The food web of the Balgzand: from bottom to top

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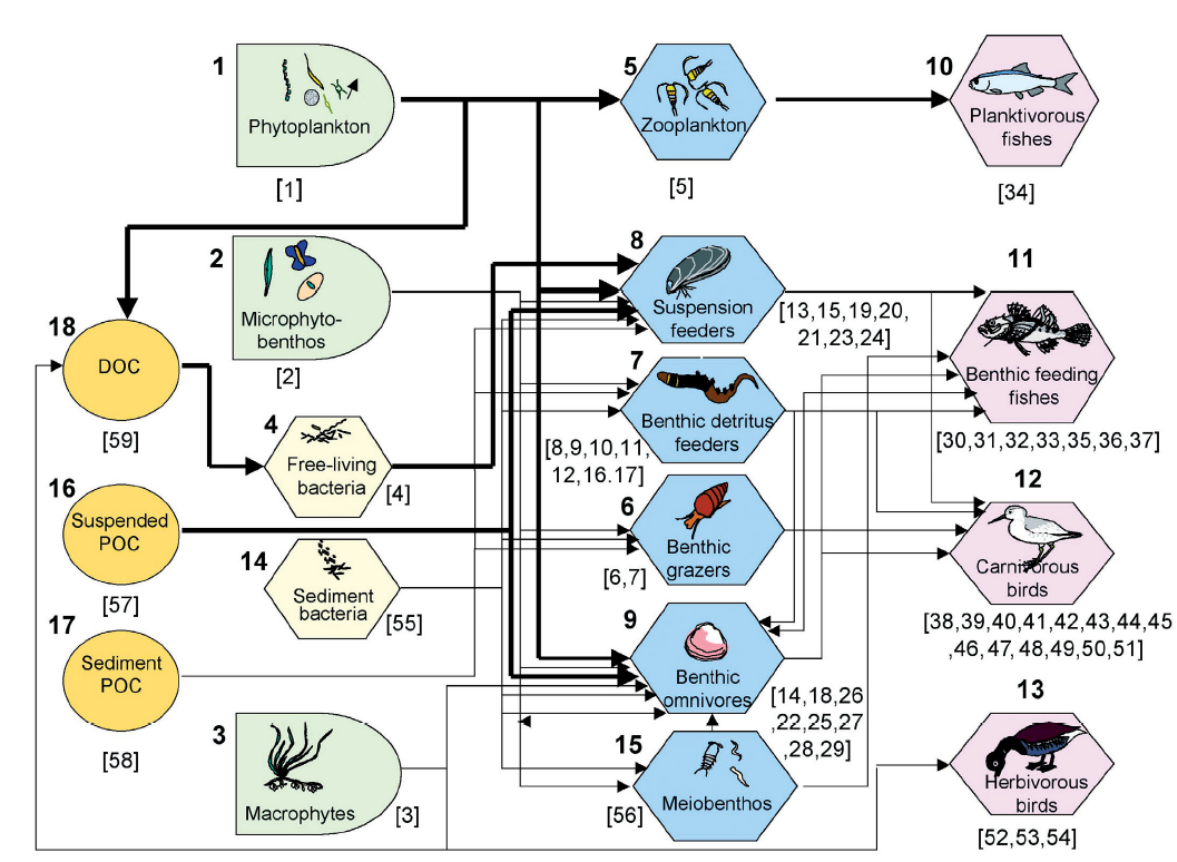
Overview

- General introduction – Balgzand
- Food web aspects
  - Nutrients
  - Primary consumers
  - Epibenthic predators
- General conclusions/ future plans



ENA food web model of a tidal flat in the Wadden Sea after Baird et al. 2004

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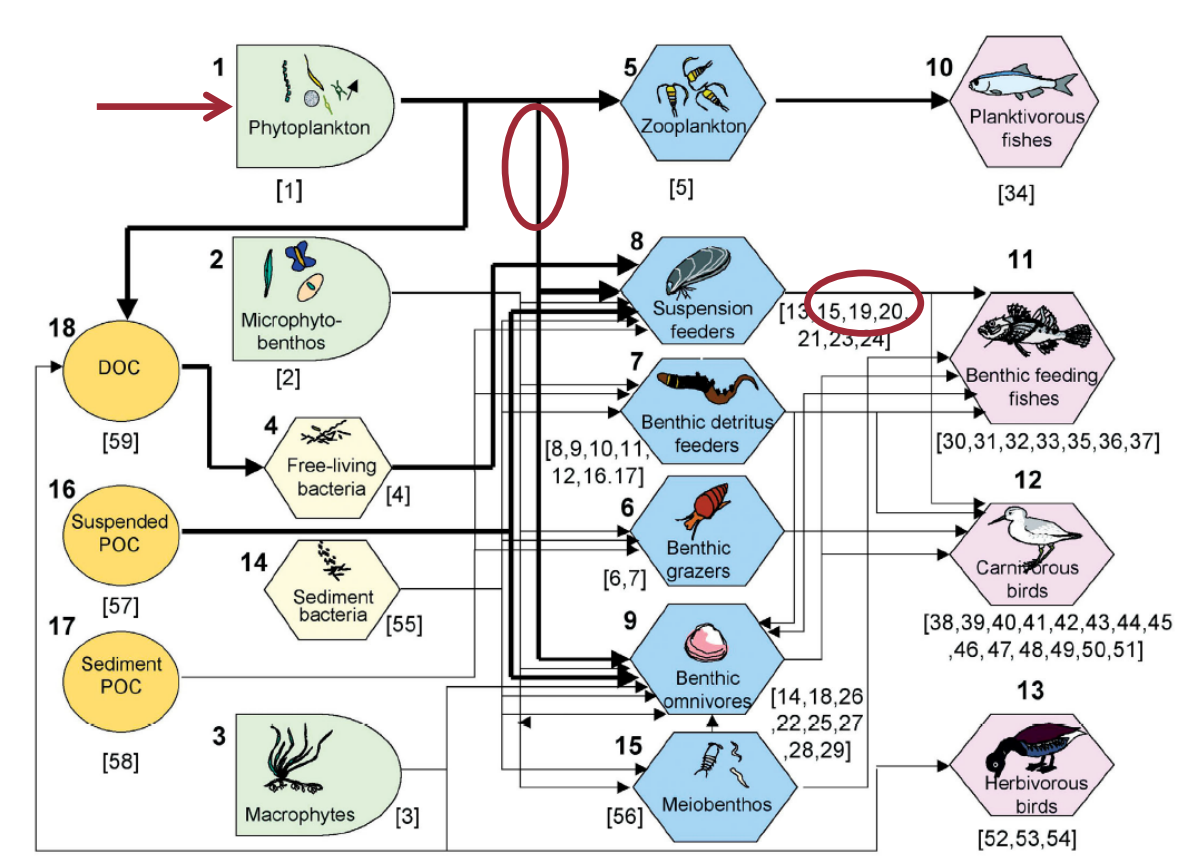

