

PML

Plymouth Marine
Laboratory

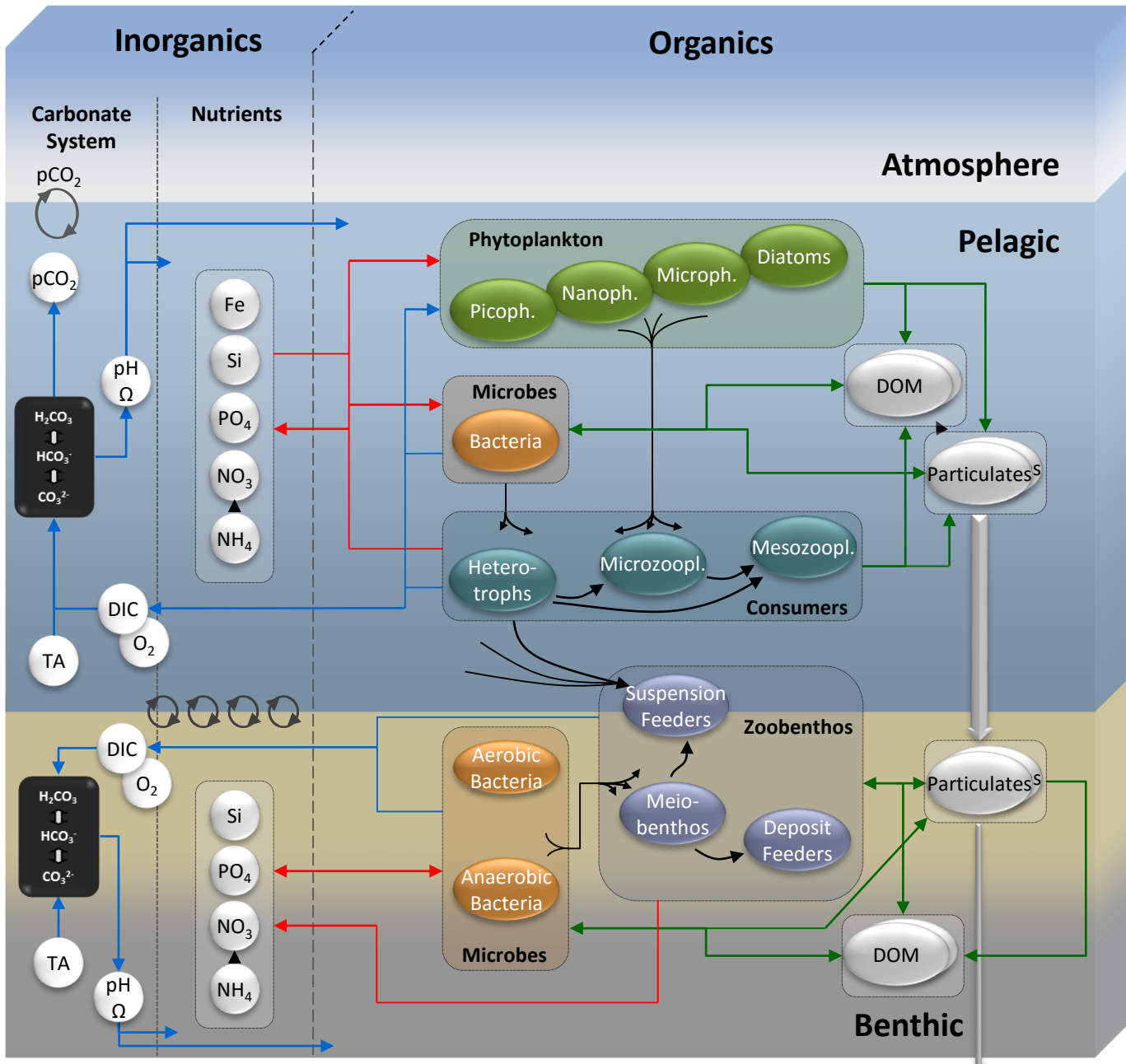
Listen to the ocean

Stoichiometry and microzooplankton: How one predator answer to food quality impacts the ecosystem around him

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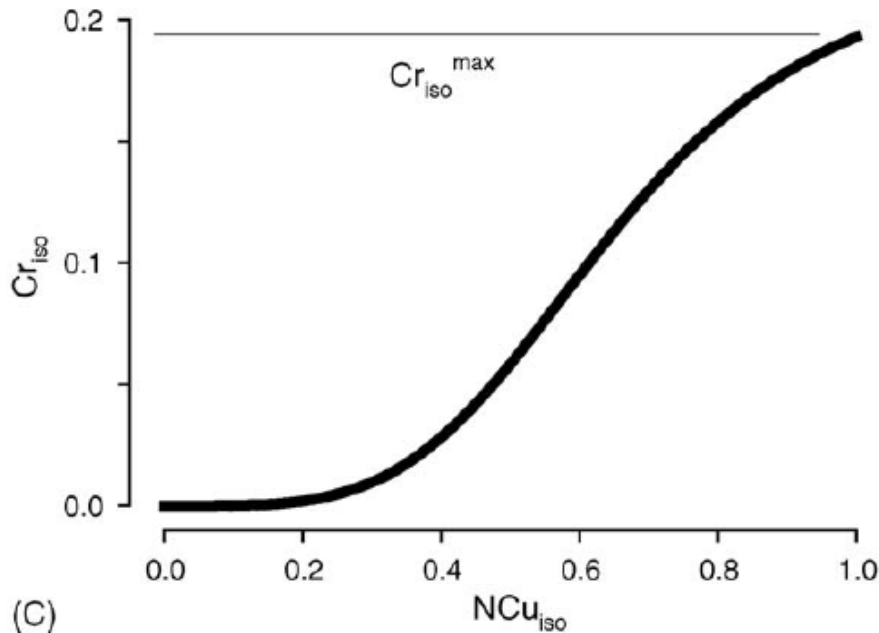
features	
4	primary producers <ul style="list-style-type: none"> • diatoms • picophytoplankton • nanophytoplankton • microphytoplankton
3	zooplankton groups <ul style="list-style-type: none"> • heterotrophic nanoflagellates • microzooplankton • mesozooplankton
3	benthic fauna groups <ul style="list-style-type: none"> • meiofauna • suspension feeders • deposit feeders
5	chemical elements C, N, P, Si, Fe

