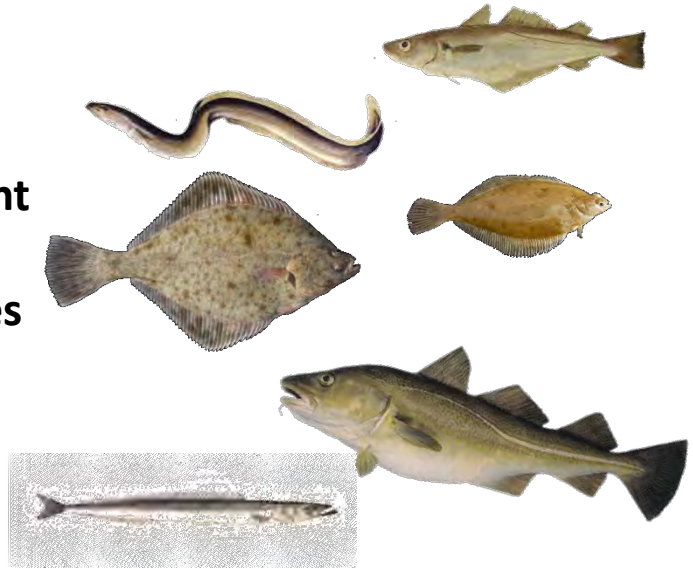
Environmental pressure drives functional diversity of fish assemblages in a temperate brackish system

Laurène Pécuchet, Martin Lindegren and Anna Törnroos

- **Assembly rules shaping communities composition**
- **Trait-based approach of biodiversity**
- **Study of communities along an environmental gradient**
- **Insight on Climate change impacts on the communities**



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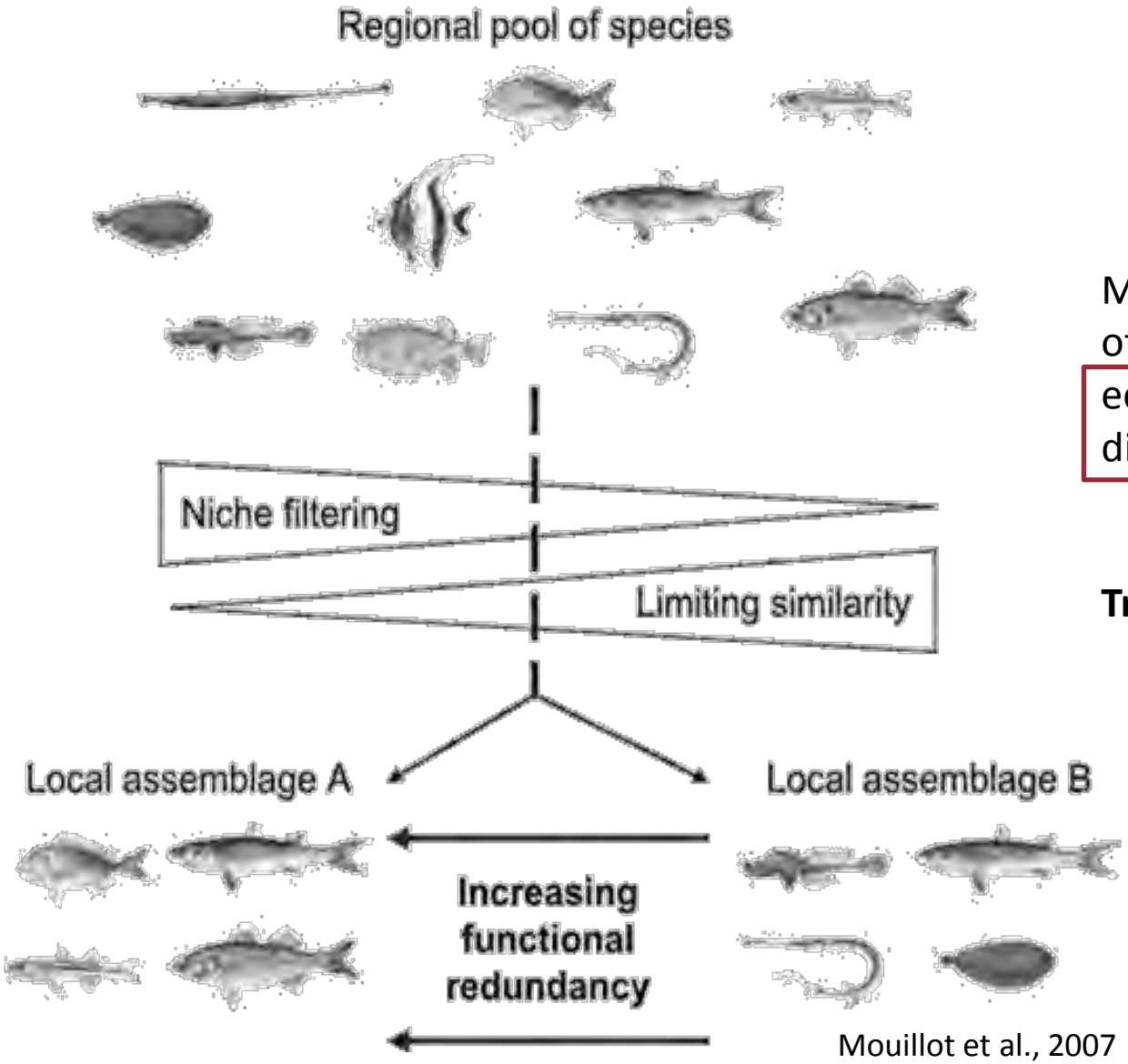
Third International Symposium
Effects of Climate Change on the World's Oceans
March 25, 2015 Santos, Brazil

Mechanisms influencing patterns of community assembly



Mouillot et al., 2007

Mechanisms influencing patterns of community assembly act on the ecological similarities and/or differences of organisms

