

Benthische data van de Nederlandse Waddenzee



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Sander Holthuijsen, Kasper Meijer,
Laura L. Govers, Han Olff, Allert I.
Bijleveld, Tjisse van der Heide, et al.

Benthische data van de Nederlandse Waddenzee



Wadden Sea is one of the last remaining large-scale, intertidal ecosystems where natural processes continue to function largely undisturbed

Benthische data van de Nederlandse Waddenzee



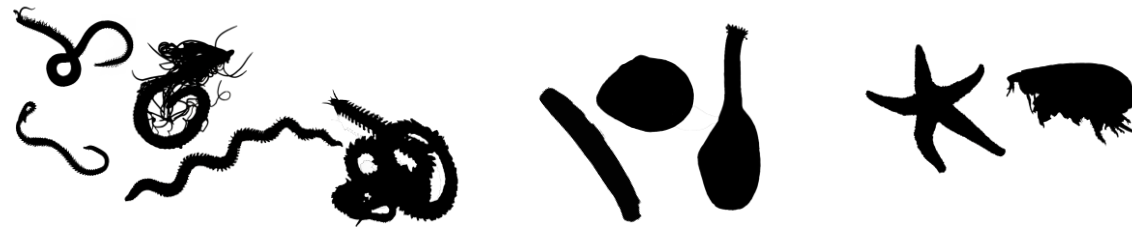
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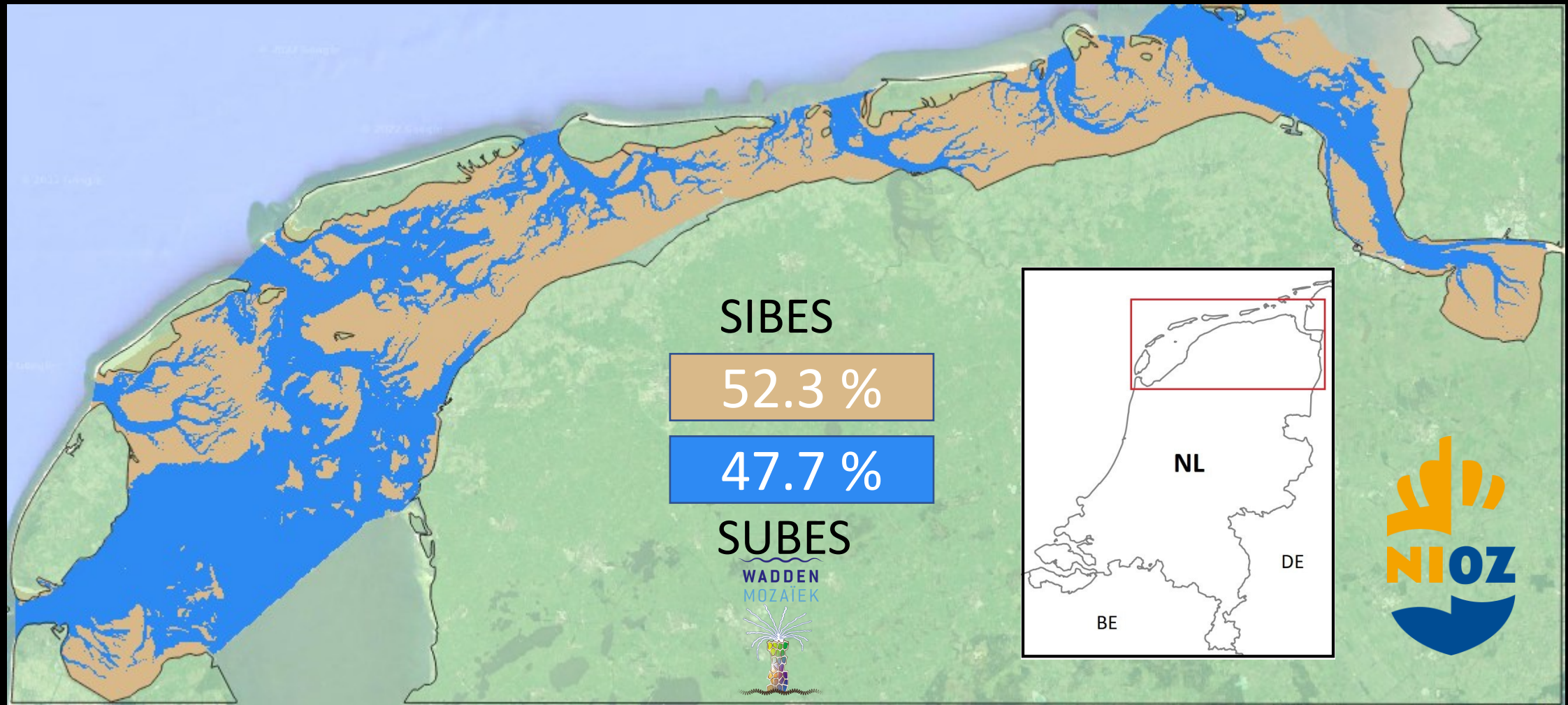
Benthische data van de Nederlandse Waddenzee



Geomorphologic adjustments
Dredging of gullies
Shrimp fishing
Mussel seed fishing
Mussel culture plots
Cockle fishing
Cable construction
Tourism
Gas extraction

Macrozoobenthos





SIBES



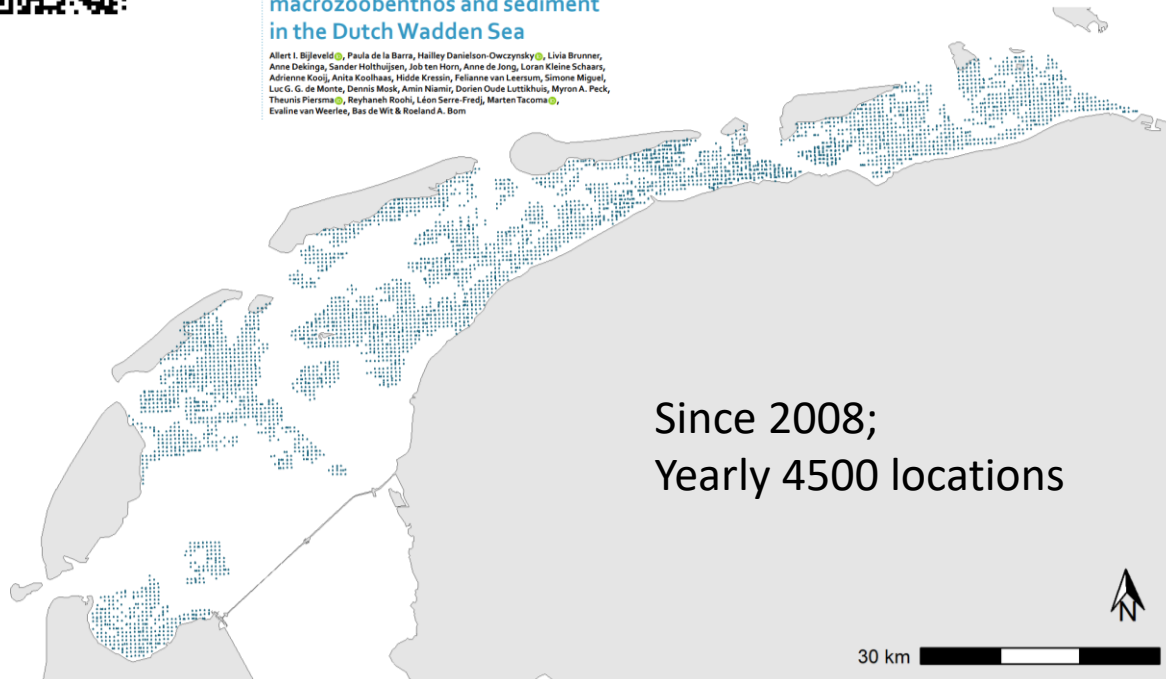
scientific **data**

OPEN

DATA DESCRIPTOR

SIBES: Long-term and large-scale monitoring of intertidal macrozoobenthos and sediment in the Dutch Wadden Sea

Allert I. Bijleveld^a, Paula de la Barra, Hailey Danielson-Owczymy^a, Livia Brunner, Anne Dekinga, Sander Holthuijsen, Job ten Horn, Anne de Jong, Loran Kleine Schaars, Adrienne Kooij, Anita Koolhaas, Hidde Kressin, Felianne van Leersum, Simone Miguel, Luc G. G. de Monto, Dennis Mosk, Amin Niamini, Dorien Oude Luttikhuis, Myron A. Peck, Theunis Piersma^a, Reyhaneh Roohi, Léon Serre-Fredj, Marten Tacoma^a, Evaline van Weerlee, Bas de Wit & Roeland A. Bom