Grazing equations: Beyond the biomass

The prey quality (grazing and assimilation efficiency dependent on prey quality).

$$G = G_{\max} \cdot \frac{P}{P + K_{\text{pred}}} \qquad G_{\max} \cdot \frac{\text{Cr} \cdot P}{\text{Cr} \cdot P + K_I}$$

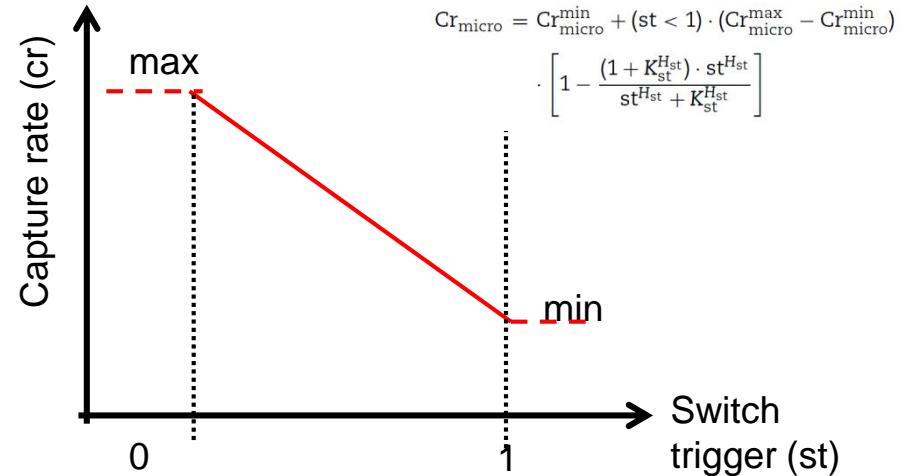
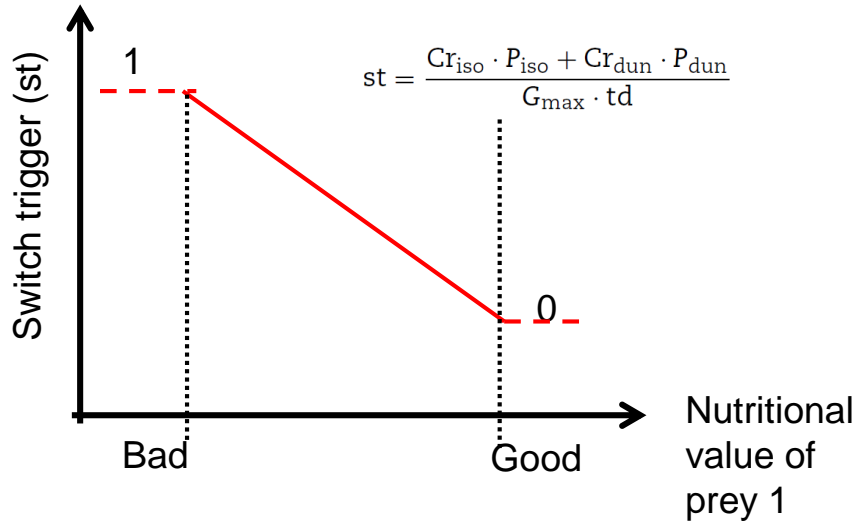
$$\text{Cr}_{\text{iso}} = \text{Cr}_{\text{iso}}^{\max} \cdot (1 + K_q^{H_q}) \cdot \frac{\text{NCu}_{\text{iso}}^{H_q}}{\text{NCu}_{\text{iso}}^{H_q} + K_q^{H_q}}$$



Cr: Prey quality parameter
 NC: nutrient content

Grazing equation: Feeding behaviour / Selectivity

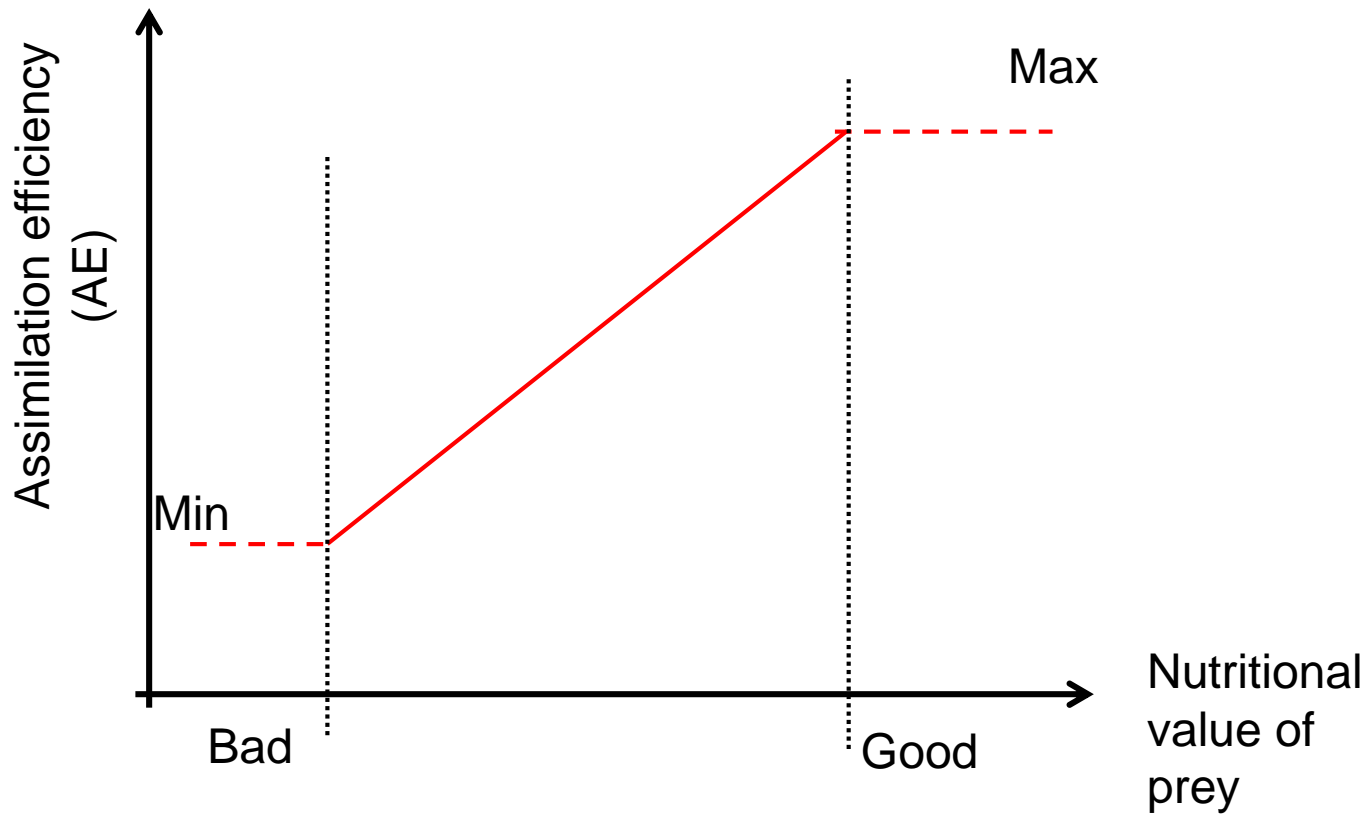
Mitra A., Flynn K. (2006)
 Accounting in prey selectivity by zooplankton.
Ecological modelling 199:82-92



