Phytoplankton Physiology Seminar

Week 8, Session 7

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Some logistics!

- Sign up for papers!

Mortality in the phytoplankton

- We'll talk about viruses in a future session, and this class will mostly be focused on mortality due to predation
- Hansen paper: can we group predators according to the type of prey they consume? How does this impact the kinds of phytos that survive?

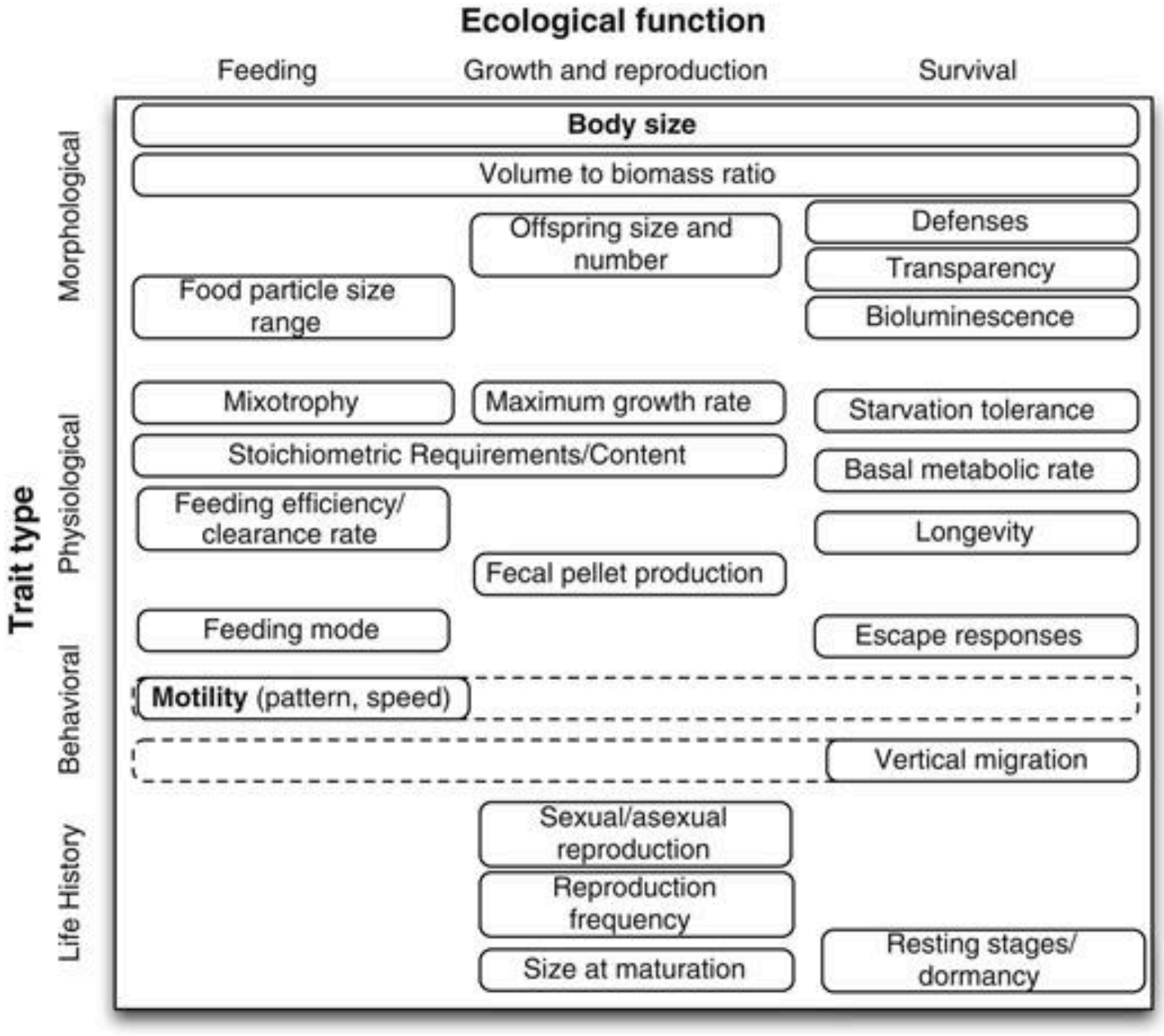
Later, we'll talk about Hansen in more detail, but for now

