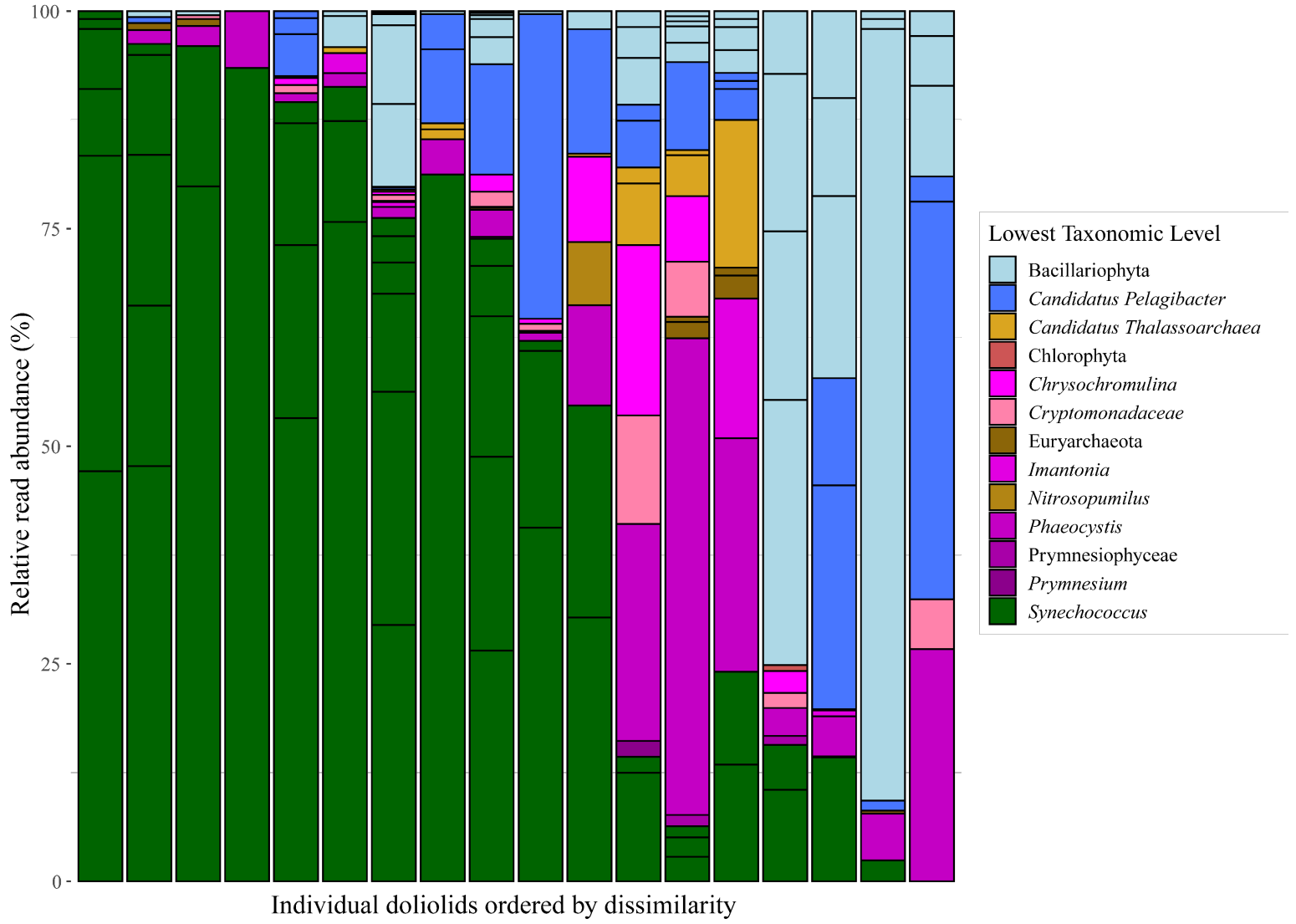


Results

- Moderately by shelf position
- Not impacted by transect

Steinman et al, 2024, *In Revision*

Which microbial prey are found in doliolids?



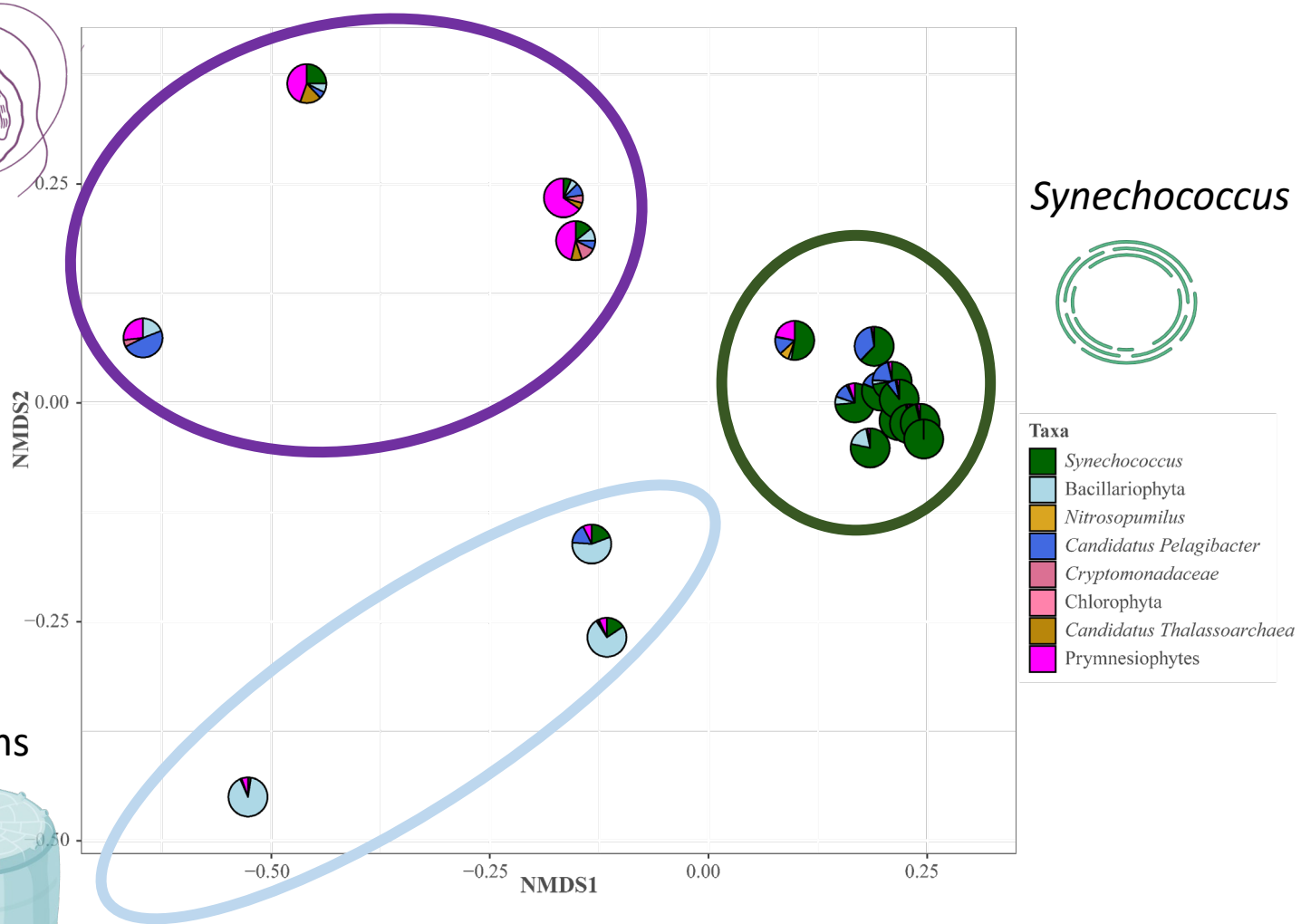
Results

- Individual differences

Steinman et al, 2024, *In Revision*

Feeding differences among doliolids?