The use of prey quality can account for toxicity, defence mechanisms, taste, metabolic by-products ... Or known preference of some zooplankton who display switching behaviour.

After grazing: Variable assimilation efficiency

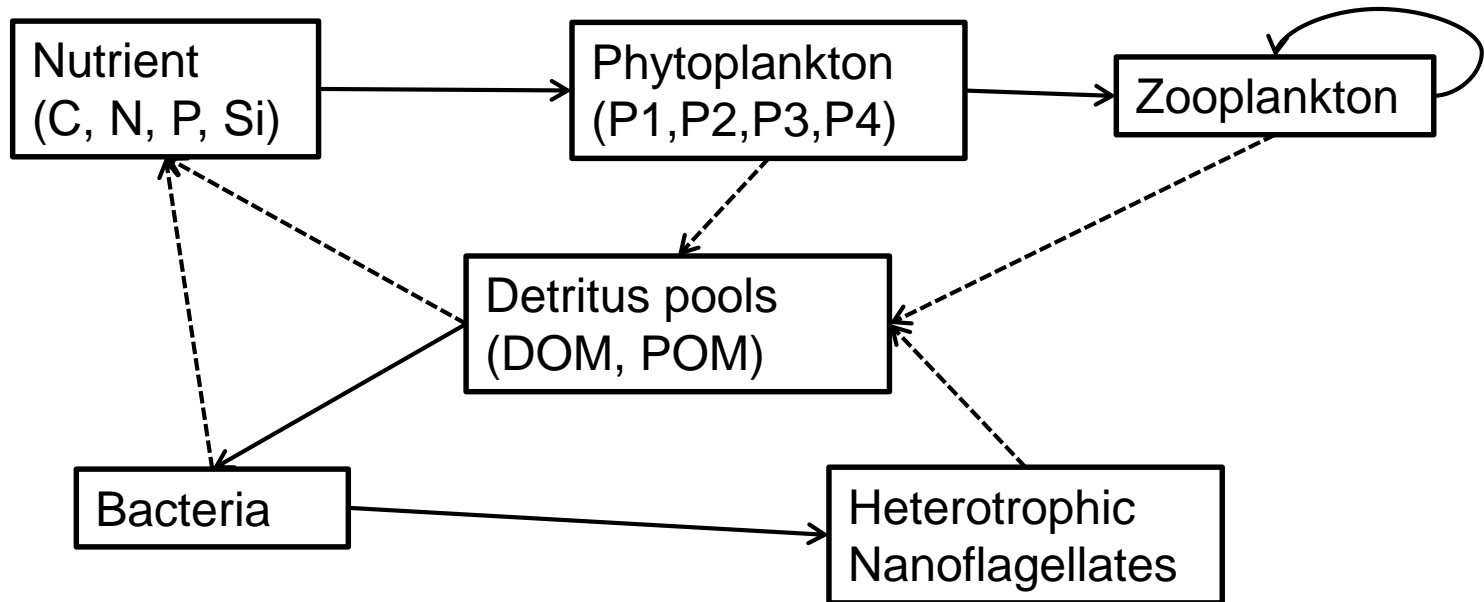
$$AE = AE_{\min} + ((AE_{\min} + AE_{\max}) * \text{Food quality}) * Z \text{ nutritional need}$$



Theoretical test cases

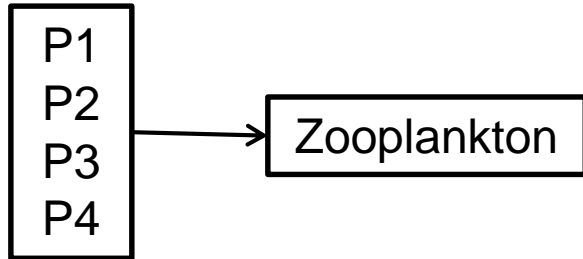
Theoretical test cases: Feeding Behavior