- Is it possible to create functional types for planktonic predators? How does mixotrophy play a role?
  - "*When more solid information on the size selectivity of these organisms becomes available, it may be possible to categorize heterotrophic plankton into functional groups based on feeding mechanisms rather than taxonomy*"

Why do zooplankton grazing & strategies matter?

- If zooplankton predators have preferences for prey, this puts an additional constraint on phytoplankton size
- Preferred size (and the ability of zooplankton predators to stretch those preferences) decides how much other determinants of phytoplankton physiology matter

Litchman et al. 2013: Trait-based approaches to zooplankton communities



Grazing tends to be the major determinant of phytoplankton mortality, especially in warmer waters

- Growth rate in North Pacific: **0.38-0.70 day^{-1}**
- Mortality rate via grazing in the same waters: **0.15-0.88 day^{-1}**
- (Obayashi et al. 2002)

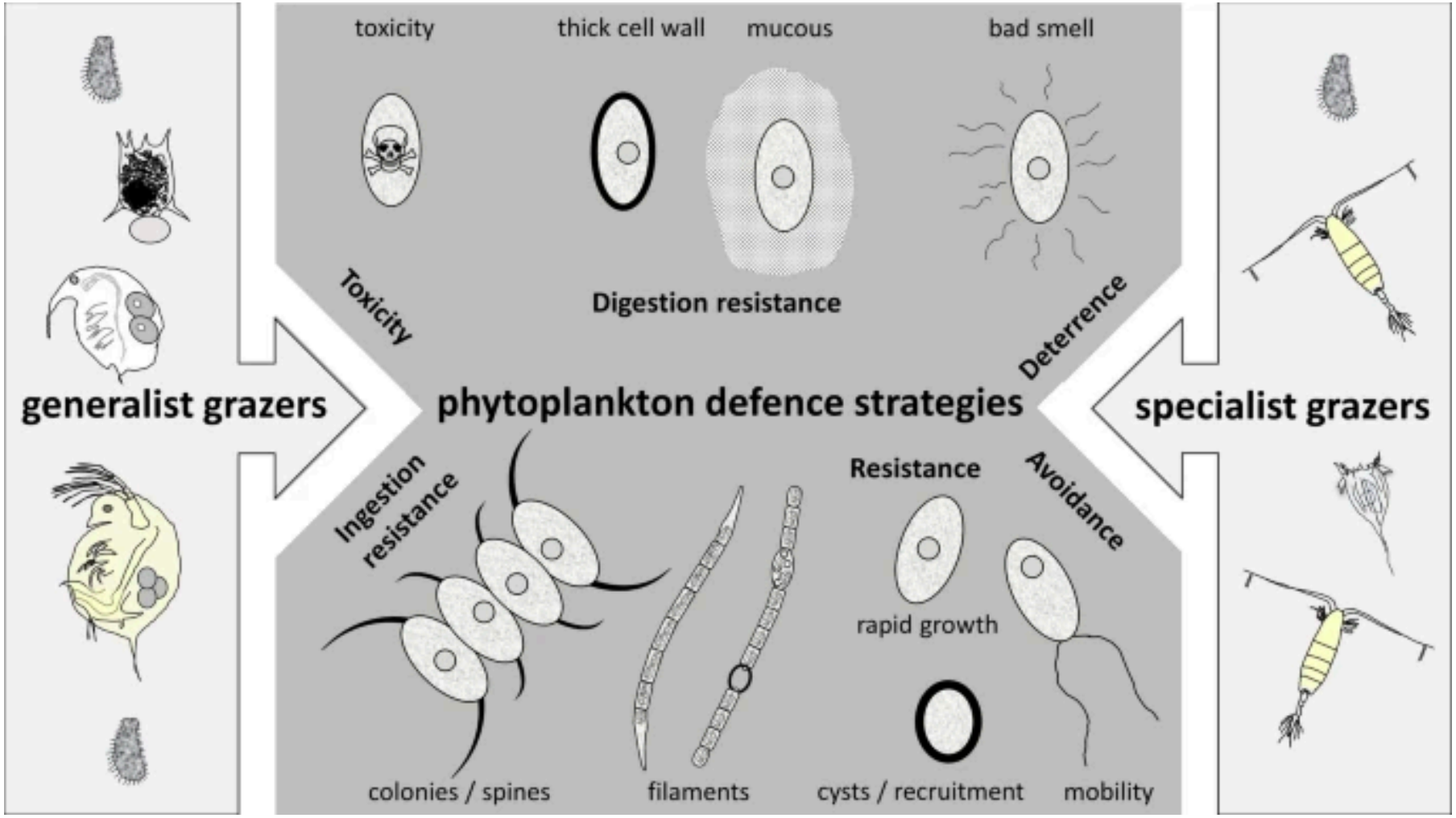
What makes more of a difference: size or taxonomy/other functions?