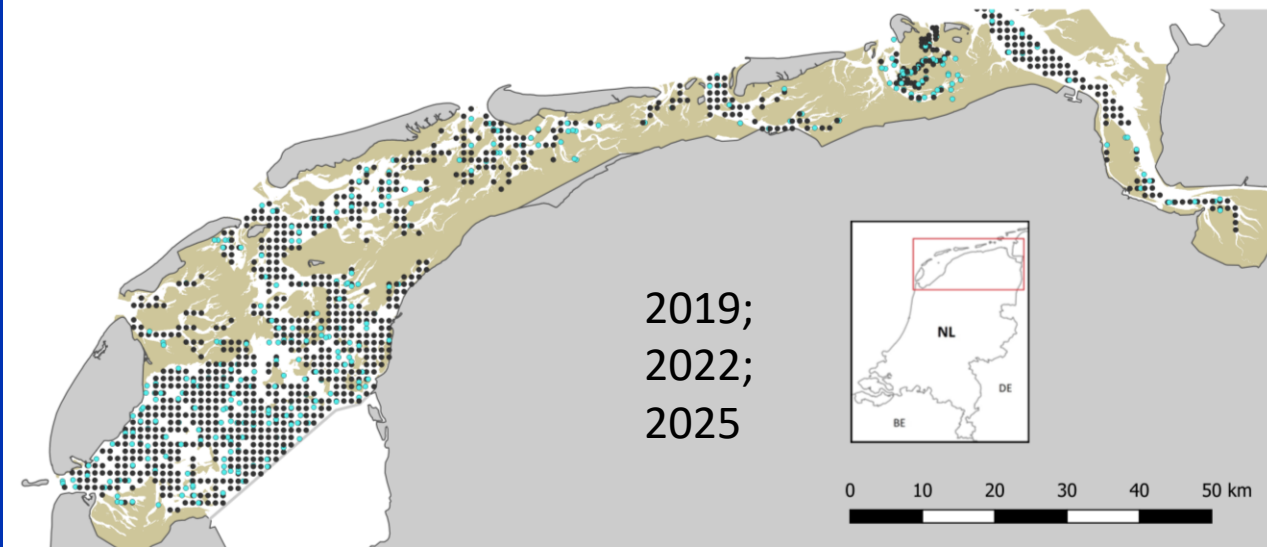


Waddenmozaïek/ SUBES



Below murky waters: Subtidal benthic species and sediment distributions in the Dutch Wadden Sea

Oscar Franken^{a,b,*}, Sander J. Holthuijsen^{a,1}, Kasper J. Meijer^a, Loran Kleine Schaars^a, Blanka Rasch^a, Jeroen Kooijman^a, Evaline van Weerlee^a, Simone Miguel^a, Anita Koolhaas^a, Dennis Mosk^a, André Dijkstra^{a,2}, Youk Greeve^{a,3}, Lodewijk van Walraven^{a,4}, Sterre Witte^{a,5}, Katrin Reilmeyer^a, Jon Dickson^a, Quirin Smeele^a, Allert Bijleveld^a, Han Olff^a, Tjisse van der Heide^{a,b}, Laura L. Govers^{a,b}



SIBES



scientific **data**

OPEN

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Since 2008;
Yearly 4500 locations

30 km

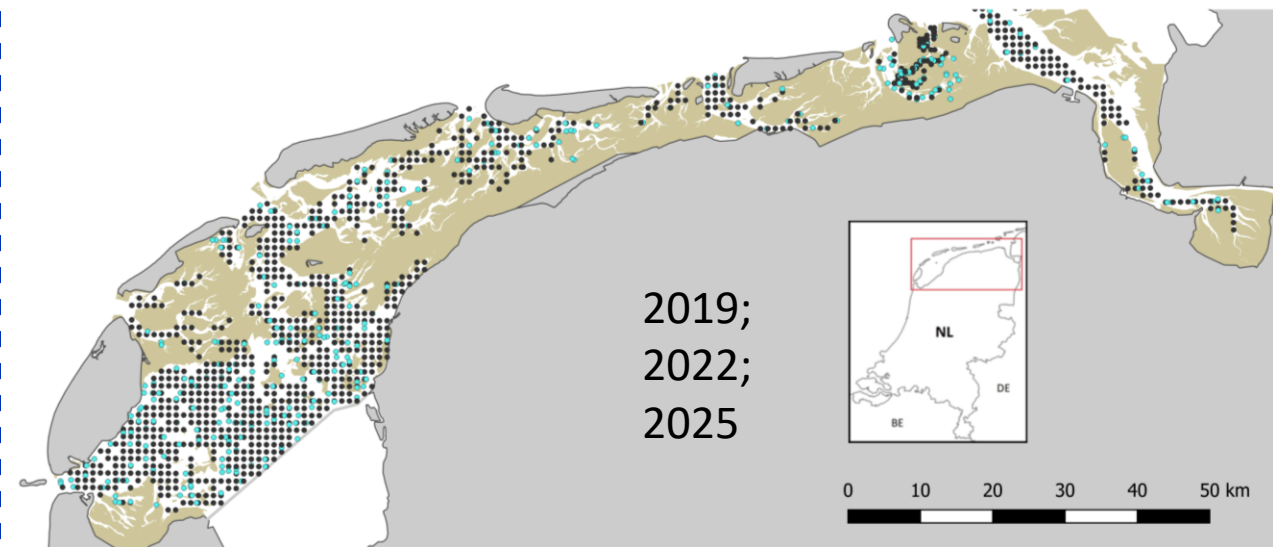


Waddenmozaïek/ SUBES



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Oscar Franken^{a,b,*}, Sander J. Holthuijsen^{a,1}, Kasper J. Meijer^a, Loran Kleine Schaars^a, Blanka Rasch^a, Jeroen Kooijman^a, Evaline van Weerlee^a, Simone Miguel^a, Anita Koolhaas^a, Dennis Mosk^a, André Dijkstra^{a,2}, Youk Greeve^{a,3}, Lodewijk van Walraven^{a,4}, Sterre Witte^{a,5}, Katrin Reilmeyer^a, Jon Dickson^a, Quirin Smeets^a, Allert Bijleveld^a, Han Olff^a, Tjisse van der Heide^{a,b}, Laura L. Govers^{a,b}