Trait-based approach

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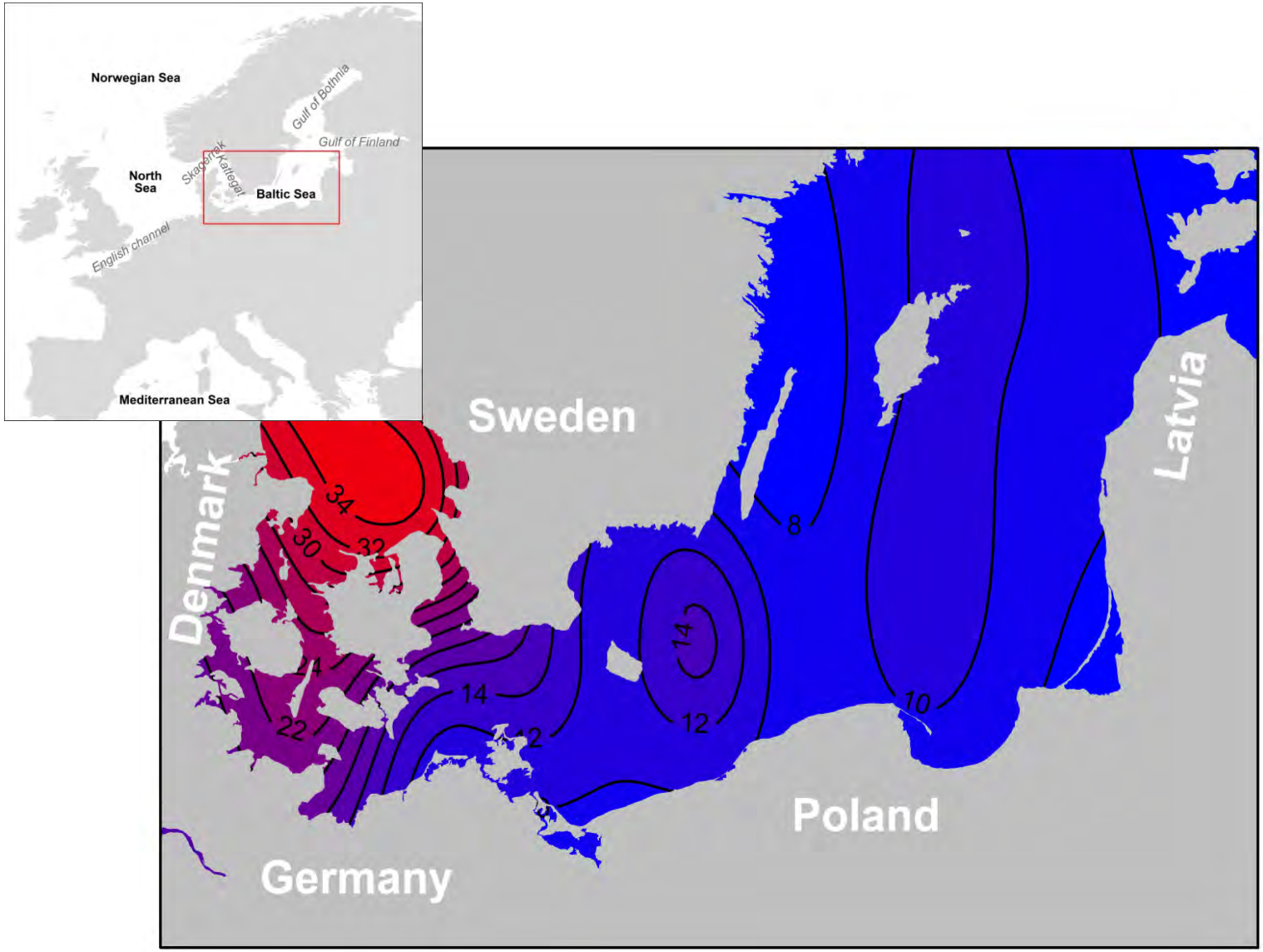
The Baltic Sea – a strong salinity gradient



