Importance of grey mullets on coastal food webs in a context of omega-3 deficiency: from sub-individual level to trophic dynamics

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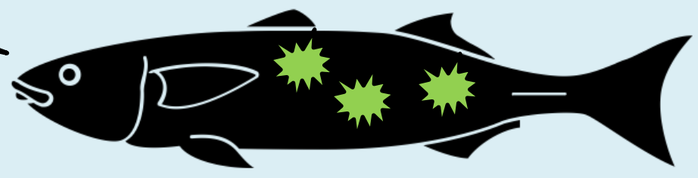
Change in microalgae physiology and communities due to climate change
Hixson and Arts (2016)

Intermediate trophic position of grey mullets
→ graze on biofilm
→ consumed by piscivorous fish and seabirds

EPA ↓
DHA ↓

Reduced production by marine micraolgae of Eicosapentaenoic (EPA) and Docosahexaenoic acids (DHA), known as omega-3 fatty acids



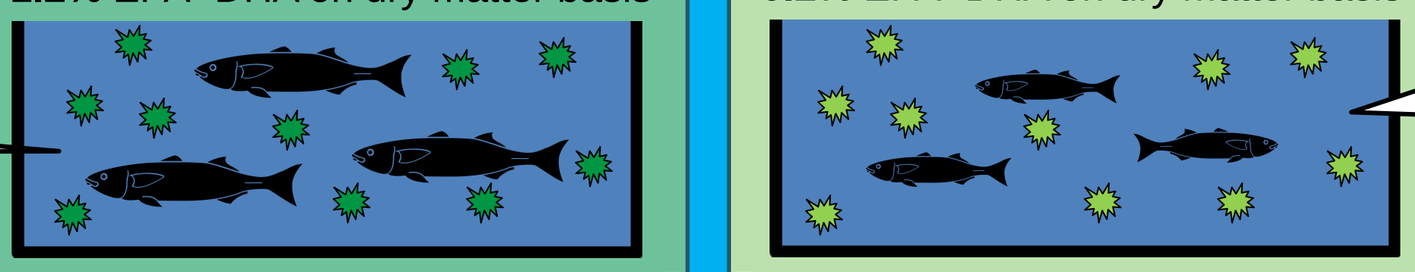
What effects on the individual fish physiology?
What consequences on the food web functioning?

Experiments

Individual & sub-individual

Standard Diet (**SD**)
1.2% EPA+DHA on dry matter basis

Low Diet (**LD**)
0.2% EPA+DHA on dry matter basis



6 months at 20°C

→ Reduced growth
→ Similar weight / length ratio
→ More efficient use of energy for activities
Vagner *et al.* (2014)

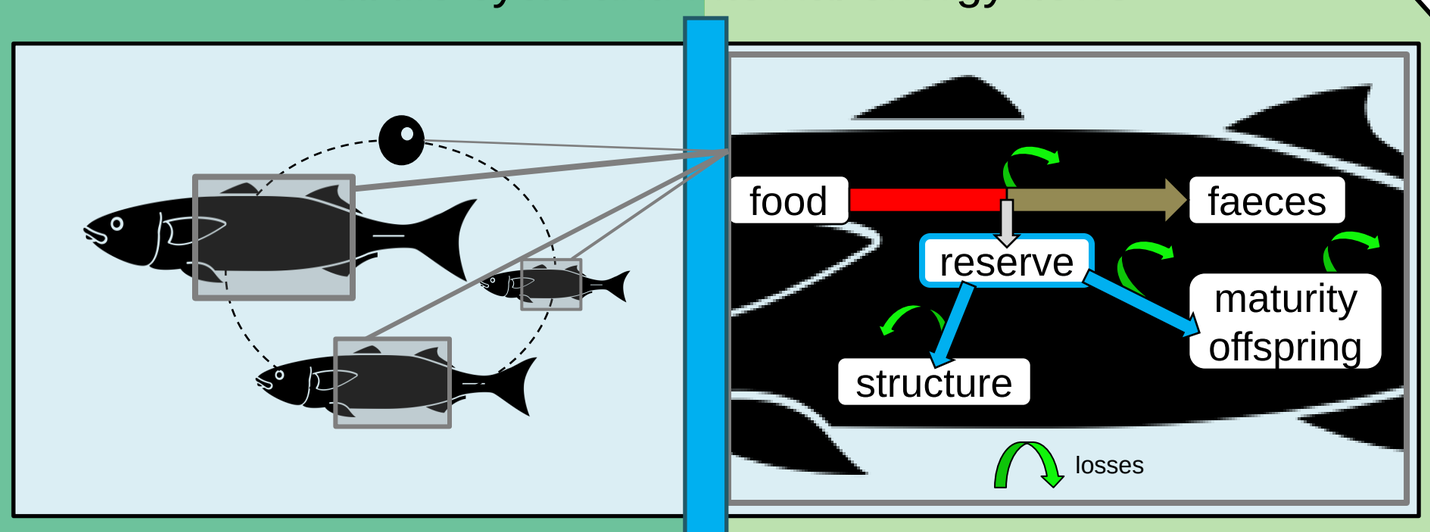
DEB modeling

Development of Dynamic Energy Budget (**DEB**; Kooijman, 2010) for the two species present in the area of interest, the Marennes-Oléron bay mudflat (**MO**; France):

