

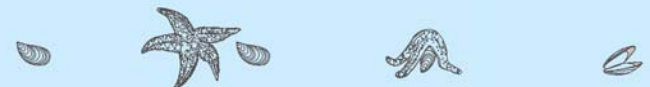
# EQA coastal + transitional waters by use of benthos: conceptual approach & first practical application

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Fred Twisk (RIKZ)





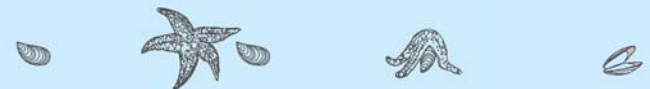
- **Macrobenthic communities and transitional/coastal waters (meso-/macrotidal)**
- **Concept of a scale-dependent classification system**
- **First application of this concept**
- **How to progress?**



# Key characteristics

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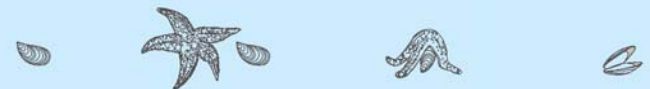
- High variability in physicochemical properties
    - Salinity
    - Tides, currents
    - Sediment
  - Strong gradients
  - Mosaic of different habitats, including low-dynamic muddy environments and high-dynamic sandy environments, ecosystem engineers (e.g. mussel beds, seagrass meadows)
- **strong impact on benthic populations**



# Functions

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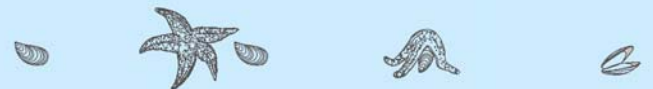
- Central role in shallow coastal and estuarine systems
- Carbon and nutrient dynamics
- Secondary production (biomass)
- Important food source for higher trophic levels



## Problems in structure and functions

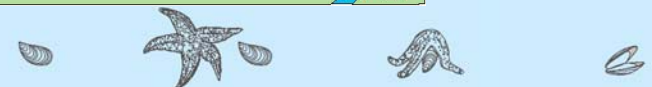
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- Water quality
- Habitat area (loss)
- Disturbance (e.g. dredging activities)
- Foodweb under pressure (links between quality elements)



# Westerschelde benthos database

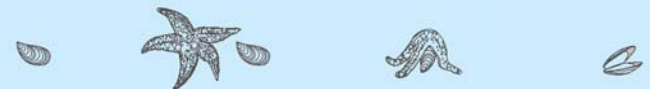
- Very large data base with > 6000 samples
- Regular monitoring since 1990
- Project based data



# A scale-dependent classification system

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- Level 1: Scale of the water body - functional
- Level 2: Ecotopes/habitats in the water body  
- spatial organisation, habitat diversity
- Level 3: Biological quality within ecotopes -  
community structure, species diversity



# A scale-dependent classification system

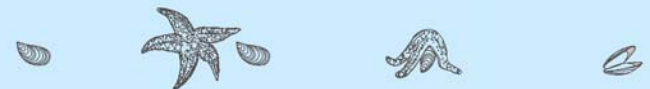
Level	Evaluations for macrobenthos	Used to assess	Links to
Whole water body	Functional: biomass, feeding types,...	System integrity, functions performed in land-ocean interaction, functions for carbon and nutrient dynamics, production for higher trophic levels	Other quality elements (chemical, phytoplankton,...): aims at integrating view Provides constraints for functions related to nature conservation, relevant to Bird and Habitat Directives
Ecotope	Spatial organisation: surface, connectivity,...	System completeness in terms of habitats and community development Possible developments under appropriate management Morphodynamic equilibrium and impact of physical stressors	Morphodynamic information Evaluations of habitats and their persistence/conservation (Habitat Directive)
Within-Ecotope	Community structure, based on species composition (diversity), abundance, biomass	Completeness and full development of the biological communities within the ecotopes Occurrence of stress symptoms, comparing species indicator values to expectations valid for the specific habitat	Local stressors Biogeochemical stressors Effects of invasive species