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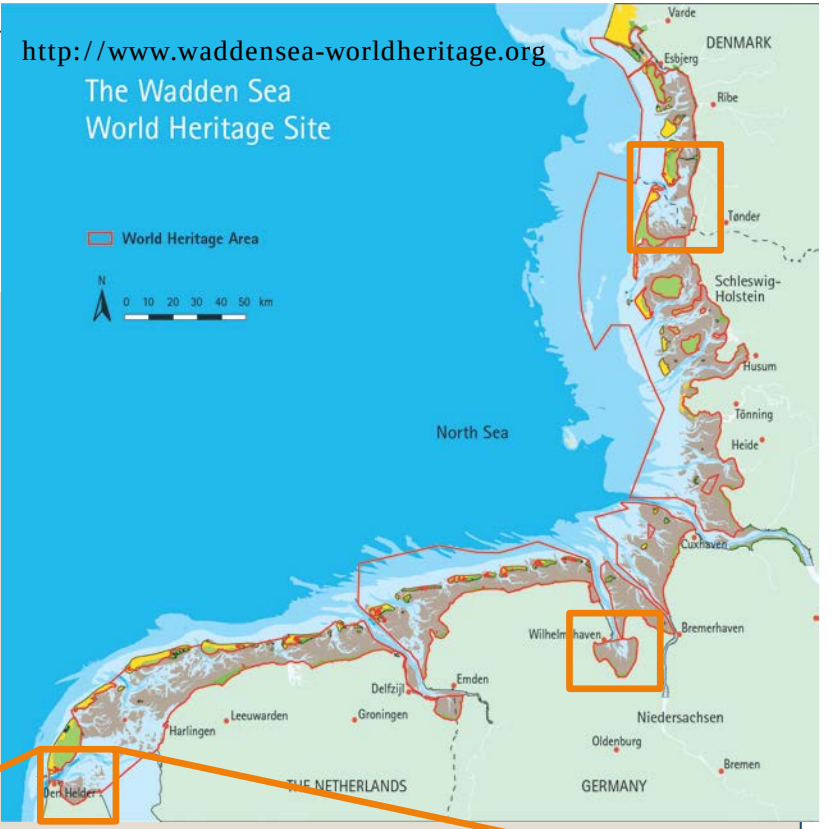
Balgzand

- Tidal range: mesotidal, 1.4 m
- Total surface area: 60 km², mainly intertidal



Balgzand

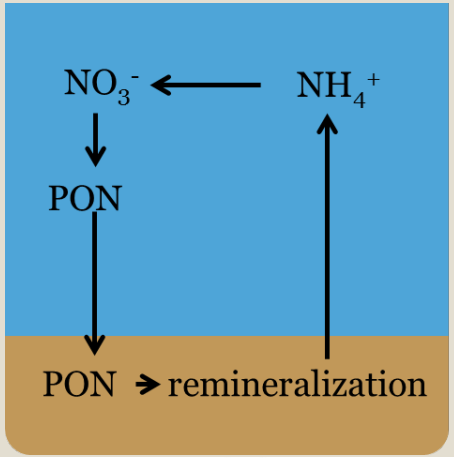
- Tidal range: mesotidal, 1.4 m
- Total surface area: 60 km², mainly intertidal
- Habitat characteristics:
  - *Arenicola* sandflats: 35%
  - Mudflats: 15%
  - Seagrass beds: 0%
- Long-term investigations available

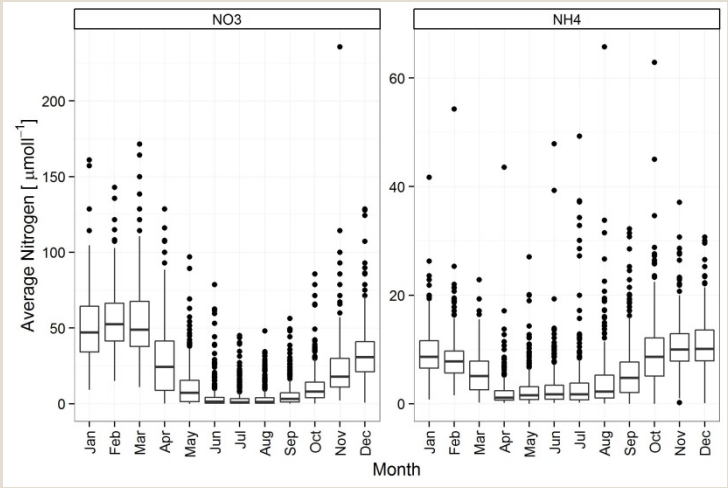
Trophic state

- Closed – symplified system :
  - Autumn NH_4^+= Winter NO_3^- =TS
- Wadden Sea – not closed, not simple
  - Autumn NH_4^+ ? Winter NO_3^- + Accumulation + Denitrification + …

TS? TS?

- Related to morphology? (Herman 2011)
- Autumn NH_4^+ \ Winter NO_3^- = c*(Depth)$^{-b}$ (for NL)
- Can be rewritten as:

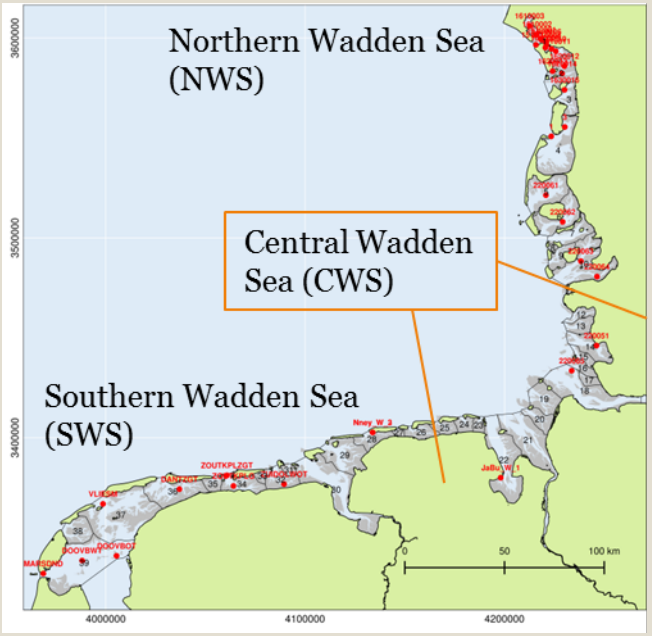




$$log(\text{Autumn}NH_{4\ i}^{+}) = a_i \times log(\text{Winter}NO_3^{-}) - b_i \times log(\text{Depth}) + c_i$$

Trophic state

- Apply to whole Wadden Sea
- Years 2001- 2010
- Separate into 3 main Regions with different characteristics (large scale morphology)