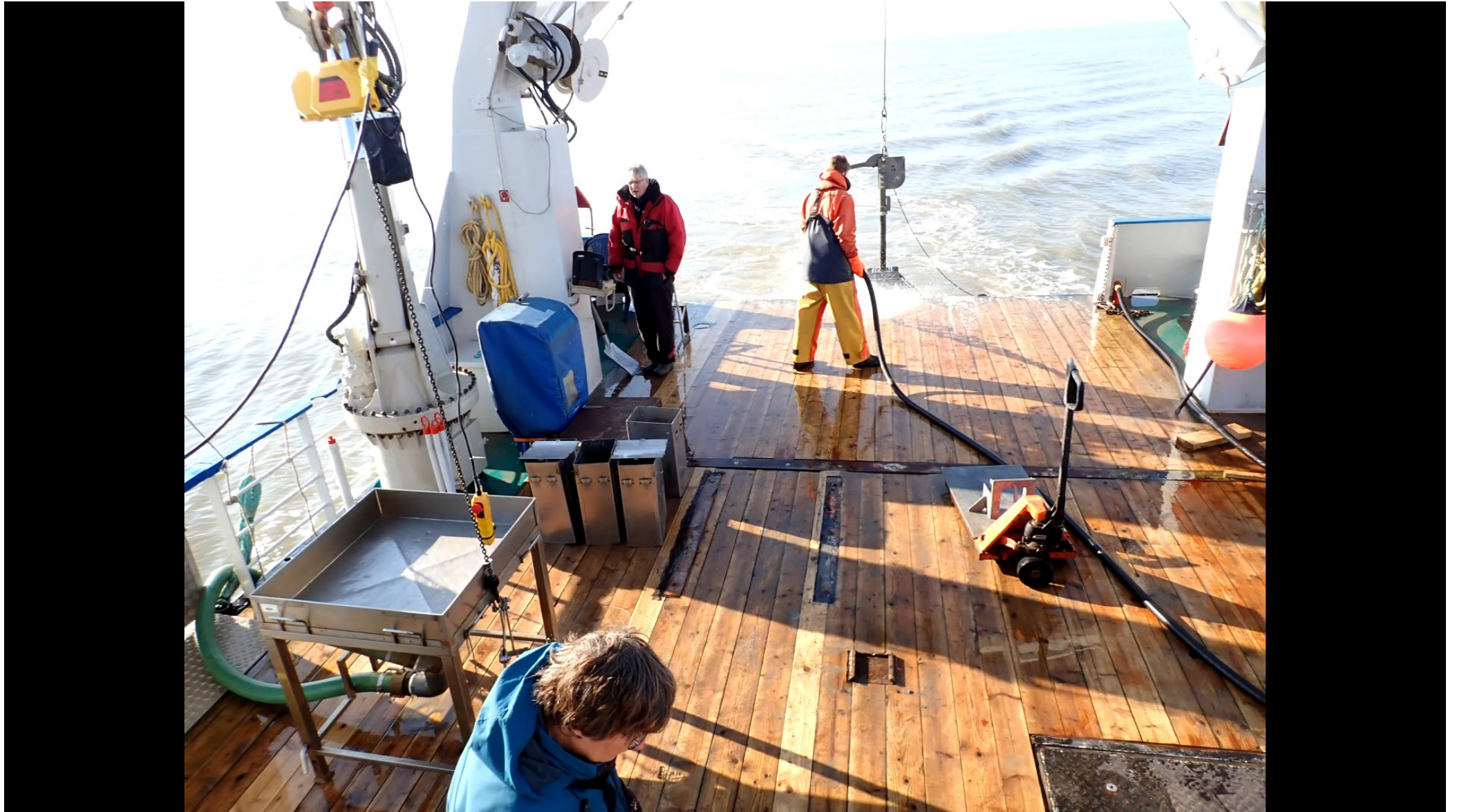




Boxcore

Longcore







Boxcore

Longcore

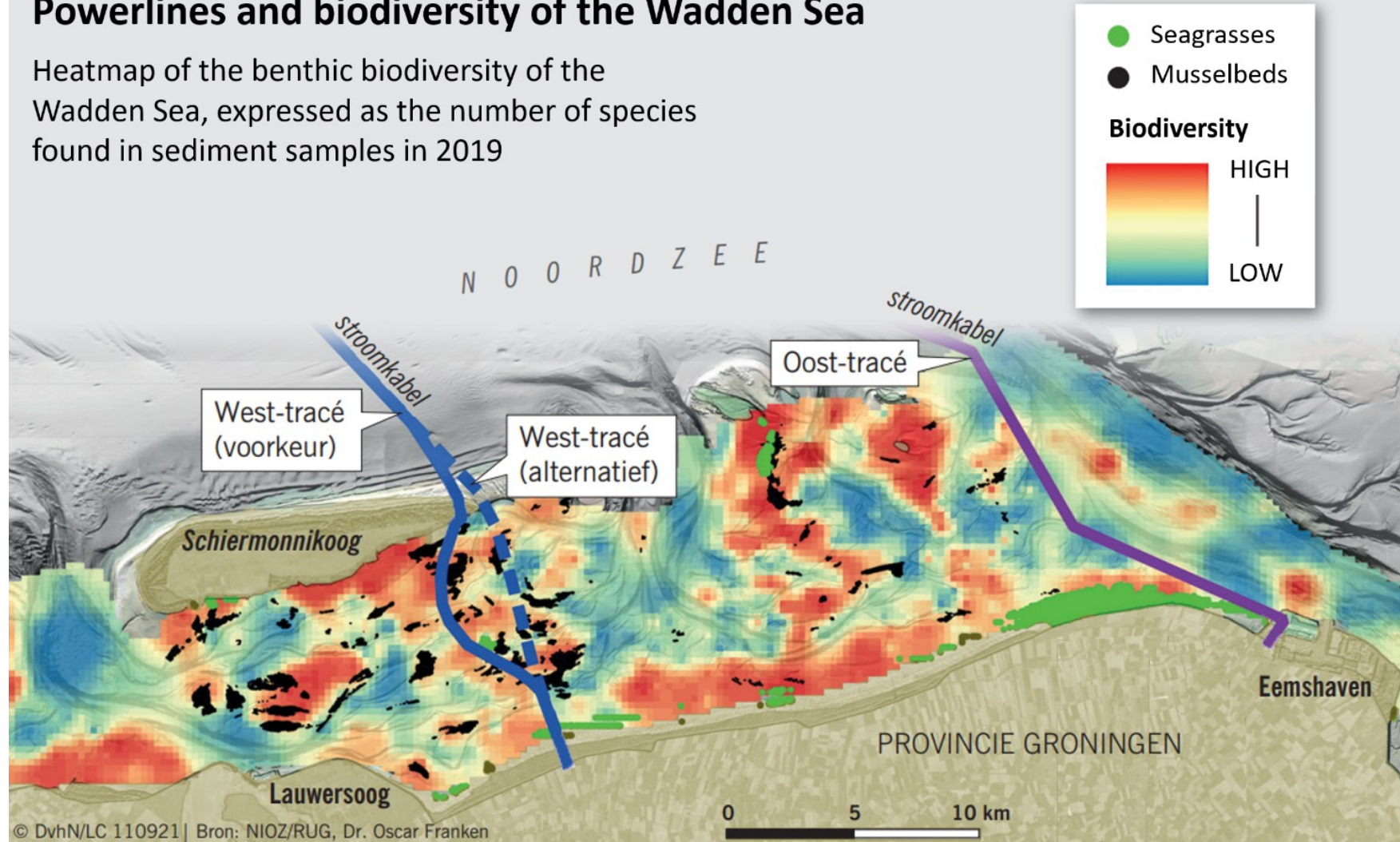


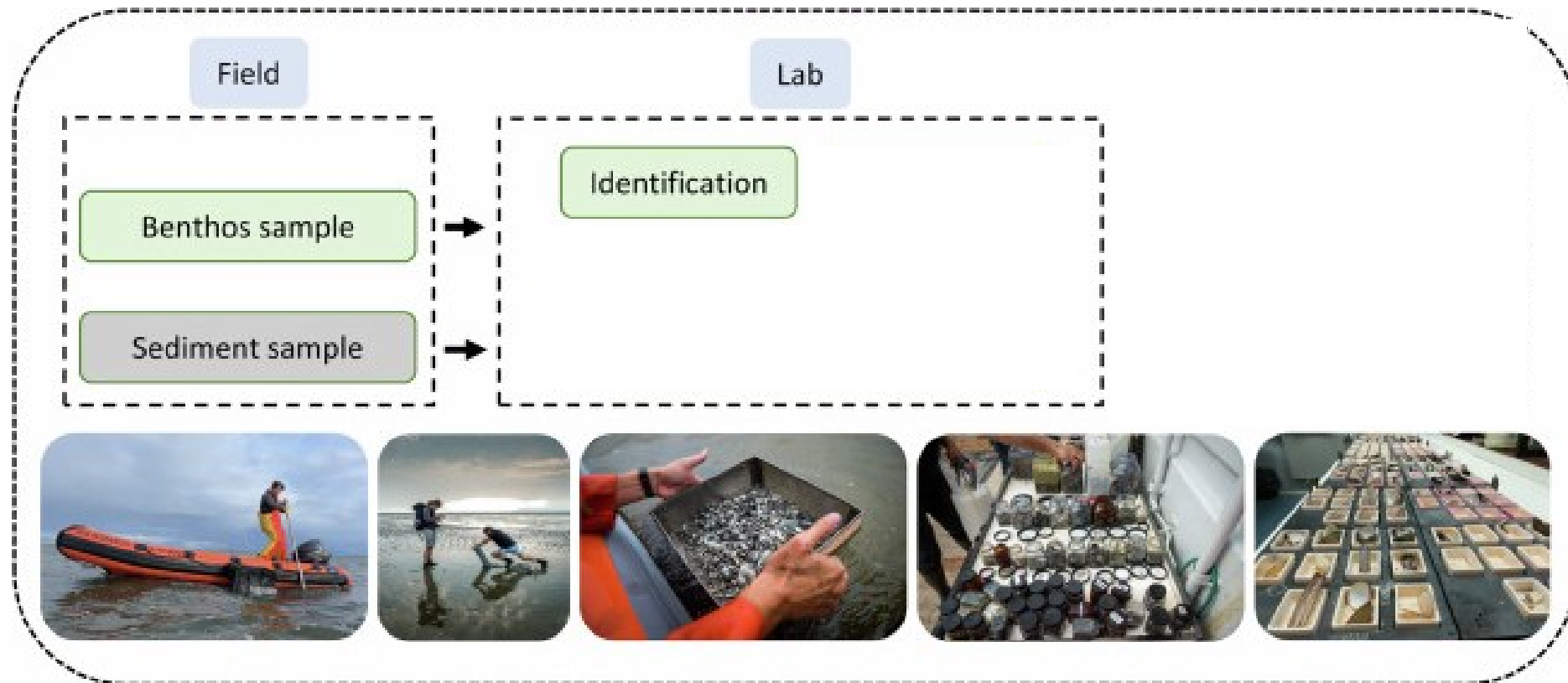
- Sediment characteristics
Species
- Presence/absence
 - Abundance & biomass



Powerlines and biodiversity of the Wadden Sea

Heatmap of the benthic biodiversity of the Wadden Sea, expressed as the number of species found in sediment samples in 2019



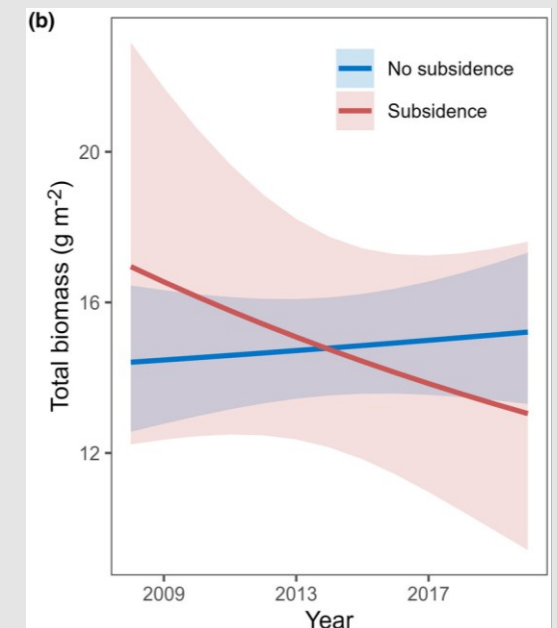
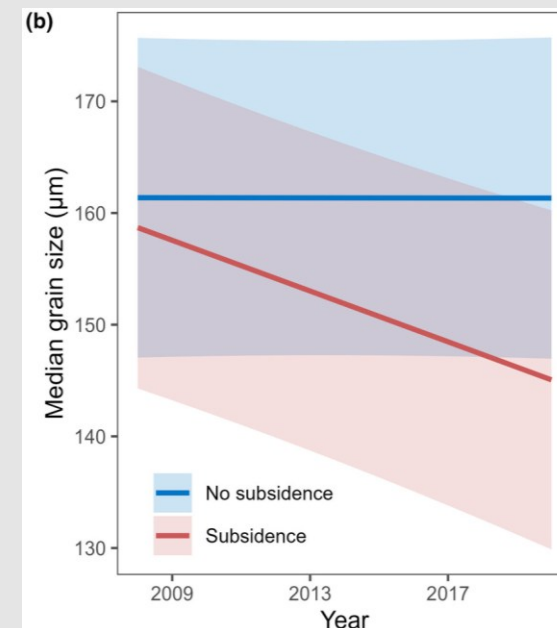
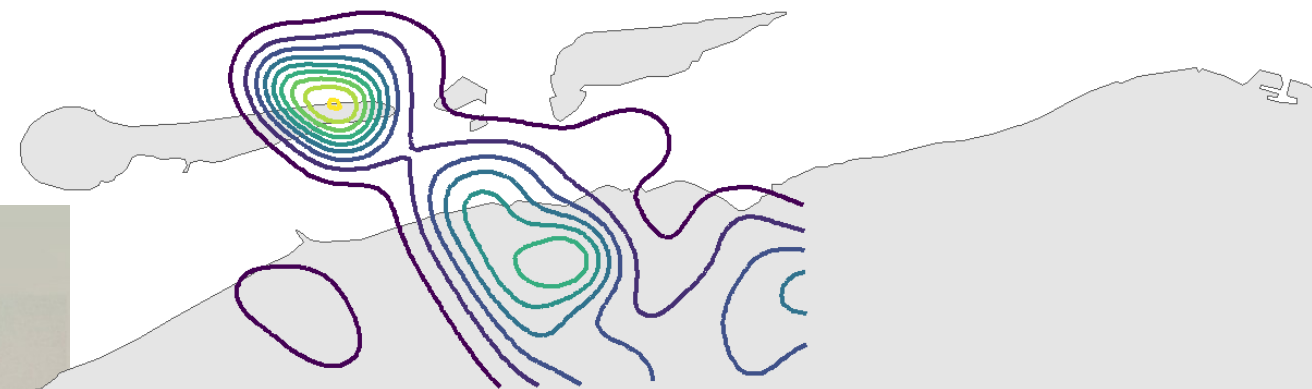


