



Scale-dependent functional patterns in the marine benthos

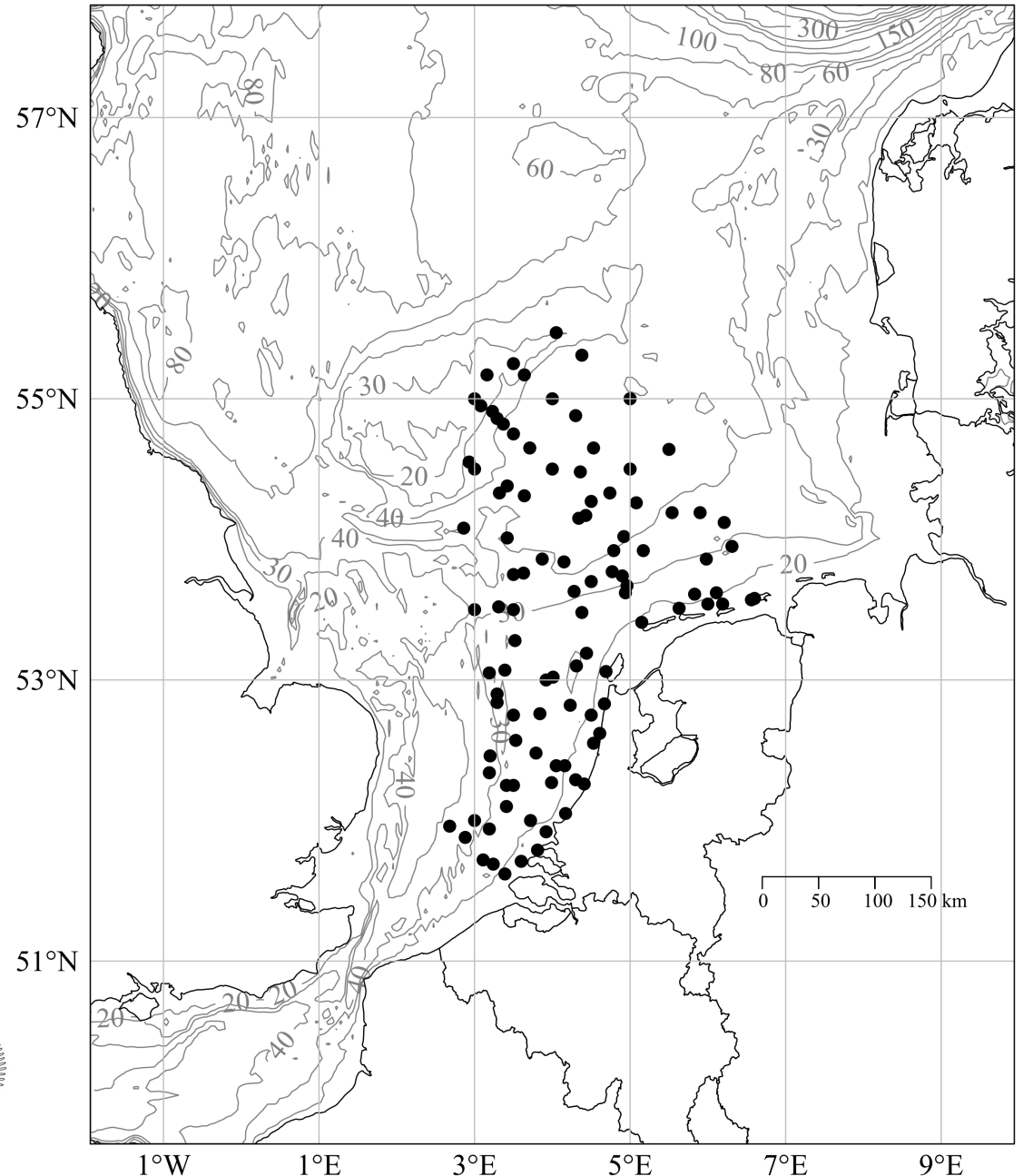
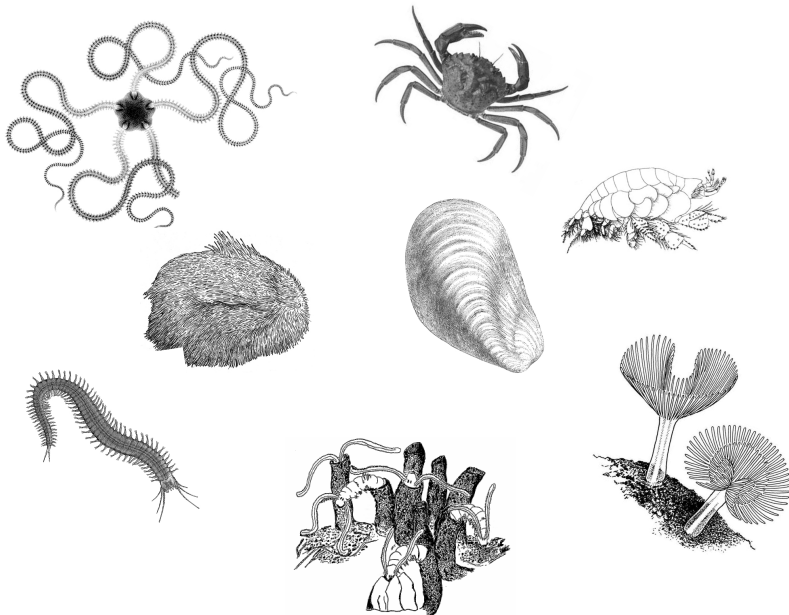


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Research context

- Long term monitoring
- Large documentation of species distributions and synecological aspects
- No investigation on the biological nature of species communities