a) Structure of the food web

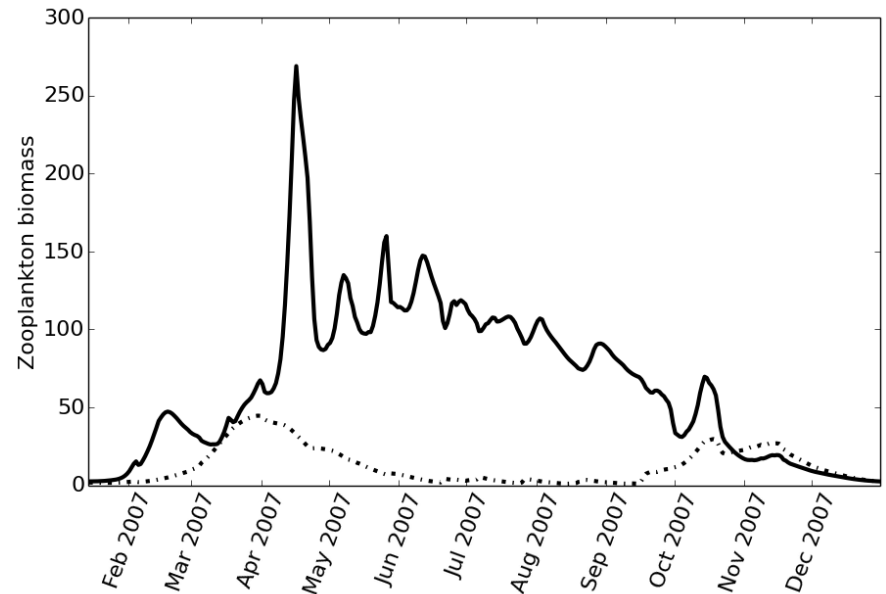
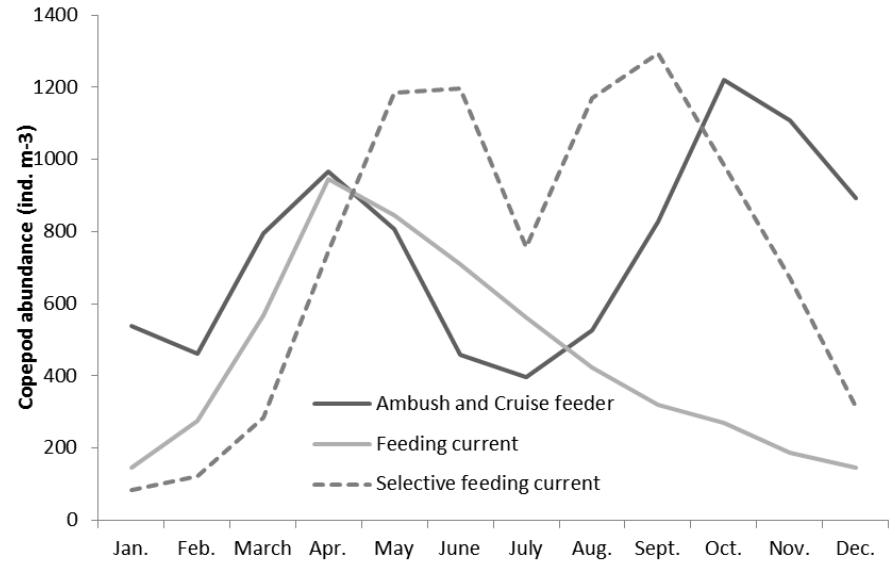
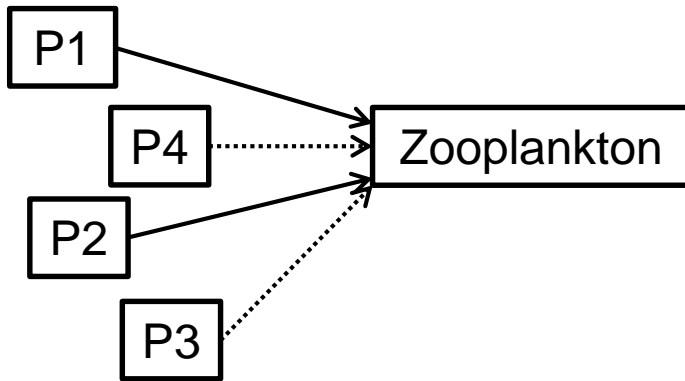