- Hansen et al. emphasizes the importance of the size distribution of predator and prey, but…
- Pigments sometimes suggest that certain taxonomic groups of phytoplankton are preferentially grazed, whilst others are less affected

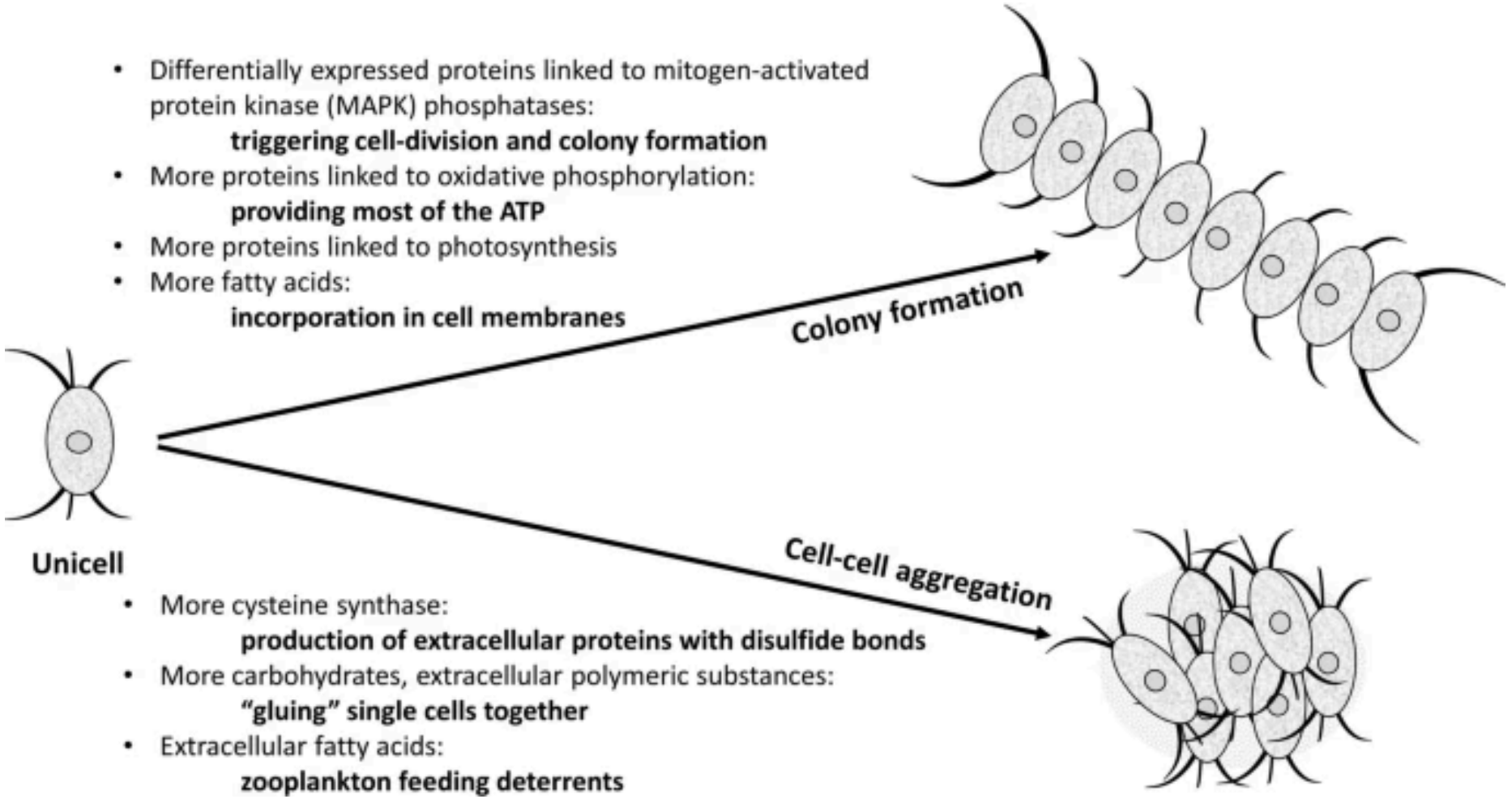
Some phytoplankton have unusual defenses against grazing