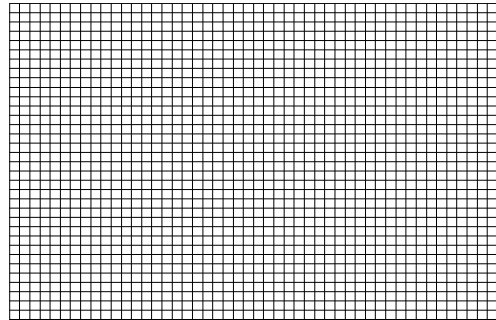
Research context

Ecological data

Habitats & Organisms

Species
occurrences

Sampling
stations



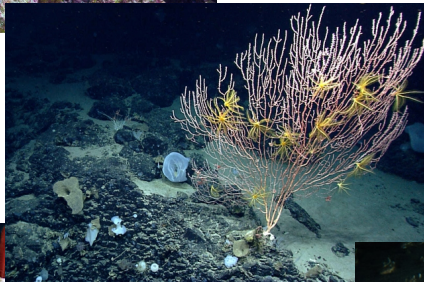
Research context

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Habitats & Organisms

Species
occurrences

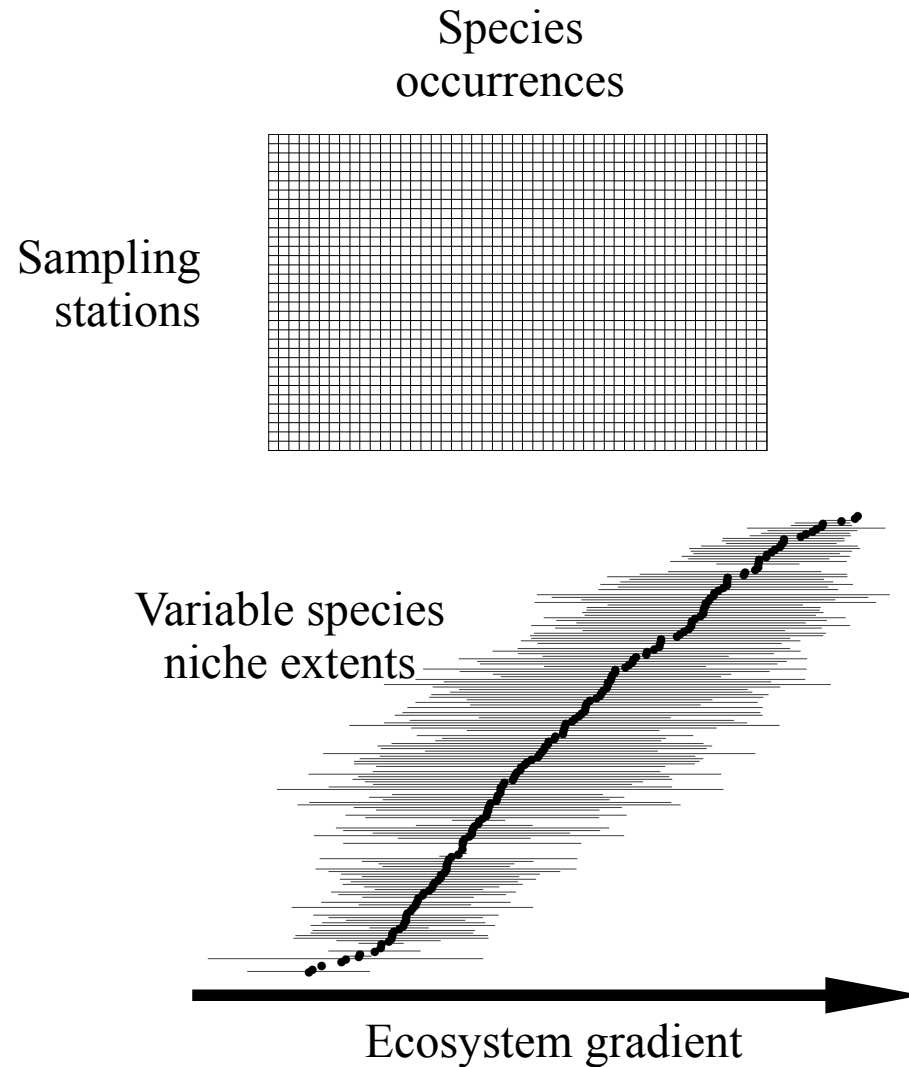
Sampling
stations



Research context

Ecological data

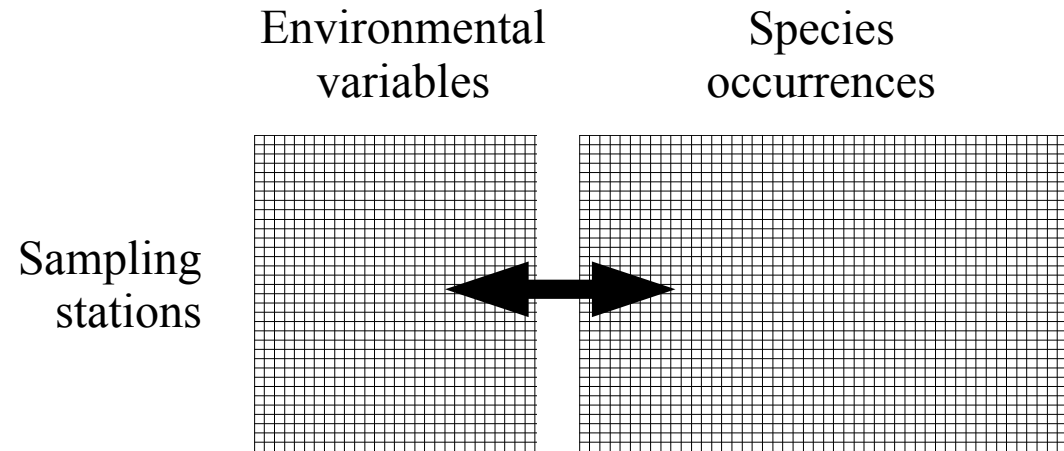
Habitats & Organisms



Research context

Ecological data

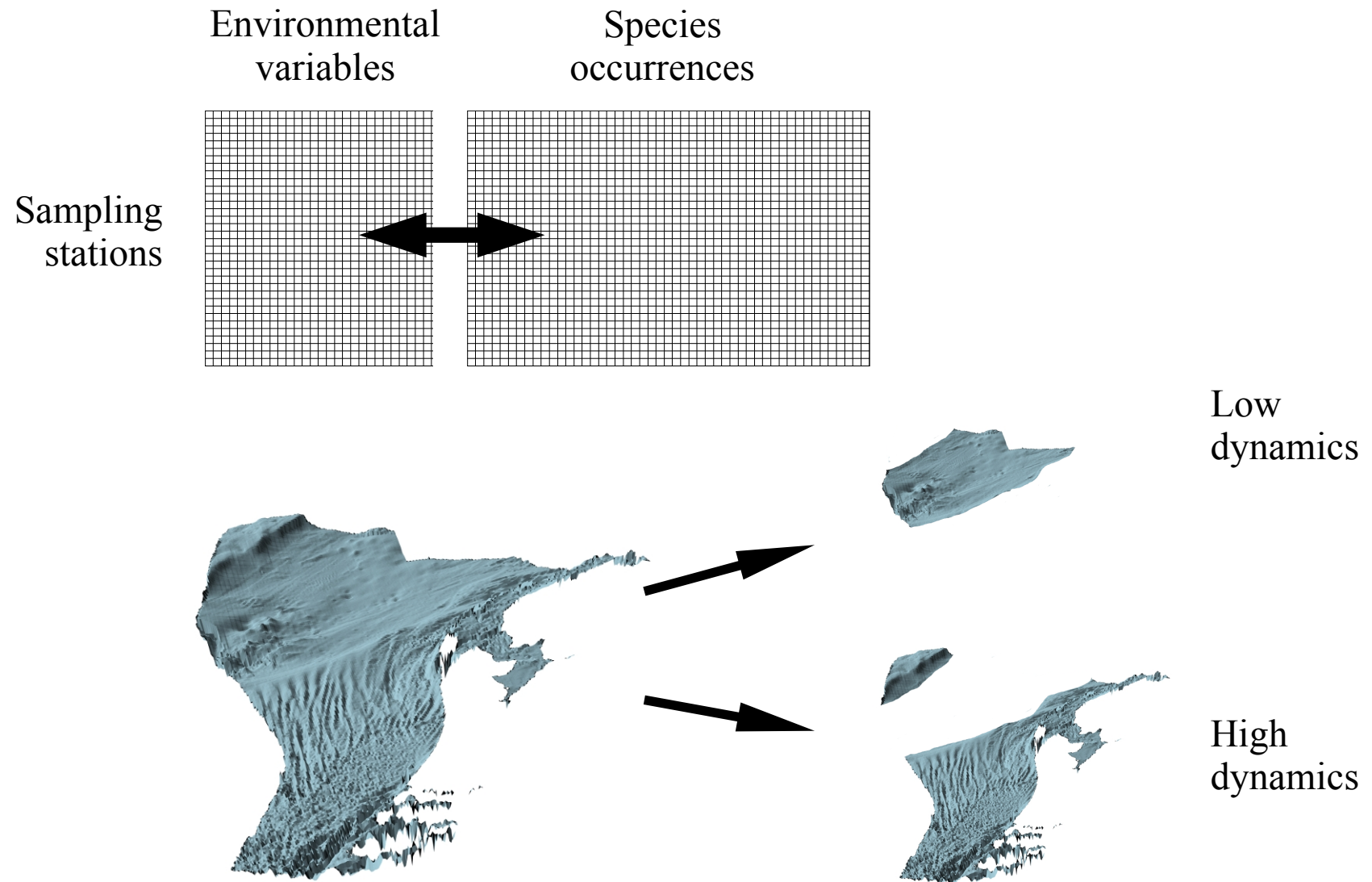