Theoretical test cases: Feeding Behavior

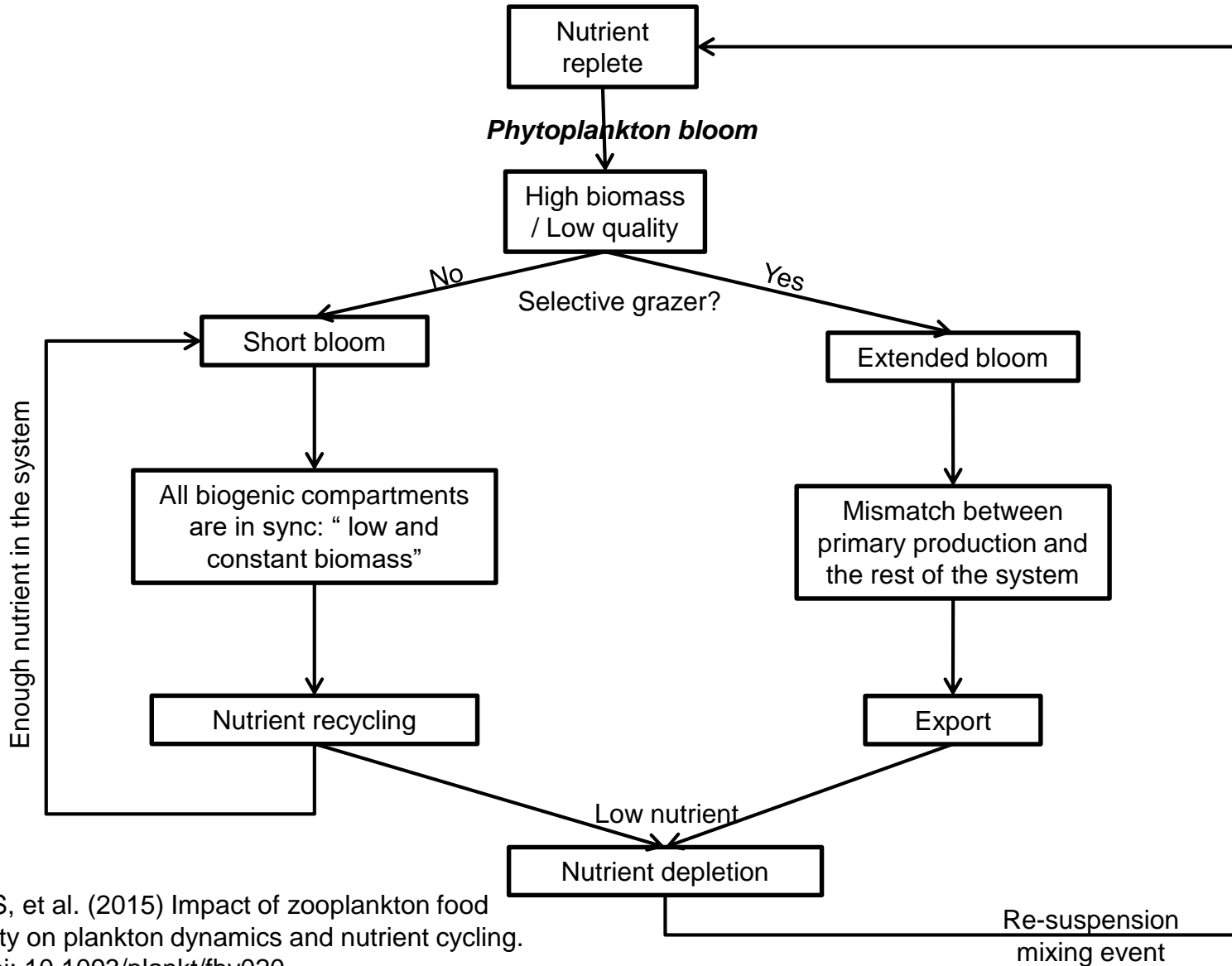
Unselective zooplankton



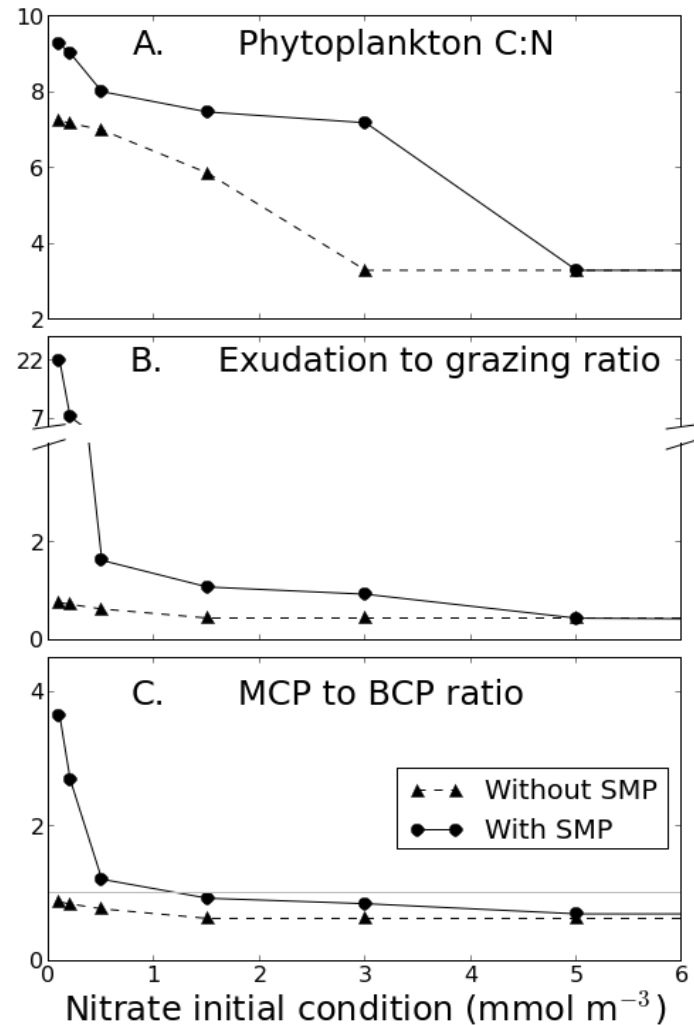
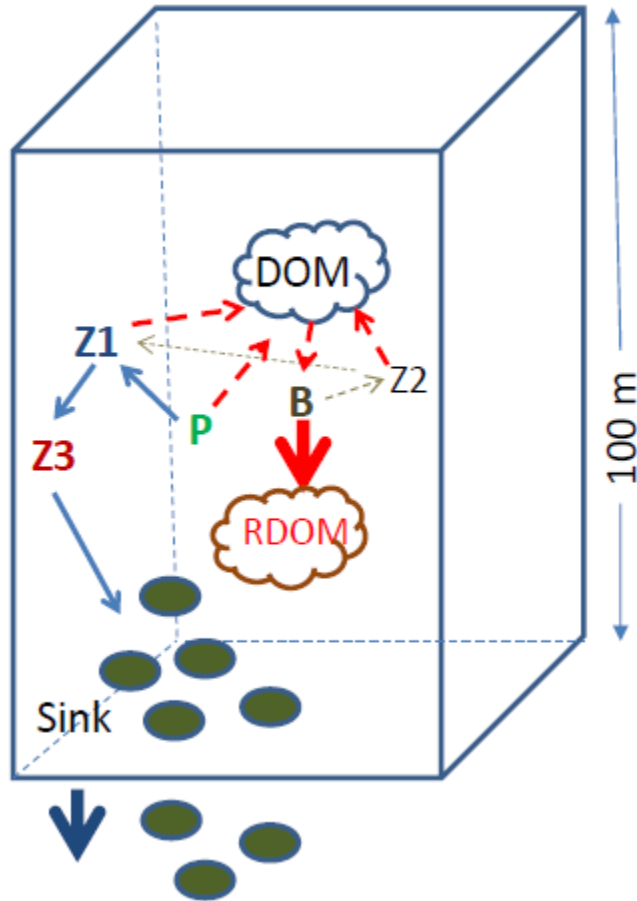
Selective zooplankton