Bijleveld et al., 2025

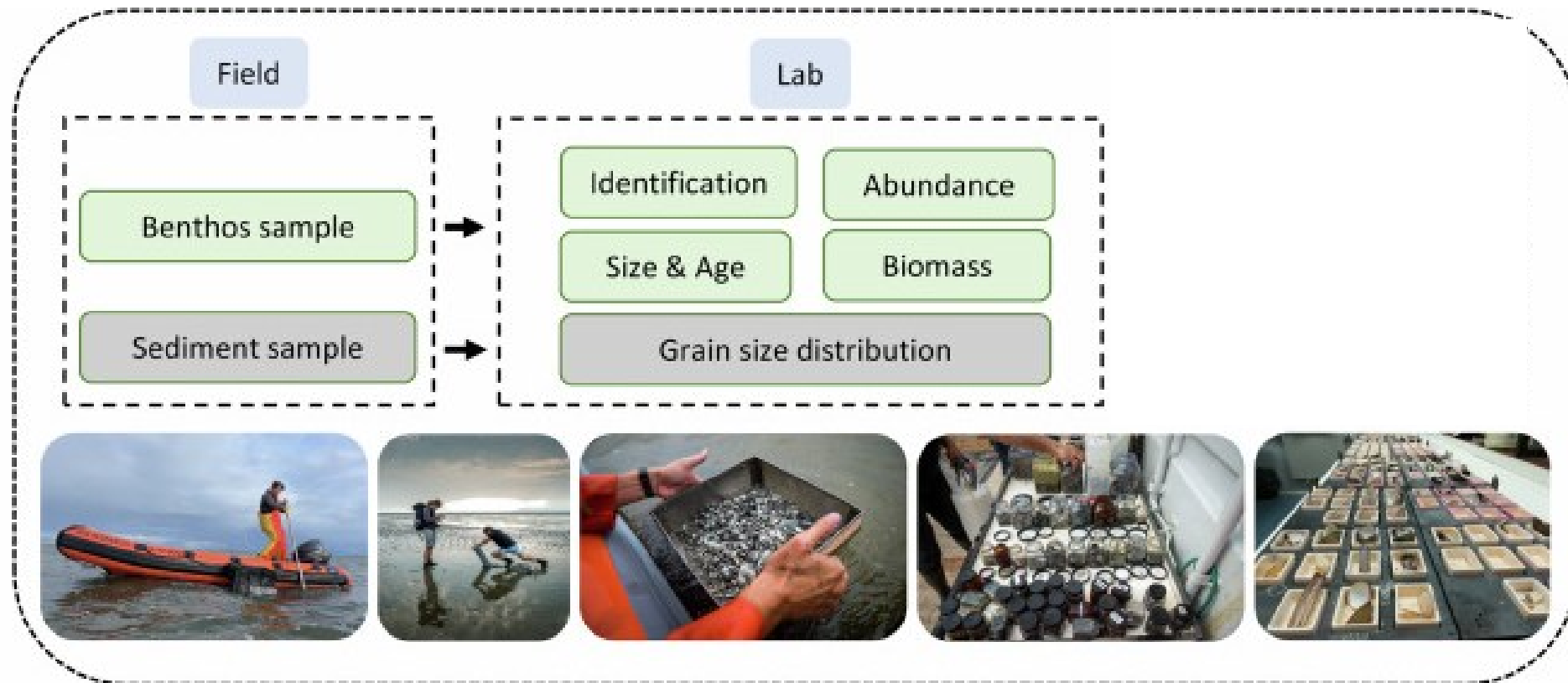


The effects of gas extraction under intertidal mudflats on sediment and macrozoobenthic communities