Region	Riverine influence	Tidal
Southern Wadden Sea	Yes	Mesotidal
Central Wadden Sea	Yes	Macrotidal
Northern Wadden Sea	No	Mesotidal

Tidal basin characteristics after Essink et al. 2005

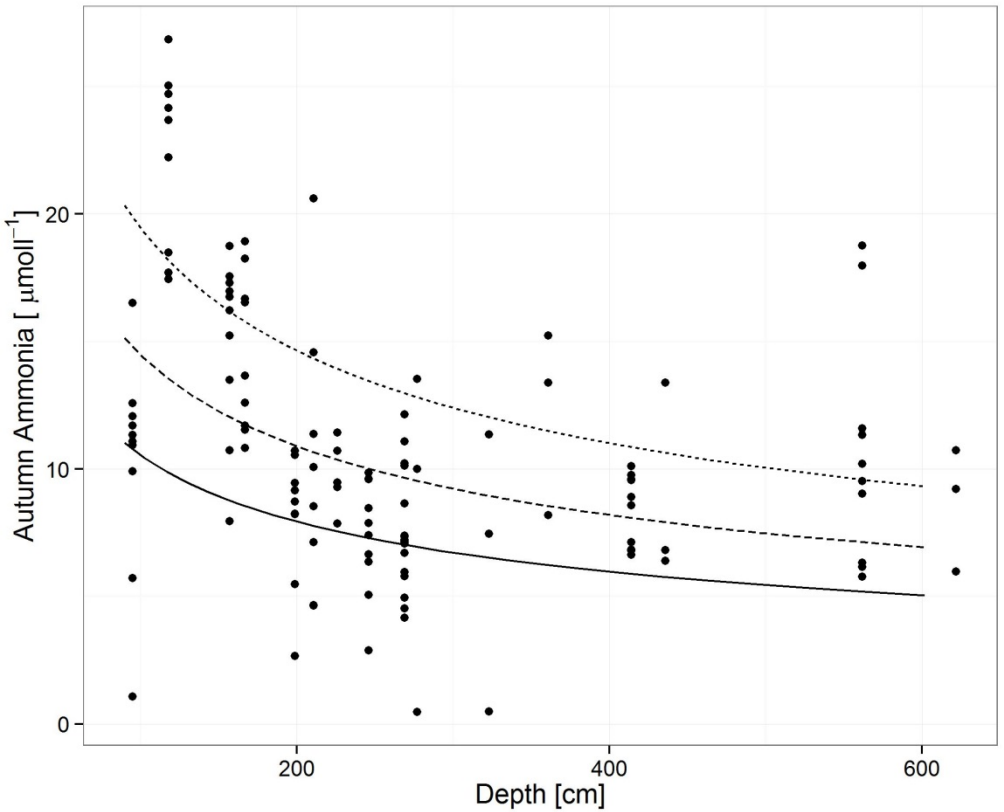
Trophic state

$$log(\text{Autumn}NH_{4\ i}^{+}) = a_i \times log(\text{Winter}NO_3^{-}) - b_i \times log(\text{Depth}) + c_i + d_i \times \text{Region} + \epsilon_i$$

	Model fit
Intercept	4.33 (1.07)***
log NO_3^-	0.14 (0.14)
log Depth	−0.41 (0.14)**
Region NWS	−0.61 (0.19)**
Region SWS	−0.30 (0.22)
R^2	0.18
Adj. R^2	0.15
Num. obs.	123

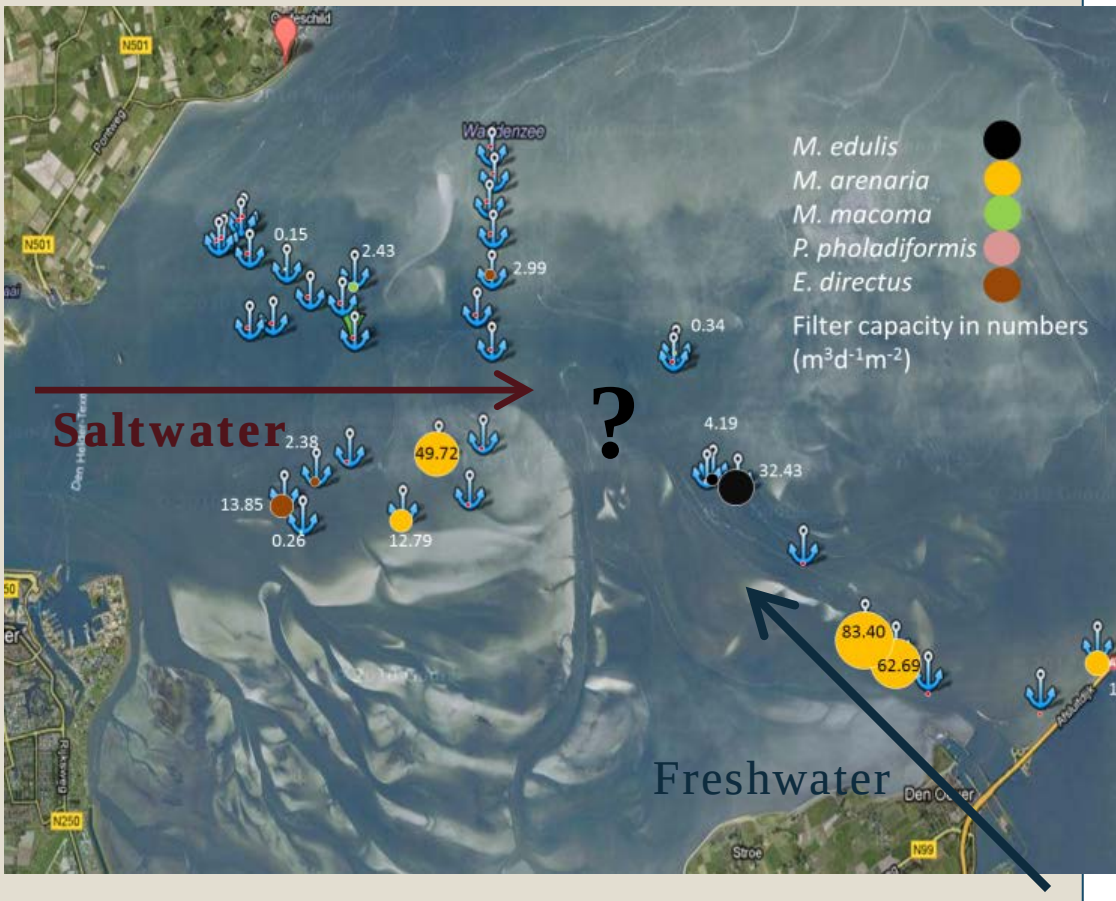
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

- Trophic status:
  North < Central & South
- Systems have different starting points