Hypothesis: Abiotic control of the biological community

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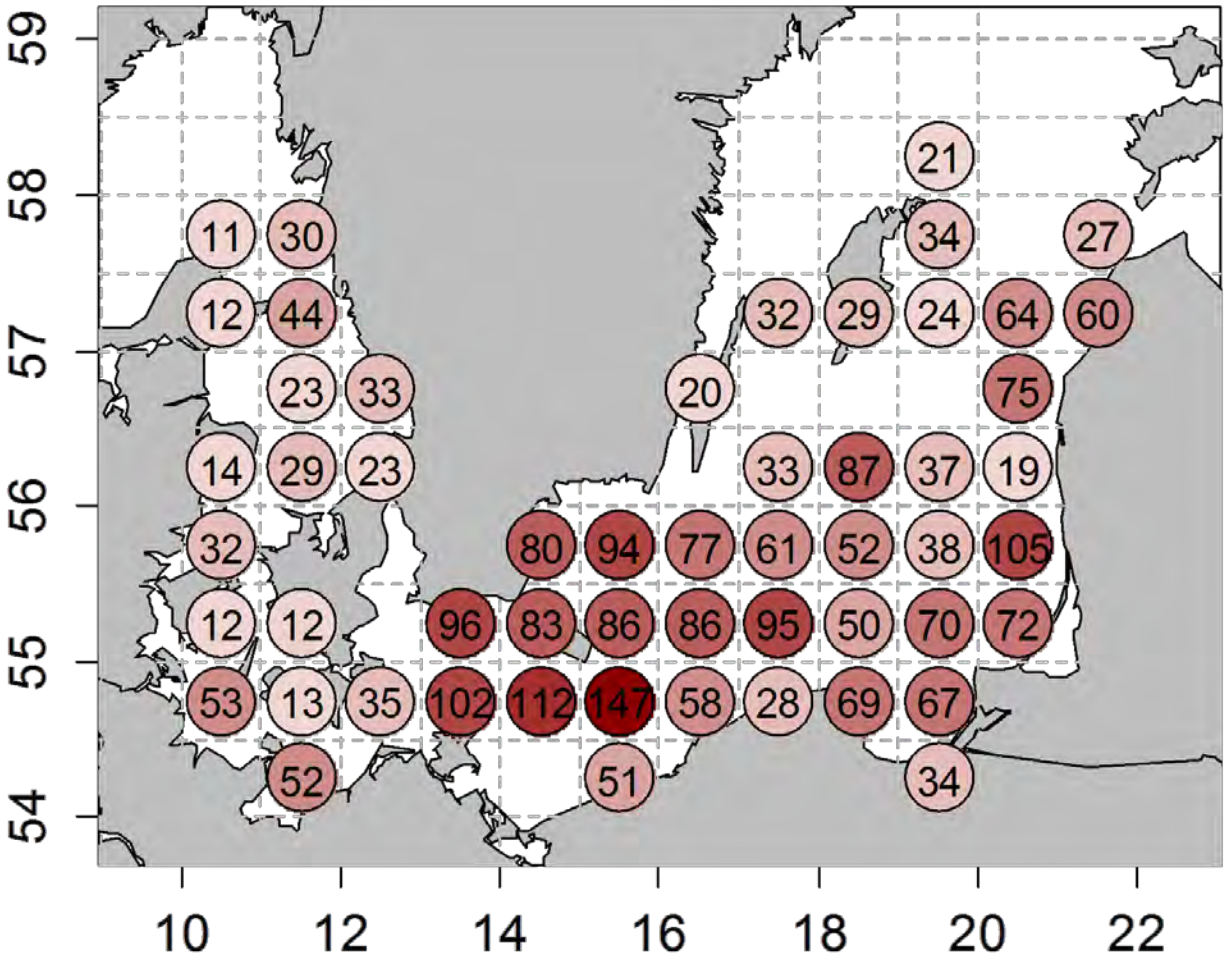
Baltic International Trawl Survey (BITS)



Number of hauls performed from 2003 to 2014 in February - March

For each haul, the species are sorted and their biomass is recorded

Occurence of Species per 1’ Long x 0.5’ Lat and species biomass per haul

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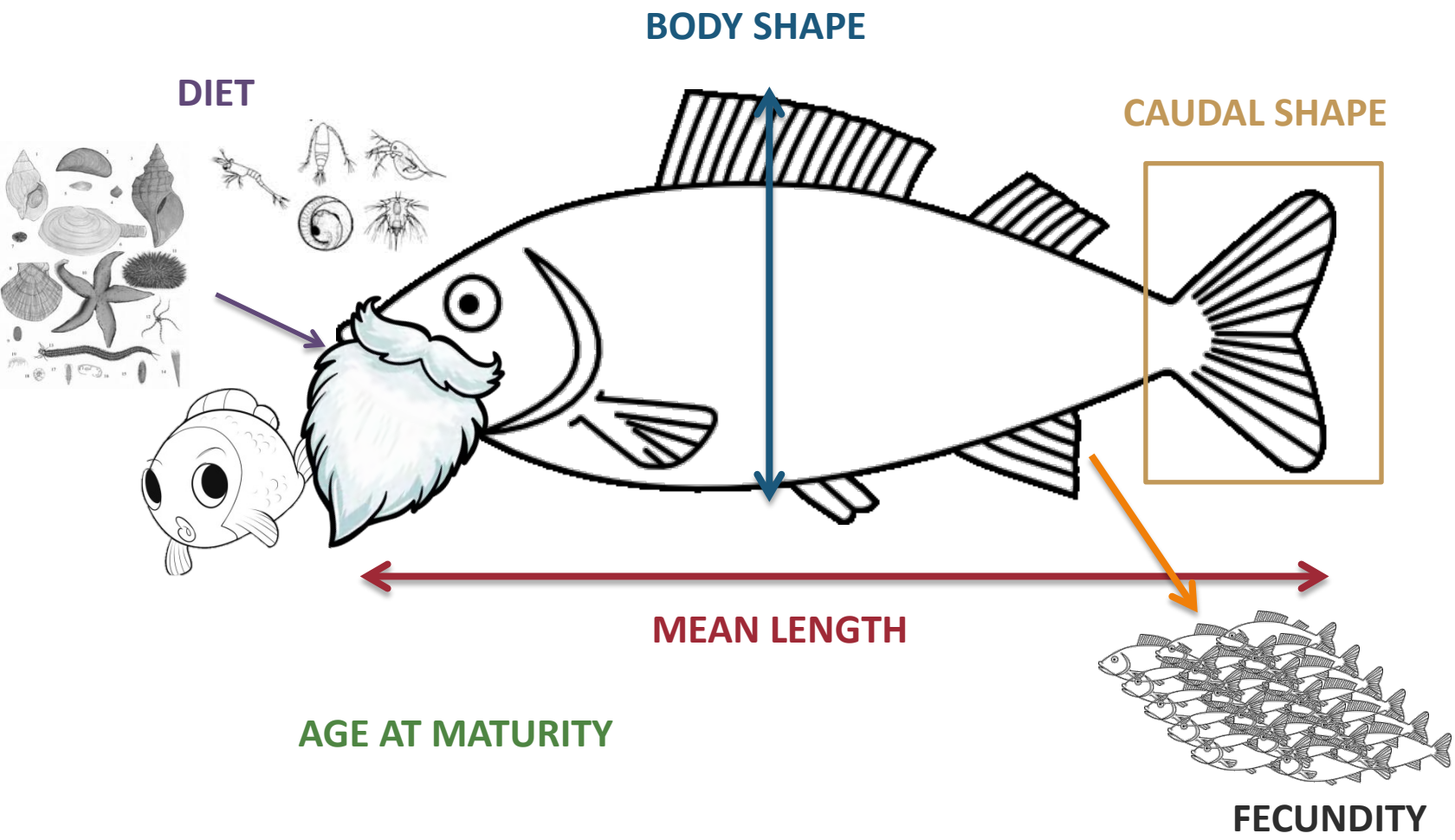
Species and traits database

Traits values for **42 demersal species** from literature primarily and secondarily through species fact sheet (FAO/FishBase)



6 traits characterising the diet, the demography, the habitat and the morphology.