Prymnesiophytes



Synechococcus

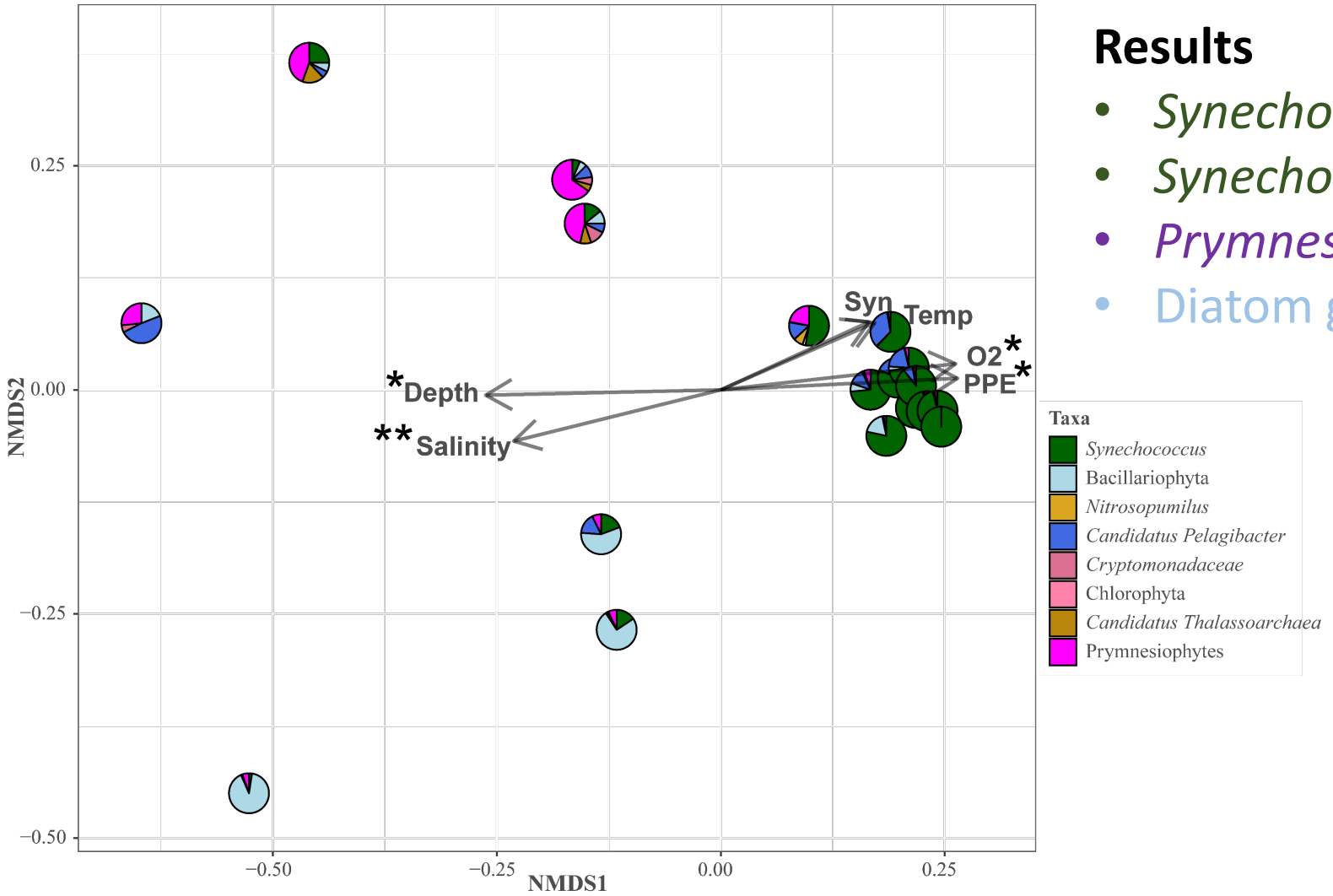
Diatoms

Results

- Three feeding groups

Steinman et al, 2024, *In Revision*

What is driving differences in feeding among doliolids?



* *p-value* < 0.05 **p-value* < 0.01

Results

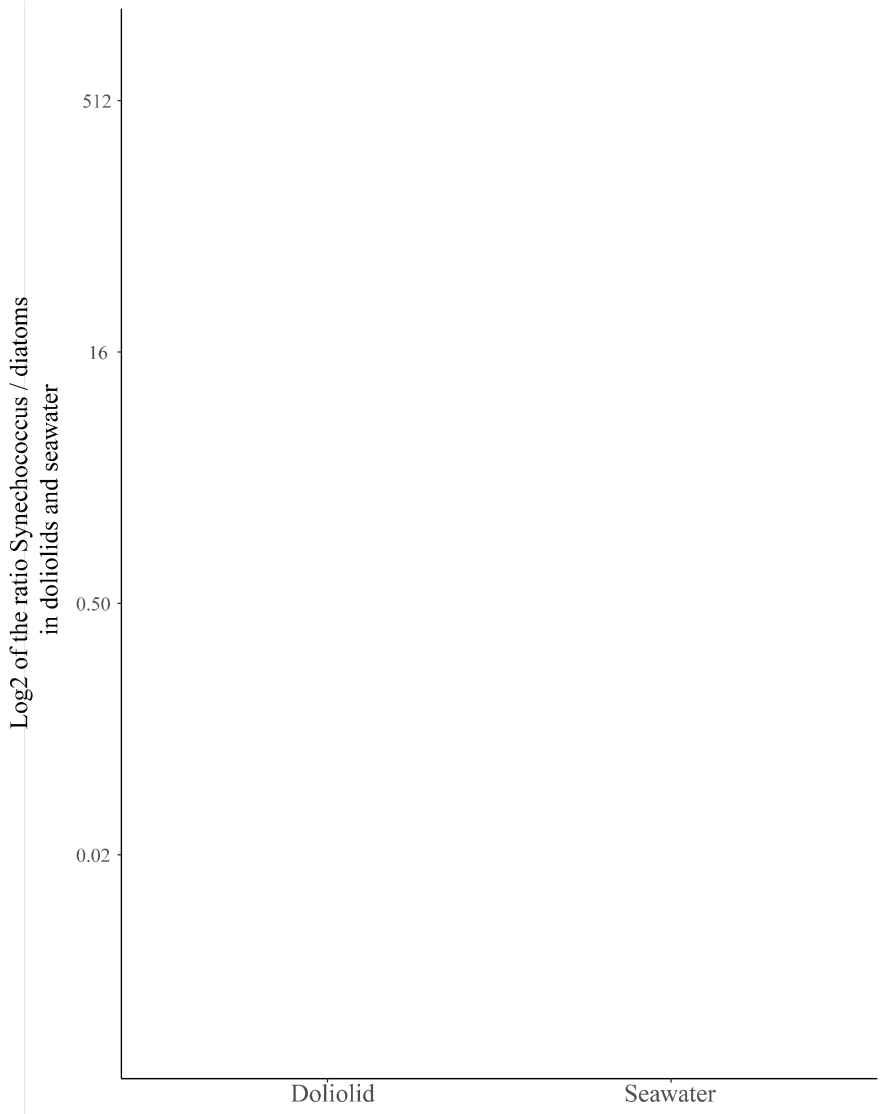
- *Synechococcus* group -> increased O_2
- *Synechococcus* group-> increased PPE
- *Prymnesiophytes group* -> depth
- Diatom group -> increased salinity