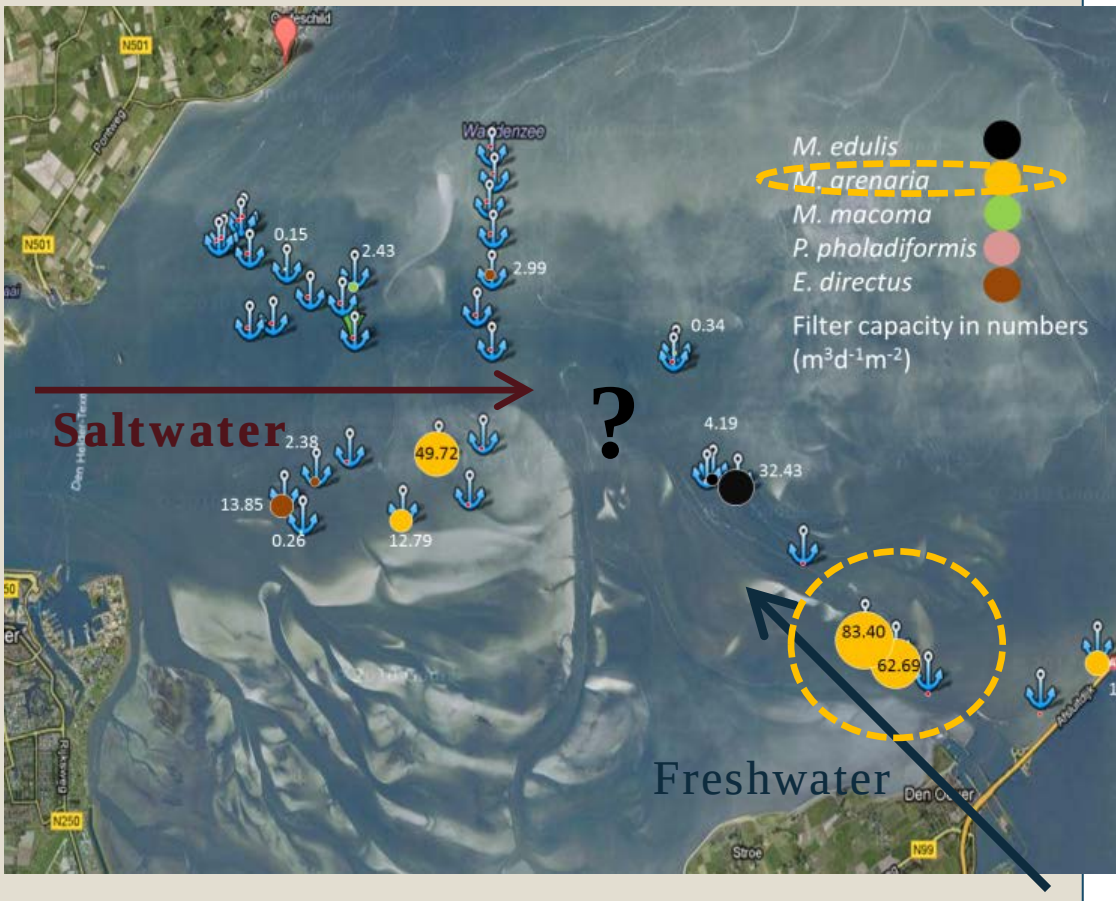
Primary consumers

- High filter capacity (>60 $m^3 d^{-1} m^2$) close to freshwater (Density + Size)
  - food source?



Primary consumers

- High filter capacity (>60 $m^3 d^{-1} m^2$) close to freshwater (Density + Size)
  - food source?
- Two fold approach:
  - Ingestion (stomach content)
  - Assimilation (stable isotopes, in cooperation with Waddensleutels)



Mya arenaria
NL: Strandgaper
EN: sand gaper

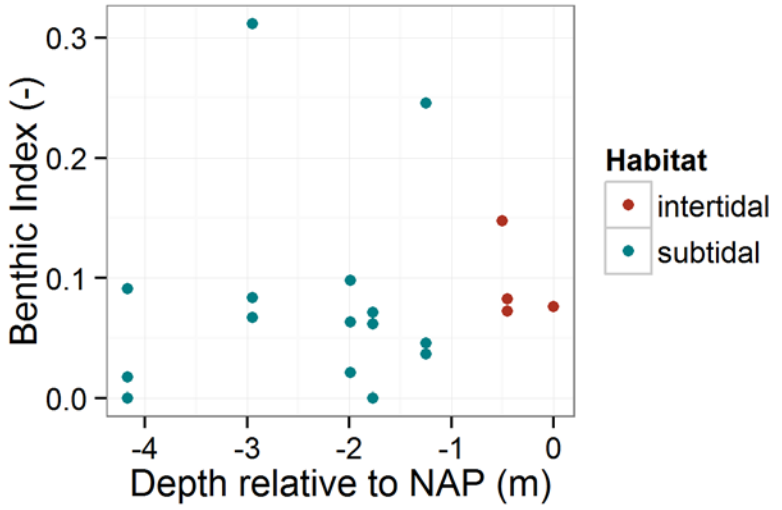
Primary consumers - Ingestion

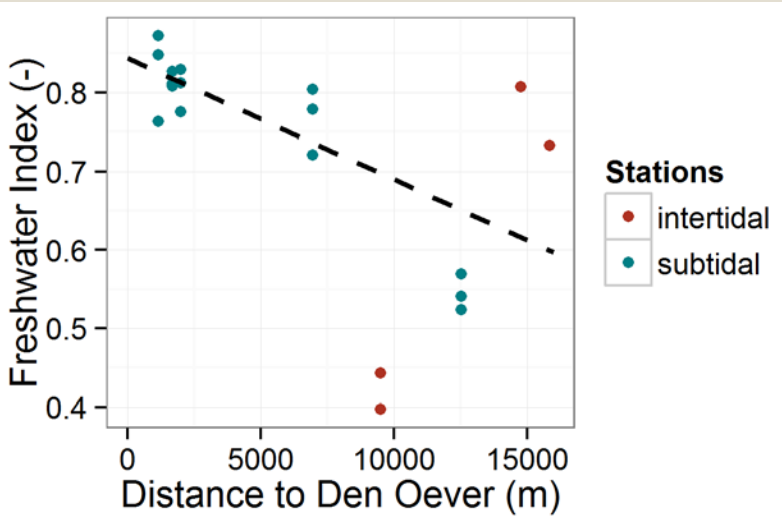
Sampling in Early Spring 2013

- Proportion of benthic algae variable but no trend
- High amounts of Freshwater algae found in bivalves in sub- and intertidal at end of Winter