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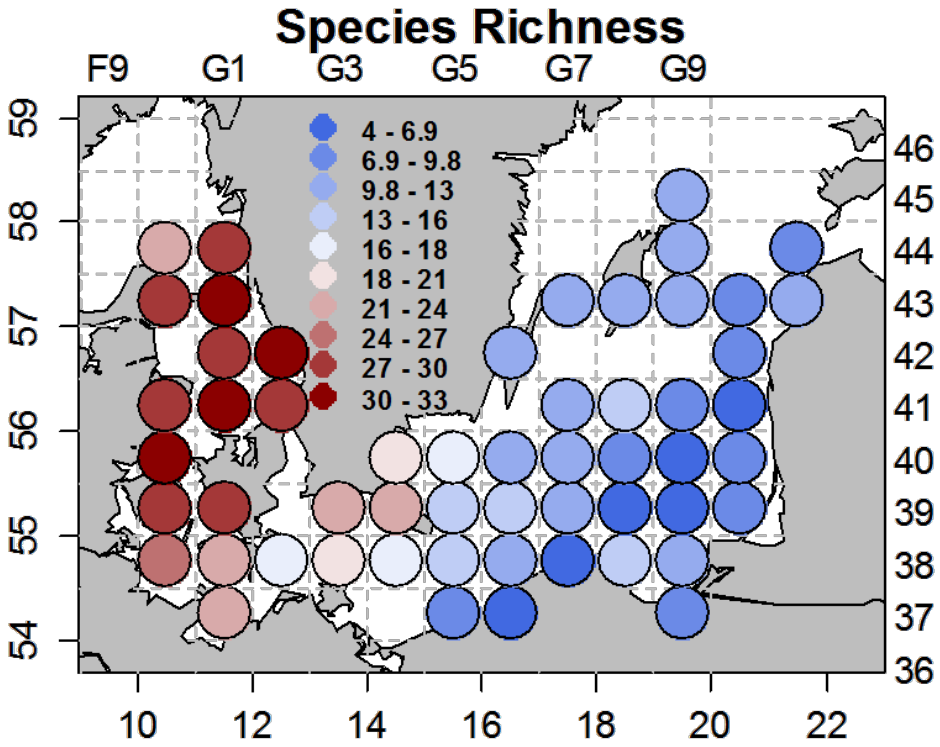
Diversity pattern of the Baltic Sea: Species vs Functional richness

Functional Richness : The amount of trait space filled by species in the community (Convex Hull)



Metrics	Best gam model	Dev.expl	Salinity alone
Species Richness	Salinity*** + habitat*** + Oxygen*** + Temp.*	92.5%	83.3%
Functional Richness	Salinity*** + habitat*** + Oxygen*	67.1%	51.8%

