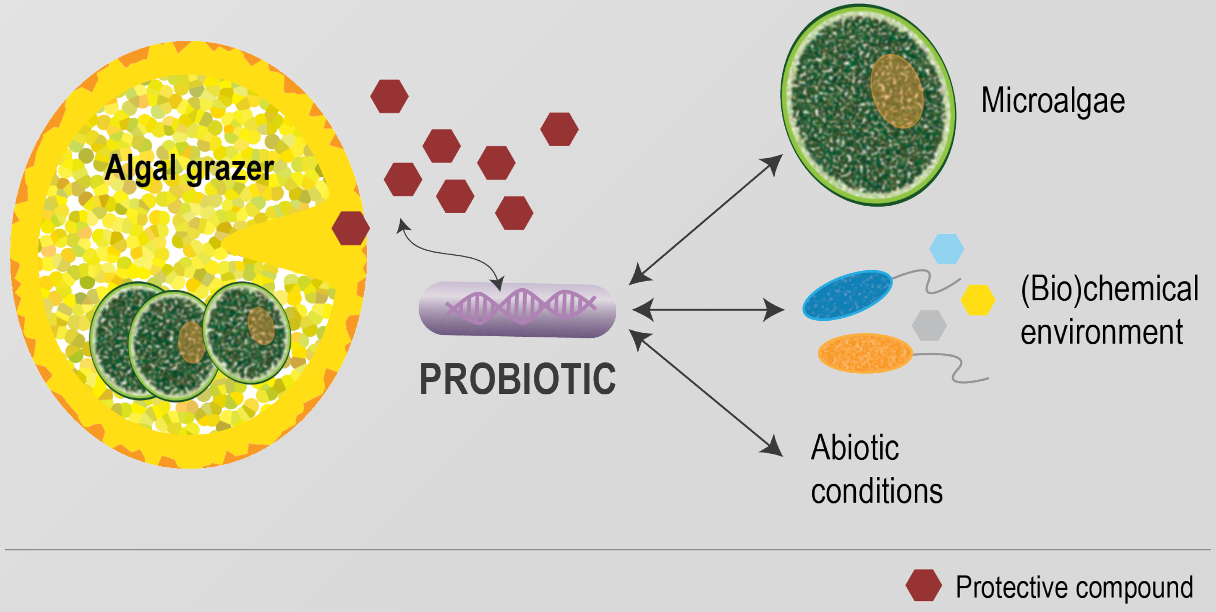
Biological Control of Pests: Consider the microbiome

Rhona Stuart,
Lawrence Livermore National Laboratory
Crop Protection Workshop
April 20, 2021

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-PRES-821480

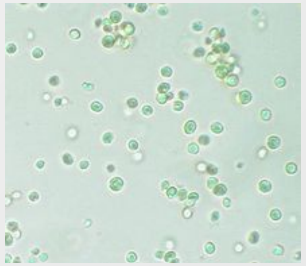
Biological Control of Pests

- Biological control agents (BCAs) in algal ponds have not been explored much (some examples of zooplanktivorous organisms).
  - Numerous examples of microbial BCAs in agriculture
- Will discuss 2 examples:
  1. Biological control agents for grazers
  2. Parasites—need to understand the resource economy in an algal pond



Algae are intimately associated with their microbiome—consider and leverage when applying biological control.