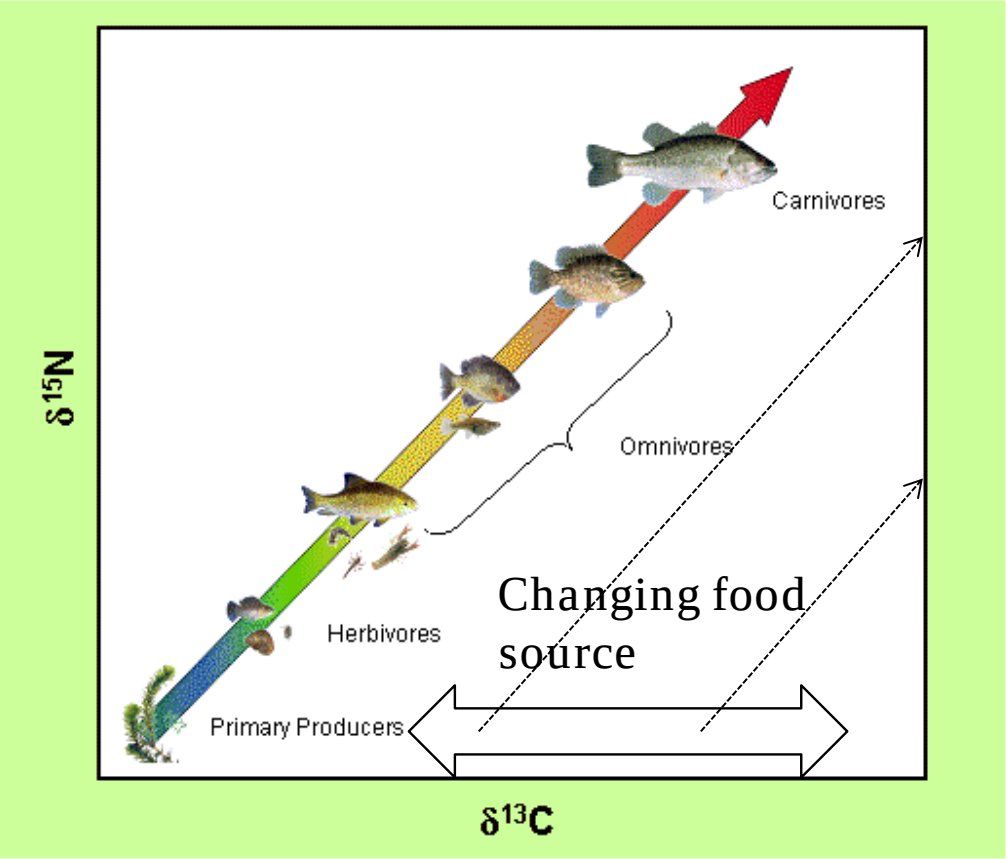
$$Benthic\ index = \frac{n(Pennate\ Diatoms)}{n(Total\ Diatoms)}$$

$$Freshwater\ index = \frac{n(Chloroccocales)}{n(Total)}$$





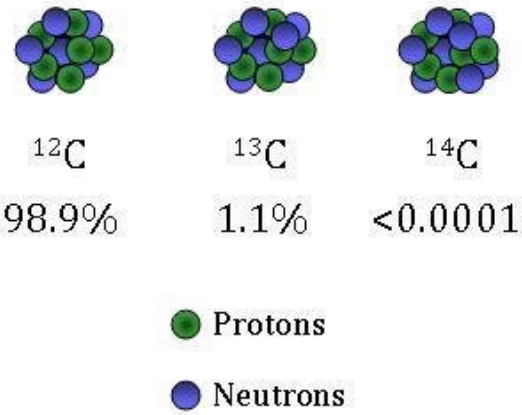
Stable Isotopes



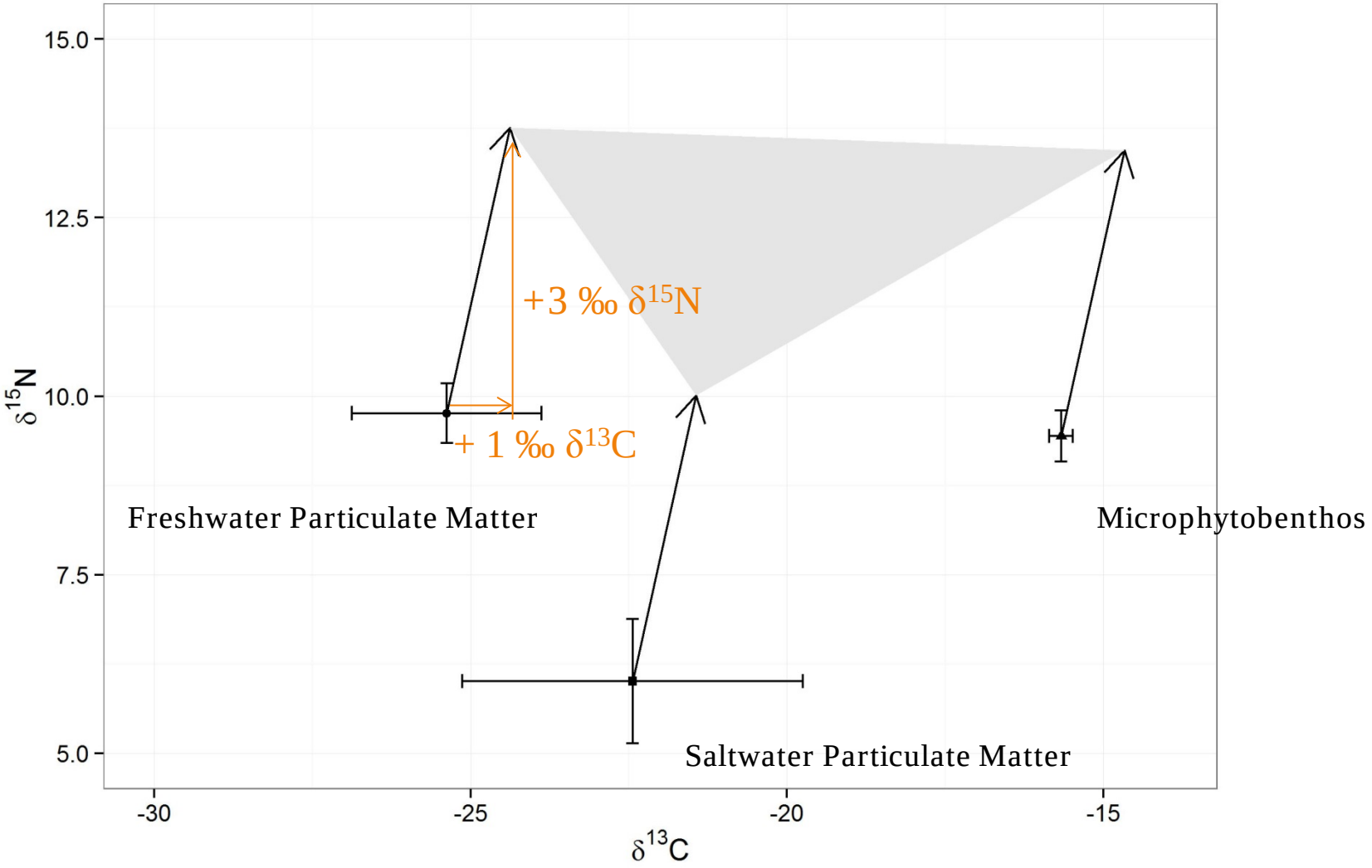
You are what you eat (+3 ‰ for Nitrogen)

What is an isotope?