## First practical application of the concept

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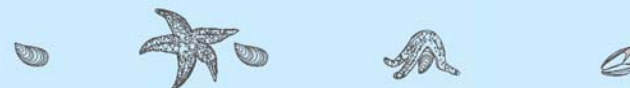
- Fred Twisk (Rijkswaterstaat, RIKZ)
- For fully mixed transitional waters (Westerschelde and Eems-Dollard) and sheltered, meso-/macrotidal coastal waters (Oosterschelde, Waddensea)
- Further evaluation needed, validation



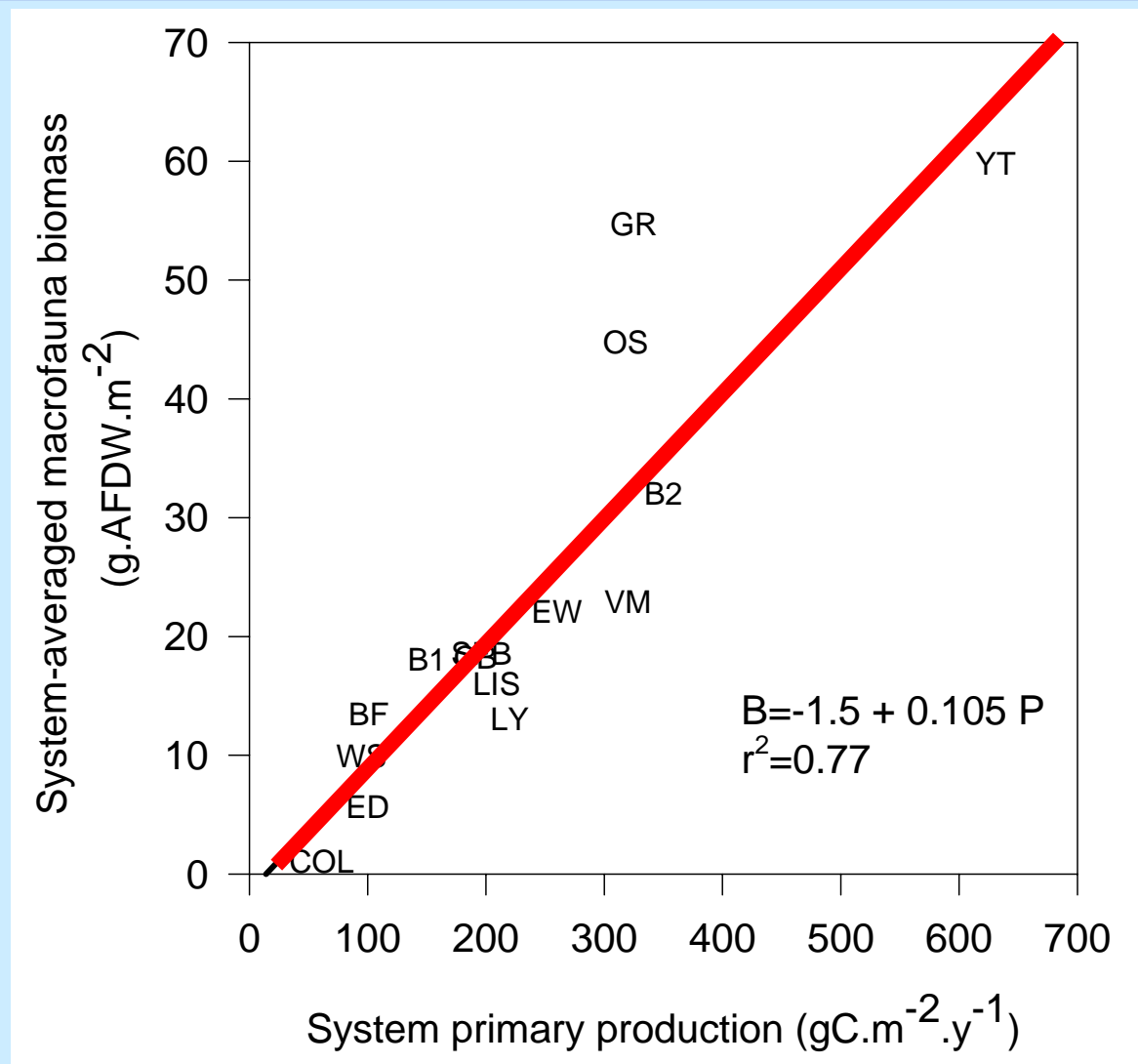
## Level 1: Scale of the water body

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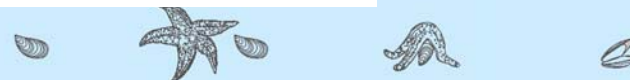
- Species list for the whole waterbody based on literature (Wolff, Michaelis, Dittmer, ...)
  - Reference = 75% of this list
- Benthos biomass - primary production relation (Herman et al., 1999, Adv. Ecol. Res.)
  - Reference = Biomass (g AFDW per m<sup>2</sup>) =  $-1.5 + 0.105$   
\* prim. prod. (g C per m<sup>2</sup> per year)



# Level 1: Scale of the water body - functional

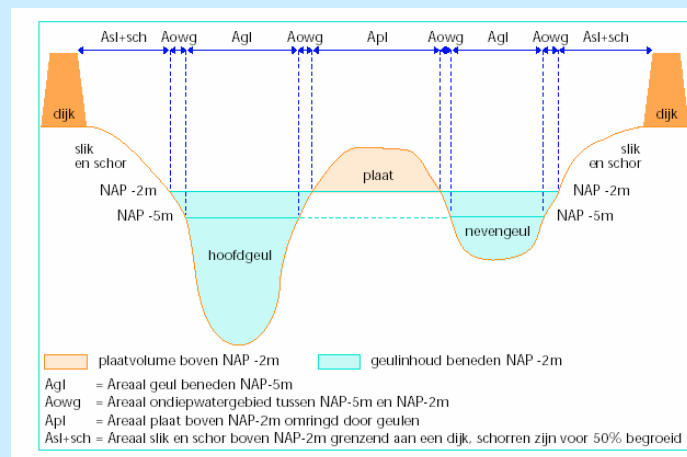


Source: Herman et al., 1999 (Adv Ecol Res)