Habitats & Organisms



Research context

Ecological data

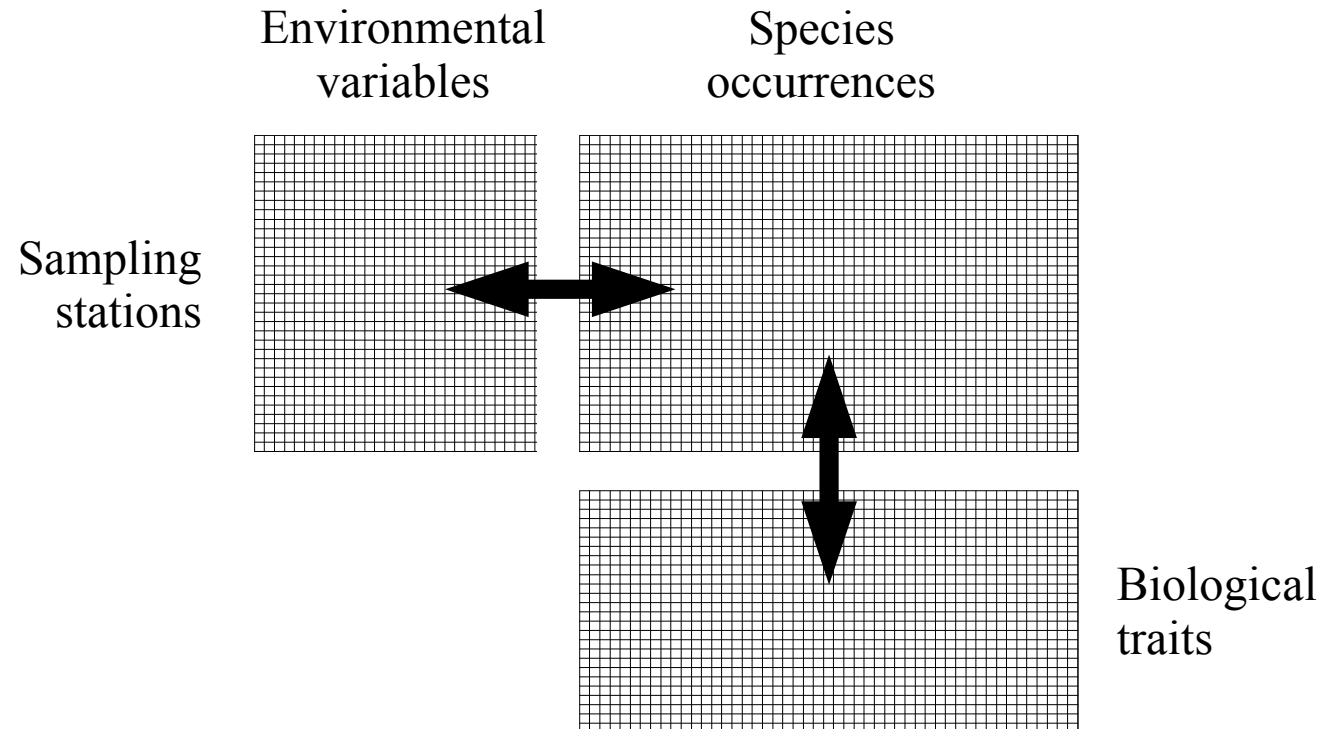
Habitats & Organisms



Research context

Ecological data

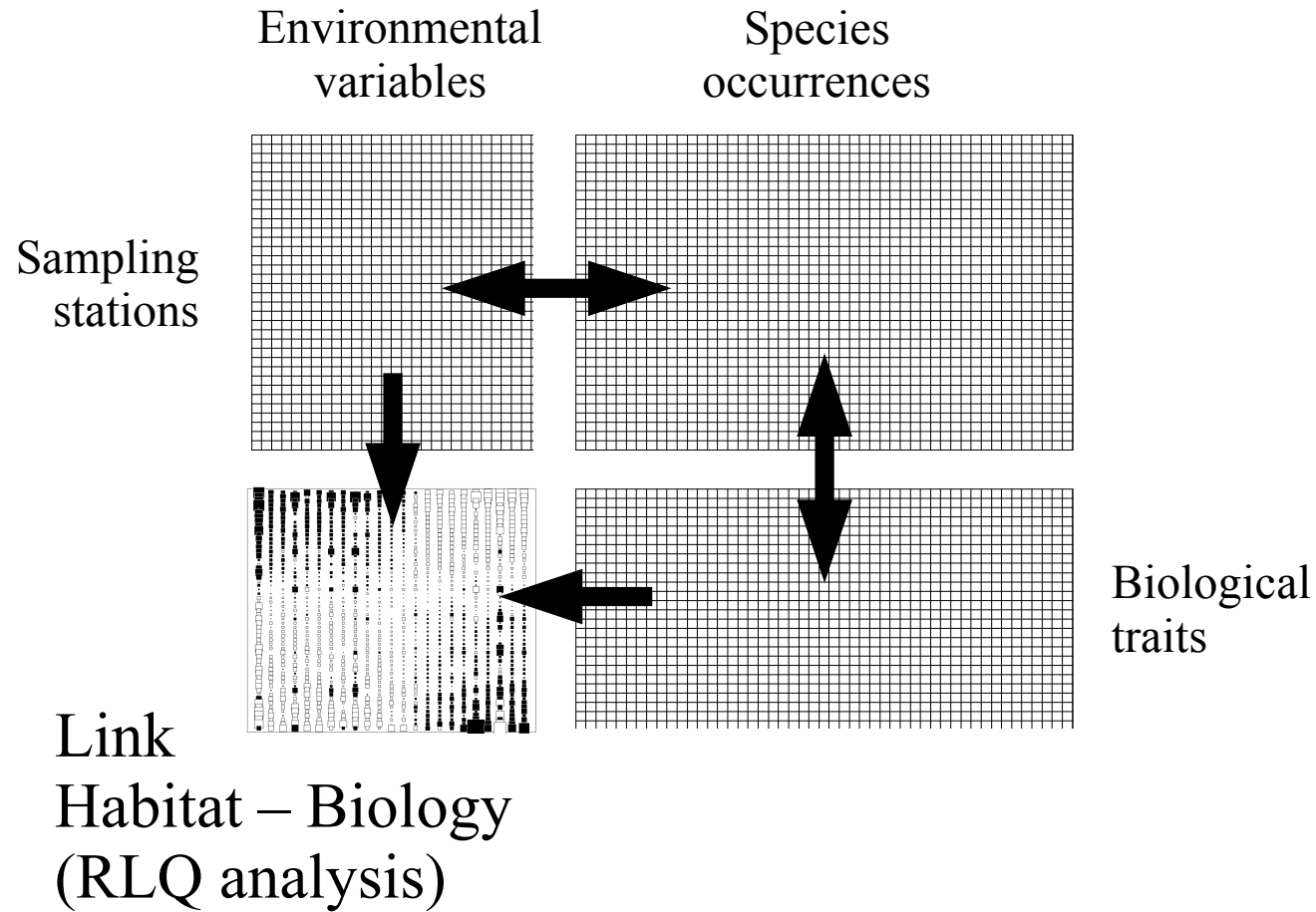
Habitats & Organisms



Research context

Ecological data

Habitats & Organisms



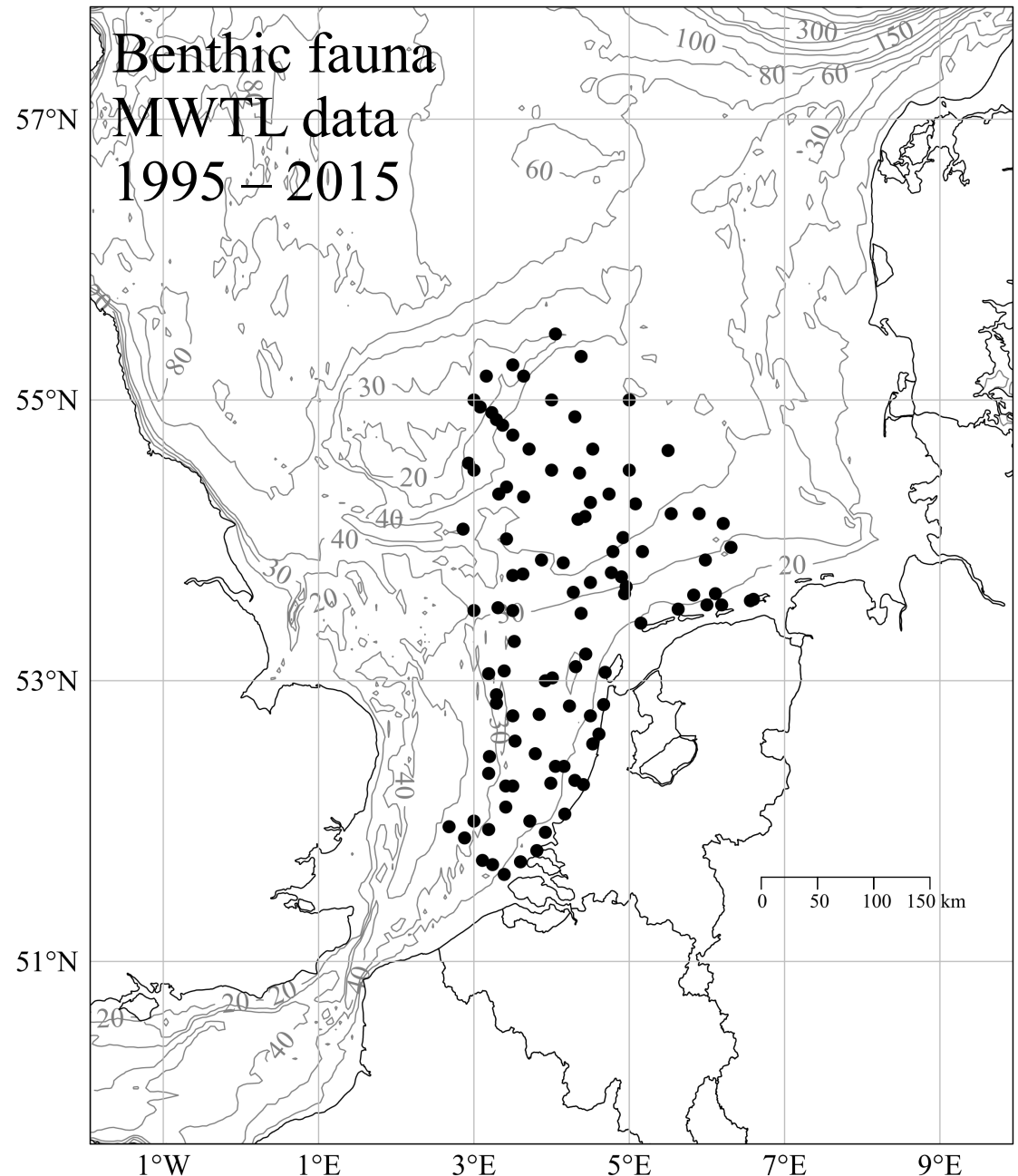
Application to the Dutch EEZ

Environmental data

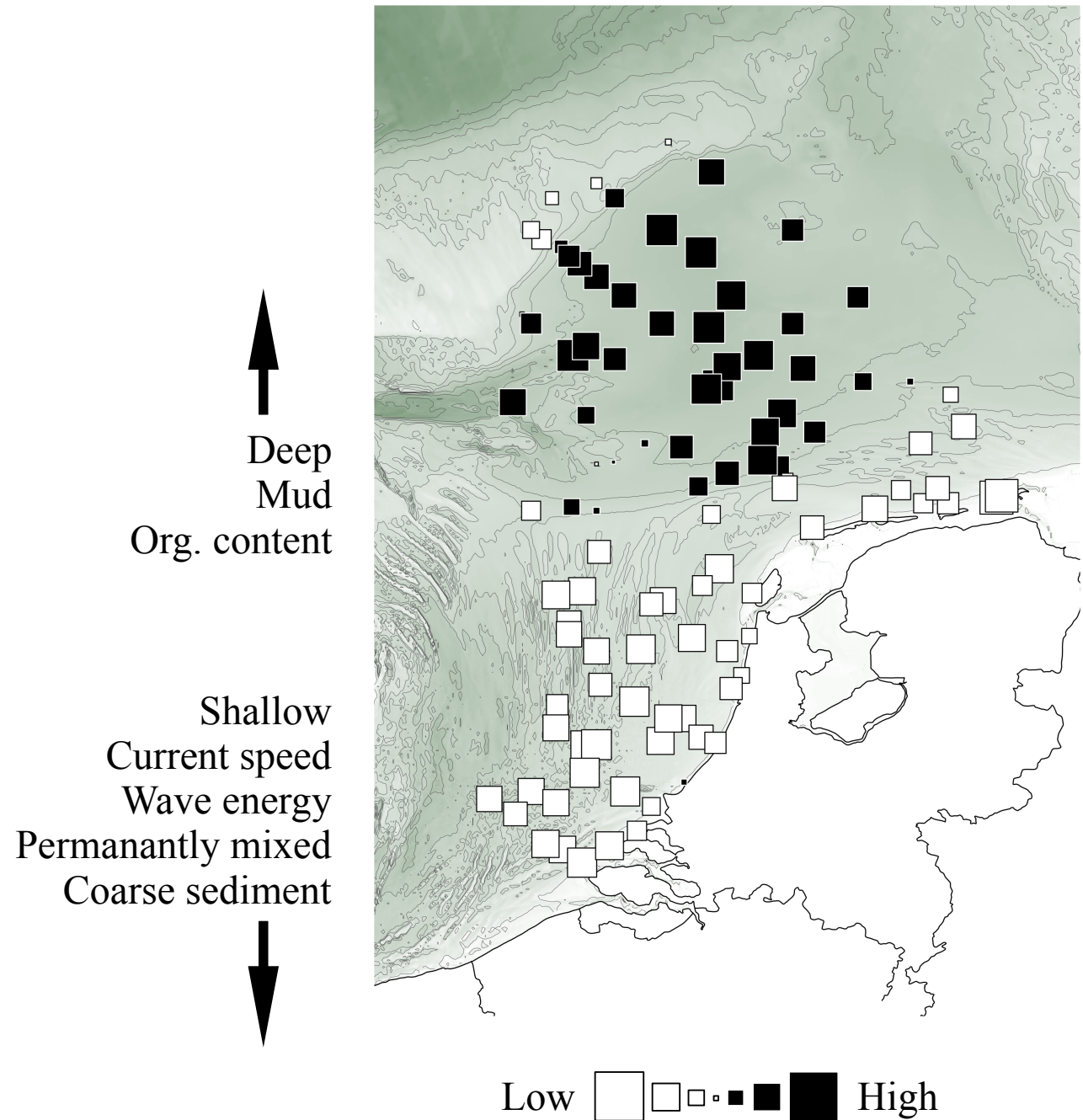
Depth
Stratification
Current speed
Wave energy
Sediment type
Benthic PP
Organic C
Humus