Steinman et al, 2024, *In Revision*

Selective feeding? Diatoms vs. *Synechococcus*

Synechococcus

Diatoms

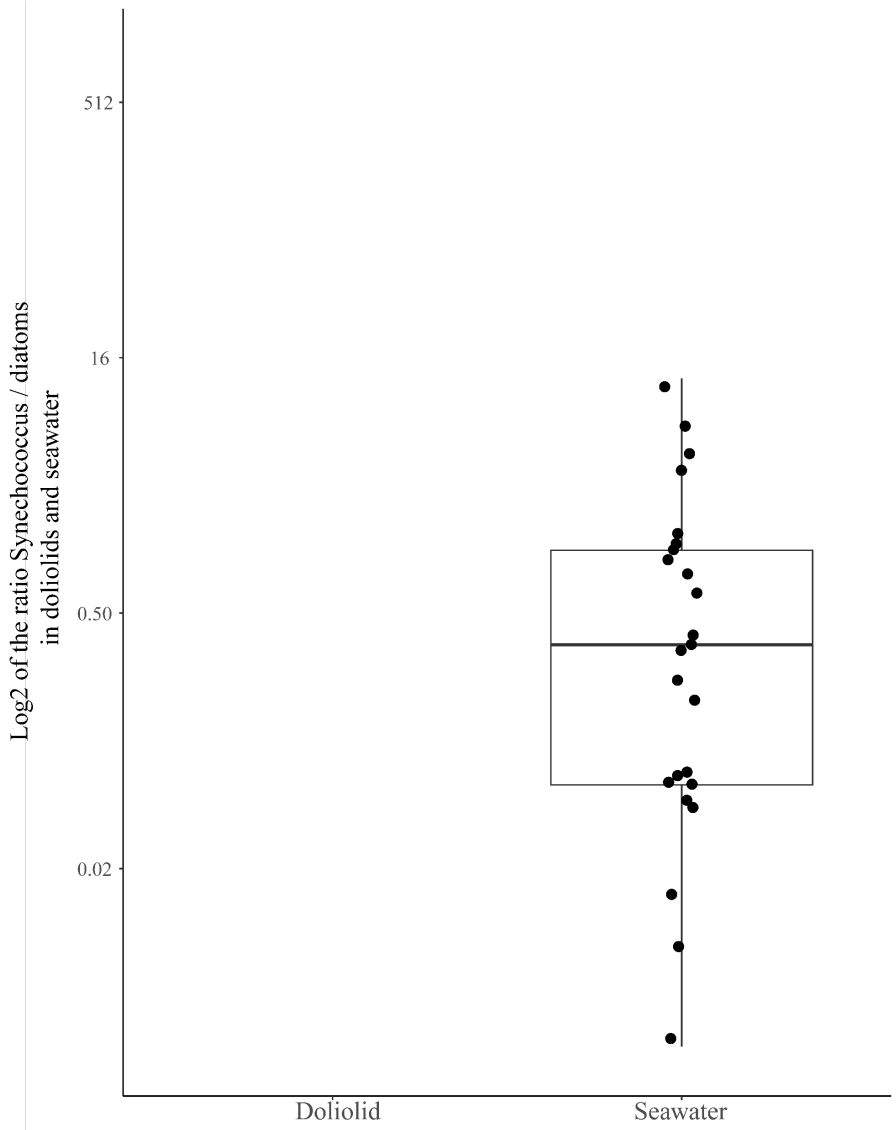


Steinman et al, 2024, *In Revision*

Selective feeding? Diatoms vs. *Synechococcus*

Synechococcus

Diatoms

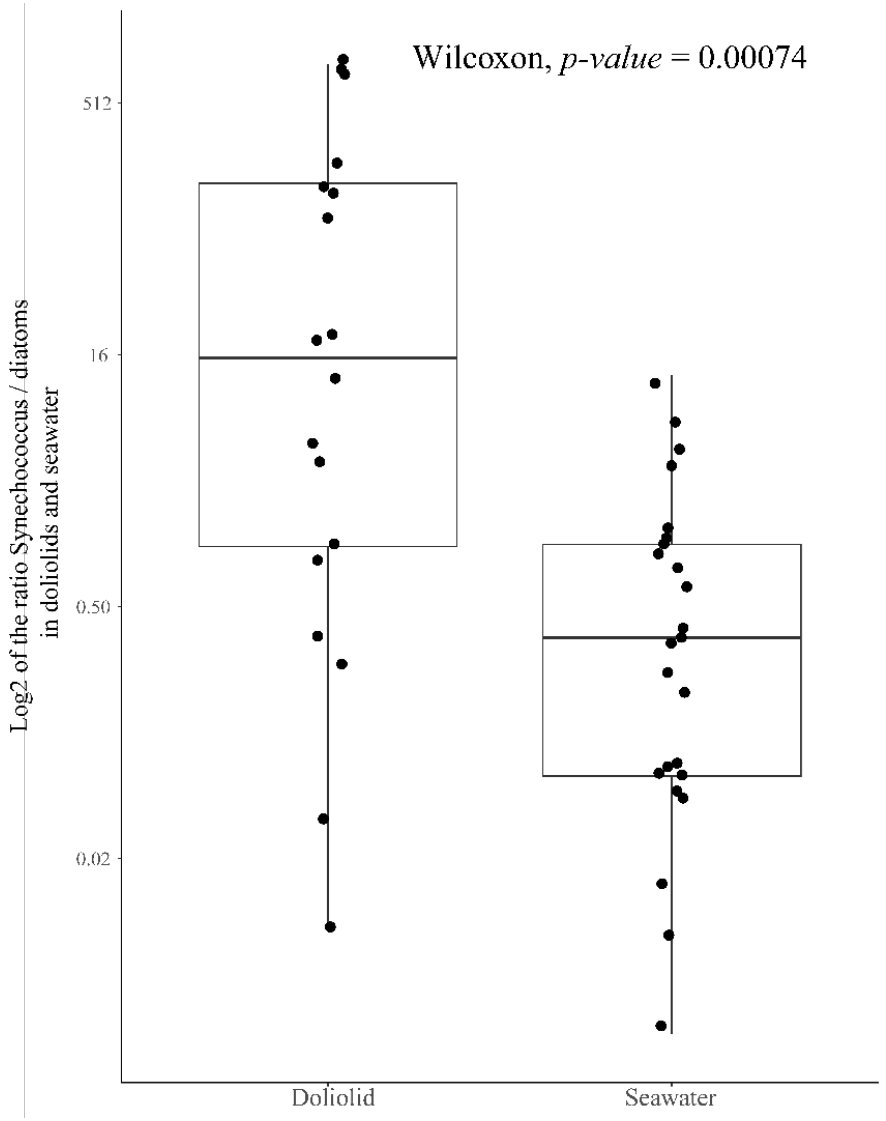


Steinman et al, 2024, *In Revision*

Selective feeding? Diatoms vs. *Synechococcus*

Synechococcus

Diatoms



Results

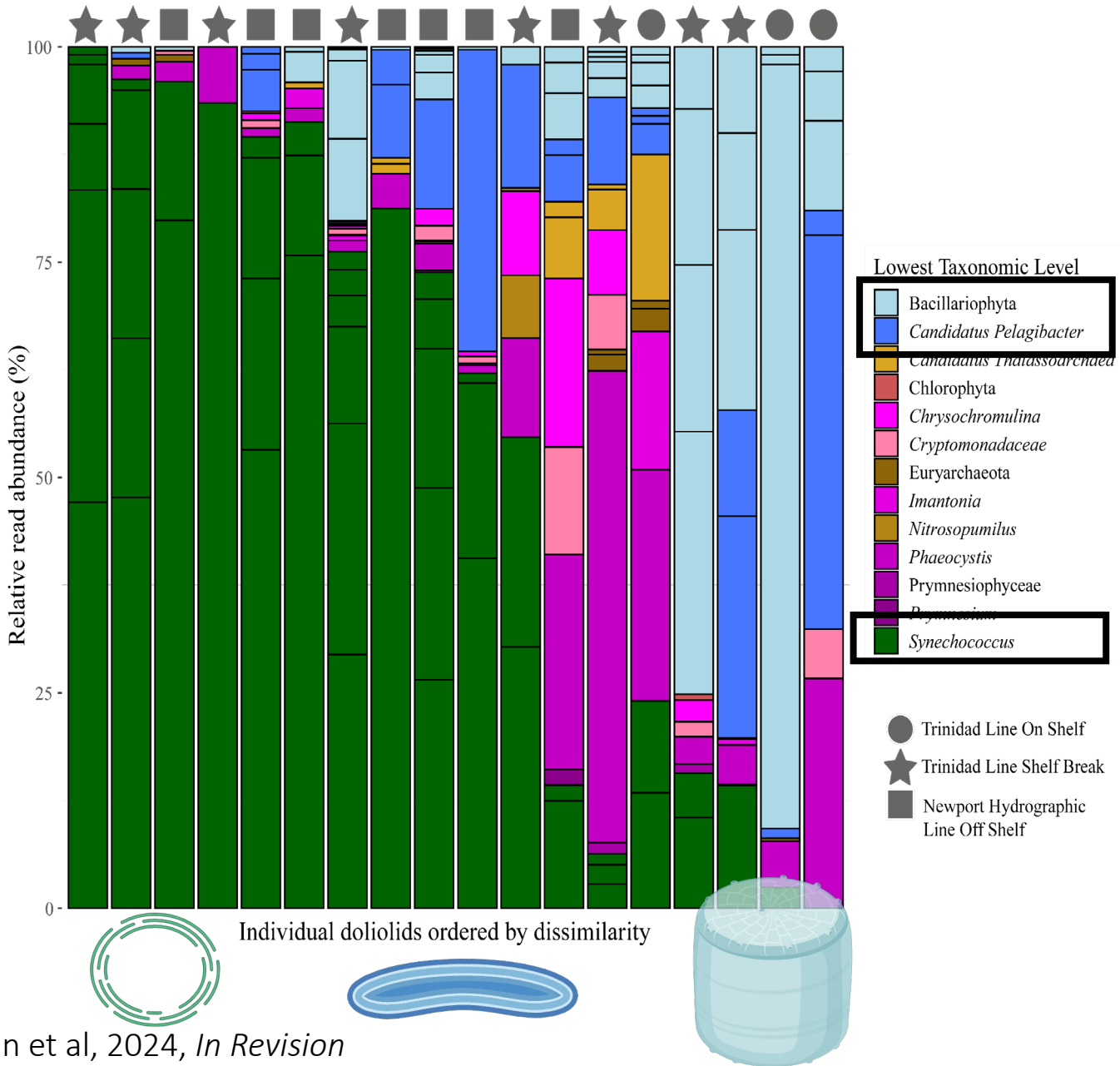
- Selection for *Synechococcus* over diatoms
- Feeding may alter size structure