Theoretical test cases: Feeding Behavior

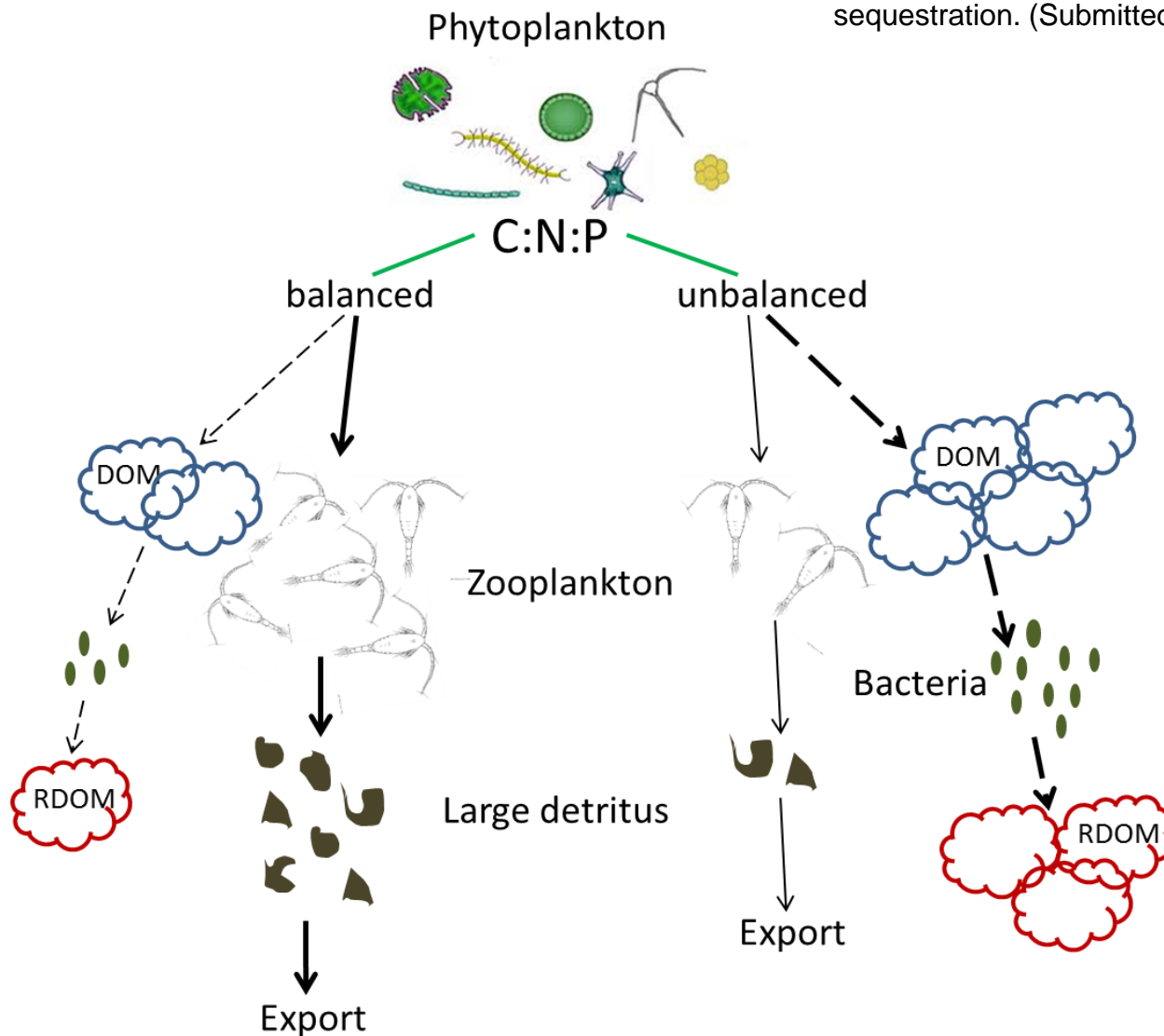


Theoretical test case: Microbial Carbon Pump

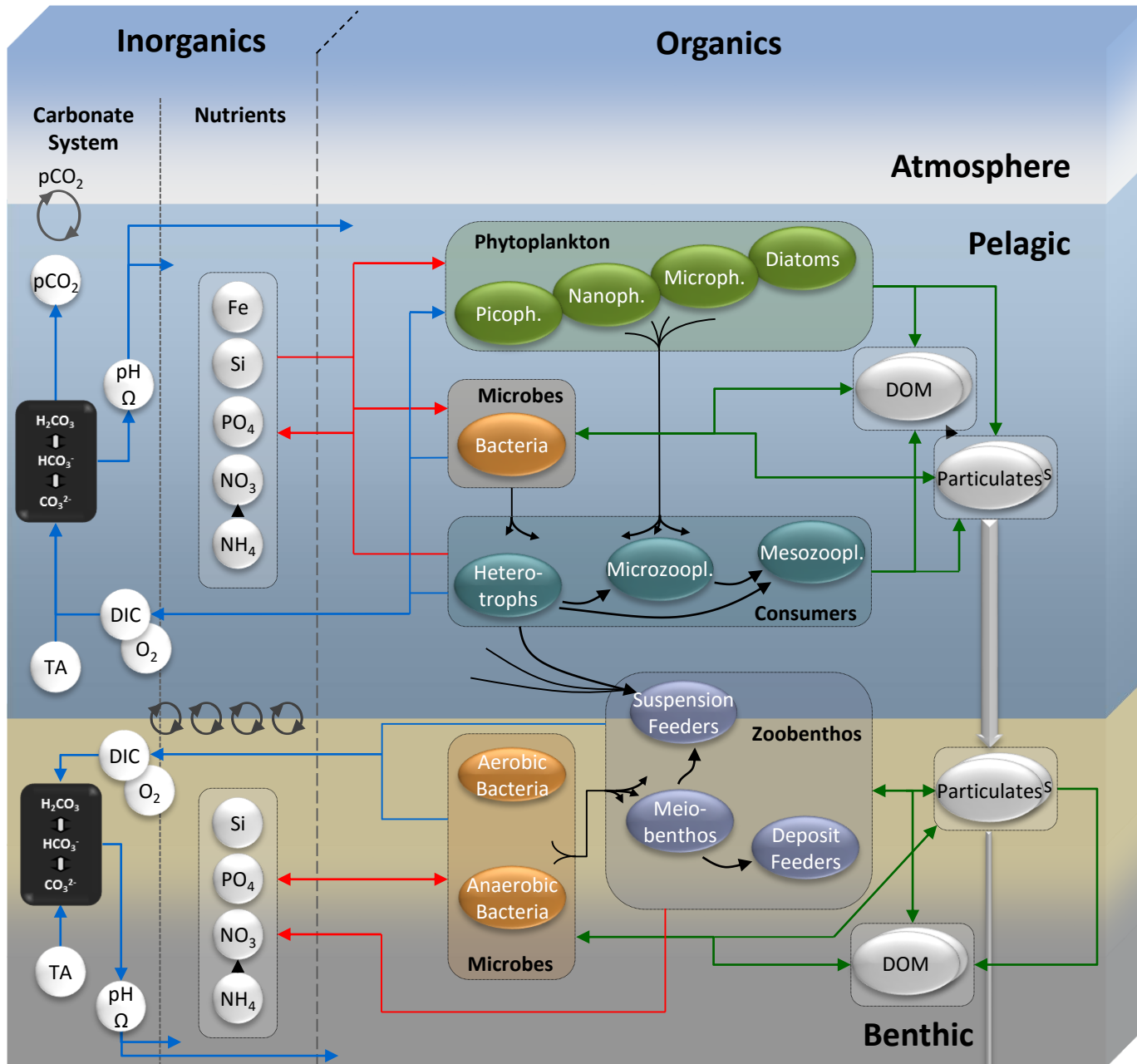


Theoretical test case: Microbial Carbon Pump

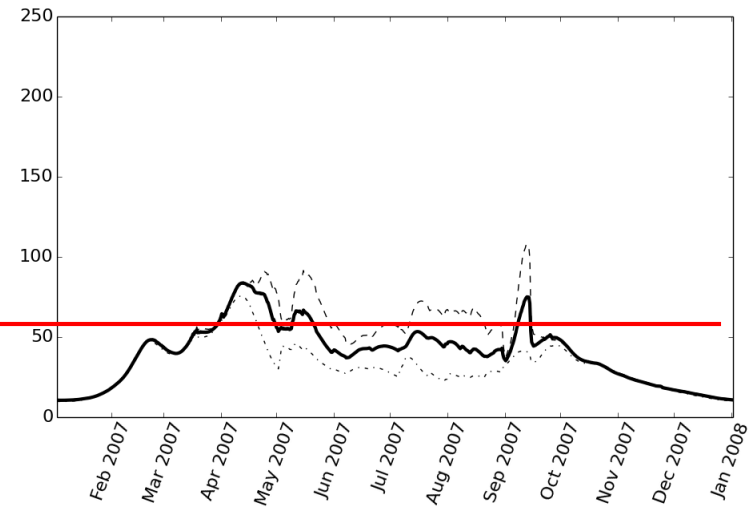
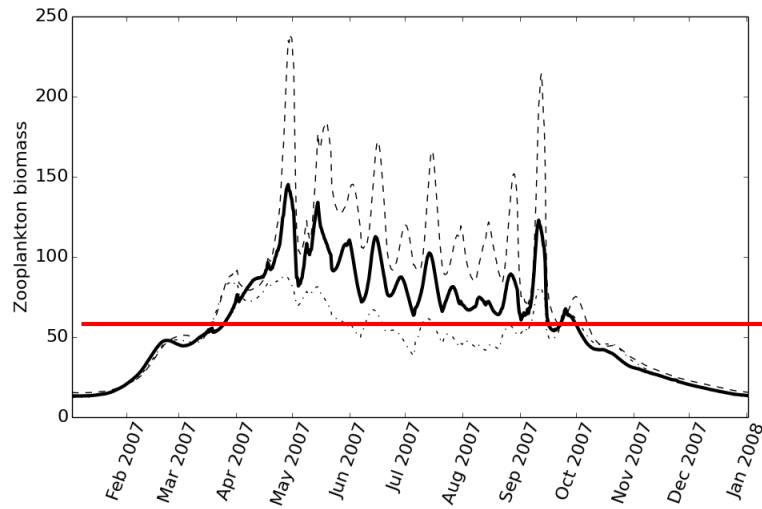