Paula de la Barra¹ | Geert Aarts^{1,2} | Allert Bijleveld¹

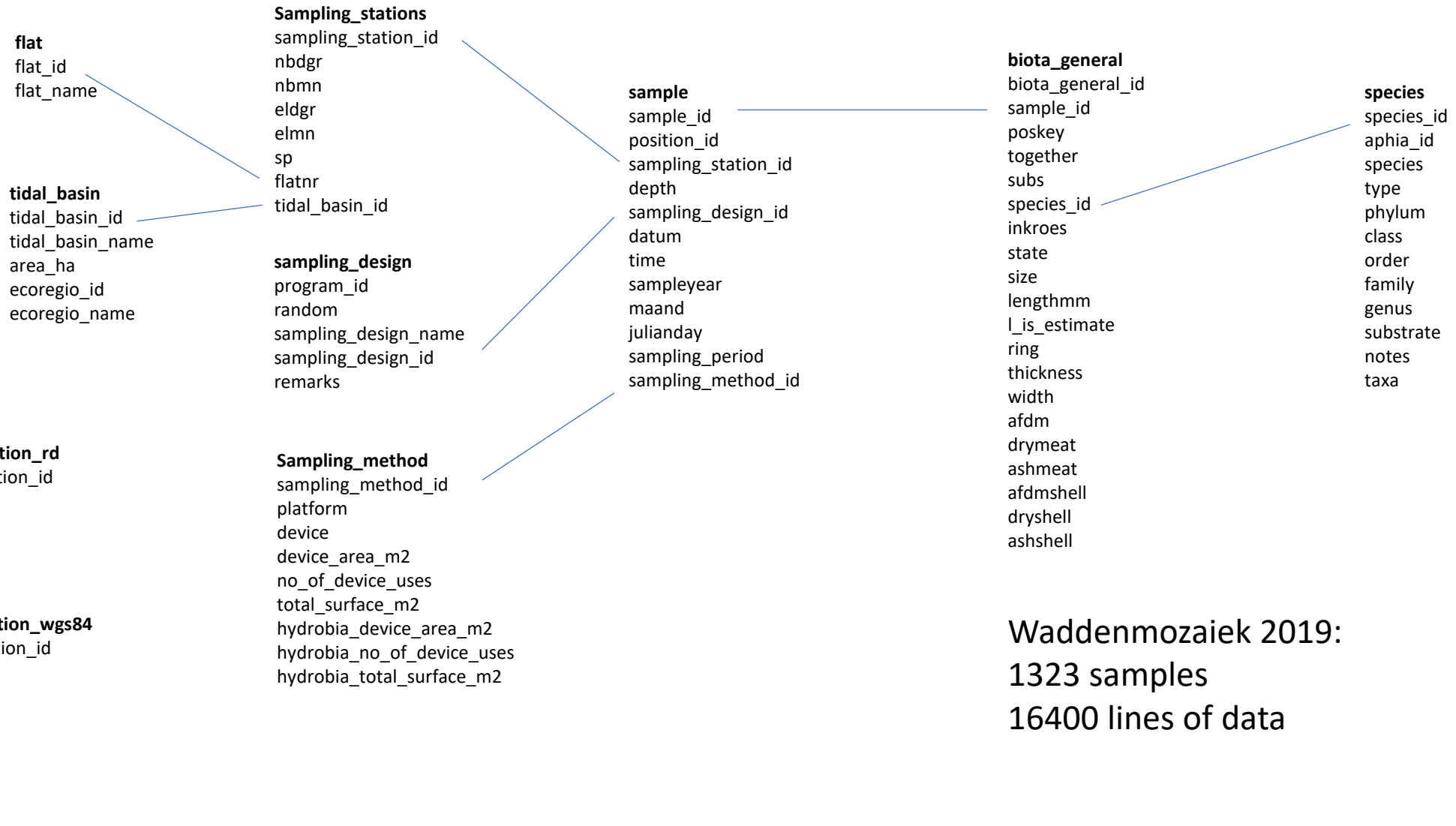


30 km



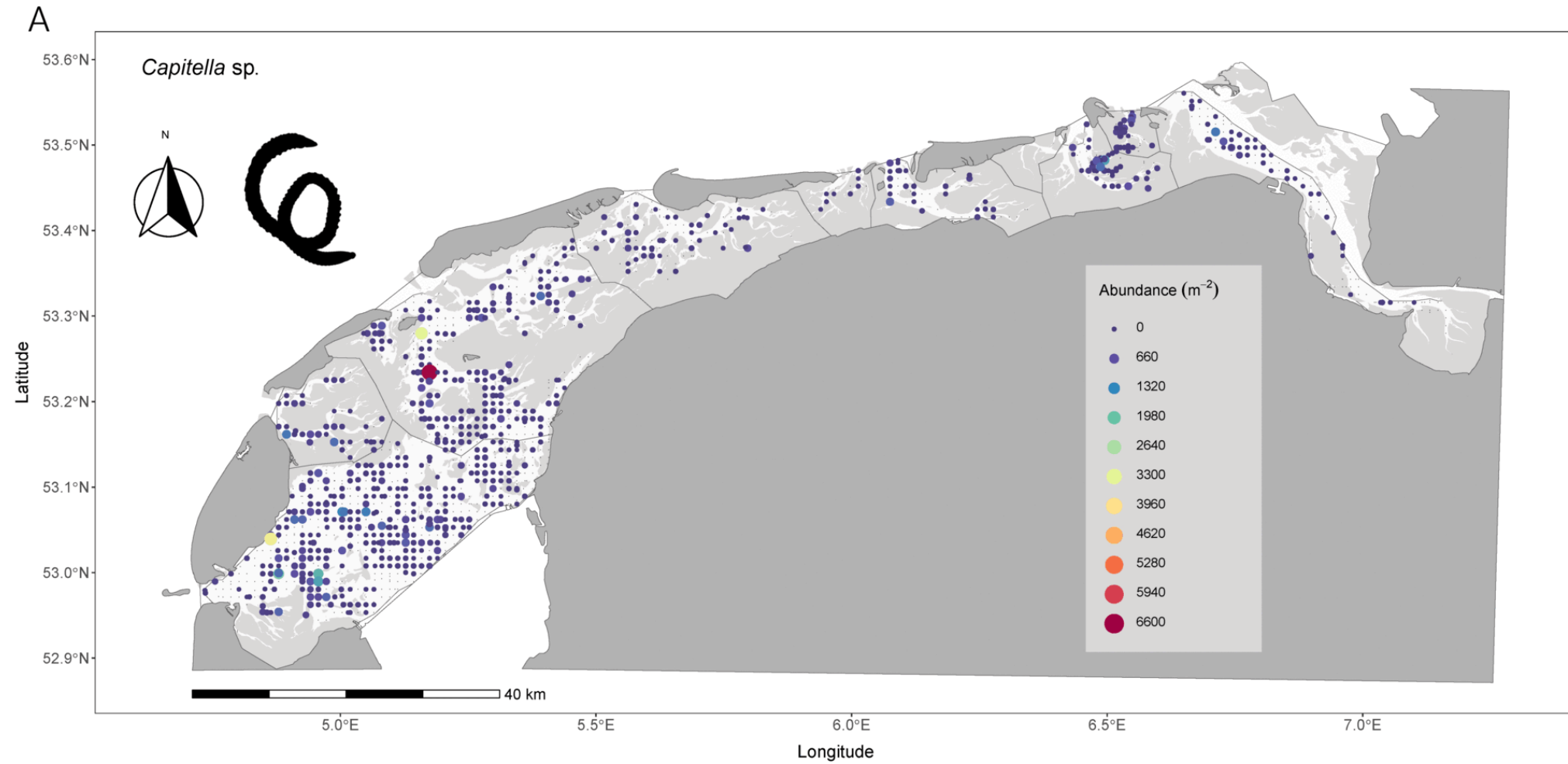
Bijleveld et al., 2025

Data-schema



Waddenmozaiek 2019:
1323 samples
16400 lines of data

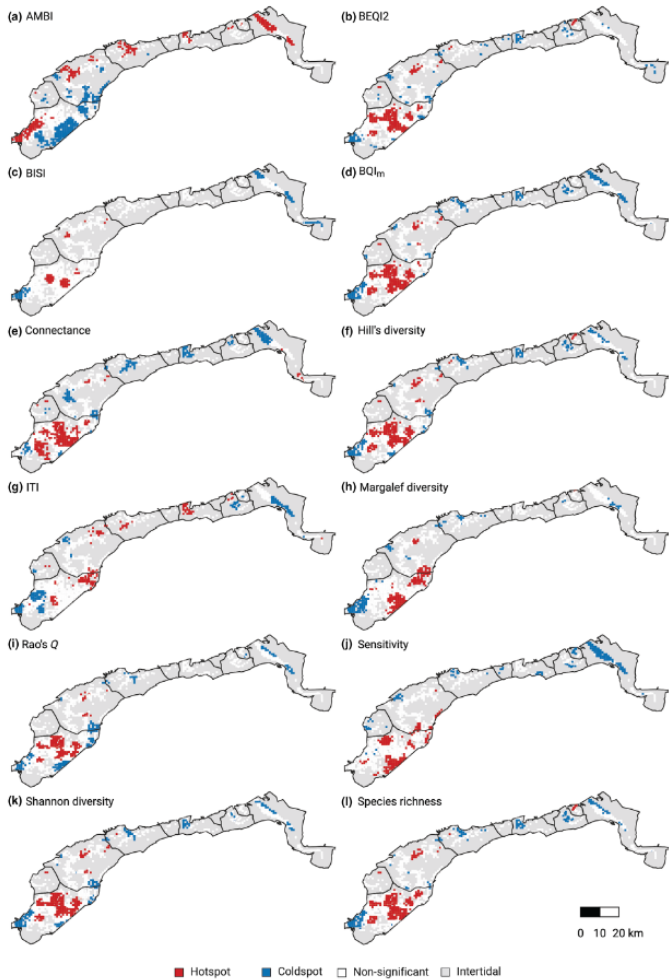
For 139 species:



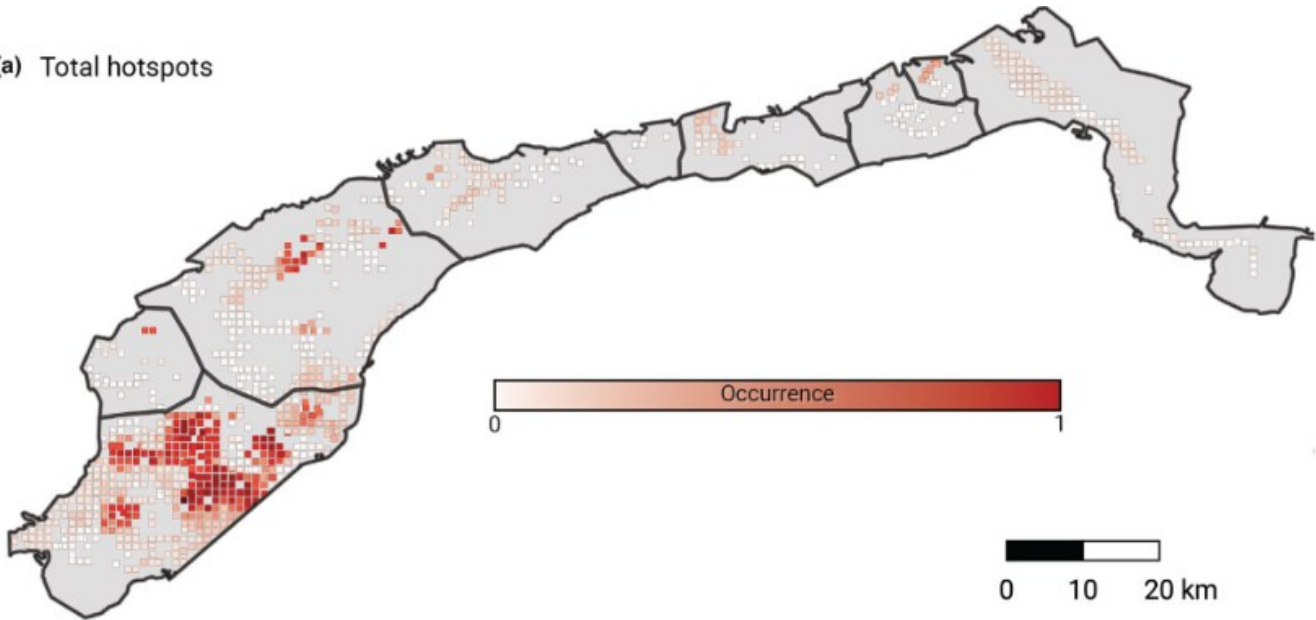


Hotspots in peril: Misalignment of conservation efforts and ecological values in a shallow coastal sea

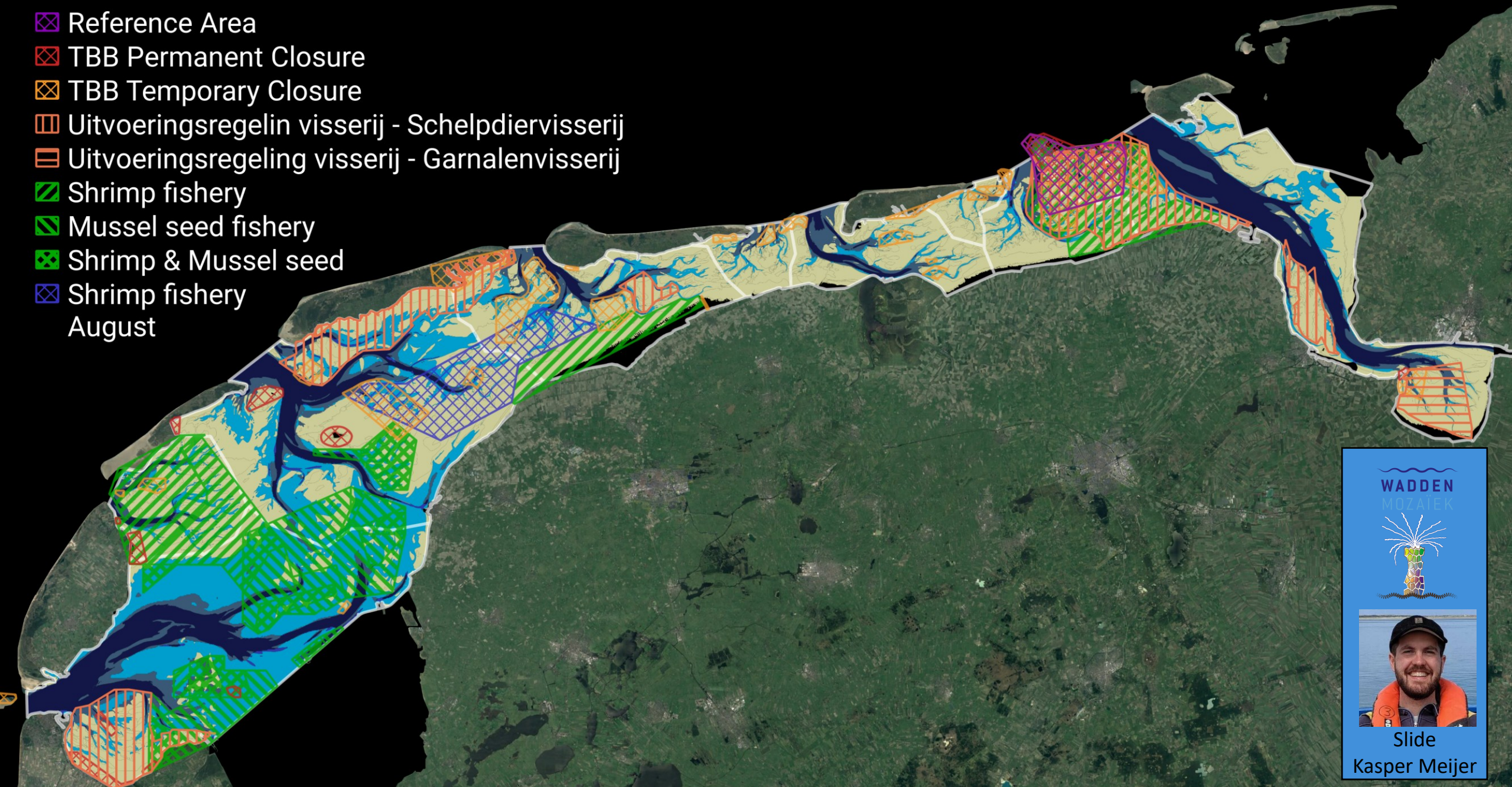
Kasper J. Meijer¹ | Oscar Franken^{1,2} | Sterre Witte² | Sander J. Holthuijsen³ |
Tjisse van der Heide^{1,2} | Laura L. Govers^{1,2} | Han Olf¹