- Diatom oxylipins
  - Defensive/allelopathic chemicals that can deter or harm predators
  - Can also control diatom-associated bacteria
  - May also synchronize cell death/blooms
- Alexandrium: chain breakup in response to copepods
- Dinoflagellates: may produce bioluminescent flashes that deter grazers
- Phaeocystis may produce larger colonies or smaller cells in response to chemical cues
  - When a ciliate is around (small particle grazer) -> colonies; when a copepod is around (large particle grazer) -> independent cells

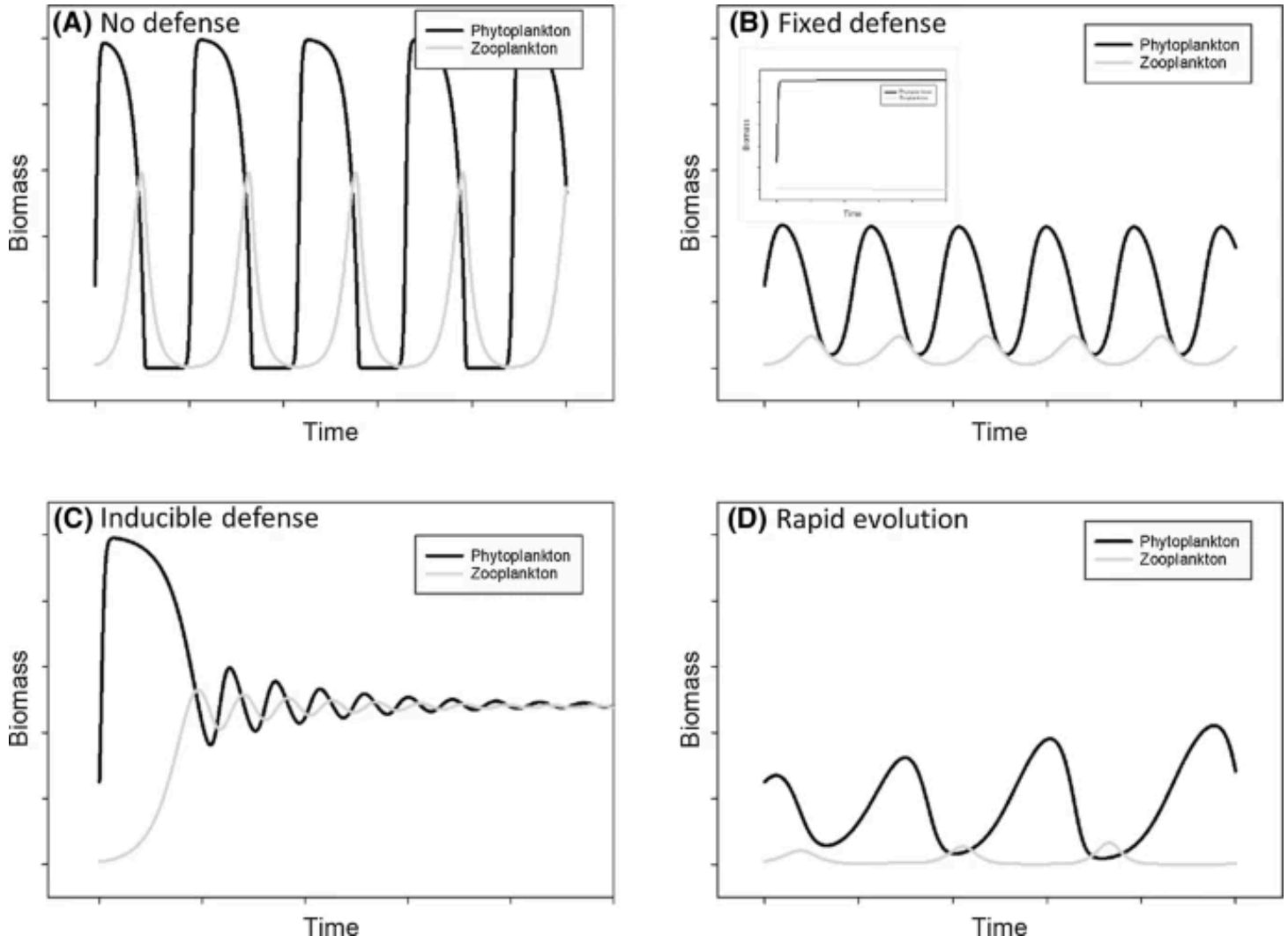
Lurling et al. 2021



Lurling et al. 2021

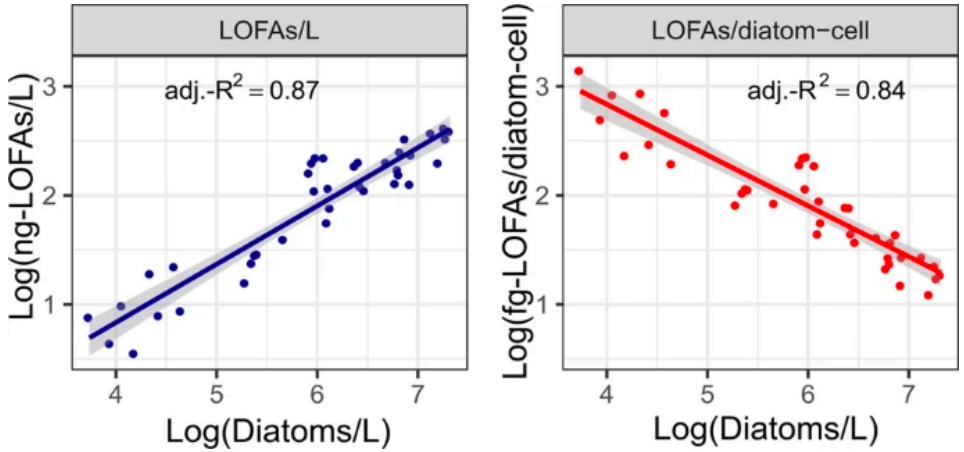


Lurling et al. 2021



Diatoms and oxylipins: communication turned cooperative strategy

- Diatoms probably originally used oxylipins to communicate
- Now, they leverage this to increase production of oxylipin/cell at low diatom concentrations = copepods have almost 100% chance of a mouthful of oxylipin

