Biogeosciences Discuss., 10, C6462–C6467, 2013
www.biogeosciences-discuss.net/10/C6462/2013/

Biogeosciences
Discussions
Open Access

Interactive comment on "The role of mixotrophic protists in the biological carbon pump" *by* A. Mitra et al.

A. Mitra et al.

a.mitra@swansea.ac.uk

Received and published: 8 November 2013

Authors' RESPONSES marked like this

Referee: Conceptually this is a very important paper; only diatoms /new production conditions are adequately represented in carbon pump models, but all other food web conditions (?regenerated production) are dominated by mixotrophs, the dynamics of which are not adequately captured in current biogeochemical modelling efforts. Climate change and eutrophication are claimed to favor mixotrophs, thus emphasizing the need to develop this alternative paradigm.

RESPONSE: Thank you very much for your supportive comments.

Referee: My only comments relate to improving the overall presentation. The language

can be much simplified. Classical vs alternative paradigm;

RESPONSE: We needed two terminologies to describe the two contrasting food-web structures which we use in our study. For this, we decided on the term "classical" to portray the food-web structure which is typically used within ecosystem and/or food-web models; this is akin to the classic vs. microbial food web terminologies commonly used in plankton ecology. On reflection, we propose to use "traditional" and "new".

Referee: immature vs mature systems (is this terminology appropriate?); r vs K selection (may be this is not needed at this stage);

RESPONSE: Consistent with the definitions used by Odum (1969, Science), which we now cite, we now use the terms "developmental stages" and "mature stages". The legend for Fig. 1 now reads: Diagrammatic portrayal of the changes to the planktonic foodweb over a year, with transitions between ecosystem states. The upper panels show changing patterns of light, inorganic nutrients and particle density (i.e., total plankton biomass) over the temperate year. Transitions from developmental and mature stages of the ecosystem are as indicated; green and orange dashed lines indicating the developmental stages where green represents conditions optimal for phototrophy and orange, for phagotrophy. Later periods (transition to the more mature state) are sub-optimal for strict phototrophs and/or strict phagotrophs, and more supportive for mixotrophs. The lower panel shows in detail the transition from developmental to mature stages, with changes in selection priorities from "r-selected" phototrophs and phagotrophs in the developmental phase of the ecosystem, to a mature ecosystem with "K-select" mixotrophs. For definitions and discussion of developmental vs. mature state, and r vs. K selection, see Odum (1969) and Parry (1981).

Also, attached Fig. 1 with the revised terminology.

REFERENCE ADDED: Odum E.P. (1969) The strategy of ecosystem development. Science 164; 262-270.

We have retained the terms r- and K-selected as these mesh with the concepts of developmental and mature, hence using terms that are more consistent with theoretical ecology.

Referee:"non-phagotrophic stages of coccolithophorids (p.4, line 21);

RESPONSE: This has been rewritten as follows: "...coccolithophorids during their strictly phototrophic stages"

Referee:the perfect beast (p.9. line 27; explain).

RESPONSE: "Perfect beast" is the title description of mixotrophs in the JPR mixotroph-model paper of Flynn & Mitra (2009). Here, this sentence has now been modified to read - "...the "perfect beast" as termed by Flynn and Mitra (2009)".

Referee: Constitutive chloroplasts

RESPONSE: By constitutive we mean chloroplasts which are intrinsic to the protists; we have replaced this terminology now (page 6 line 8) such that the new sentence reads: "They photosynthesize using their intrinsic chloroplasts (for which they contain full genetic control; see Flynn & Hansen 2013), while obtaining additional nutrition through the ingestion of bacteria, thence competing with the HNFs for bacterial prey."

REFERENCE ADDED Flynn KJ, PJ Hansen (2013) Cutting the canopy to defeat the "selfish gene"; conflicting selection pressures for the integration of phototrophy in mixotrophic protists. Protist 164; 811-823

Referee: What does "in silica" mean.

RESPONSE: In silico is an expression used to mean "performed on computer or via computer simulation." It is a widely used phrase, coined in the late 1980's as an analogy to the Latin phrases in vivo, in vitro, and in situ, in order to describe experiments performed using models on computer.

Referee: Fig.2. When comparing the complex diagrams A and B, all that is different is

the red arrow of MNF eating bacteria, and the dashed blue arrow from MNF back to DIP, DIN pools. The impact of including mixotrophy in models clearly is much more; the sizes of pools are different (illustrated in Fig.3) and so are the sizes of the flows. This is only adequately illustrated in Fig.6 (which is much clearer). Combine Figs 2 and 6 somehow.

RESPONSE: Figure 2 has now been replaced with a box-schematic (new Fig.2 attached), in a form that is more consistent with schematics used by modellers.

Referee: Figs.4, 5 . For clarity, match the colour coding used in Fig 3 and 6

RESPONSE: Thank you for this suggestion, which we have implemented.

Interactive comment on Biogeosciences Discuss., 10, 13535, 2013.

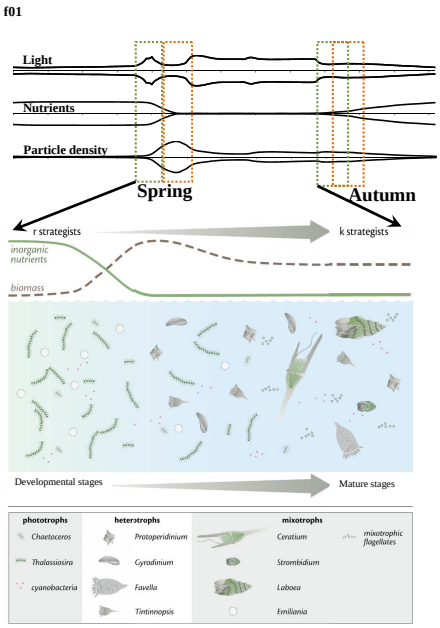

Fig. 1. Revised Figure 1

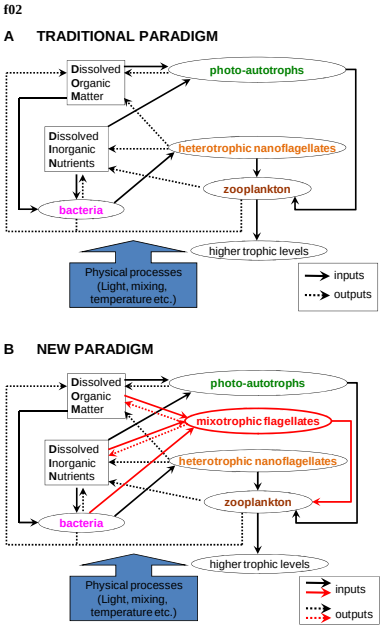

Fig. 2. Revised Figure 2