Biological traits

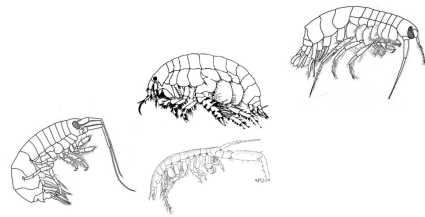
Body mass
Motility
Life span
Maturity
Reproductive frequency
Fecundity
Fertilisation
Offspring type
Offspring size
Offspring protection
Offsp. development type
Offsp. benthic stage duration
Offsp. pelagic stage duration
Trophic type
Burrowing depth



Large scale pattern



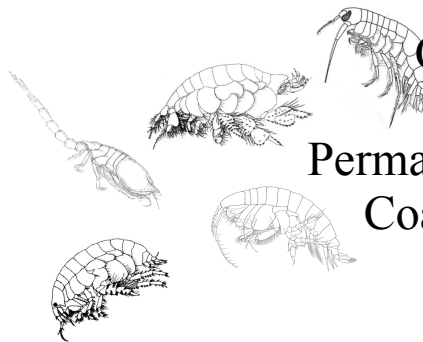
Large scale pattern



Shallow
Wave energy

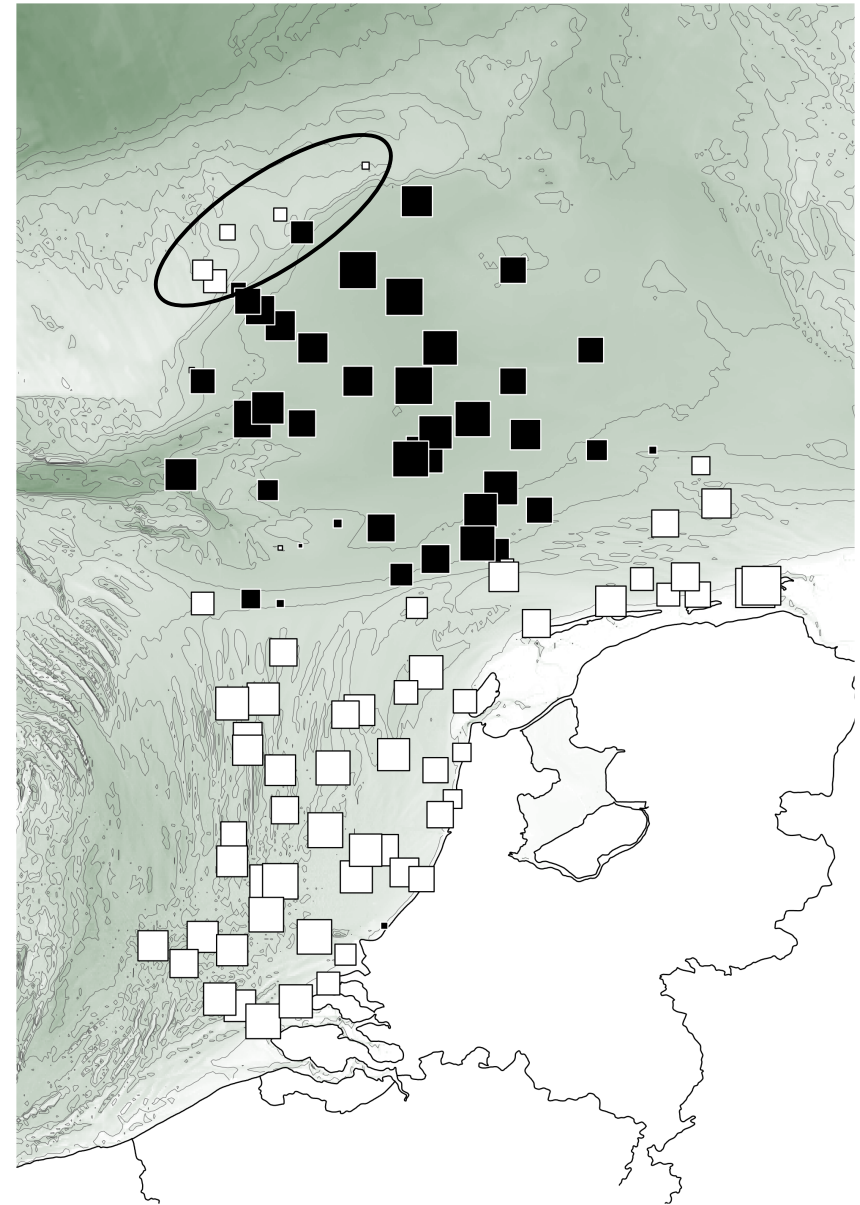


Deep
Mud
Org. content



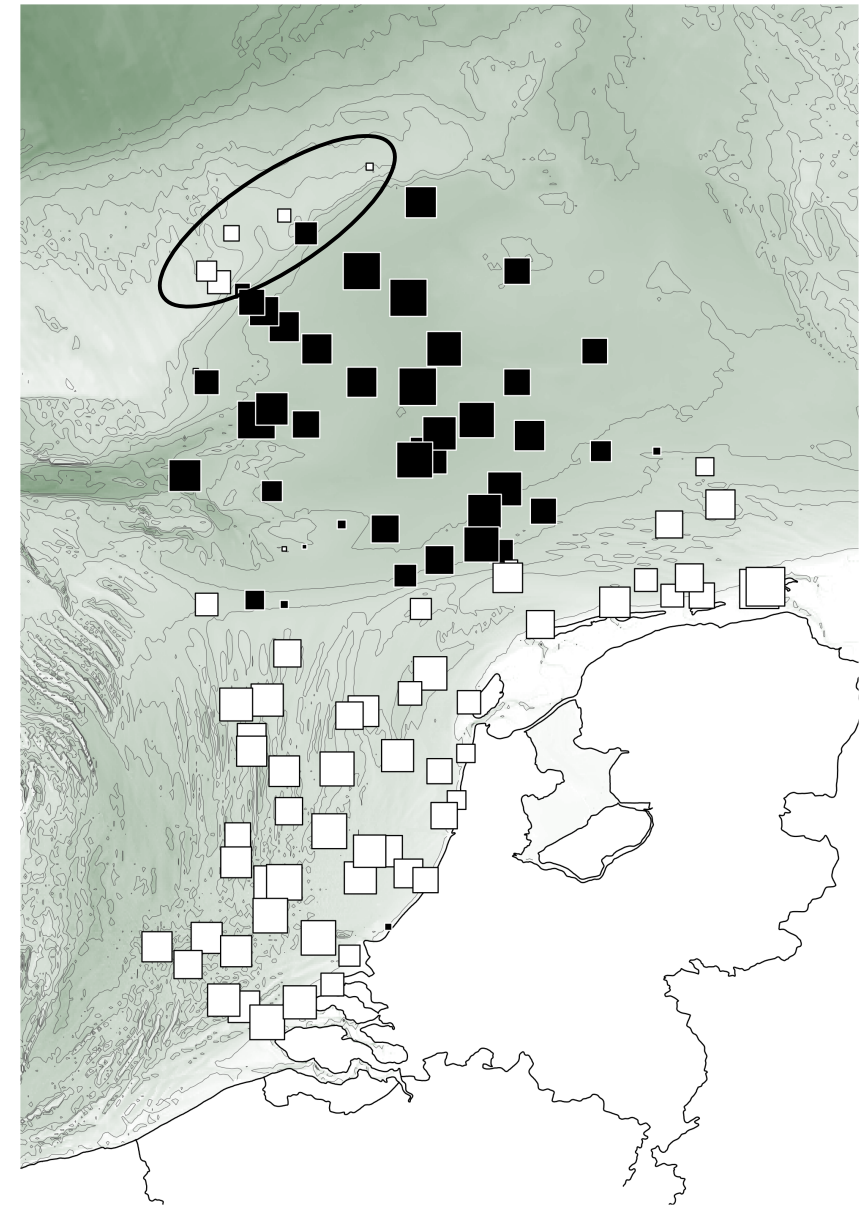
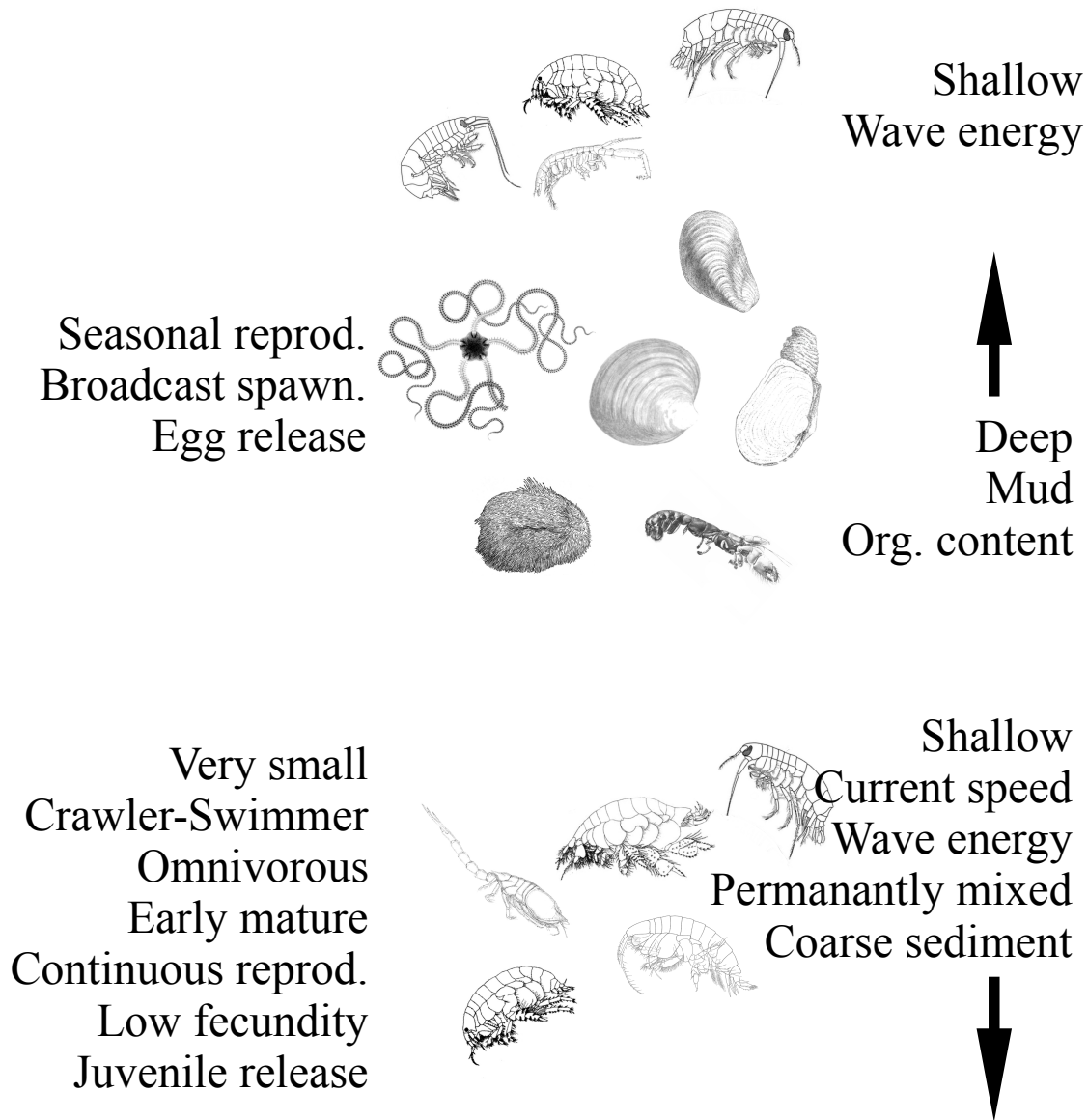
Very small
Crawler-Swimmer
Omnivorous
Early mature
Continuous reprod.
Low fecundity
Juvenile release