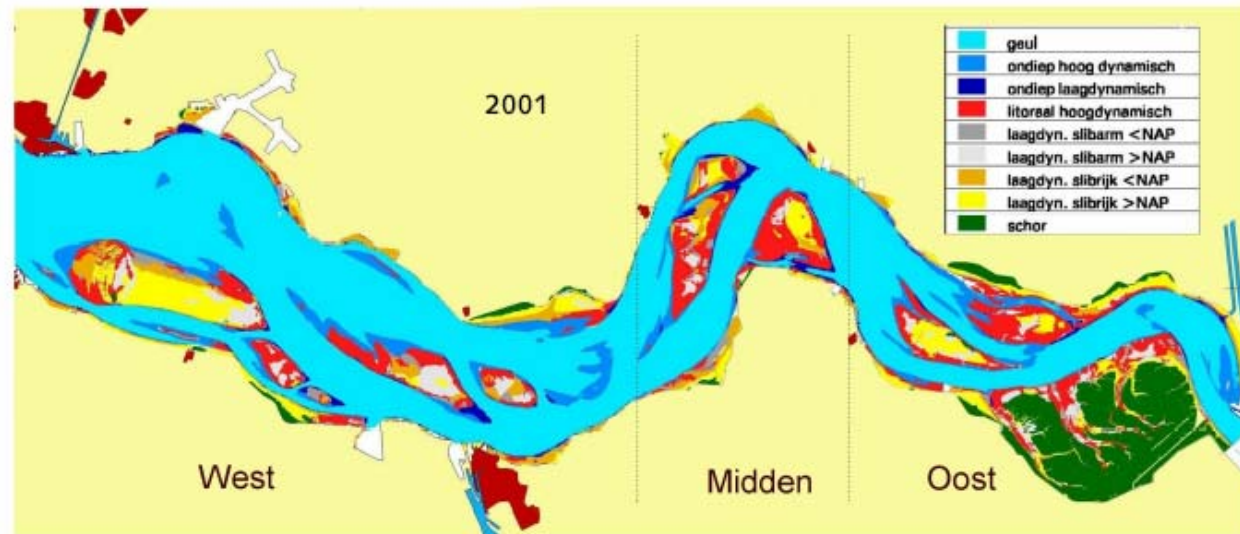
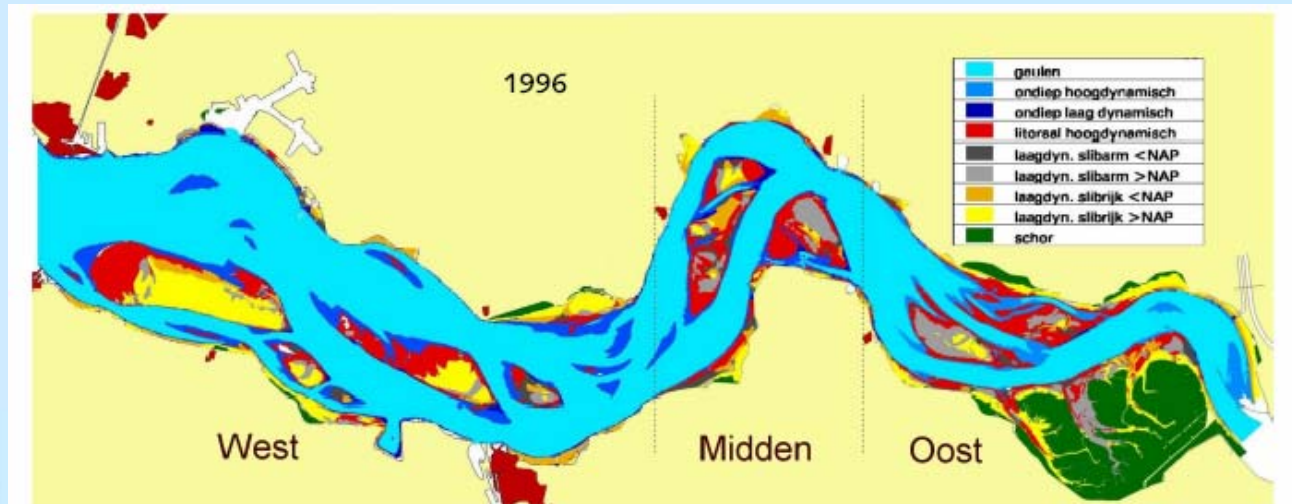


## Level 2: Ecotopes/habitats in the water body

- Which habitat types do we expect in a water body, given its morphodynamic characteristics? How much?
- System completeness in terms of habitats
- Dutch classification ~ EUNIS
- Salinity, depth, hydrodynamics (sediment composition)
- Eco-elements: e.g. musselbeds