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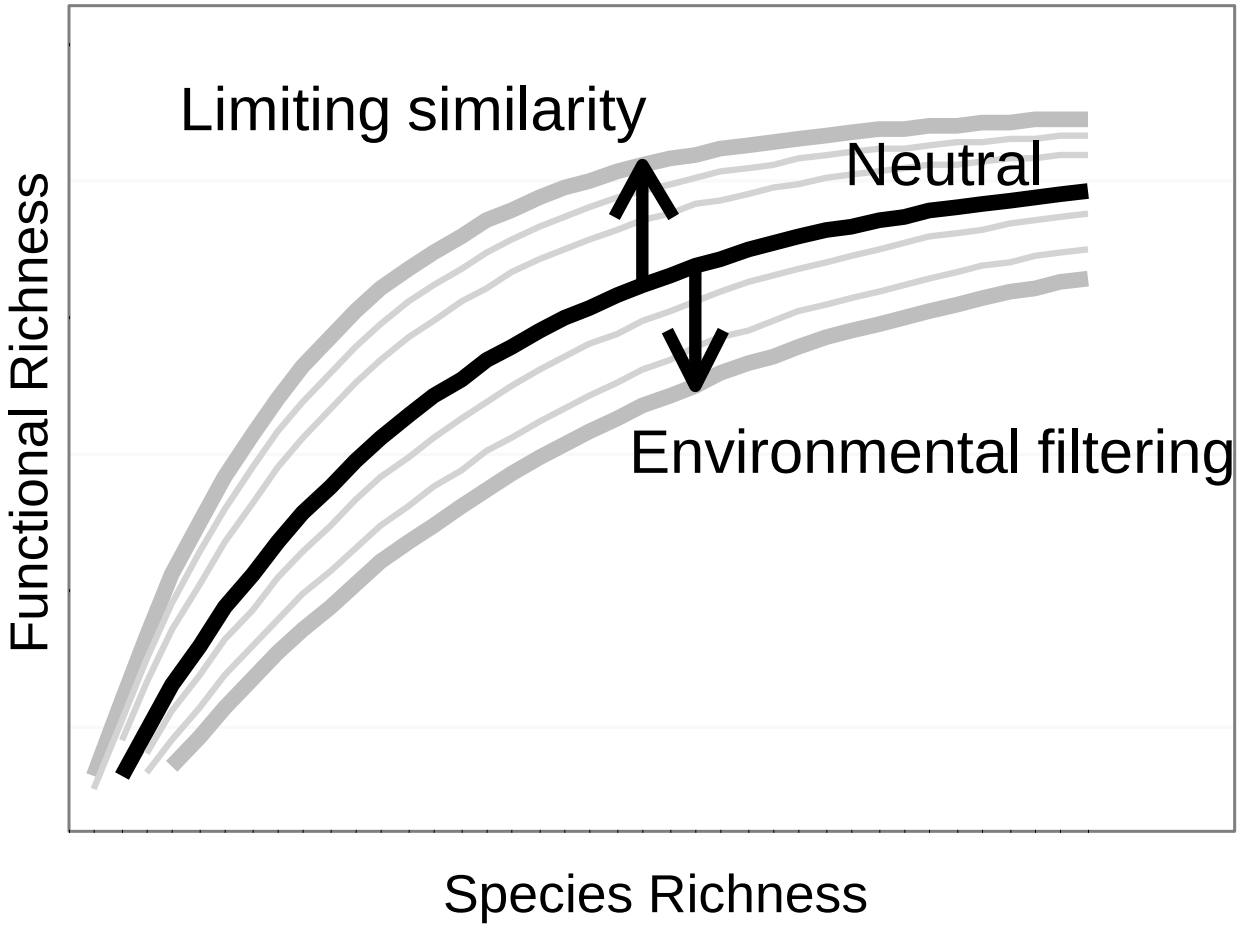
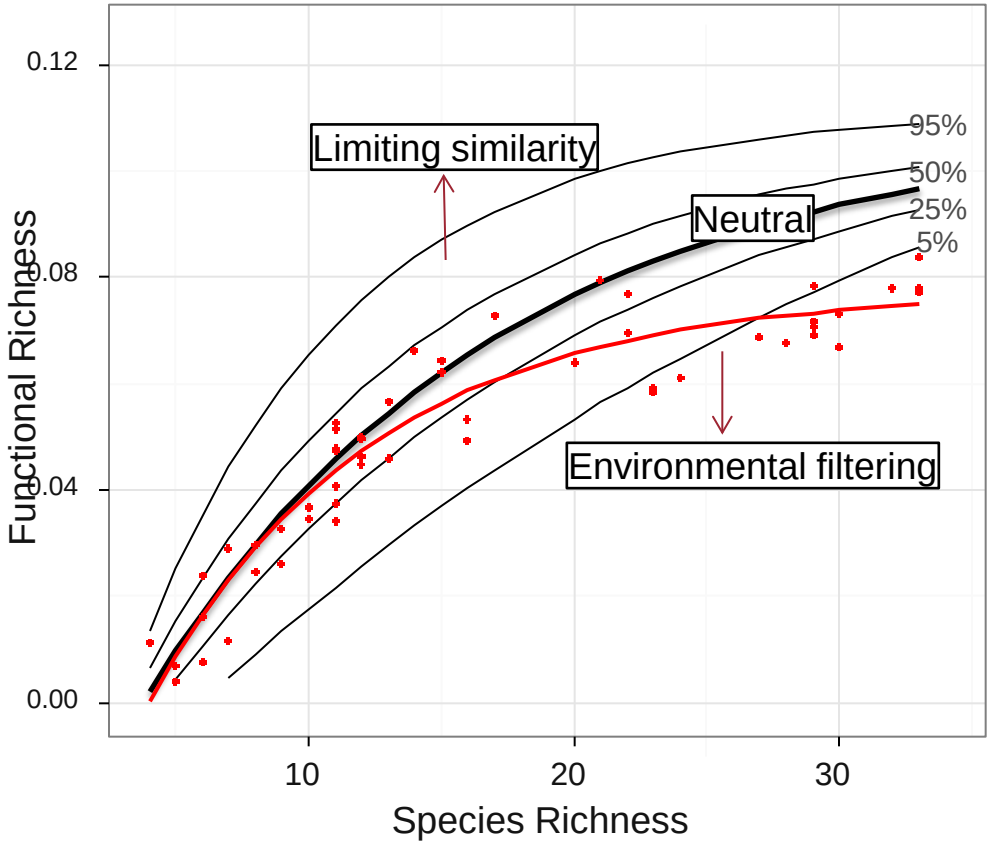
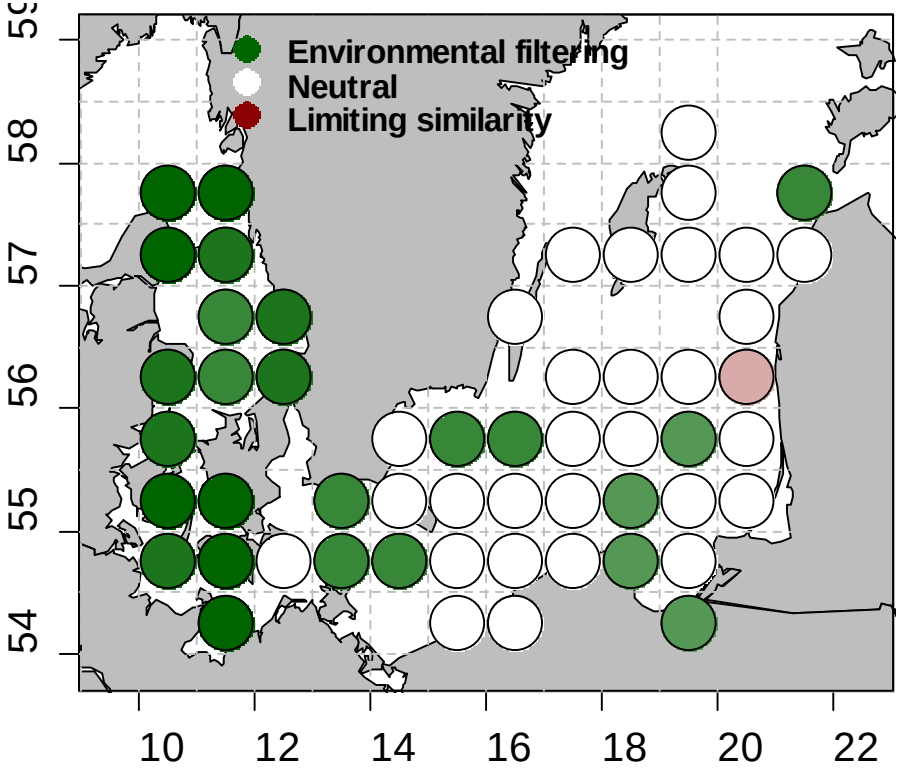
Investigating the assembly rules
- Observed Functional Richness vs null model