Nuclei and Relative Abundance of Carbon Isotopes



Primary Consumers - Assimilation



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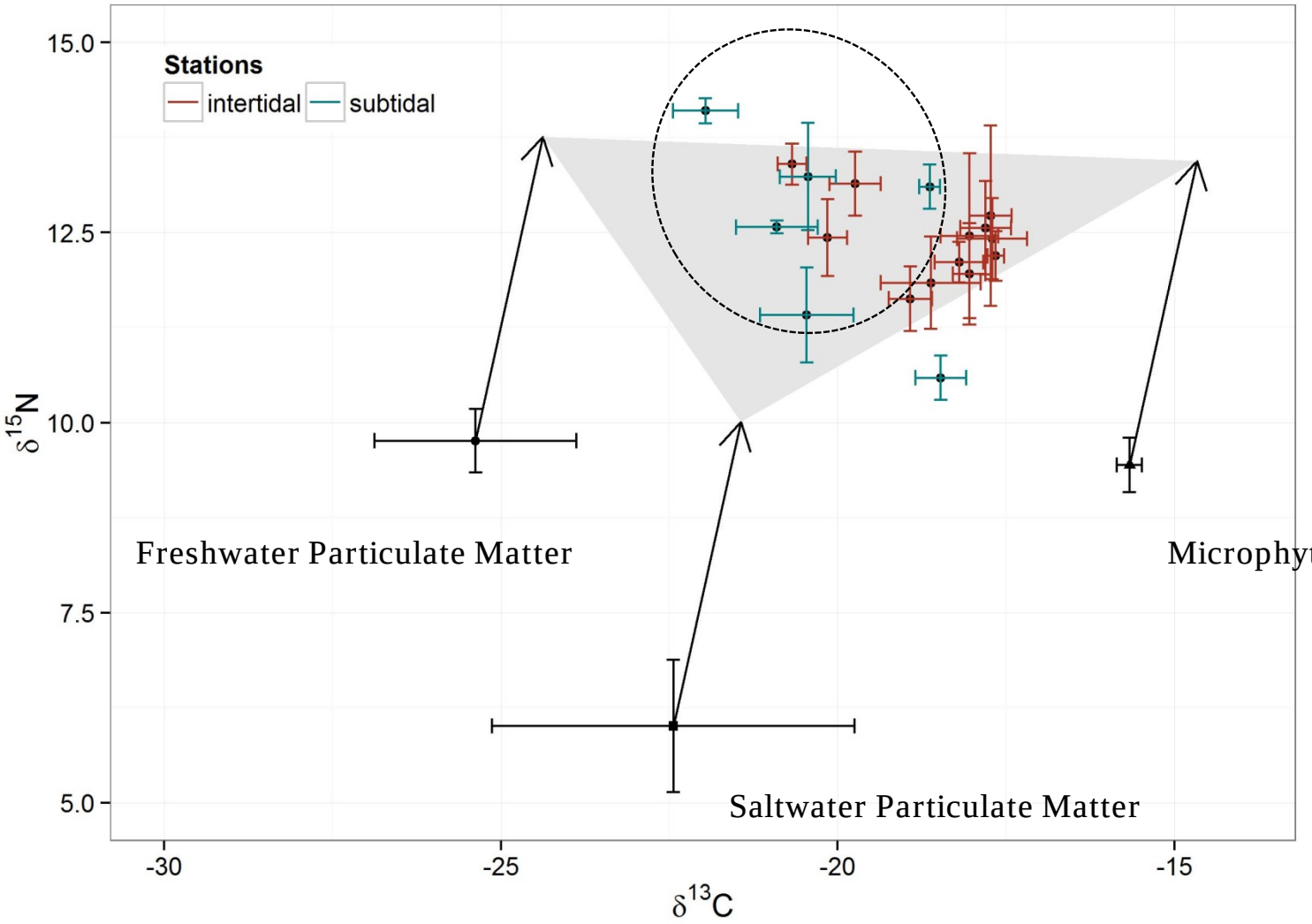


Freshwater algae also important!

Epibenthic Predators

- Species- specific seasonal patterns in abundances
- Very high densities in some species
- Importance for predation pressure?