Shallow
Current speed
Wave energy
Permanantly mixed
Coarse sediment



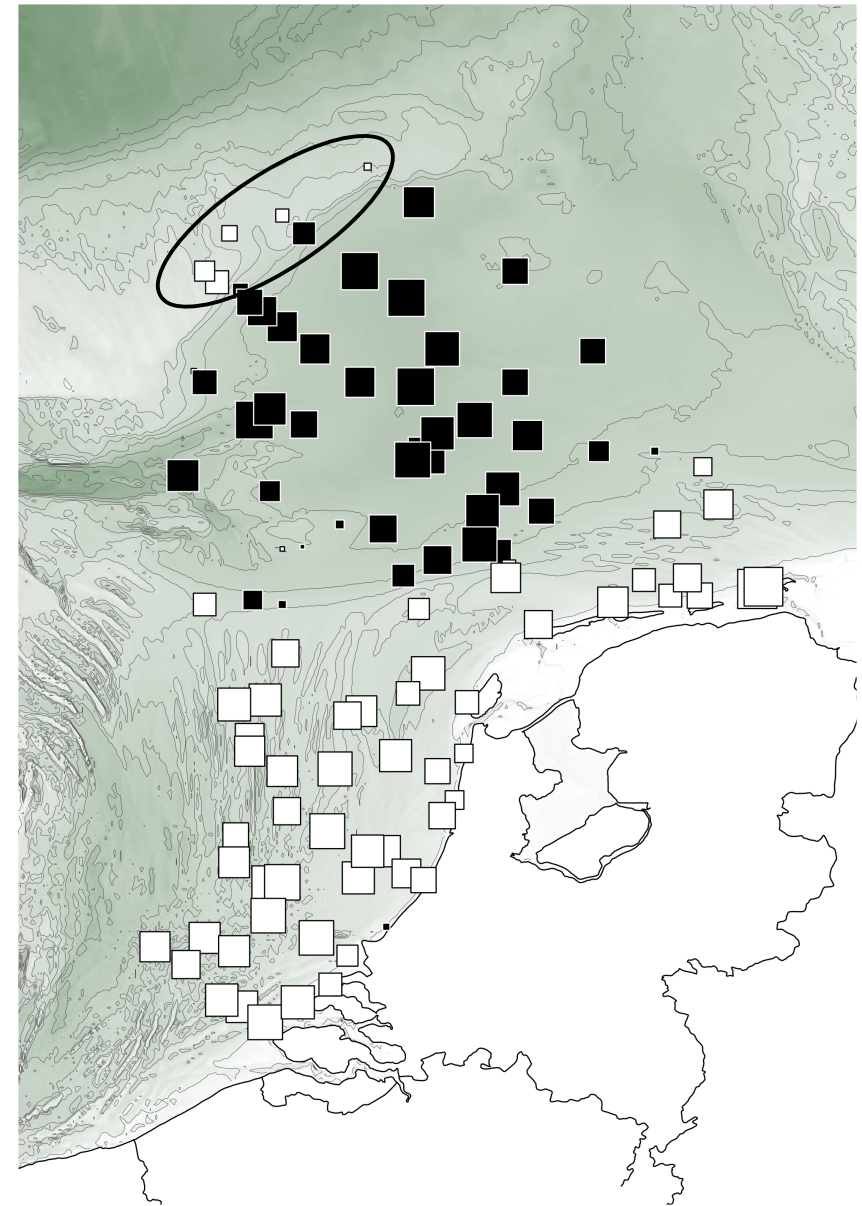
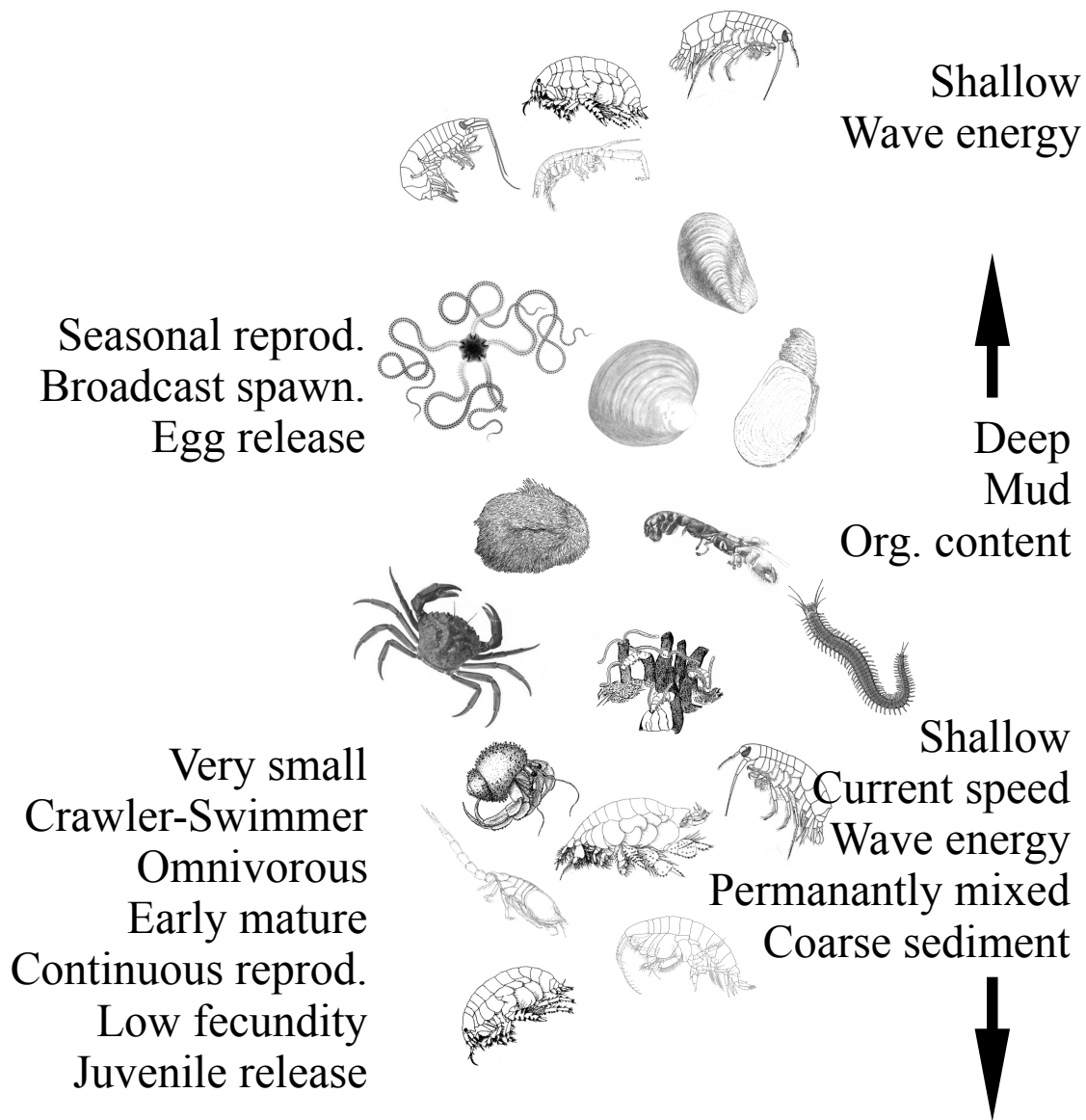
Low High