Null model : for each species richness level, Functional Richness is calculated from random assemblages of species from the species pool

Observed Functional Richness vs null model





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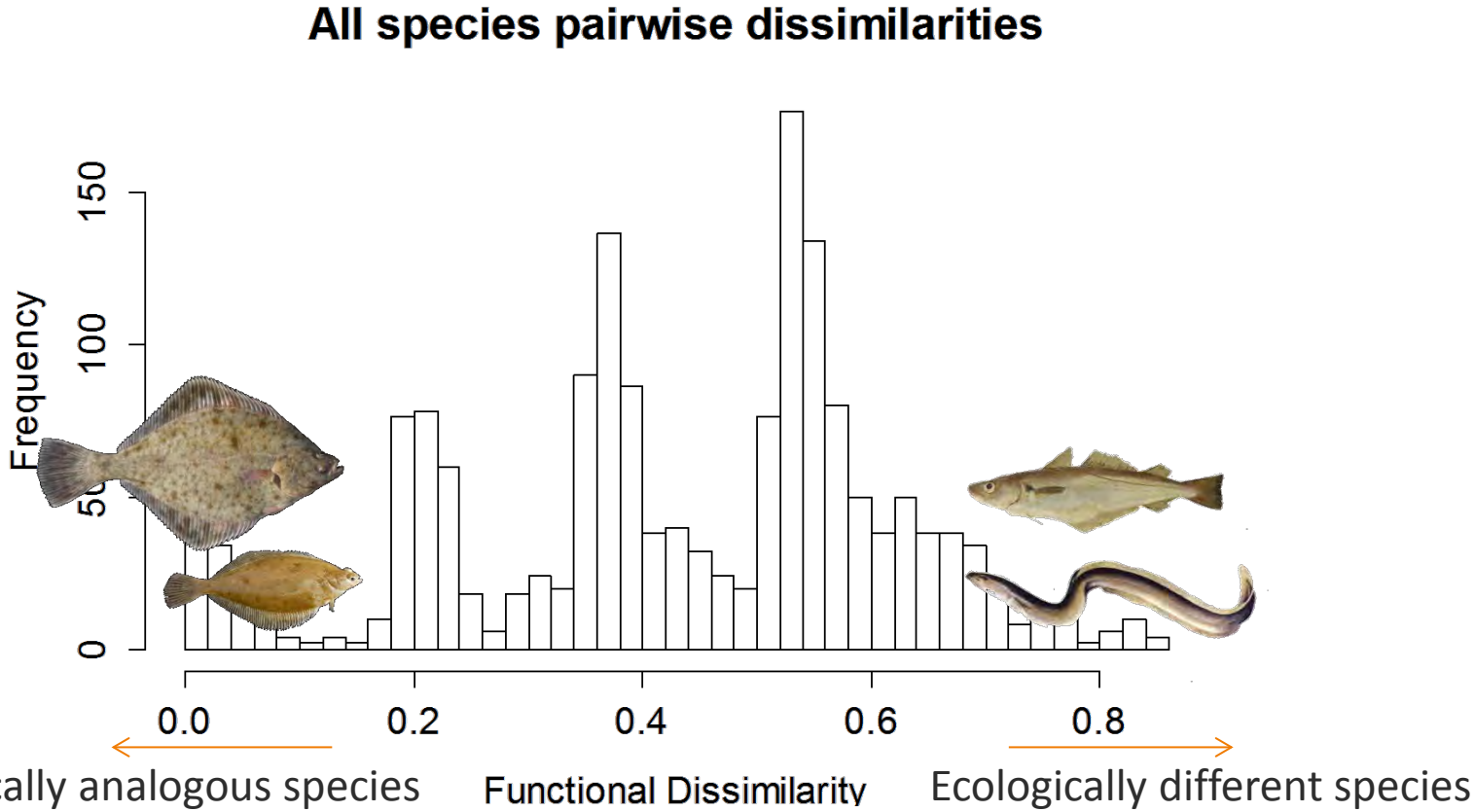
What about the biomass distribution in the communities?

Calculation of communities weighted Functional Dissimilarities

Functional Dissimilarity: Quantify how similar/dissimilar are two species based on their traits