Kuipers & Dapper 1984

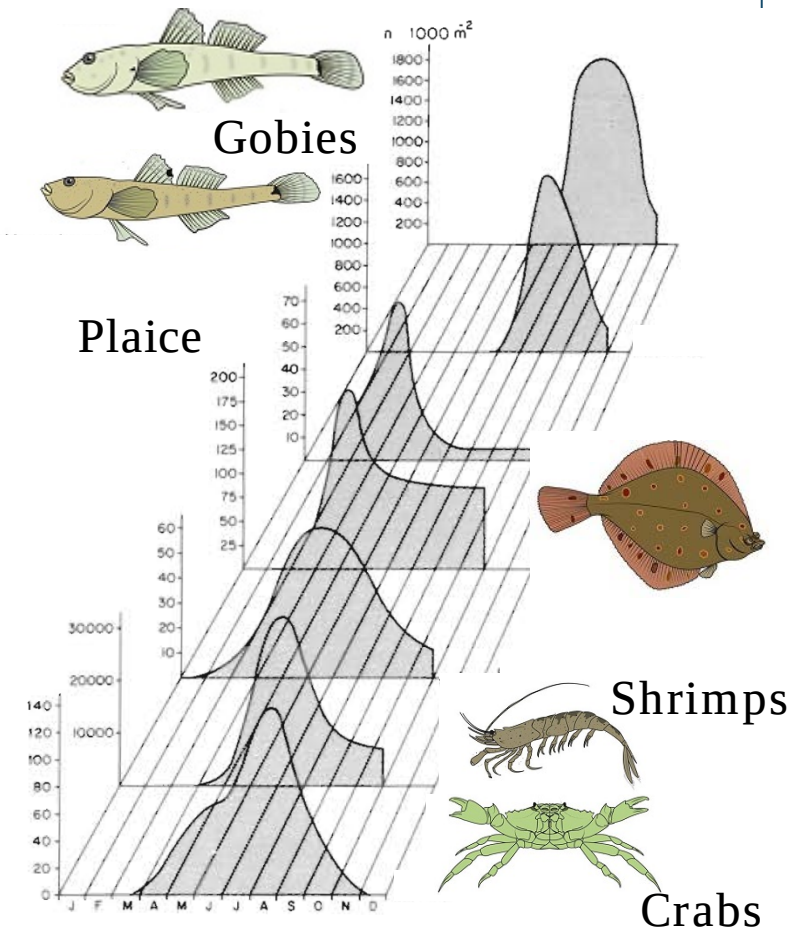


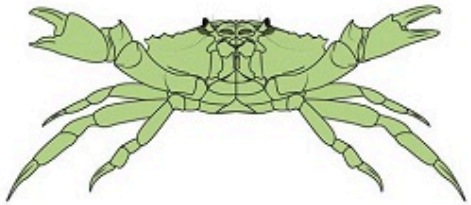
Fig. 8. Seasonal population curves (numbers 1000 m^{-2}) of different carnivore populations on Balgzand tidal flats (*Pomatoschistus microps* and *P. minutus* from van Beek, 1976: 2 ys; Plaice 0^-, I^- and II-group from Kuipers, 1977: 4 ys; *Crangon crangon* from Kuipers and Dapper, 1981: 4 ys; *Carcinus maenas* from Afman, 1980: 2 ys

Epibenthic Predators

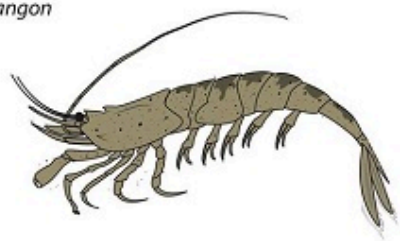
- Long-term (36 Stations, 10 years in period 1975-2009)
- Density and Biomass
- Maintenance and growth estimated
- Yearly food intake per species