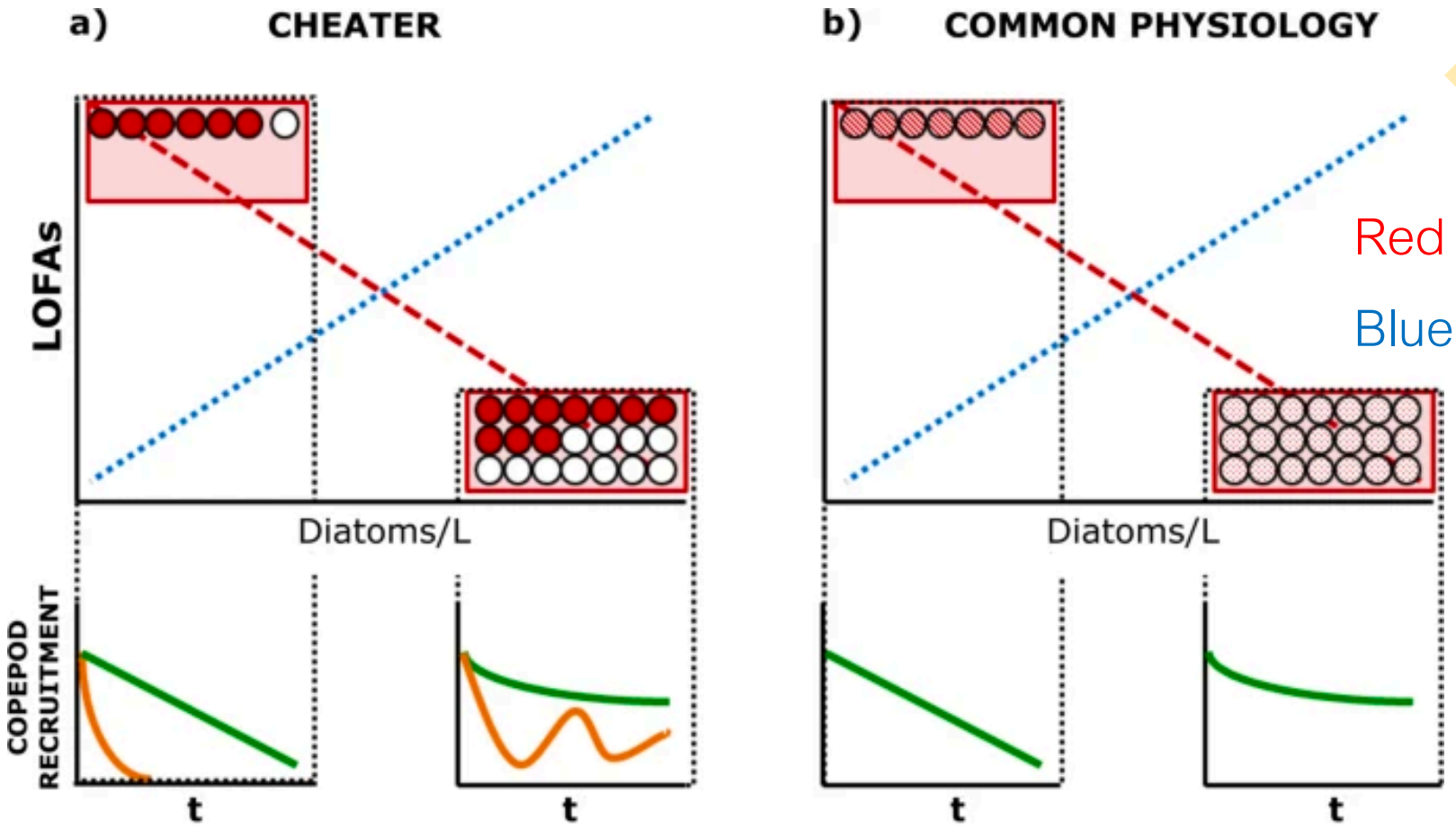


Article | Open Access | Published: 14 October 2019

Density-dependent oxylipin production in natural diatom communities: possible implications for plankton dynamics

Ennio Russo, Giuliana d'Ippolito, Angelo Fontana, Diana Sarno, Domenico D'Alelio, Greta Busseni, Adrianna Ianora, Eric von Elert & Ylenia Carotenuto