(a) Total hotspots

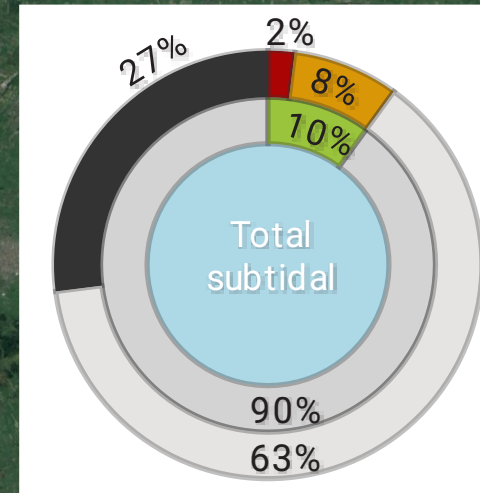


- ⊠ Reference Area
- ⊠ TBB Permanent Closure
- ⊠ TBB Temporary Closure
- ▨ Uitvoeringsregelin visserij - Schelpdiervisserij
- ▨ Uitvoeringsregeling visserij - Garnalenvisserij
- ▨ Shrimp fishery
- ▨ Mussel seed fishery
- ▨ Shrimp & Mussel seed
- ⊠ Shrimp fishery
August

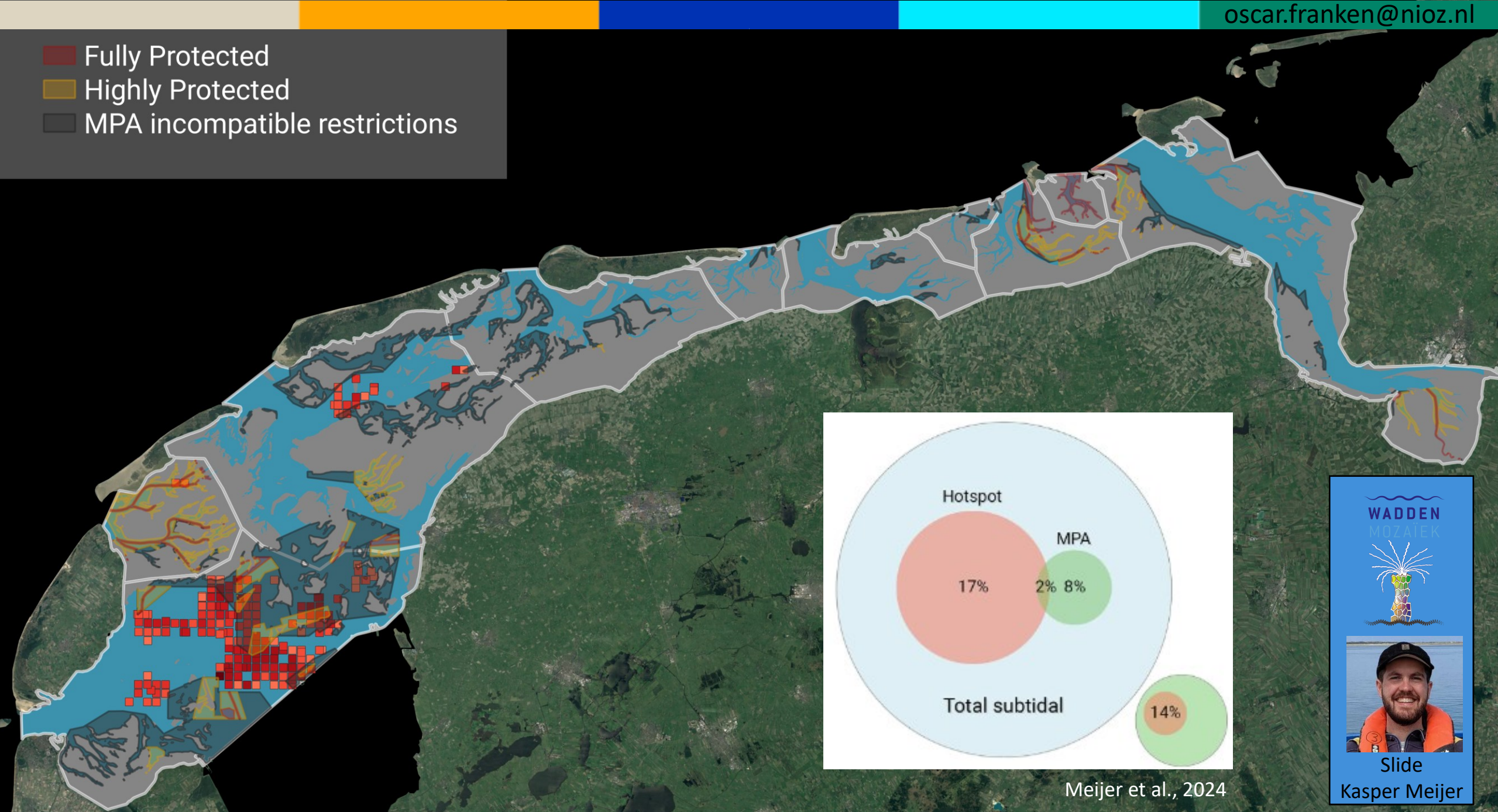
WADDEN
MOZAIEK

Slide
Kasper Meijer

- ☒ Reference Area
- ☒ TBB Permanent Closure
- ☒ TBB Temporary Closure
- ▨ Uitvoeringsregelin visserij - Schelpdiervisserij
- ▨ Uitvoeringsregeling visserij - Garnalenvisserij
- ▨ Shrimp fishery
- ▨ Mussel seed fishery
- ▨ Shrimp & Mussel seed
- ☒ Shrimp fishery August



