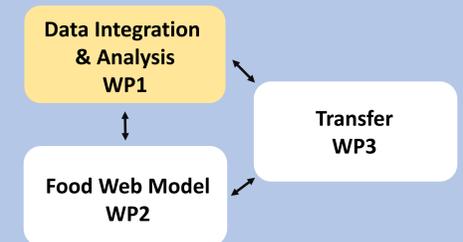


Changes in biodiversity and food webs in the southern North Sea

WP1: SPATIO-TEMPORAL ANALYSIS OF TRAITS WITHIN TAXONOMIC GROUPS

Maité Guignard_(AWI), Eileen Heße_(TiHo), Kim Ludwig_(TI-SF), Raquel Marques_(SaM), Anja Singer_(SaM)



Our Mission

The Southern North Sea (SNS) is changing rapidly, driven by changes in human activities and environmental conditions. The BioWeb mission is to investigate the response of biodiversity in SNS food webs to support ecologically, economically and socially sustainable exploitation of biological resources.

In WP1 we aim to understand the main drivers of changes in biodiversity and functional traits of 5 taxonomic groups (marine mammals, fish, benthos, zooplankton, phytoplankton).

Hypothesis

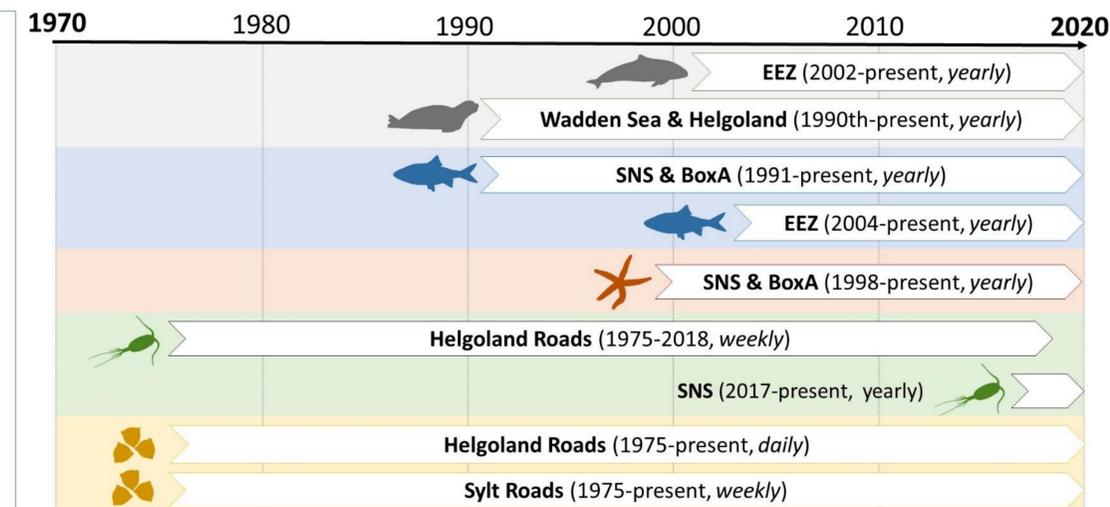
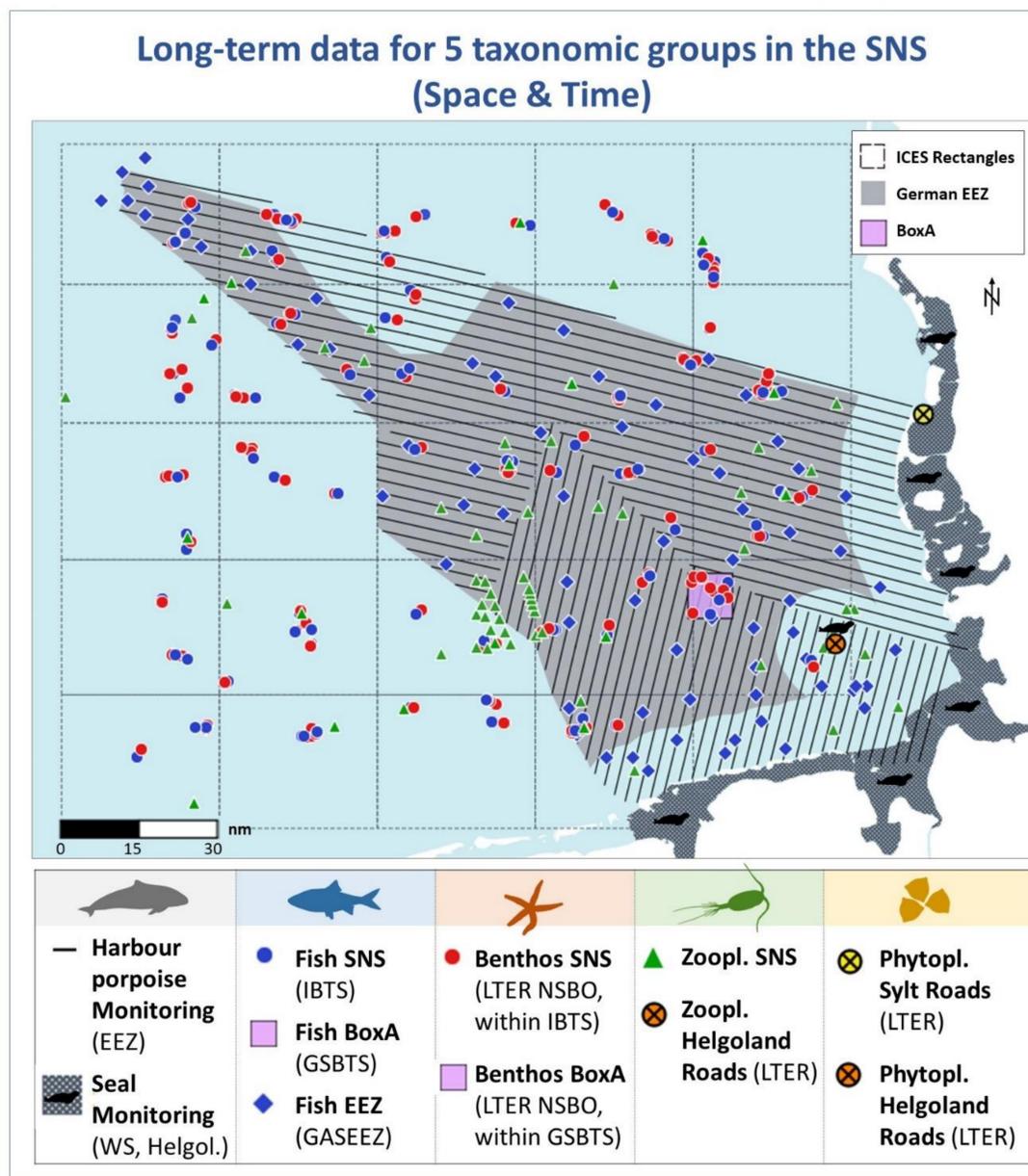
- Changes in environmental conditions (temperature increase) and anthropogenic activities (decreasing fishing pressure, de-eutrophication) have led to changes in taxonomic and functional biodiversity within each trophic group.

Upcoming work

Stable isotopes, molecular methods, stomach content and faeces etc.

Transfer data from species to trait level to analyse changes in dominant traits

Combination of statistical methods (e.g. MAFA, DFA, SDM)

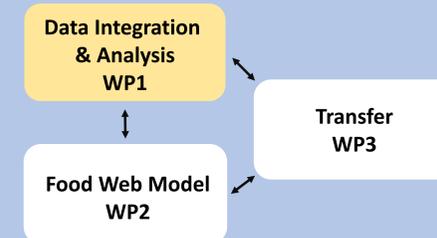


Output

- A better understanding of the relationships between environmental and anthropogenic parameters & taxonomic and functional biodiversity.
- Produce input parameters for the food web model in WP2 (functional groups, trophic interactions, habitat suitability maps).
- Provide validation data for the food web model and expected scenarios (WP2).