Large scale pattern



Low  High

Large scale pattern



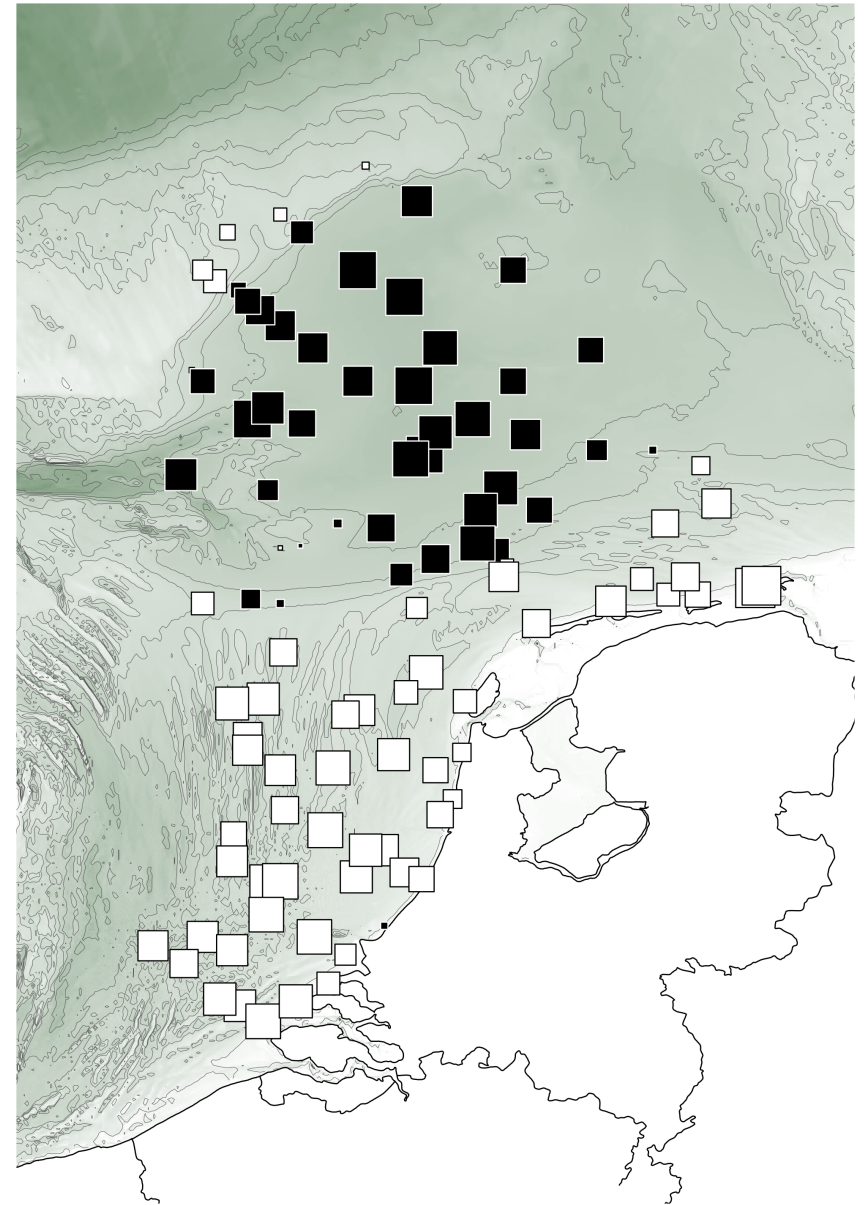
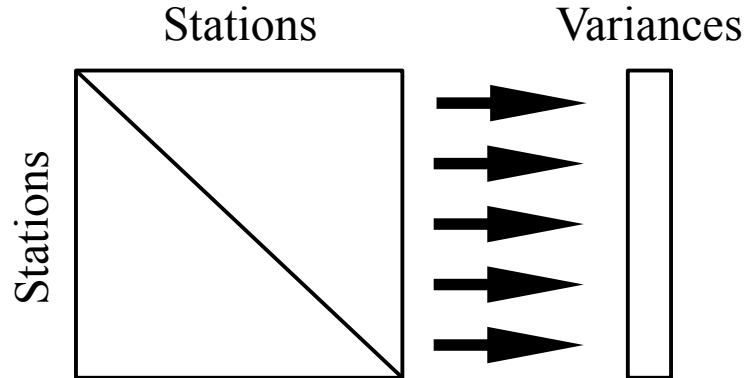
Low High

Large scale pattern

RLQ axis



Matrix of
functional distances



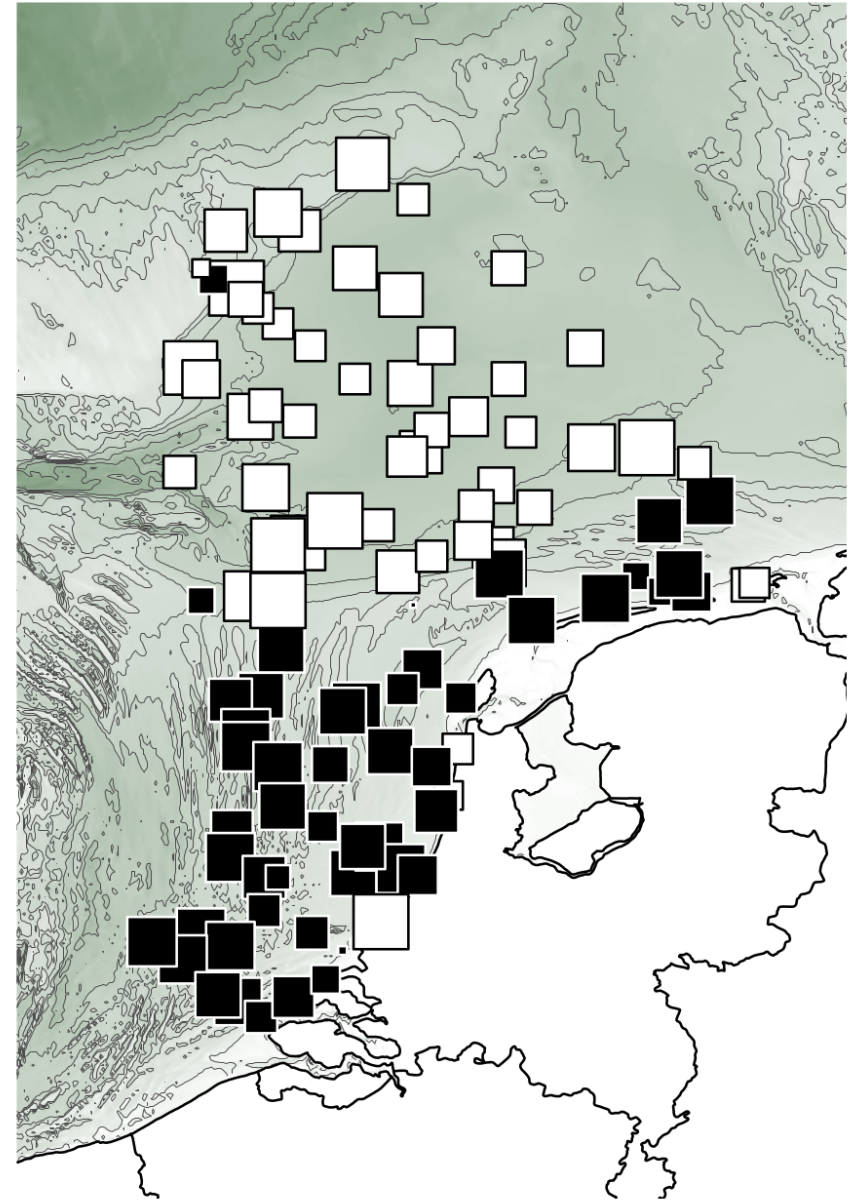
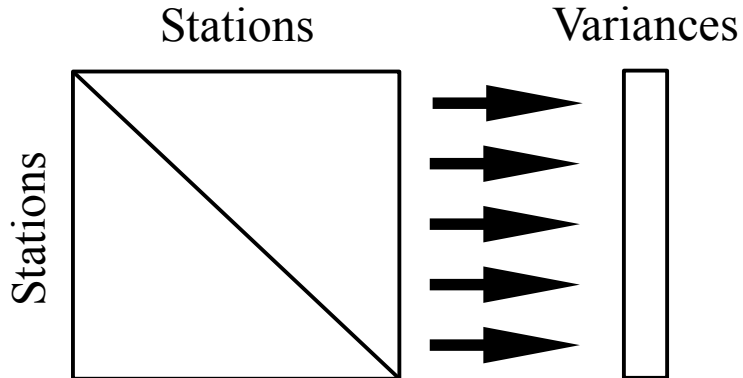
Low  High