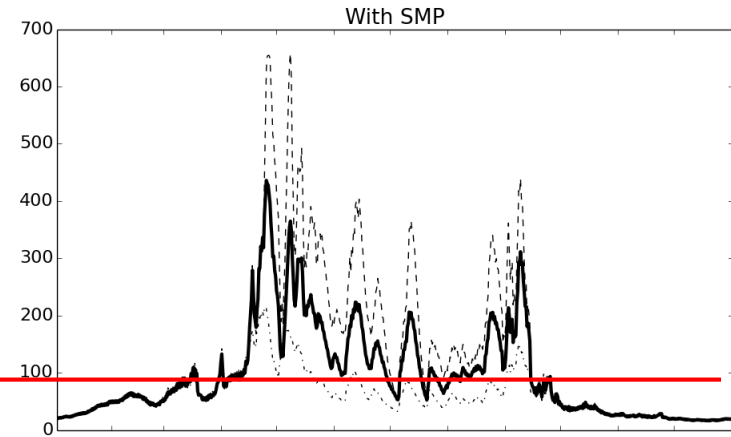
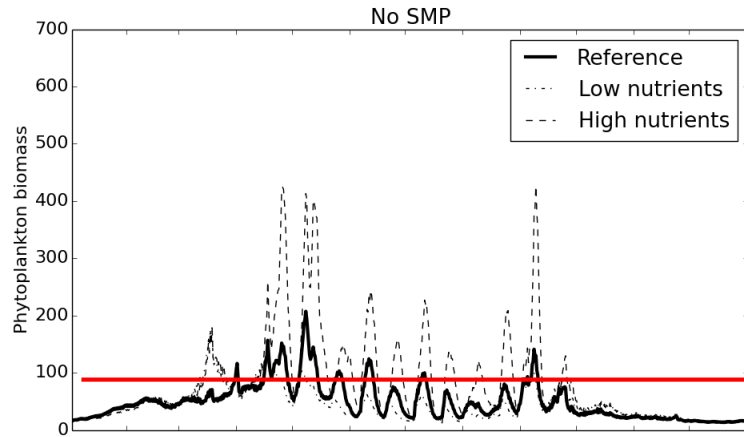
Polimene L, Sailley S, Clark D, Mitra A, and Allen I. Biological or Microbial Carbon Pump? The role of phytoplankton stoichiometry in Ocean carbon sequestration. (Submitted to JPR)