Work package leaders

Prof. Dr. Maarten Boersma (AWI), Dr. Anita Gilles (TiHo), Prof. Dr. Ingrid Kröncke (SaM), Dr. Cédric Meunier (AWI), Dr. Jasmin Renz-Gehnke (SaM), Dr. Anne Sell (TI-SF), Prof. Dr. Ursula Siebert (TiHo), Prof. Dr. Karen Wiltshire (AWI)



WP1: INTER-SPECIFIC LINKAGES BETWEEN TAXONOMIC GROUPS

Maité Guignard_(AWI), Eileen Heße_(TiHo), Kim Ludwig_(TI-SF), Raquel Marques_(SaM), Anja Singer_(SaM)

Changes in biodiversity and food webs in the southern North Sea

Our Mission

The Southern North Sea (SNS) is changing rapidly, driven by changes in human activities and environmental conditions. The BioWeb mission is to investigate the response of biodiversity in SNS food webs to support ecologically, economically and socially sustainable exploitation of biological resources.

In addition to analysing biodiversity changes over space and time for individual taxonomic groups our target is to gain a fundamental understanding of how these changes are linked between taxonomic groups.

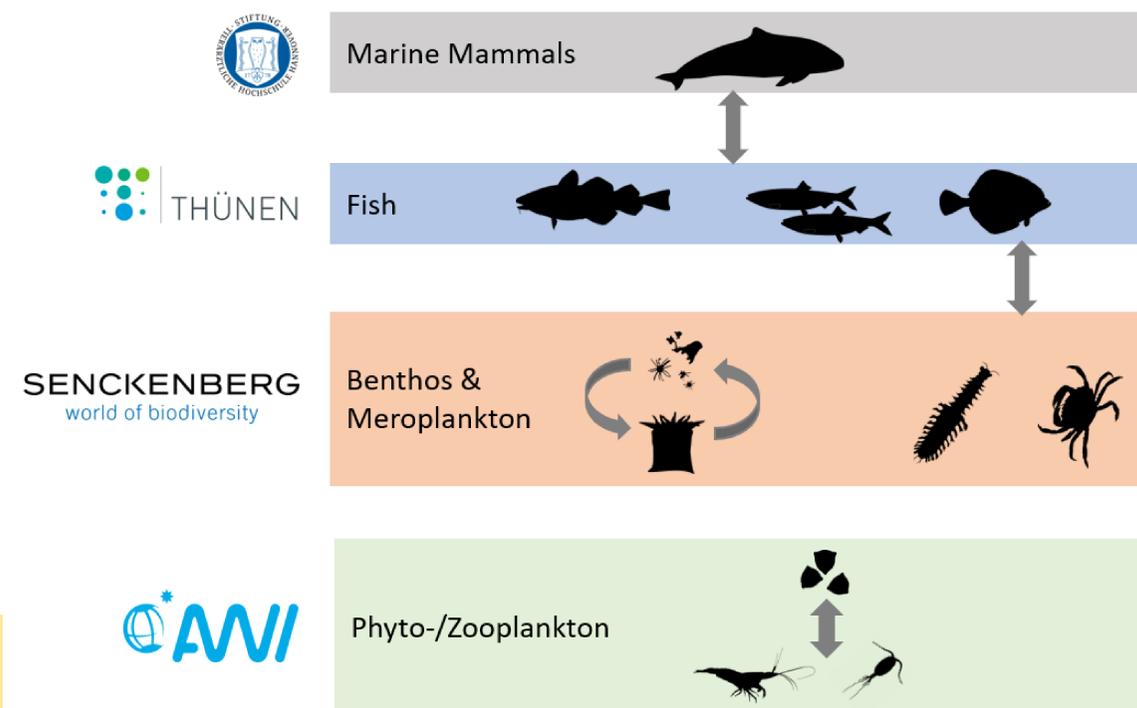
Hypotheses

- Changes in one trophic group will result in changes in other trophic groups, based on the theory of bottom-up and top-down regulations of ecosystems.
- The taxonomic groups in the SNS are closely interlinked through trophic relationships and therefore sensitive to abundance and trait changes in both predator and prey species.