Large scale pattern

RLQ axis



Matrix of
functional distances



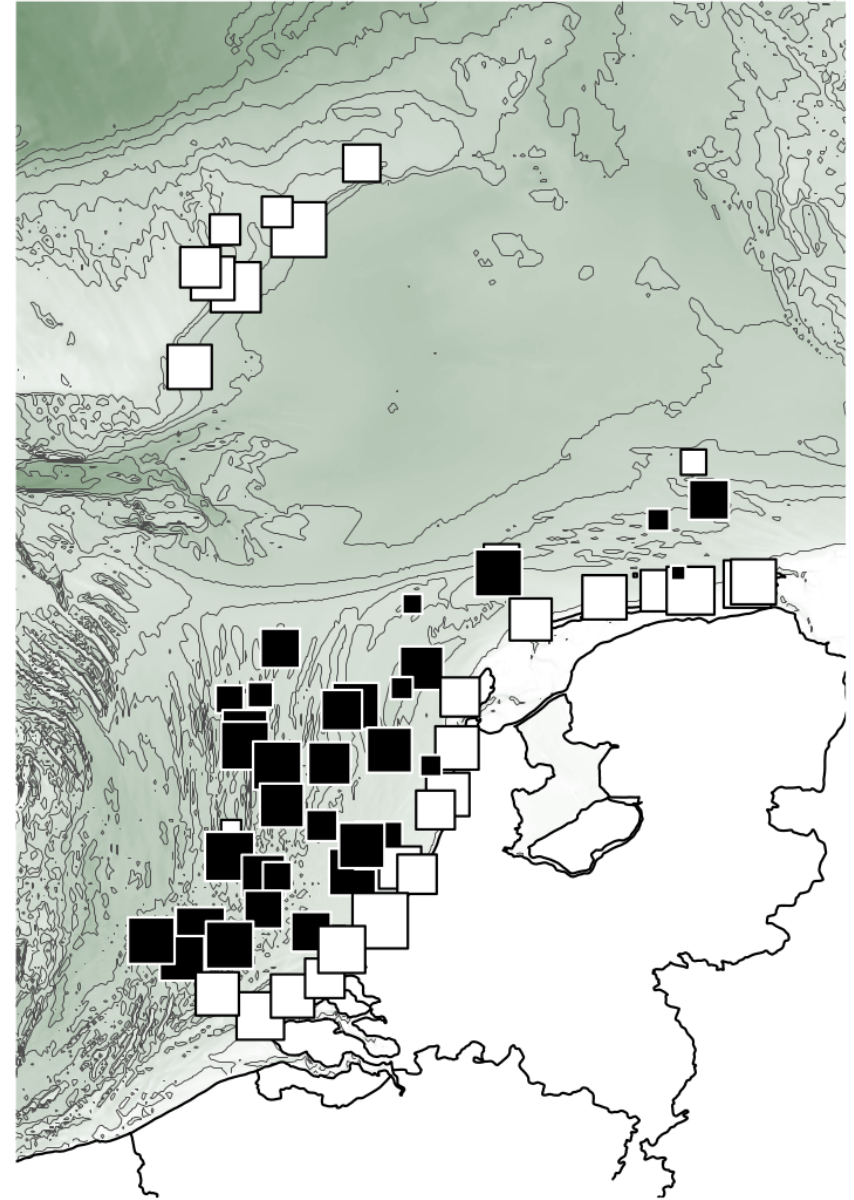
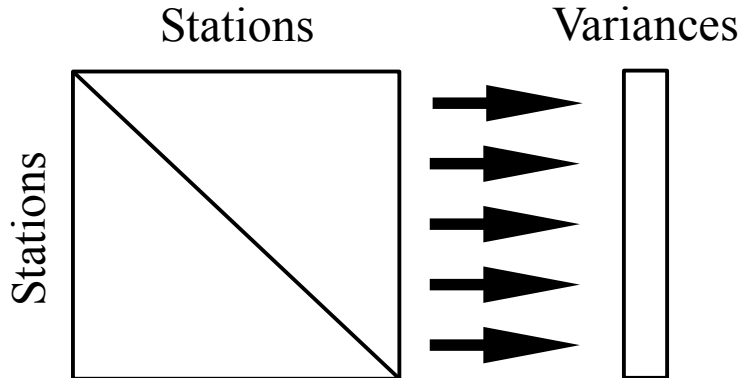
Low  High

Large scale pattern

RLQ axis



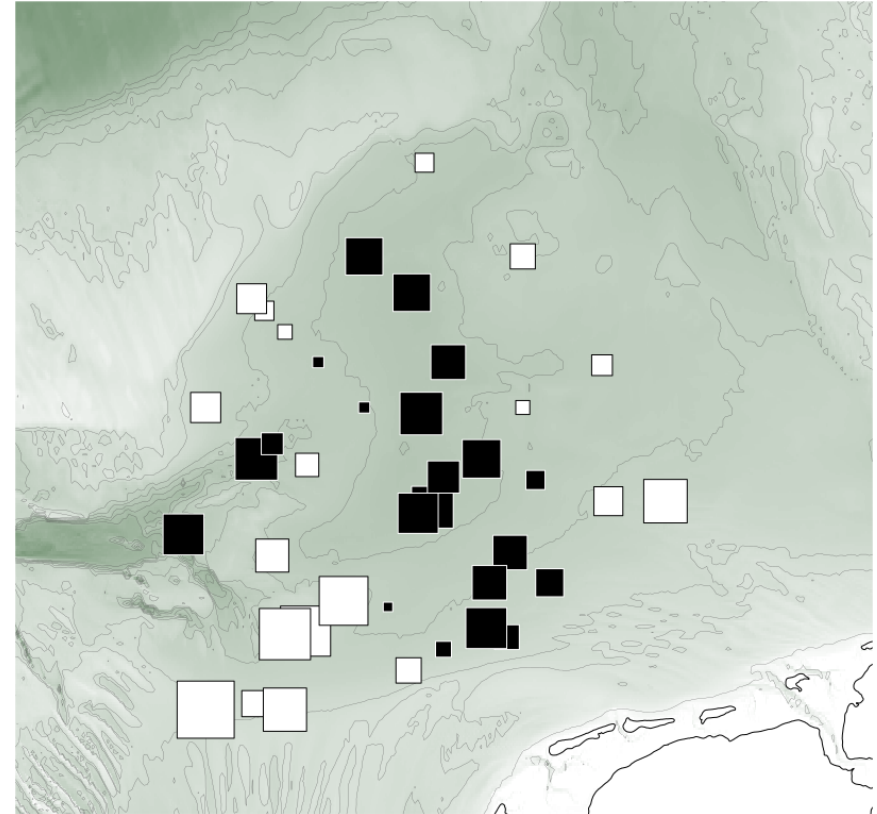
Matrix of
functional distances



Low     High

Low dynamics pattern

- One significant RLQ axis
- Only a few traits correlated to the environmental gradient
- Poor biological contrasts in uniform environmental conditions



Low     High

Environment

Interm. stratified
Shallower

Trans. stratified
Deeper

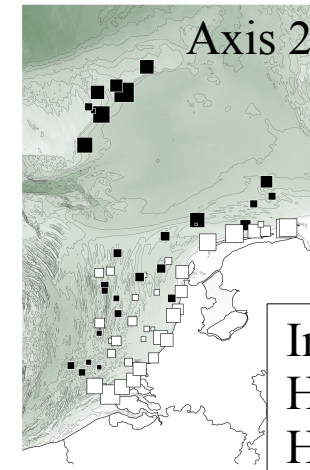
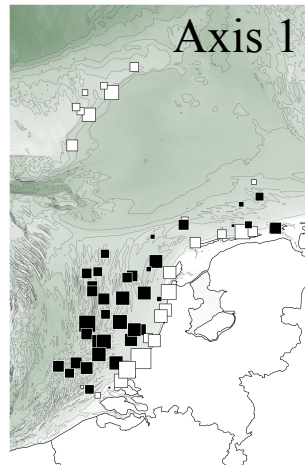
Traits

Very small
Continuous reprod.
Low fecundity
Large offspring

Seasonal reprod.
High fecundity

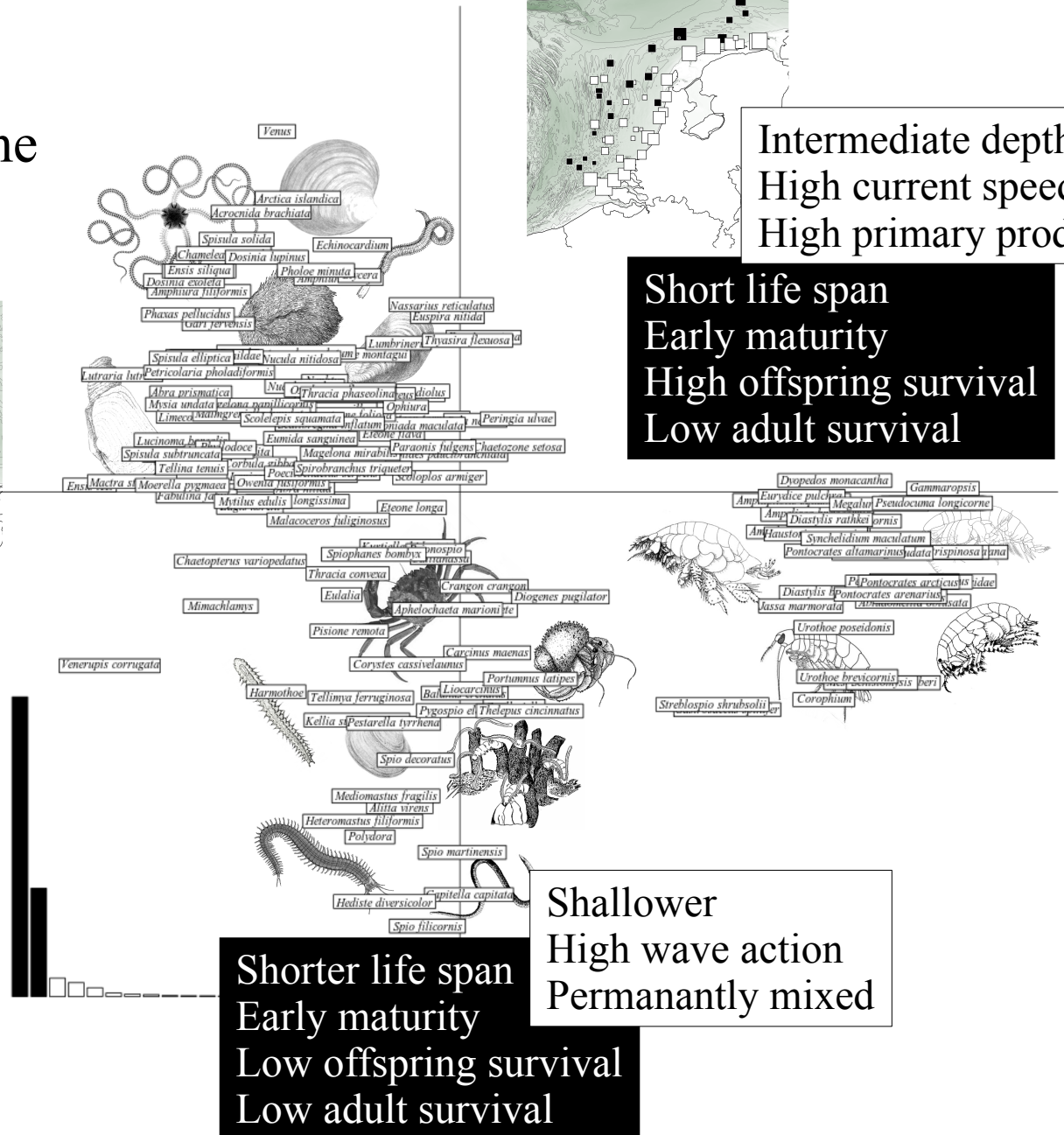
High dynamics pattern

- Two significant RLQ axes
- Many traits correlated to the environmental gradients



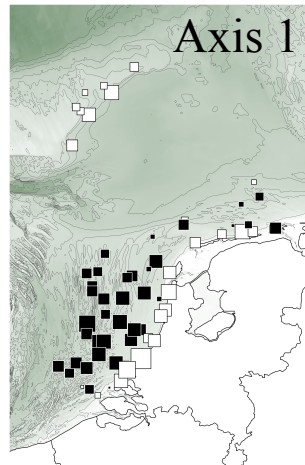
Intermediate depth
High current speed
High primary prod.