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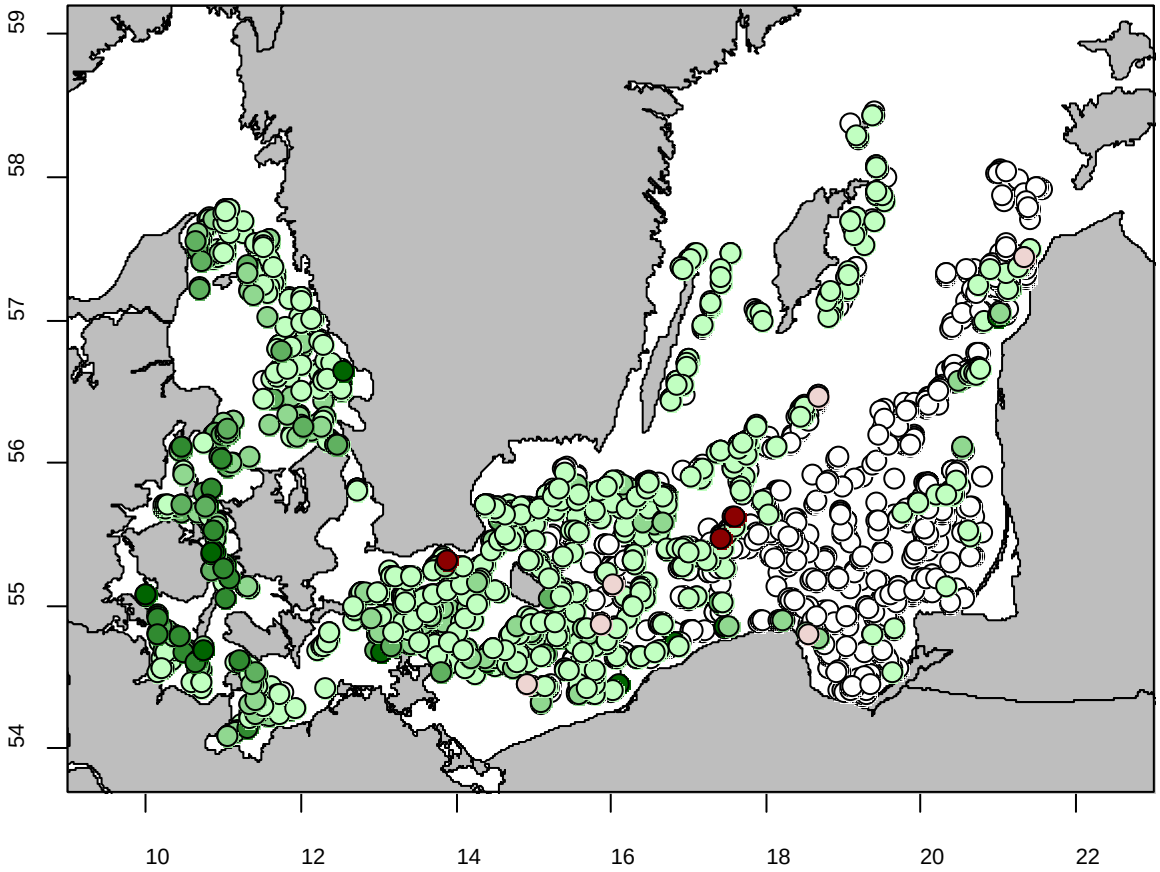
What about the biomass distribution in the communities?

Mean Functional dissimilarity per hauls of the pairwise functional dissimilarities of the two species with the highest abundance in each haul.



Environmental Filtering

- 0.026 - 0.11
- 0.11 - 0.2
- 0.2 - 0.28
- 0.28 - 0.37
- 0.37 - 0.45

Neutral

- 0.45-0.55

Limiting similarity

- 0.55 - 0.61
- 0.61 - 0.67

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Which communities can be expected under climate change?

The **knowledge gained** on studying the communities along a structuring environmental gradient can be **used to get insight into the future communities** under environmental change

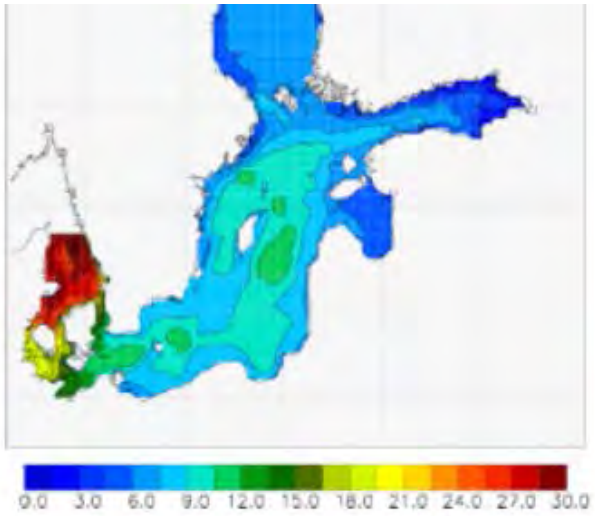
What could be the impact of salinity changes in an already species poor ecosystem?

Which communities can be expected under climate change?

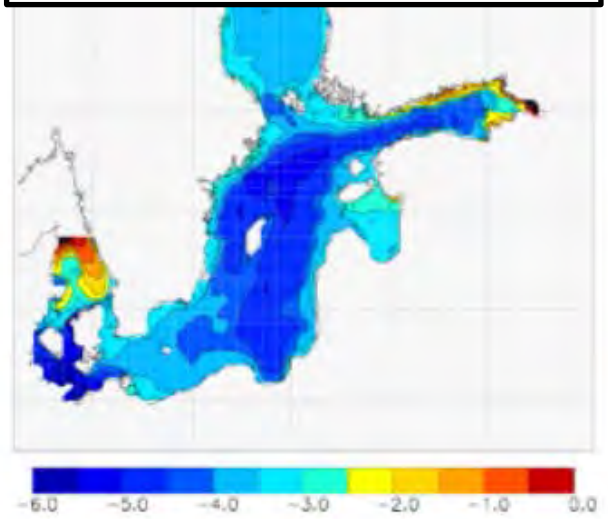
Salinity is the main environmental stressor acting on fish assemblages