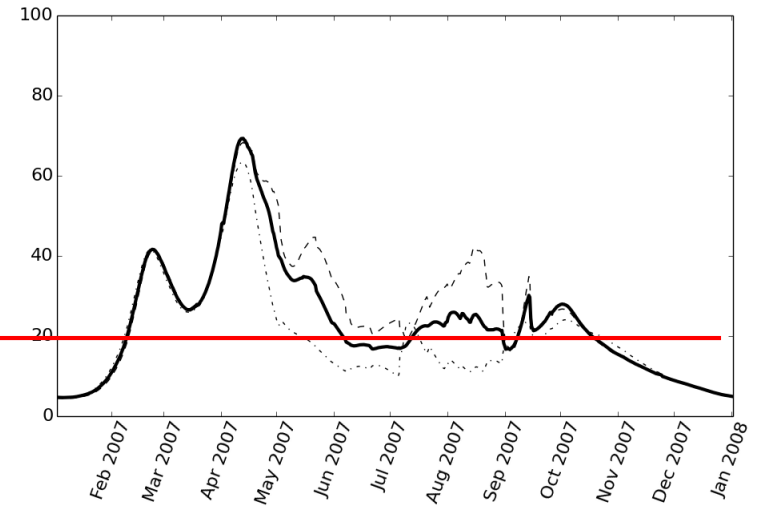
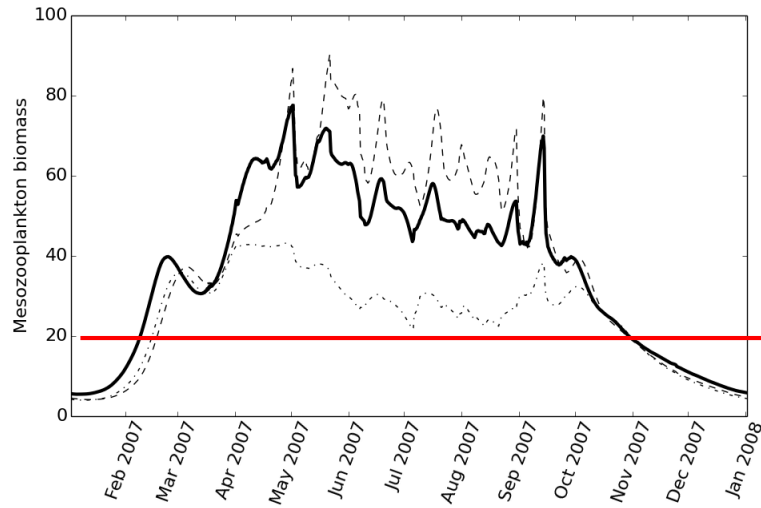
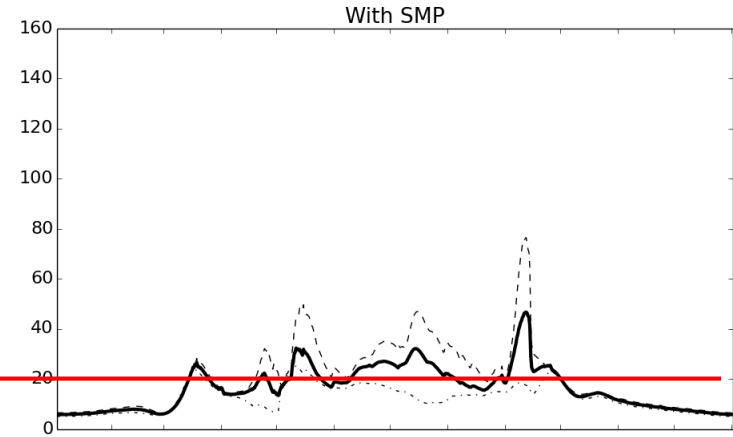
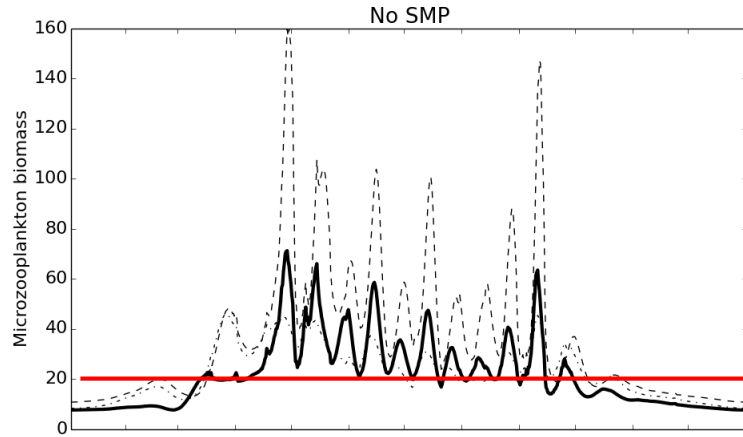
Using the full model: Importance for higher trophic levels



Using the full model: Importance for higher trophic levels



Using the full model: Importance for higher trophic levels



Food for thoughts:

- A small matter such as selection of prey has a disproportionate impact on both the biogeochemistry and the timing of food presence
- As zooplankton is the link between primary production and higher trophic level it is important to look at its diversity (number of groups) but also key traits (feeding behavior) and their physiology (internal stoichiometry, lipid reserves, ...)