Steinman et al, 2024, *In Revision*

Chapter 3 Conclusions – doliolid feeding

- Prokaryotes present in doliolids
- Feed on more microbial groups than previously known
- Doliolids select *Synechococcus* over diatoms
- Restructure microbial communities?
- Doliolids may impact the prey of higher trophic levels

Synechococcus, diatoms and SAR11 are abundant in doliolids.



Prey differences?

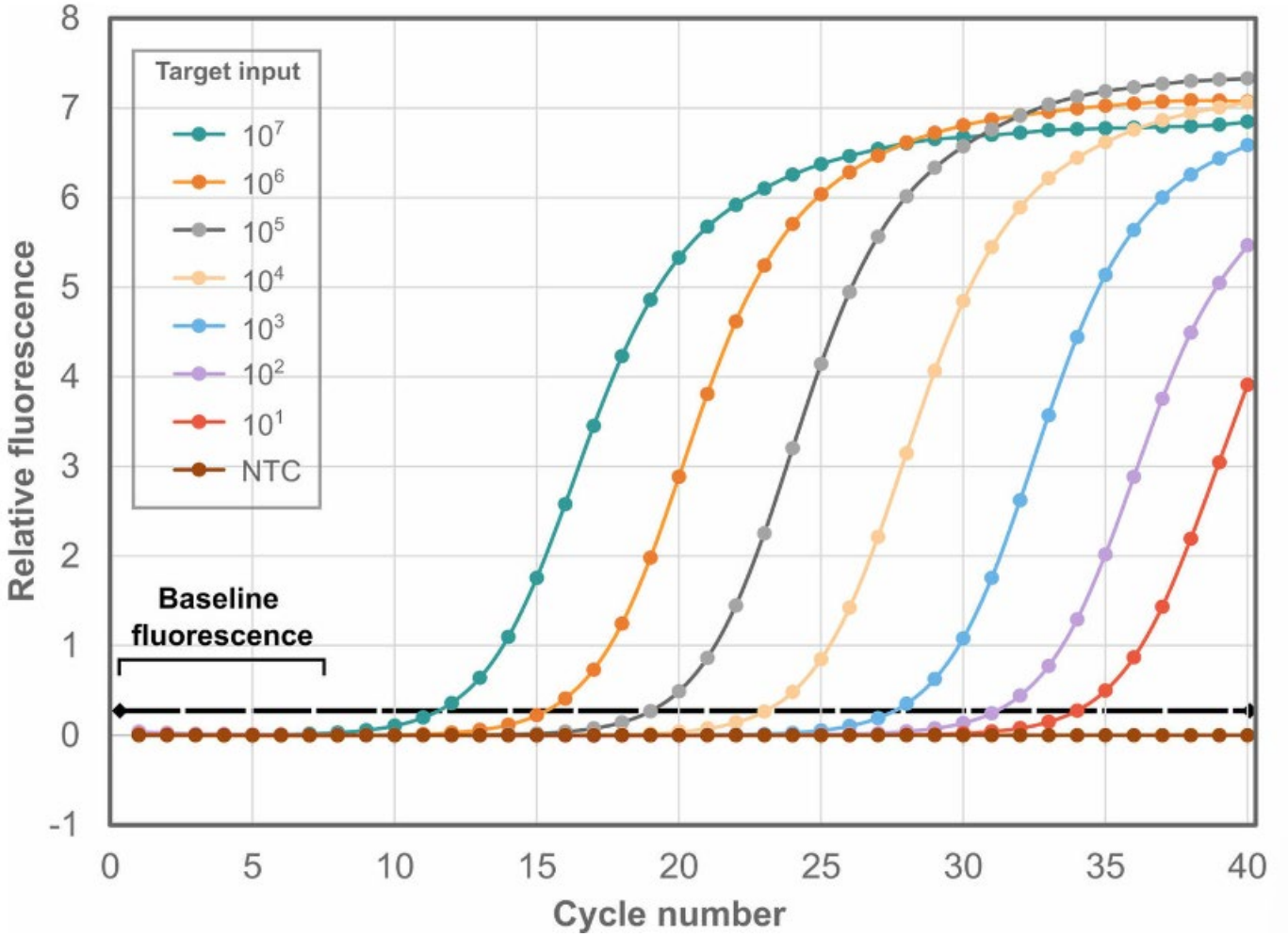
- Unique surface properties
- Abundant cells in seawater
- Selective feeding