Expected changes in the Baltic Sea salinity

Averaged salinity (%) 1961-1990

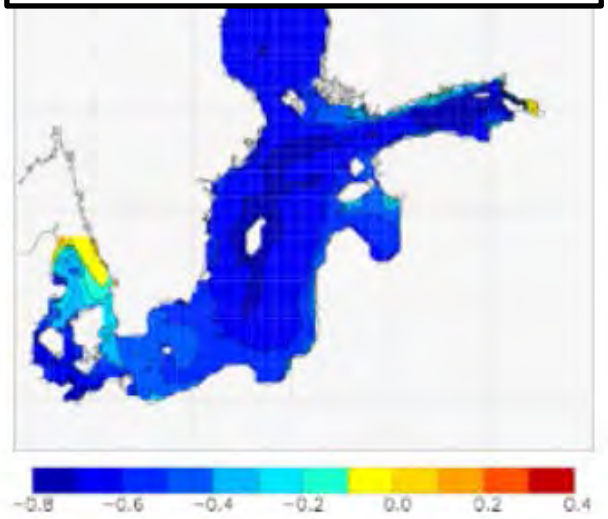


IPCC A2 CO2 2071– 2100
ECHAM4/OPYC3 model



- 3-6 PSU

IPCC A2 CO2 2071– 2100
HadAM3H model



Meier, 2006

- 0.4-0.8 PSU

Sea Surface Temperature are also predicted to increase (Meier, 2006)

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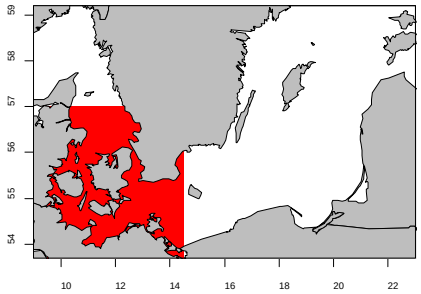
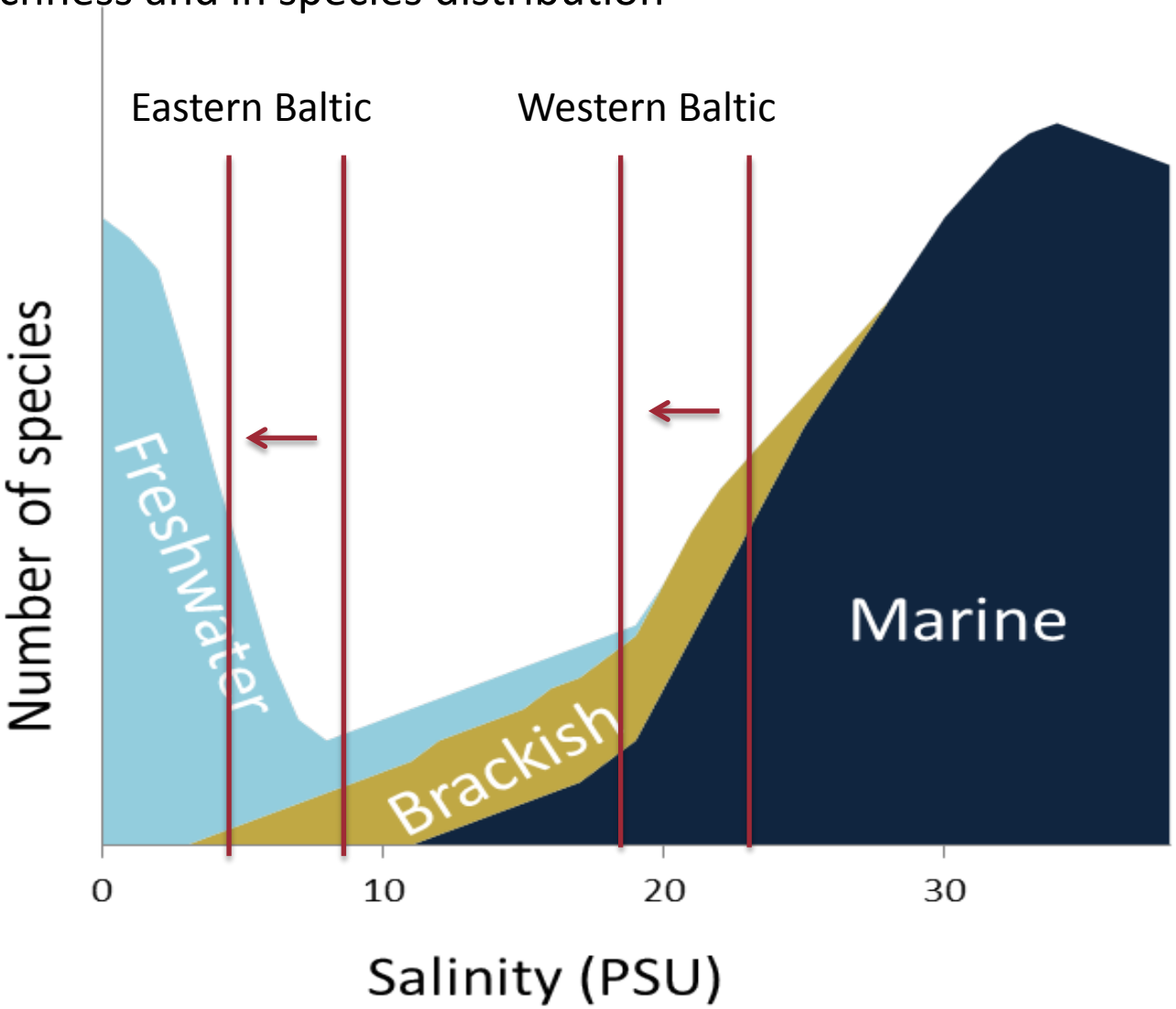
Which communities can be expected under climate change?

Changes in species richness and in species distribution





+ Potential arrival of new species from neighbouring Sea

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Summary

- Strong environmental control : Salinity high explanatory power of species and functional richness in the Baltic.
- In general, Environmental pressure drive the Baltic fish assemblages composition and is especially strong in the Western Baltic, which corresponds to the salinity transition zone.
- The fish communities in the Baltic have a lower functional richness than expected by random. The communities are composed of species with similar traits.
- Studying the communities composition along a structuring environmental gradient can give insight into the potential communities composition under environmental change

Thanks for your attention

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