Picture sources :

Taxa icons: Phylopic.org; creative commons 3.0, diatoms: Harold N. Ester, harbour porpoise: Chris Huh, caridea: Maija Karala.

Fotos: Seal (Nick Upton/NPL), copepod (sciencenewsstudents.org), *carcinus meanas* (undine-baltic.eu).



Bottom-up and top-down regulations



The Key: Joint Data!

- Marine surveys in the SNS have produced datasets for different taxa which share the same spatial and temporal resolution.
- These data resources allow for direct linkages of (taxonomic and functional) changes between groups, e.g. benthos and fish or meroplankton and benthos.
- Additionally, dietary data for marine mammals can be linked to fish abundance and biomass data.

Output

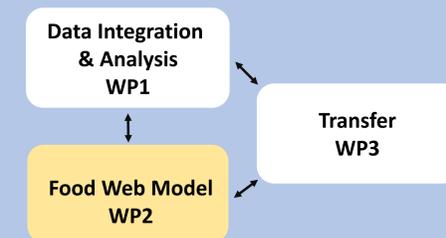
- We will produce a complementary set of modelling results with a high spatio-temporal resolution (small-scale), in addition to the Ecopath food web model, which will integrate data from all taxa/trophic levels in WP2 (large-scale).
- This will allow us to compare overall dynamics of bottom-up/top-down processes in the food webs with directly observed cross-taxa interactions.

Work package leaders

Prof. Dr. Maarten Boersma (AWI), Dr. Anita Gilles (TiHo), Prof. Dr. Ingrid Kröncke (SaM), Dr. Cédric Meunier (AWI), Dr. Jasmin Renz-Gehnke (SaM), Dr. Anne Sell (TI-SF), Prof. Dr. Ursula Siebert (TiHo), Prof. Dr. Karen Wiltshire (AWI).

WP2: MODELLING THE FOOD WEB OF THE SOUTHERN NORTH SEA

Miriam Püts_(TI-SF)



Our Mission

The Southern North Sea (SNS) is changing rapidly, driven by changes in human activities and environmental conditions. The BioWeb mission is to investigate the response of biodiversity in SNS food webs to support ecologically, economically and socially sustainable exploitation of biological resources.

In our workpackage we focus on consequences from changes in bottom-up and top-down processes as response to external influences with the aid of a spatio-temporal ecosystem model.

Hypotheses

- **Climate change** and **fisheries** induce **shifts in species composition** and **biodiversity**.
- **Human activities** alter **top-down** and **bottom-up** processes in the SNS food web with major implications for maximum sustainable yield from marine living resources.

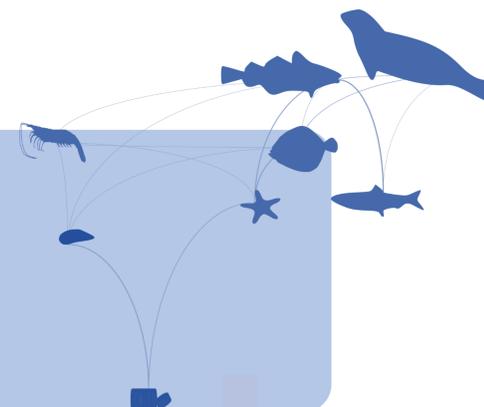
Status Quo

- Ecopath (Stäbler et al. 2016, 2018)
 - Ecosim (Stäbler et al. 2016, 2018)
 - Ecospace (Püts et al., 2020)
- Fish centric models