Chelon auratus *Chelon ramada*

Individual

Full life cycle and internal energy flows



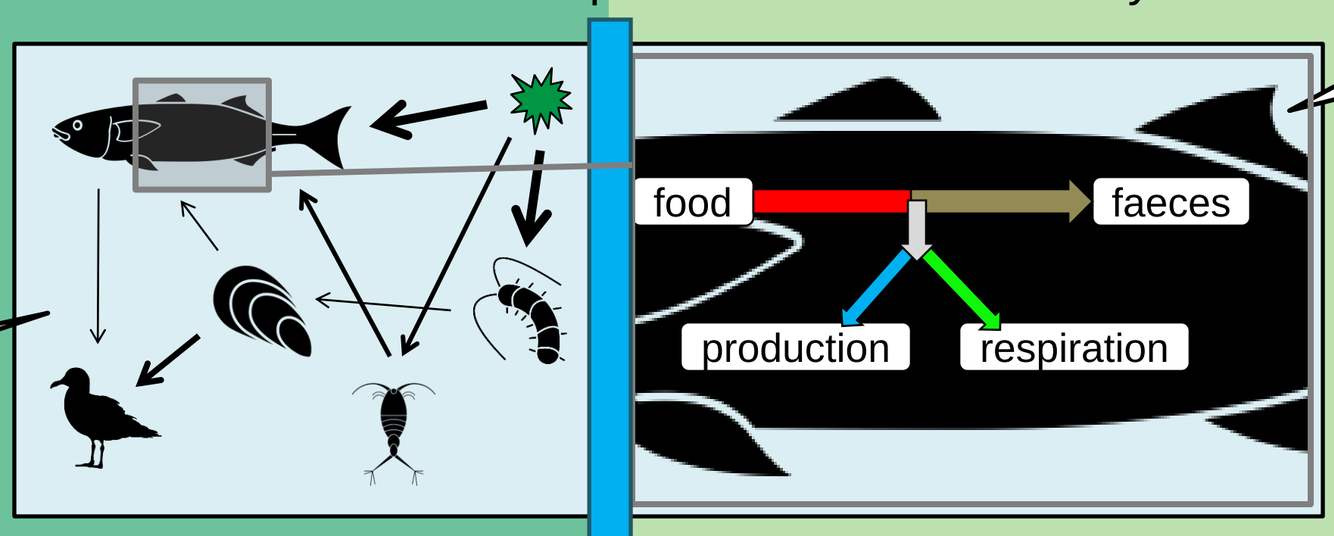
Reduction of metabolism and growth by modification of:
→ volume-specific somatic maintenance (**-25%**)
→ energy conductance (**-24%** ; altering the mobilization of energy from the reserves in the organism)

LIM modeling

Update of a previous Linear Inverse Model (**LIM**; van Oevelen *et al.*, 2010) of MO (van der Heijden *et al.*, 2020) from DEB and literature

Trophic Network

Static mass-balanced trophic flows with uncertainty



Definition of flows similar in all LIM trophic groups

19 trophic groups

No LIM simulation of the ecosystem state with LD because it would consider the different biomasses as static

LIM outputs used on initial inputs of biomasses, trophic links, satiation, inertia, losses other than predation and detritus consumption

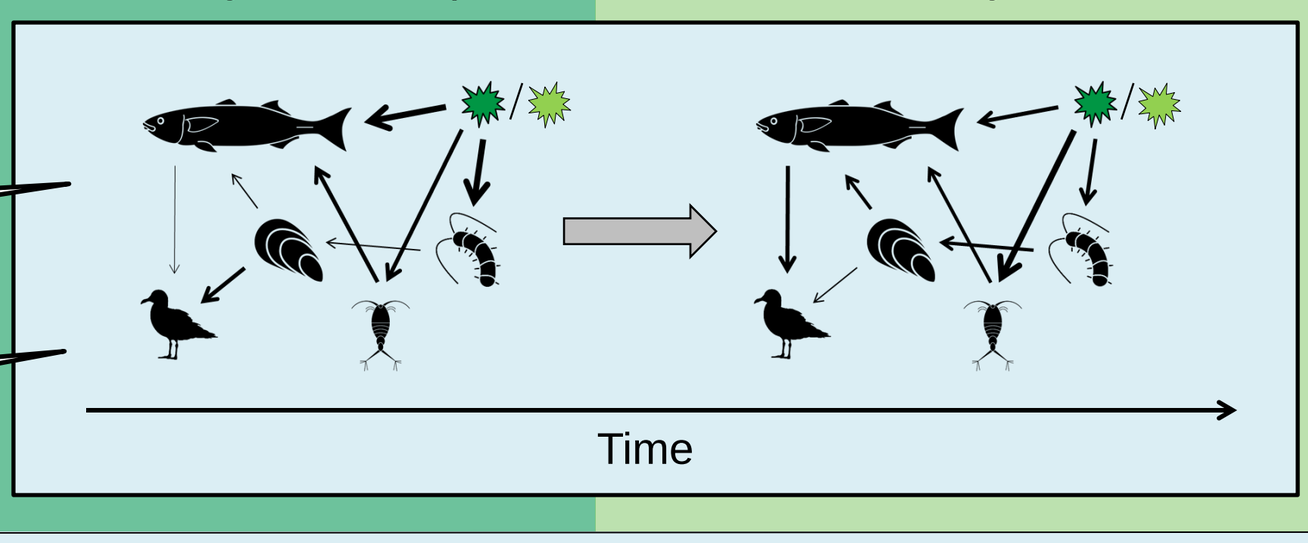
LIM constraints on
defined from DEB
to simulate the current MO ecosystem state with Standard Diet

CaN modeling

Development of a Chance and Necessity model (**CaN**; Planque and Moullon, 2019) of MO from LIM outputs

Dynamic Trophic Network

Dynamic trophic flows with uncertainty



DEB outputs used on CaN constraints:
→Consumption: **-14%**
→ Production / Consumption: **+6%**
→ Respiration: **-21%**

Flows definition similar to LIM

11 trophic groups

Comparisons of biomasses, exports of Carbon and Ecological Network Analysis

Work in progress…