Steinman et al, 2024, *In Revision*

Exact quantities of targeted prey taxa with qPCR

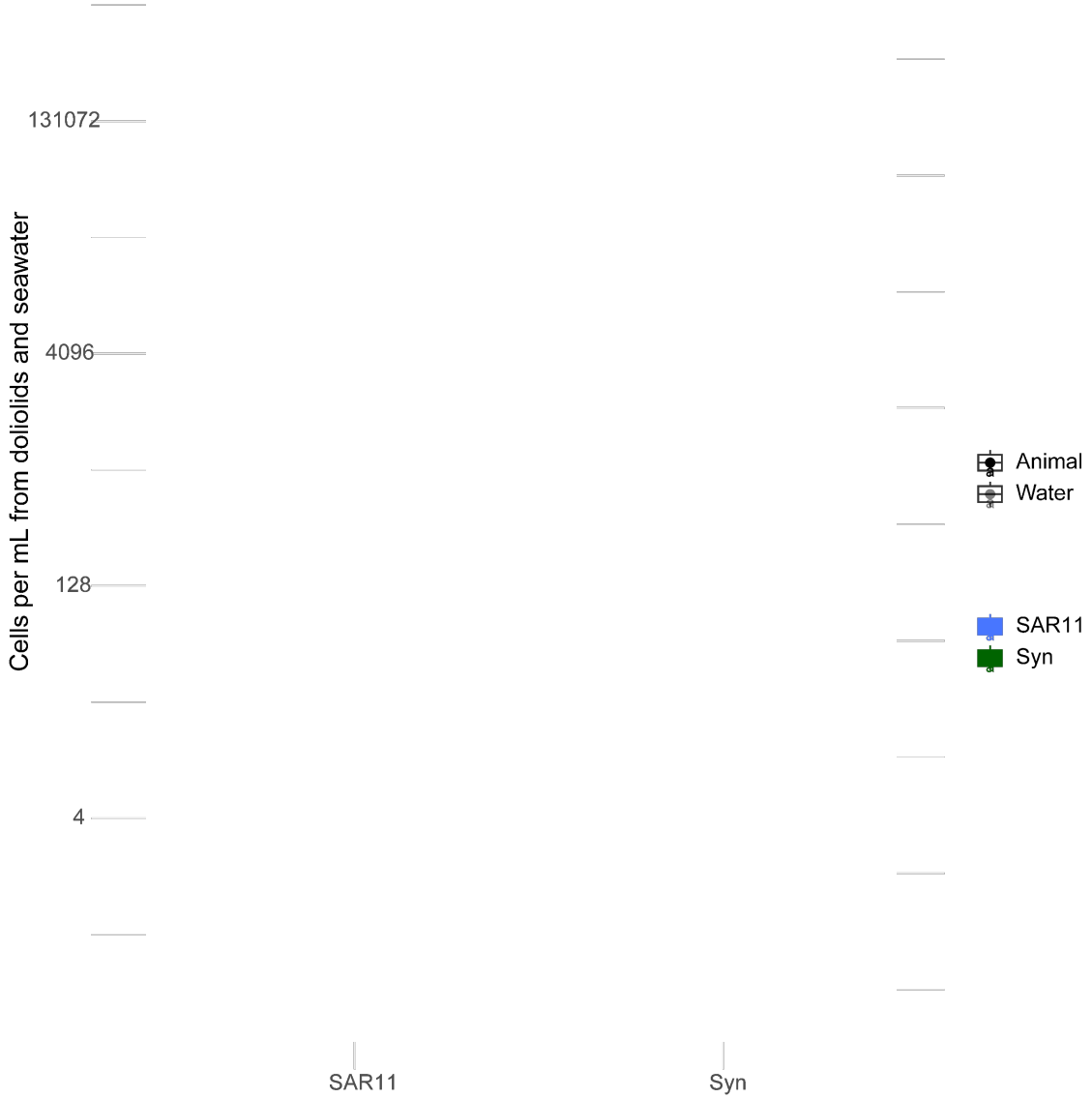
Three published qPCR assays:

- *Synechococcus* Clade 1
  - Ahlgren, 2012
- Diatoms
  - Frischer et al. 2014; 2021
- SAR11
  - Suzuki et al. 2001