Short life span
Early maturity
High offspring survival
Low adult survival



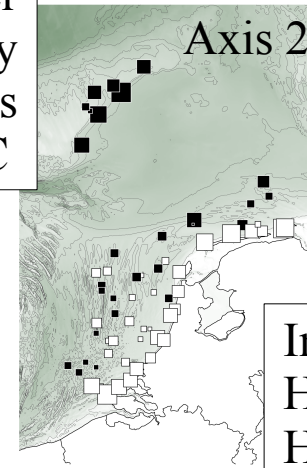
High dynamics pattern

- Two significant RLQ axes
- Many traits correlated to the environmental gradients



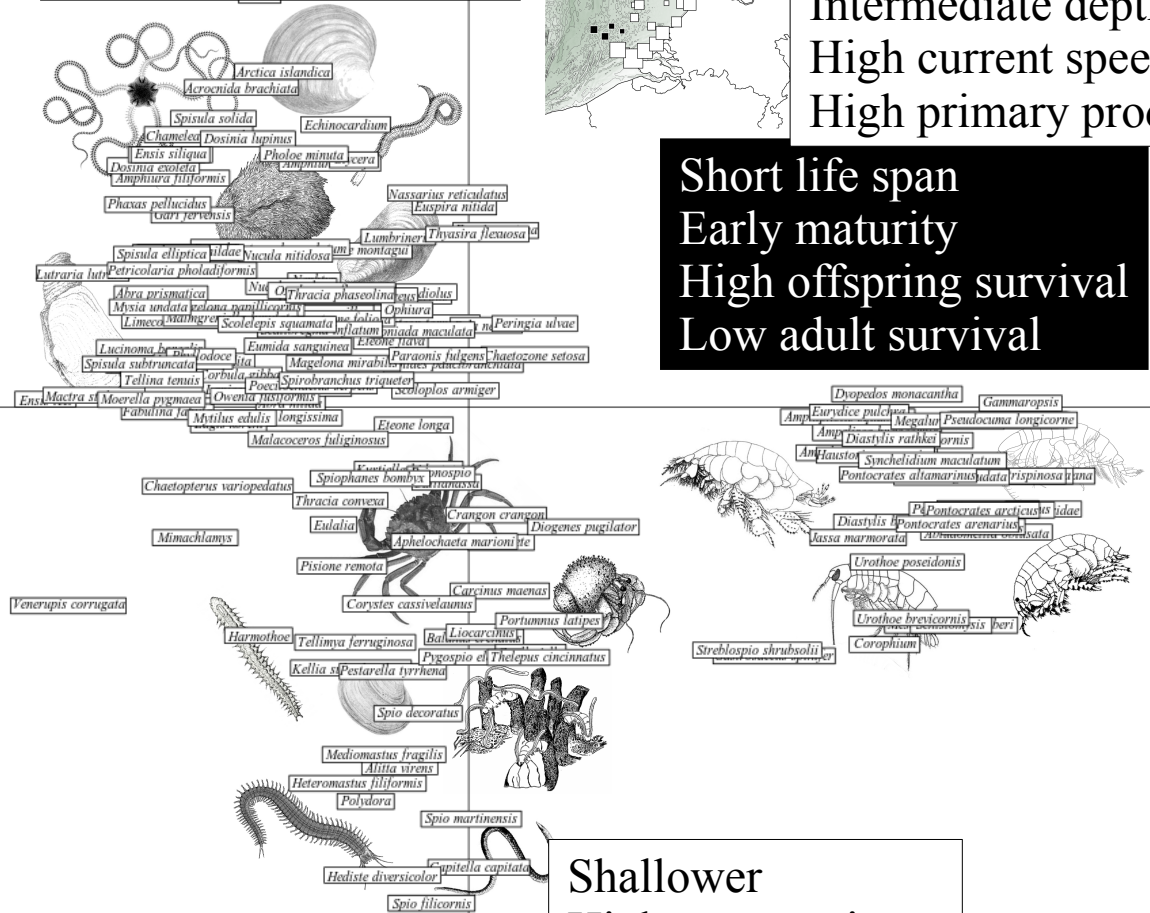
Very large
Long life span
Late maturity
Low offspring survival
High adult survival

Deeper
Muddy
Humus
Org. C



Intermediate depth
High current speed
High primary prod.

Short life span
Early maturity
High offspring survival
Low adult survival

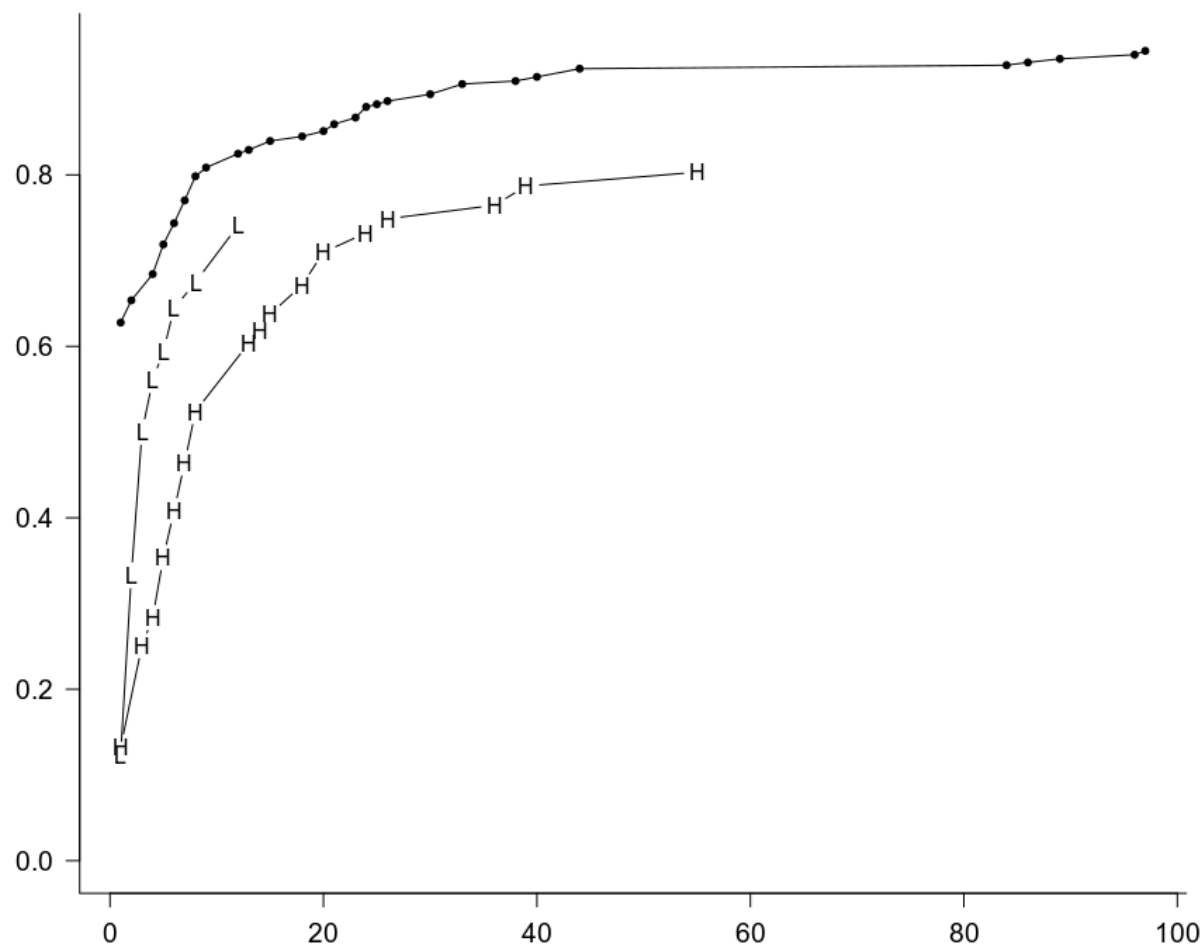


Shorter life span
Early maturity
Low offspring survival
Low adult survival

Shallower
High wave action
Permanently mixed

Spatial pattern magnitude

R^2 (proportion of explained RLQ variation)



← Large

Small →

Modelling of the RLQ patterns with Moran's Eigenvector Maps (MEM)



Conclusions

- Existence of contrasting seascapes in the Dutch EEZ
- Mechanistic patterns habitat-biology detectable, but scale dependent
- Habitat of high dynamics: does not host only resistant/resilient communities
- MPA implementation may be constrained by patchy distributions of vulnerable zones; ensuring connectivity may require large spatial extents