- Fully Protected
- Highly Protected
- MPA incompatible restrictions

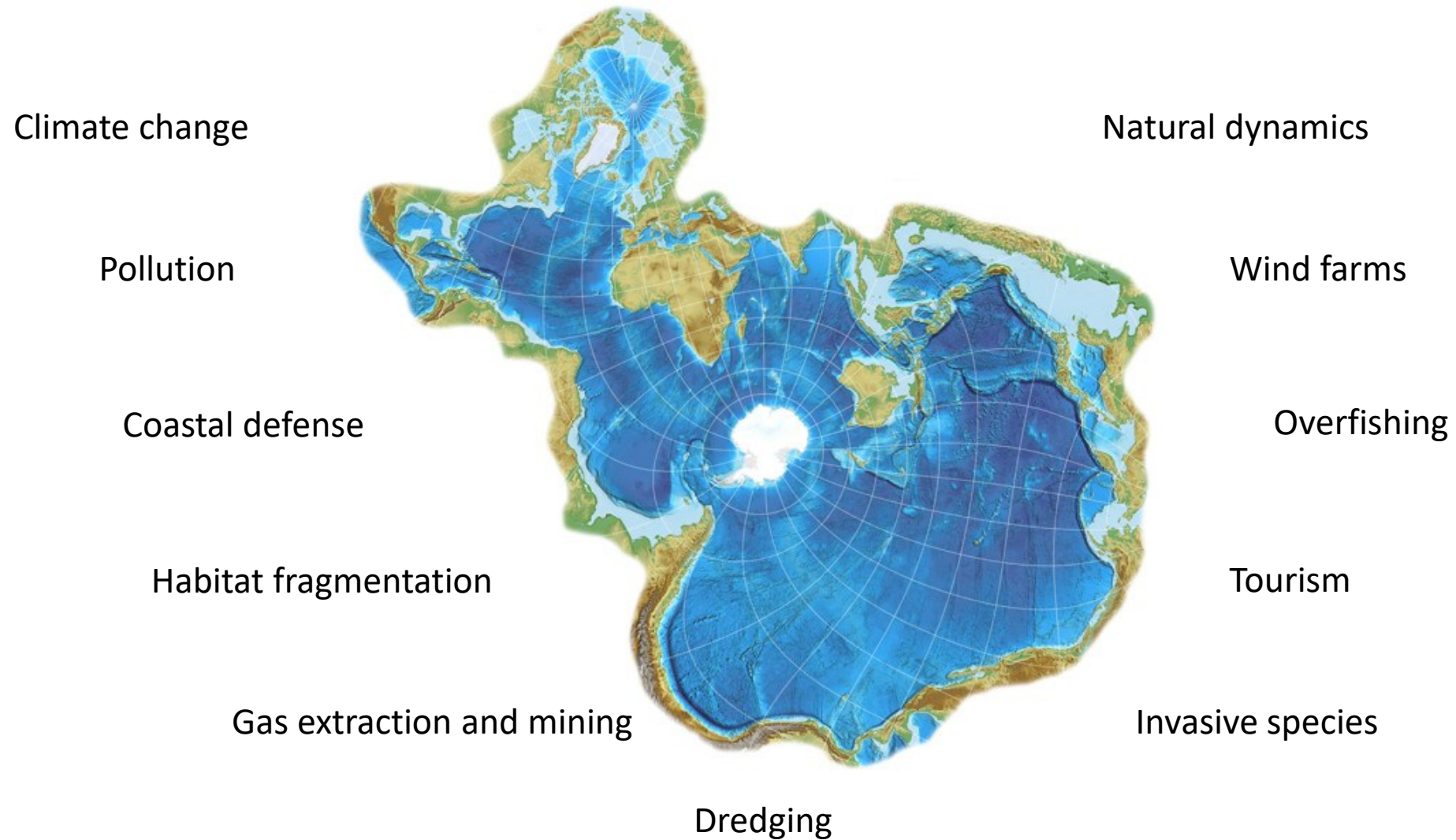


Meijer et al., 2024

WADDEN
MOZAIK

Slide
Kasper Meijer

Global challenges



Acknowledgements

All volunteers, taxonomists, technicians, students, shipping crew and others involved in collecting and processing the samples from all these sampling campaigns



rijksuniversiteit
 groningen

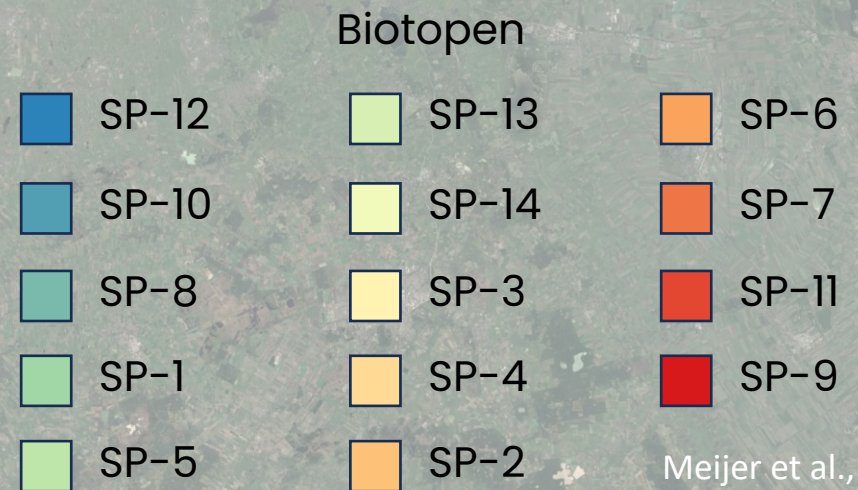
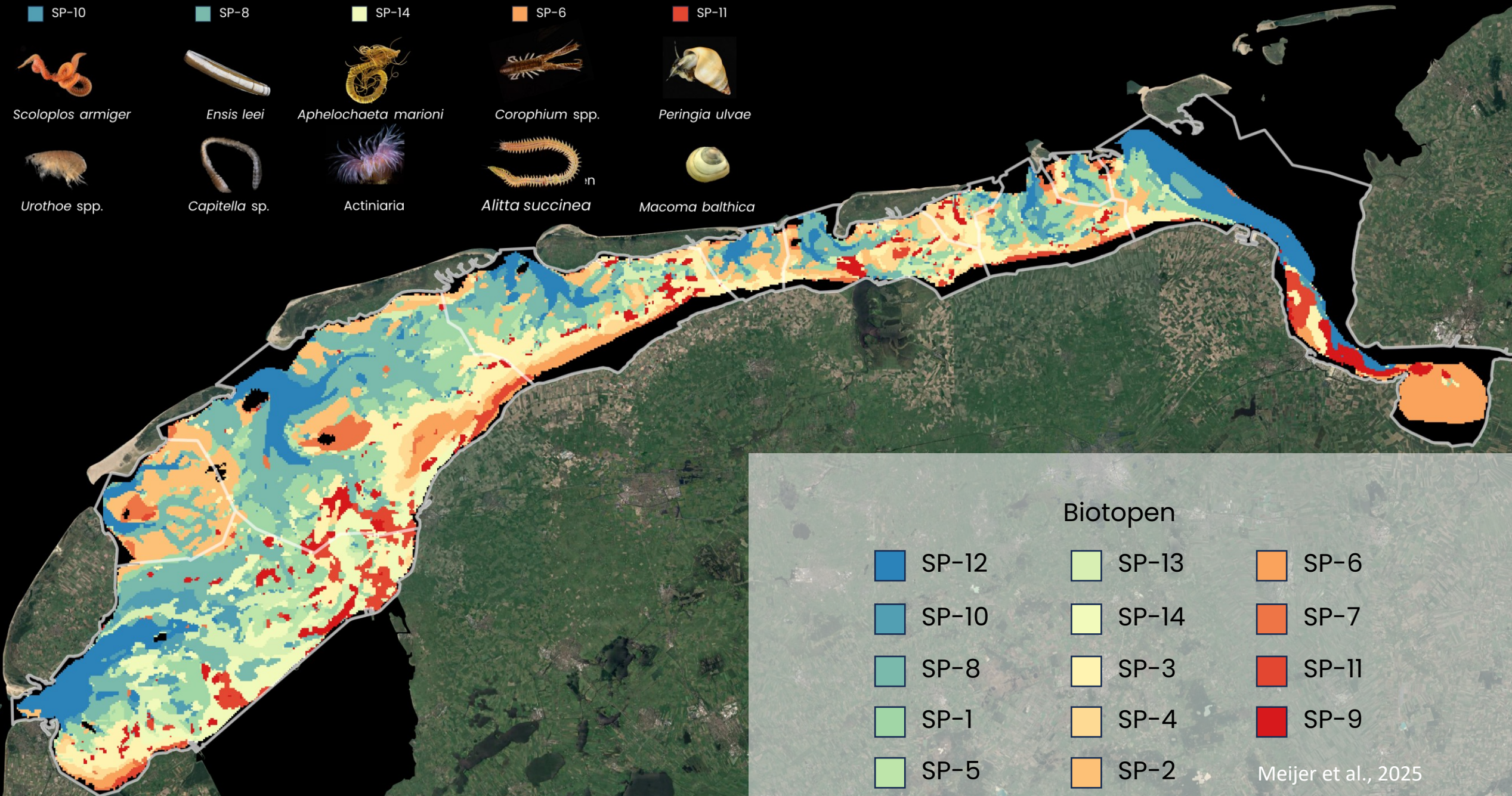
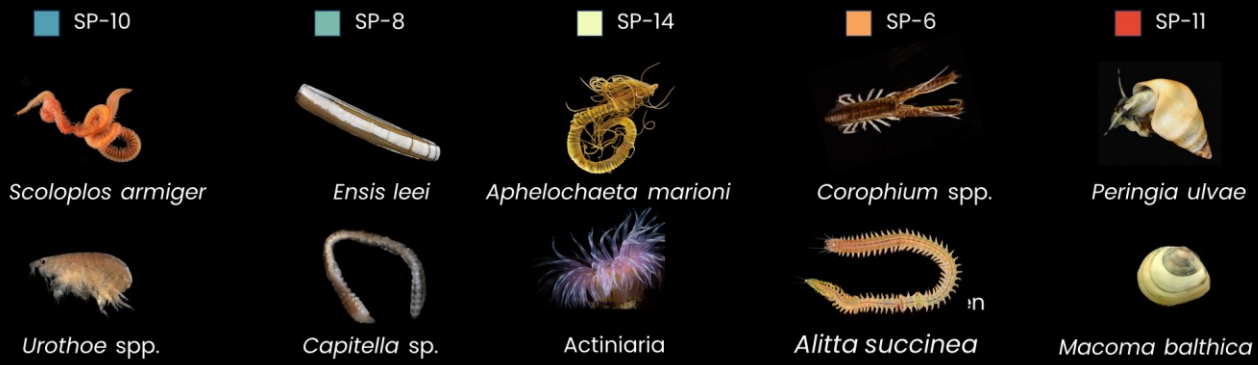