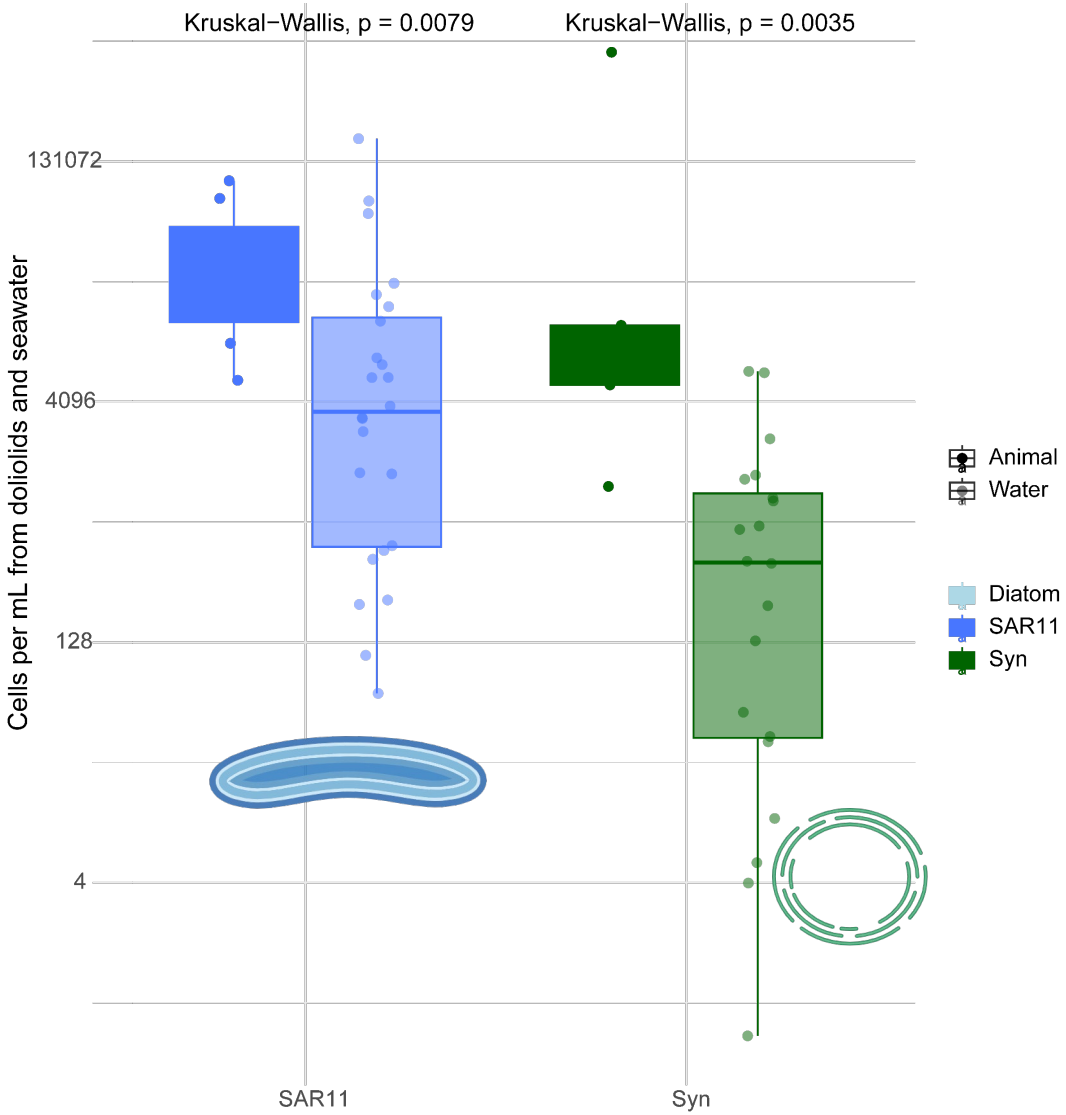


BioRad.com
Integra-biosciences.com

Doliolids enrich SAR11 and *Synechococcus – active feeding*



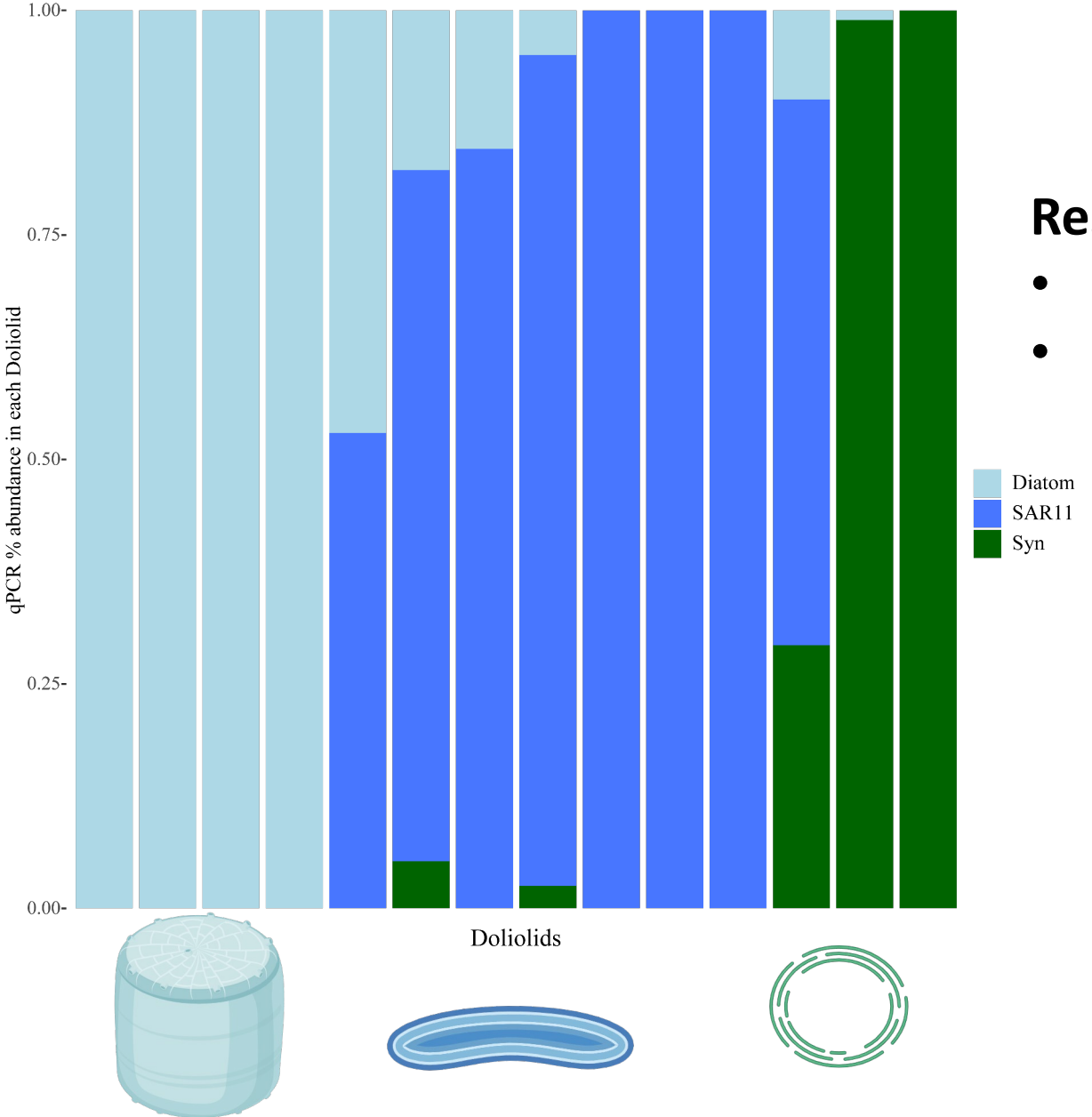
Doliolids feed selectively on SAR11 and *Synechococcus*



Results

- First evidence of feeding on SAR 11
- SAR11 is enriched 2-fold
- First study to quantify feeding on *Synechococcus*
- *Synechococcus* is enriched 118-fold