Copepod recruitment = population growth

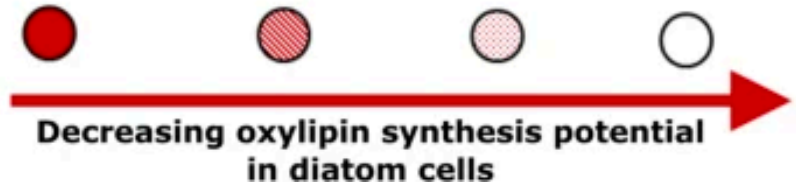


Red = LOFA/cell

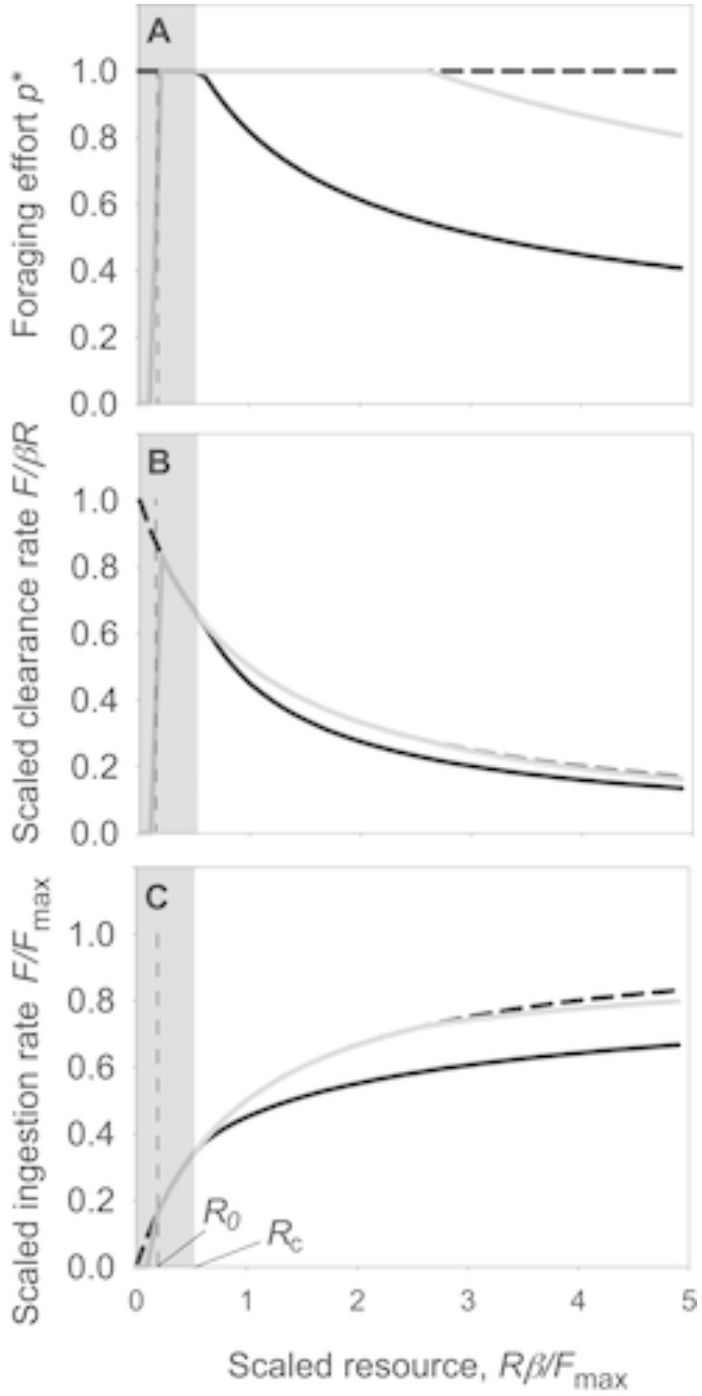
Blue = LOFA/L

Green = unselective strategy