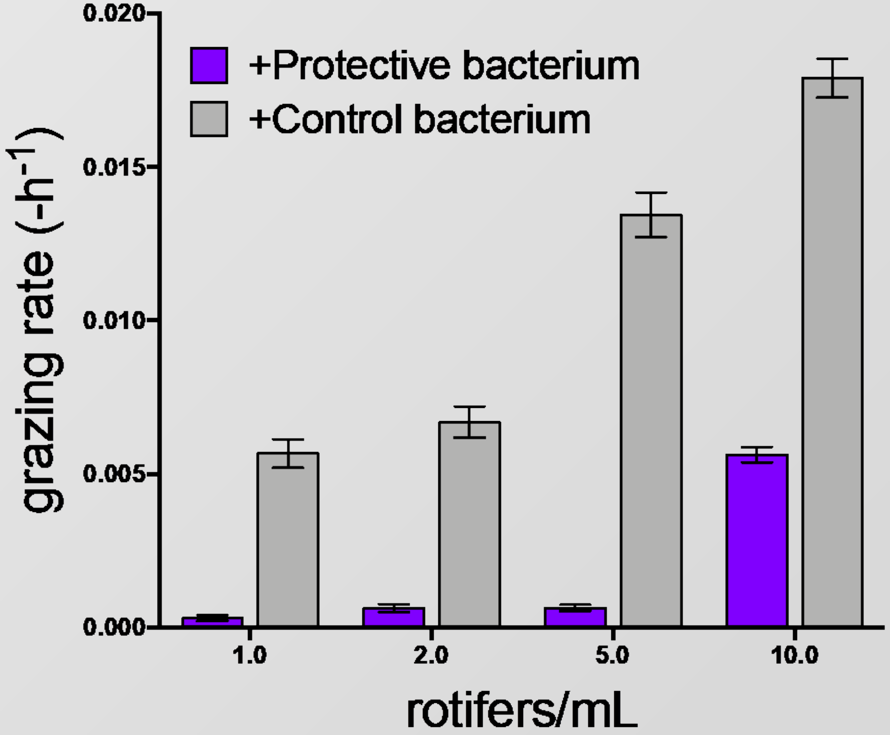
1. Biological control of grazers



Nannochloropsis salina

Brachionus plicatilis

Protective bacterium

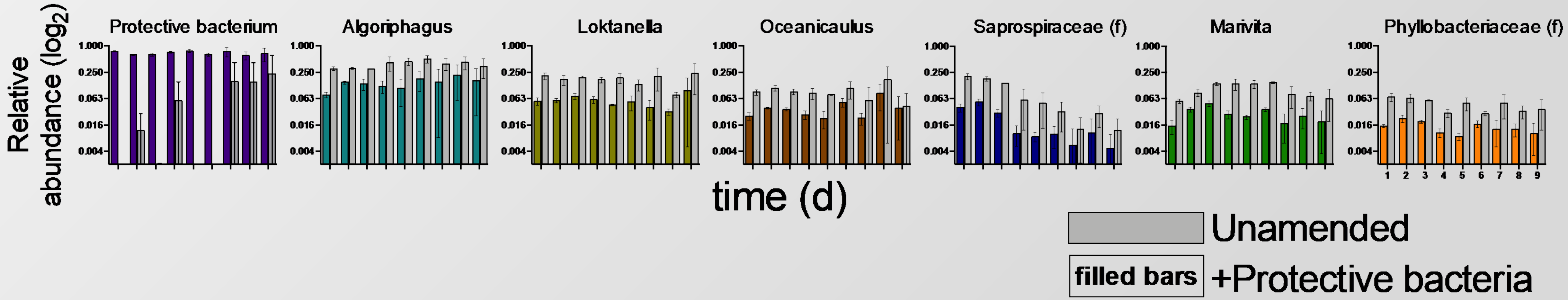


Protective bacterium reduces rotifer grazing of *Nannochloropsis salina* in a biologically complex community (outdoor)

We are developing a protective bacterial application to deter grazing by rotifers

Ward *et al* in review, Ward *et al* in prep

1. Biological control of grazers: microbiome effects

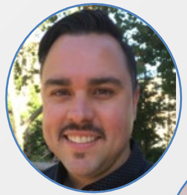


- ➢Adding the protective bacterium does not selectively displace abundant members of the resident algal microbiome

Protective bacterium may have a distinct niche, so it doesn't compete

Ward *et al* in review, Ward *et al* in prep

2. Biological control for Parasites: Give them what they need?



Ty Samo

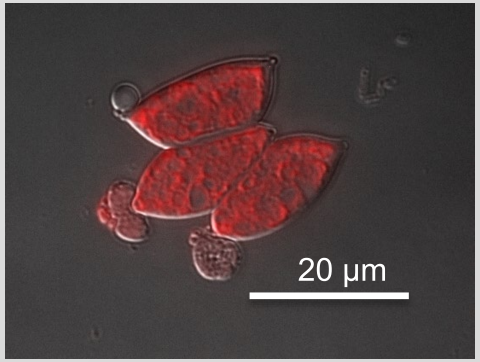
Chris Ward (BGSU)

Megan Morris

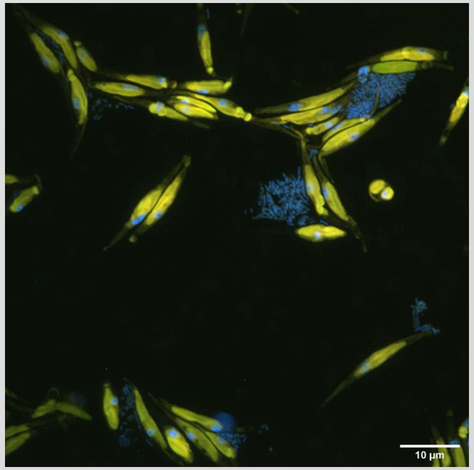
Xavier Mayali

- Parasitic chytrid fungi can proliferate on algal exudate, without the need for lysing algal cells.
  - Current project is investigating algal-produced compounds that delay infection.

- Supplementing algicidal-bacteria and diatom co-cultures with specific nutrients can deter killing (high concentrations) or delay attack (low concentrations)



Scenedesmus cells infected with chytrid parasites. Photo credit: Ty Samo



Parasitic bacteria (blue) aggregate in high density towards diatom cells (green) on the precipice of attack. Photo credit: Megan Morris

Lysing algae is hard work—if parasites can avoid and still proliferate, they will.

Future Research Opportunities:

- A microbiome which does not compete for those resources
- A microbiome which provides the resources for the parasites.

Early days: Hurdles in applying protective bacteria

- Specificity of the application—can we expand to other pests?
  - Need to know the mechanism of protection to see whether might apply to other pests
  - Need to have a library of pests to test against
  - Need to develop consistent assays for each pest to test protection
- Quantifying impact and efficacy
  - Need to develop reliable modeling of biological induced crashes and their annual costs
  - Crash prevention metrics:
    - Artificial model assays are important for screening and identifying protection…BUT over a year how many crashes does the application prevent? If only one pest targeted, then need to know how often that pest crashes the culture, and hard to replicate.