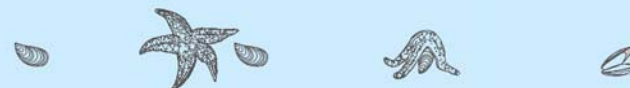
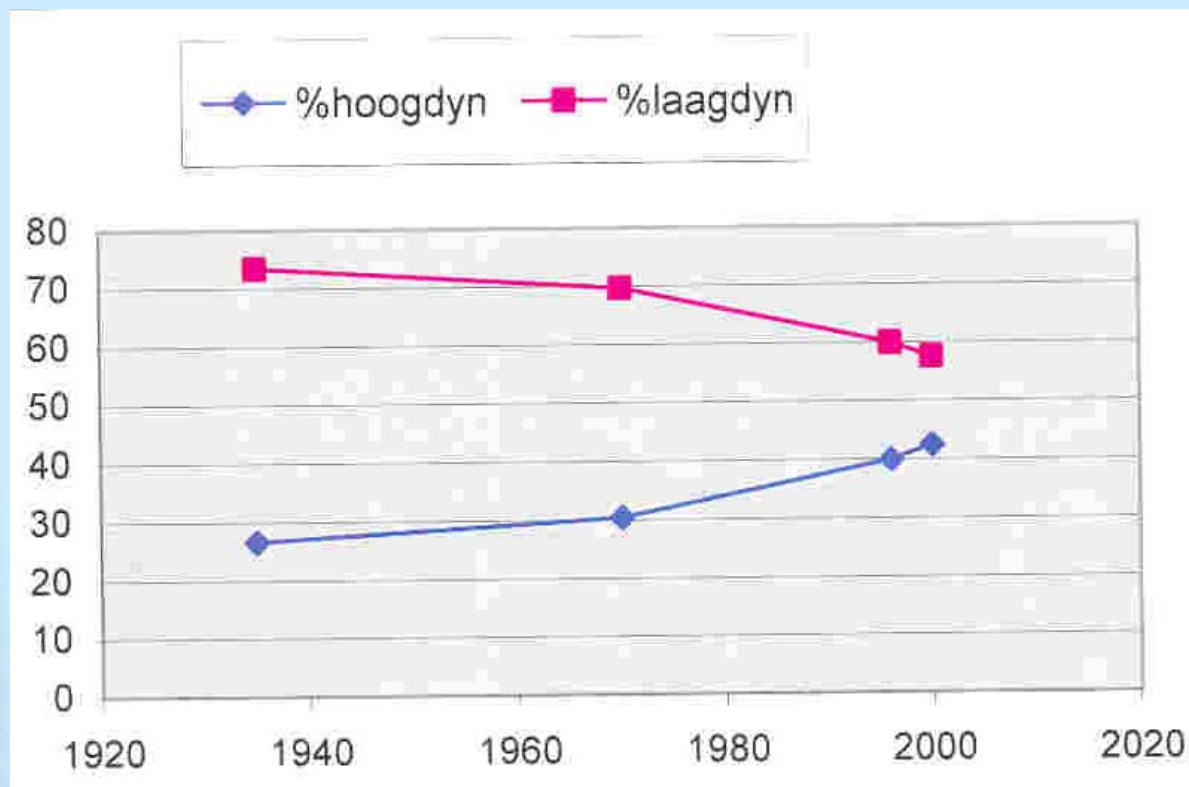


# Ecotope maps



# Area is important

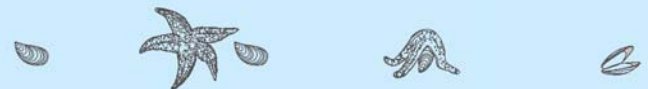