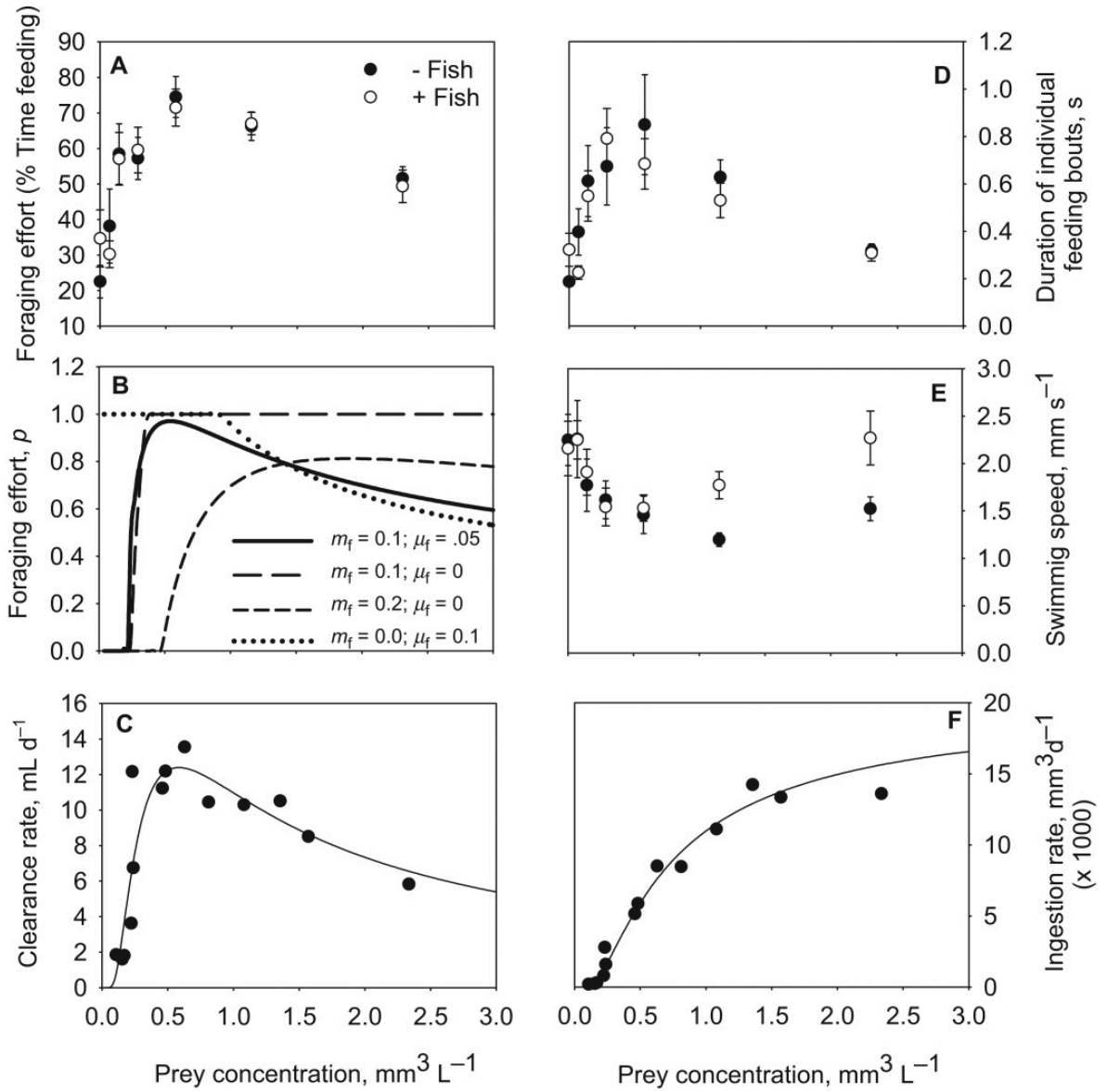
Orange = selective strategy



Foraging patterns vs. resource concentration (Kiorboe et al. 2017)



Foraging & resources (Kiorboe et al. 2017)



Holling Type Functional Responses