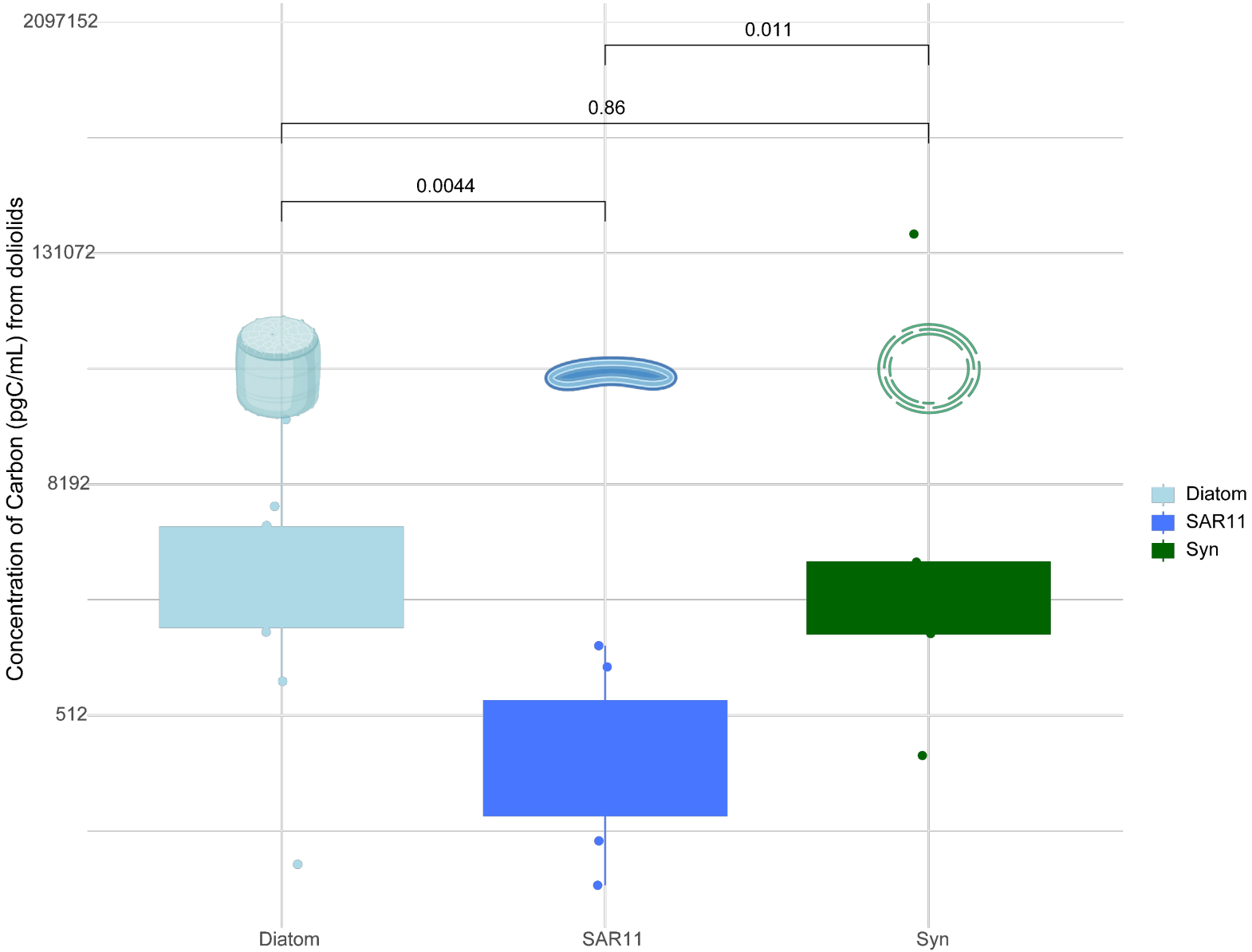
Feeding differences among doliolids?



Results

- Doliolid feeding varies between individuals
- Supports results from Chapter 3

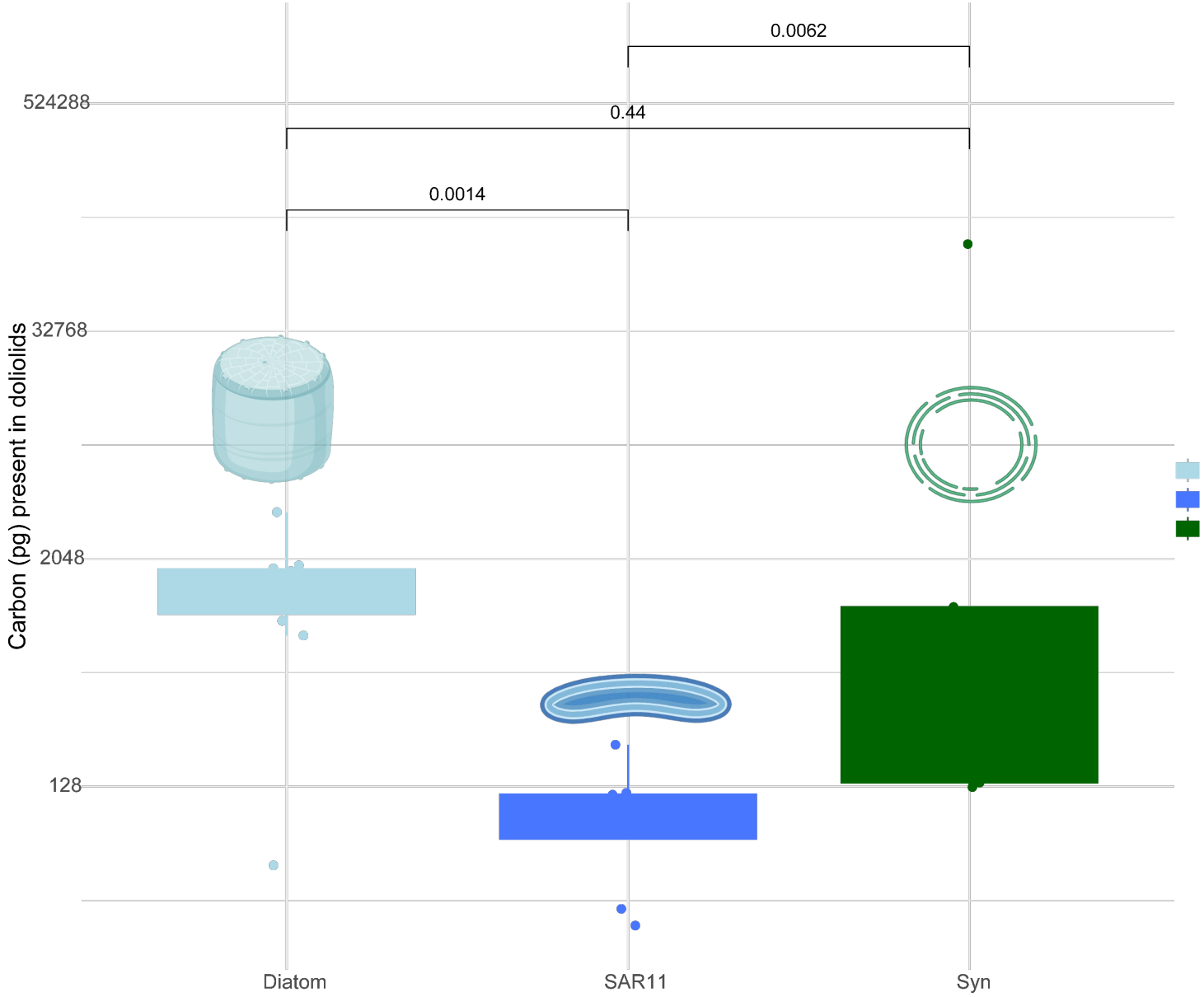
Carbon contribution is different between taxa