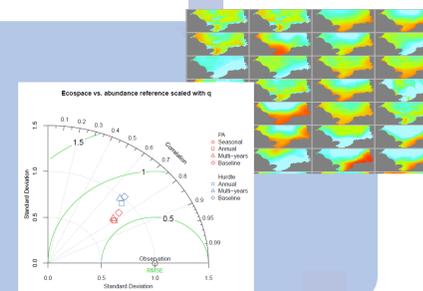
Upcoming work

Input WP1

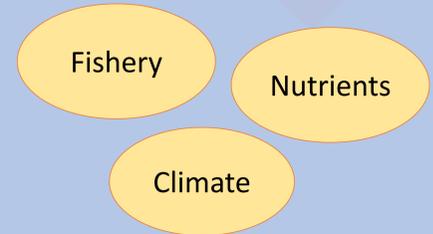
Integrate **new functional groups** and improve parametrization of all trophic levels



Skill assessment



Execute scenarios



Output WP3

Input from BioWeb partners

Mammals



Fish



Benthos & Meroplankton



Zoo- & Phytoplankton



Output

- **Spatio-temporal ecosystem model** representing most important processes and dynamics in all trophic levels.
- Better **understanding of main drivers** behind observed changes in the SNS food web and fisheries.
- **Scenario outcome** and **discussion material** for transfer to regional and local stakeholder workshops conducted in WP3.

Work package leaders

Dr. Alexander Kempf (TI-SF); Dr. Jasmin Renz-Gehnke (SaM)

References

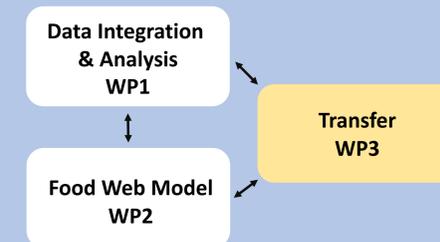
Püts, M., Taylor, M.H., Nuñez-Riboni, I., Steenbeek, J., Stäbler, M., Möllmann, C., Kempf, A. (2020) Insights on integrating habitat preferences in process-oriented ecological models - a case study of the southern North Sea. *Ecol Model* 431:109189

Stäbler, M., Kempf, A., Mackinson, S., Poos, J.J., Garcia, C., Temming, A. (2016). Combining efforts to make maximum sustainable yields and good environmental status match in a food-web model of the southern North Sea. *Ecol. Modell.* 331, 17–30.

Stäbler, M., Kempf, A., Temming, A. (2018). Assessing the structure and functioning of the southern North Sea ecosystem with a food-web model. *Ocean and Coastal Management* 165, 280–297.

WP3: TRANSFER TO REGIONAL AND LOCAL STAKEHOLDERS

Eileen Heße_(TiHo)



Our Mission

The Southern North Sea (SNS) is changing rapidly, driven by changes in human activities and the effects of climate change. The BioWeb mission is to investigate the response of biodiversity in SNS food webs to ultimately support ecologically, economically and socially sustainable exploitation of biological resources.

In WP3, the developed scenarios (from WP2) regarding changes in biodiversity and consequences for the food web in the SNS will be communicated to local and regional stakeholders, e.g. from fisheries, aquaculture and tourism.

Stakeholders



Biodiversity & food web specialists of BioWeb

Fisheries | Policy maker
 Aqua culture | NGOs
 Coastal municipalities
 National park authorities

Output

- Realistic economic and social future scenarios for direct involved parties like fisheries and aquaculture.
 - Show consequences for coastal communities, e.g. trade and tourism.
 - Representative perception of economical and social risks, including different adaptation scenarios for the local economy and coastal communities.
- POLICY ADVICE**

Case Study: Seal-Fisheries Interaction

The recovery of grey seal and harbour seal populations:

perceived as a seemingly direct conflict with human use of SNS

Travel industry

The successful protection of these two iconic species has contributed to the inclusion of the Wadden Sea as a UNESCO World Heritage Site.

Fishermen

Seals are competitors of the same resource, damage catches, fishing gear and fish farms.^{1,2}

POLARIZED DISCUSSION

The role and function of marine mammals (here seals) in the North Sea ecosystem has never been systematically investigated.