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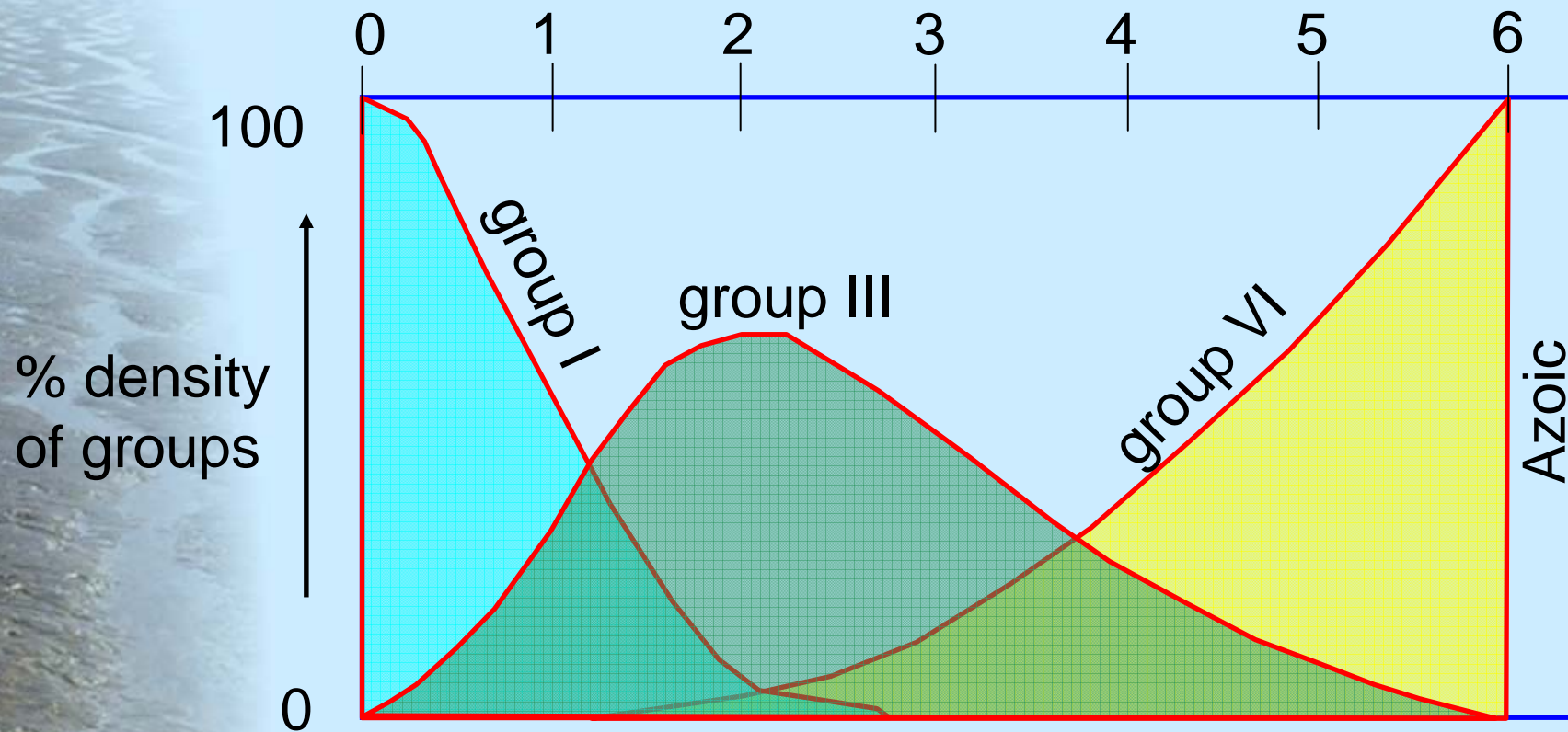
## Level 2&3: Ecotopes and species composition