Results

- SAR11
  - Most abundant cell
  - Least carbon biomass
- Diatoms
  - Least abundant
  - Most carbon biomass
- *Synechococcus*
  - More carbon than SAR11

Snapshot of carbon contained in doliolids



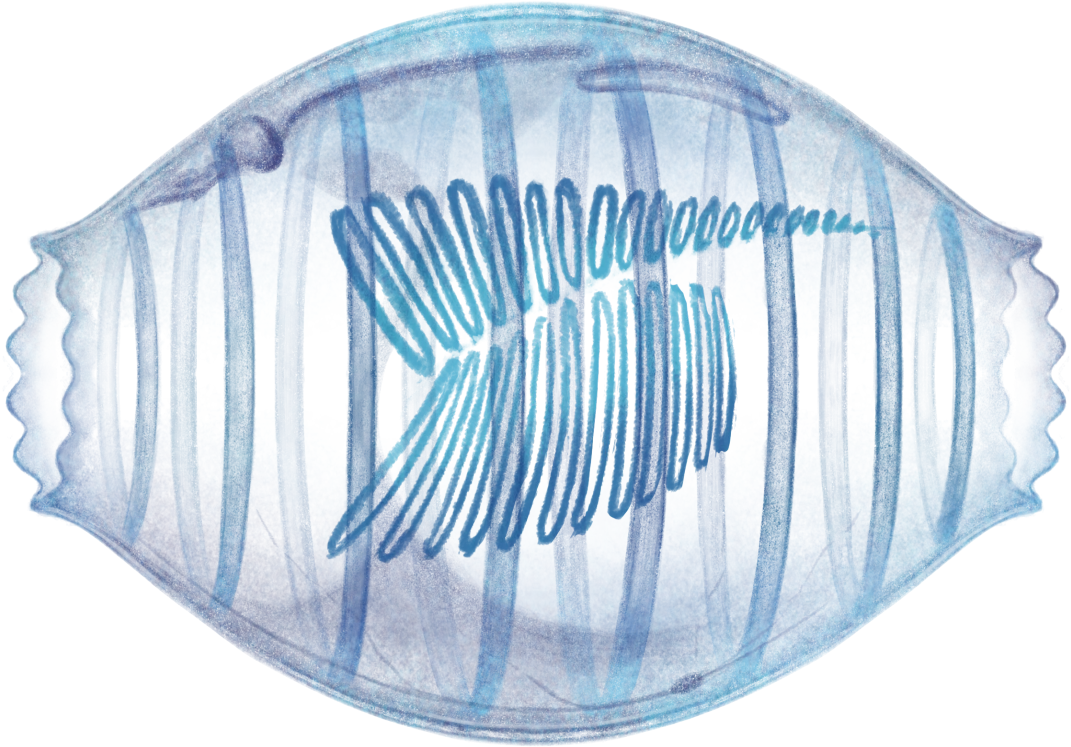
Results

- Meet carbon needs by selective feeding

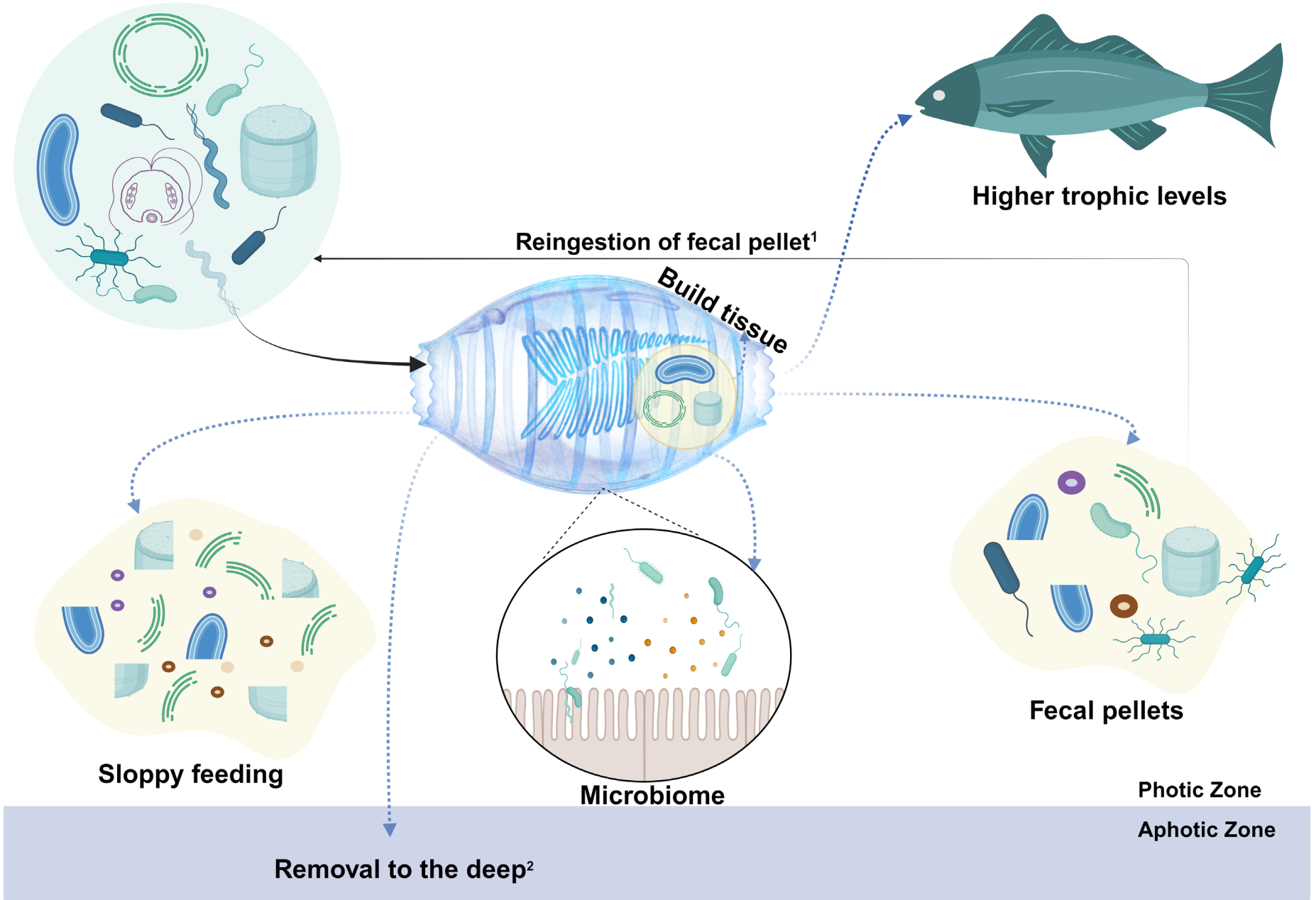
Chapter 4 Conclusions – Quantifying targeted prey

- Doliolids actively feed on SAR11
- Doliolids actively feed on *Synechococcus*
- Doliolid feeding varies between individuals
  - Supporting results from Chapter 3
- Doliolids can meet their carbon requirement through selective feeding on diatoms or *Synechococcus*

Doliolid – microorganism interactions?



Model of doliolid impacts on marine microorganisms



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References

References