Density + Size -> Biomass -> Maintenance + Growth -> Food Intake

Carcinus maenas

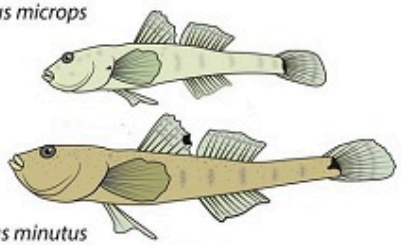


Crangon crangon

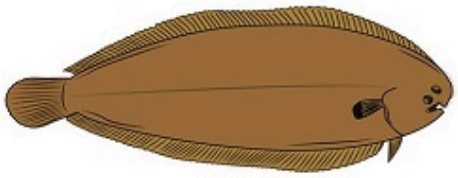


Pomatoschistus microps

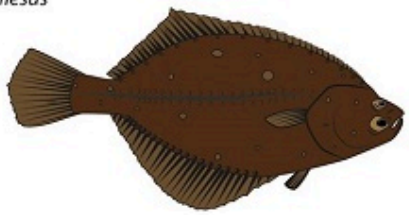
Pomatoschistus minutus



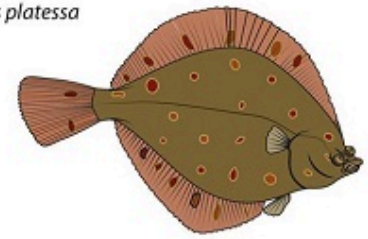
Solea solea



Platichthys flesus

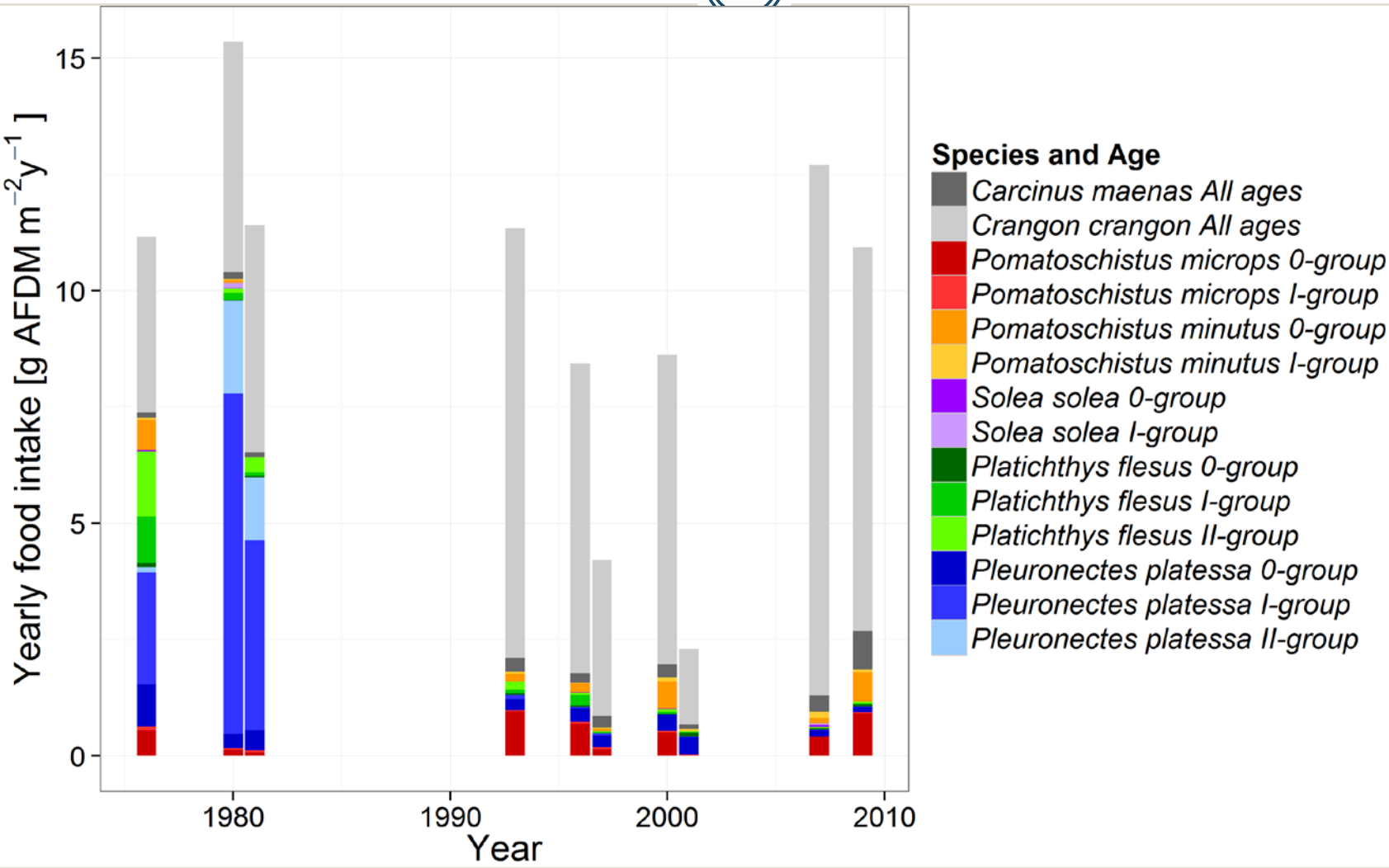


Pleuronectes platessa



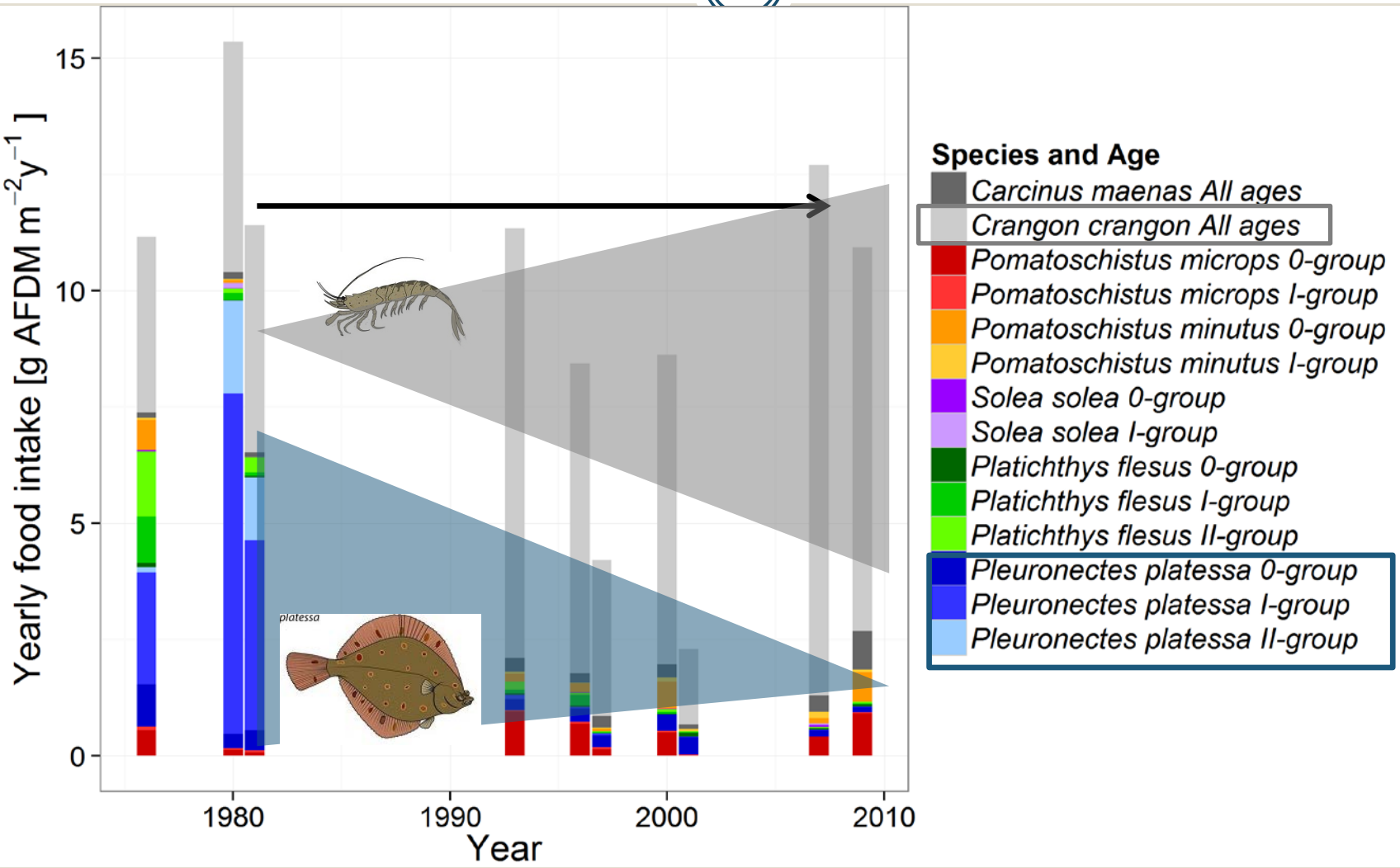
Felipe Ribas©

Epibenthic Predators – Annual Food Intake



Jung et al. in prep.

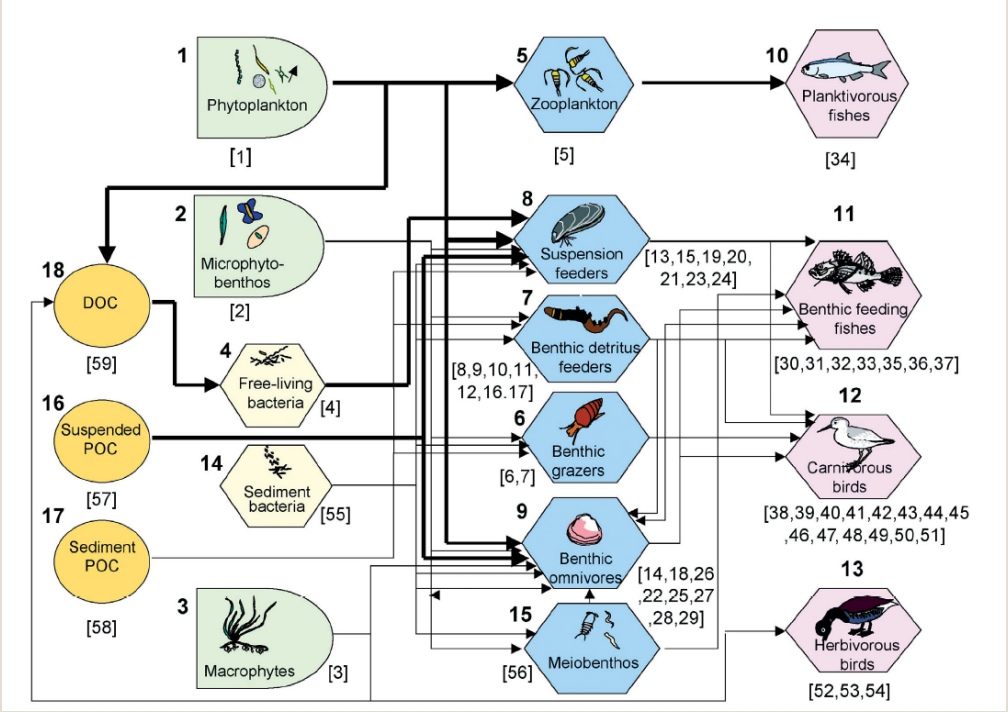
Epibenthic Predators – Annual Food Intake



General Conclusions

- Nutrients:
  Different areas have different starting points
- Primary consumers:
  Freshwater input important
- Epibenthic predators:
  Long-term shift in predation pressure from fish to crustaceans

- Next step:
  First version of ENA of Balgzand (Sylt, January 2015)



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Thank you for your attention!

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The crew of the RV Navicula & Stern
All Students involved in this Project

And many more...

Any Questions?