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- Six ecotopes distinguished
- Based on literature data the species composition and abundance was estimated for each ecotope = reference condition
- AMBI index (Borja et al. 2000) calculated for each ecotope

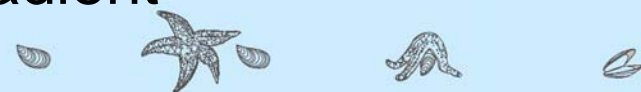


# Biotic Coefficient



% density of groups

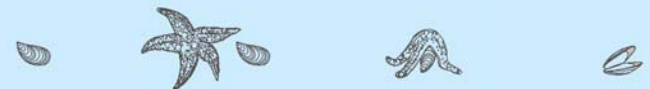
“Pollution” gradient



# Consequences

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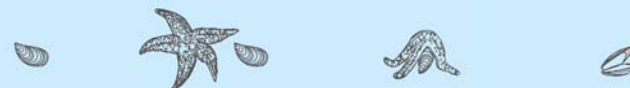
- Metrics such as *AMBI* not directly applicable to transitional waters (both in the mesohaline as in the polyhaline areas)
- In estuaries organic enrichment is natural and not necessarily negative
- Local organic enrichment is related to local dynamics. With the *AMBI* index high dynamic areas score low, low dynamic areas score high, this does not reflect the ecological quality correctly
- Metrics should be habitat-specific



## Level 2&3: Ecotopes and species composition

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- Six ecotopes:
  - BC1 = 2,5 polyhaline, low dynamic, subtidal
  - BC2 = 1,5 in polyhaline, high dynamic, intertidal
  - BC3 = 2,5 in polyhaline, low dynamic, intertidal
  - BC4 = 3,5 in polyhaline, low dynamic, middle intertidal
  - BC5 = 2,5 in polyhaline, low dynamic, high intertidal
  - BC6 = 5,0 in mesohaline, low dynamic, intertidal
- Mussel beds: separate category, based on surface area expected



## Comments

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- Not fully developed
- Actual monitoring not sufficient to give data for each habitat type [e.g. species composition]
- Habitat type specific, but no surface area included yet
- Further evaluation needed, validation
- How to deal with invasive species?