- I. complexity of predator-prey interactions
- II. extent of top-down control
- III. other influences on the food web not taken into account

Will be worked out in **BioWeb** and transferred to local stakeholders in an explicable way.

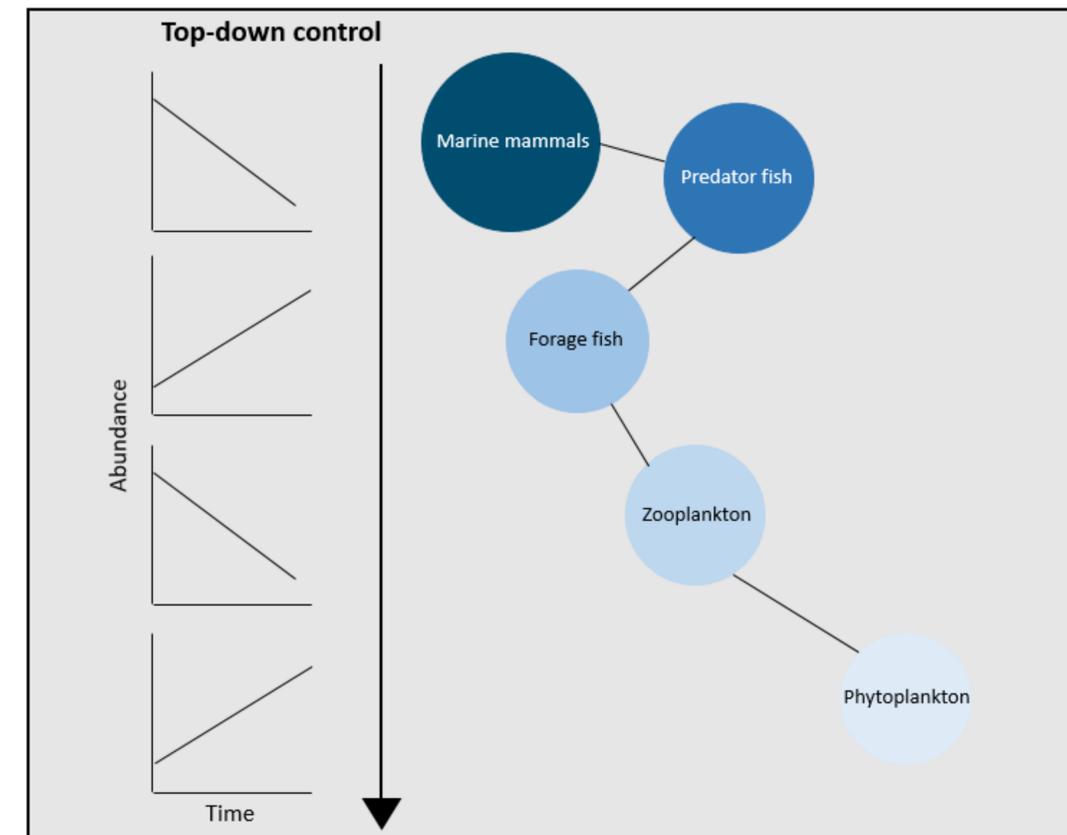


Figure 1 Possible scenario to discuss during the case study workshop. Increases and decreases (left) of different trophic levels (right) in a top-down controlled food web³.

Workpackage leaders

Dr. Anita Gilles (TiHo), Dr. Gerd Kraus (TI-SF)

References

- ¹Morissette L, Christensen V, Pauly D (2012) Marine mammal impacts in exploited ecosystems: would large scale culling benefit fisheries? PloS One 7(9): e43966.
²Olsen MT, Galatius A (2018) The history and effects of seal – fishery conflicts in Denmark. Marine Ecology Progress Series 595: 233–243.
³Cury P, Shannon L & Shin YJ (2001) The Functioning of Marine Ecosystems. Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem.
 Image: John Brookes via Pixabay 2021
 Image: Patrick Stührk, ITAW