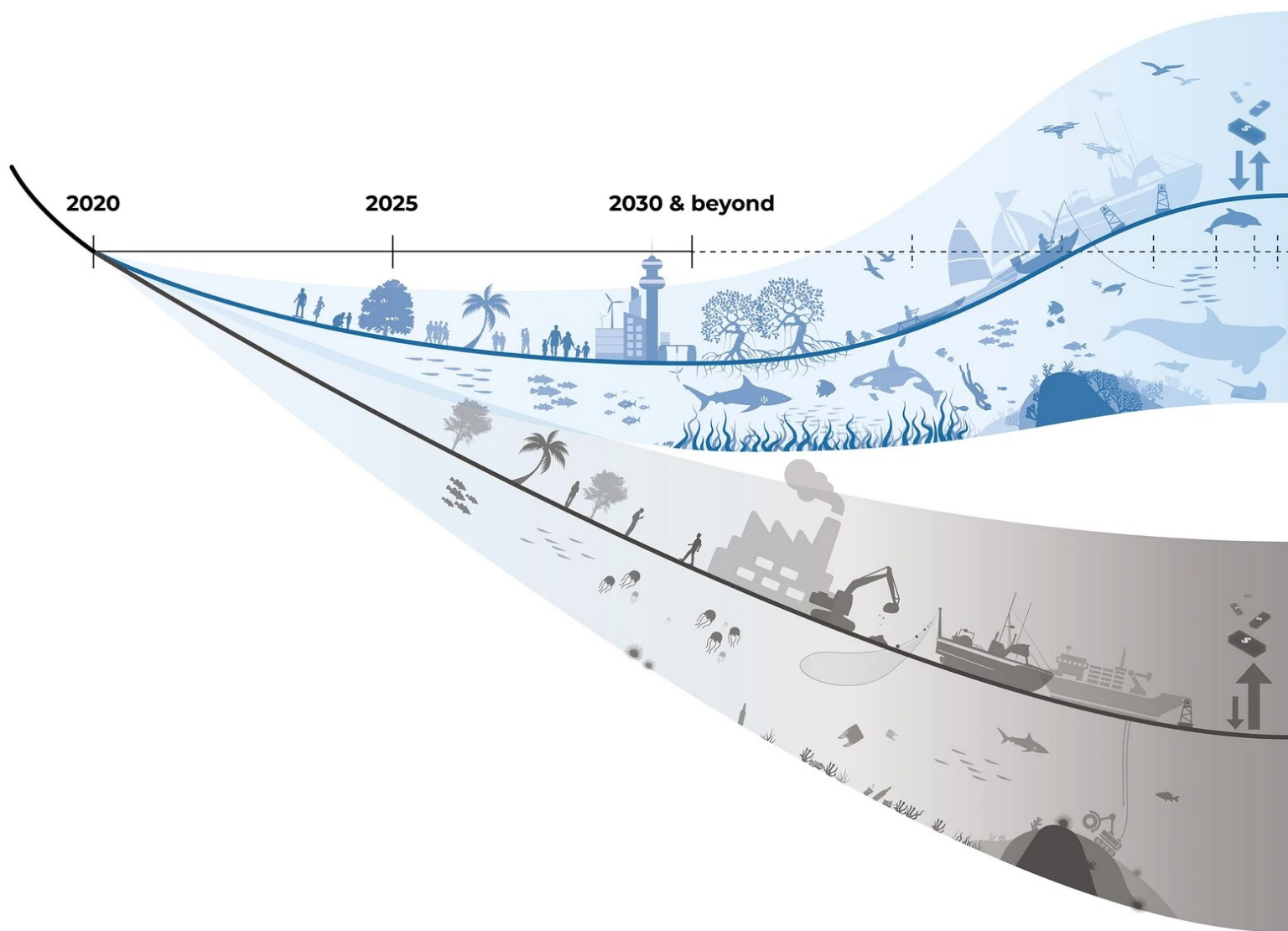
the fieldwork company



provinsje fryslân
 provincie fryslân







Business As Usual Future



Photo: Source ask Kai Eskildsen NPA

Wadden Sea Quality Status Report Subtidal habitats

K. Ricklefs, O. Franken, S. Glorius, F. Mascioli, P. Nielsen, H.-C. Reimers, A.

Trampe

2022

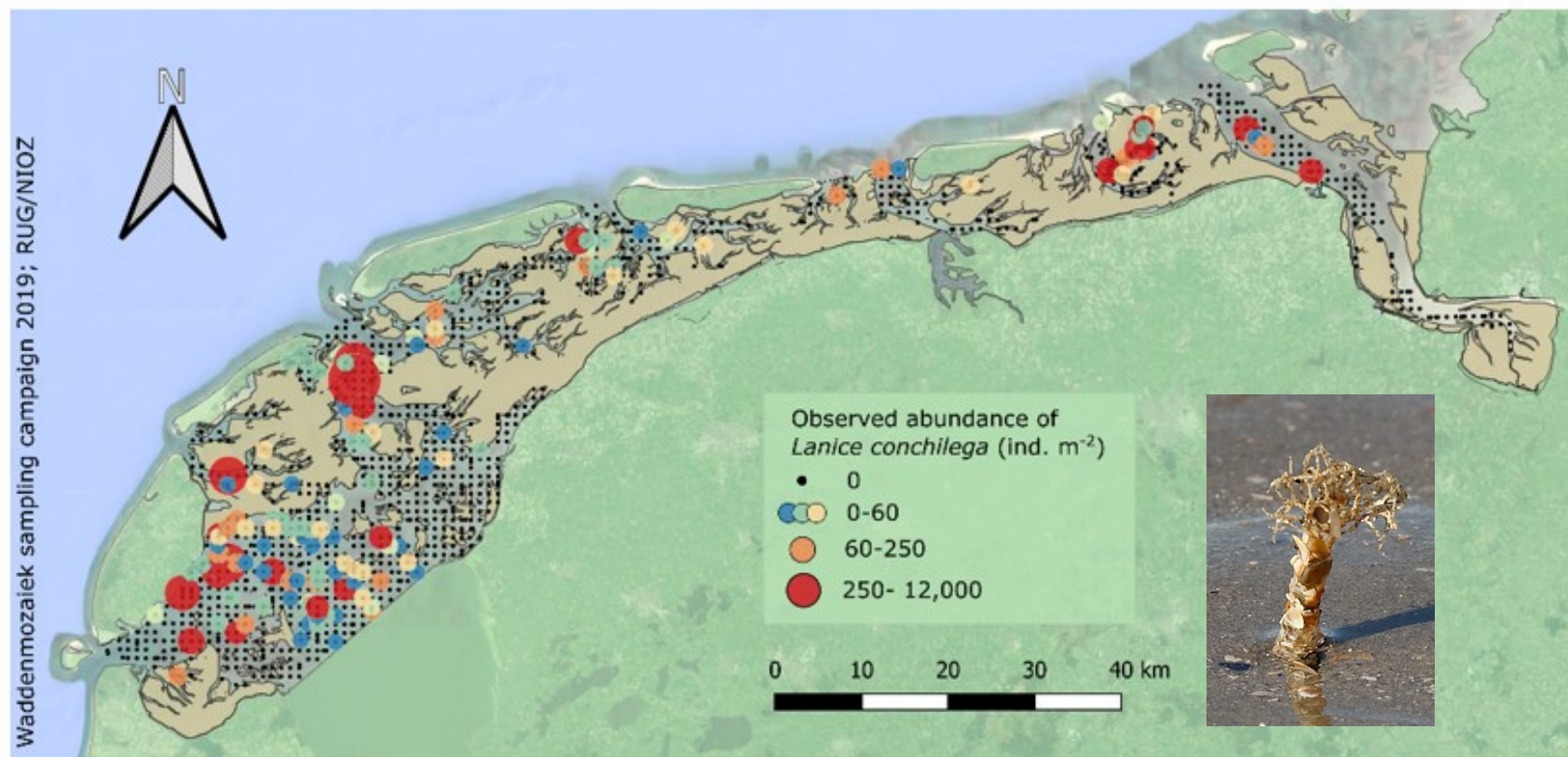
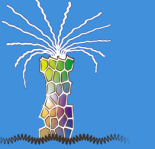


Figure 11: Sampled locations in the Dutch subtidal Wadden Sea in 2019 (grey dots), with locations where *L. conchilega* was observed displayed as a gradient from small blue dots to larger red dots with increasing abundance.

Cumulative human activities



WADDEN
MOZAIK



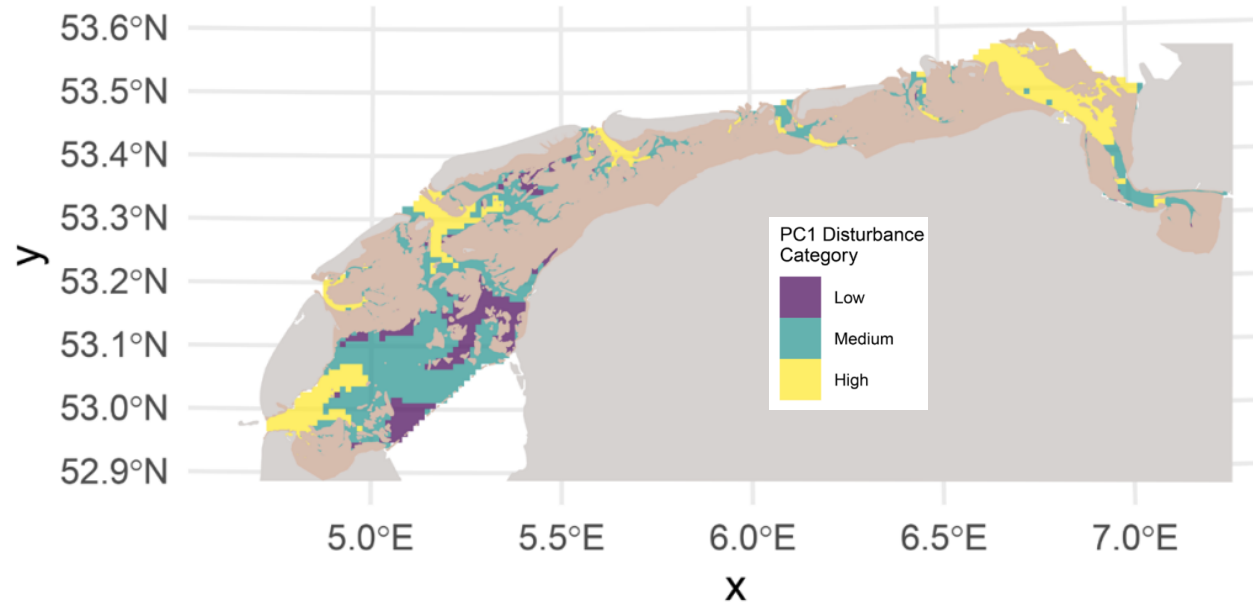
Slide
Kasper Meijer

Case studies



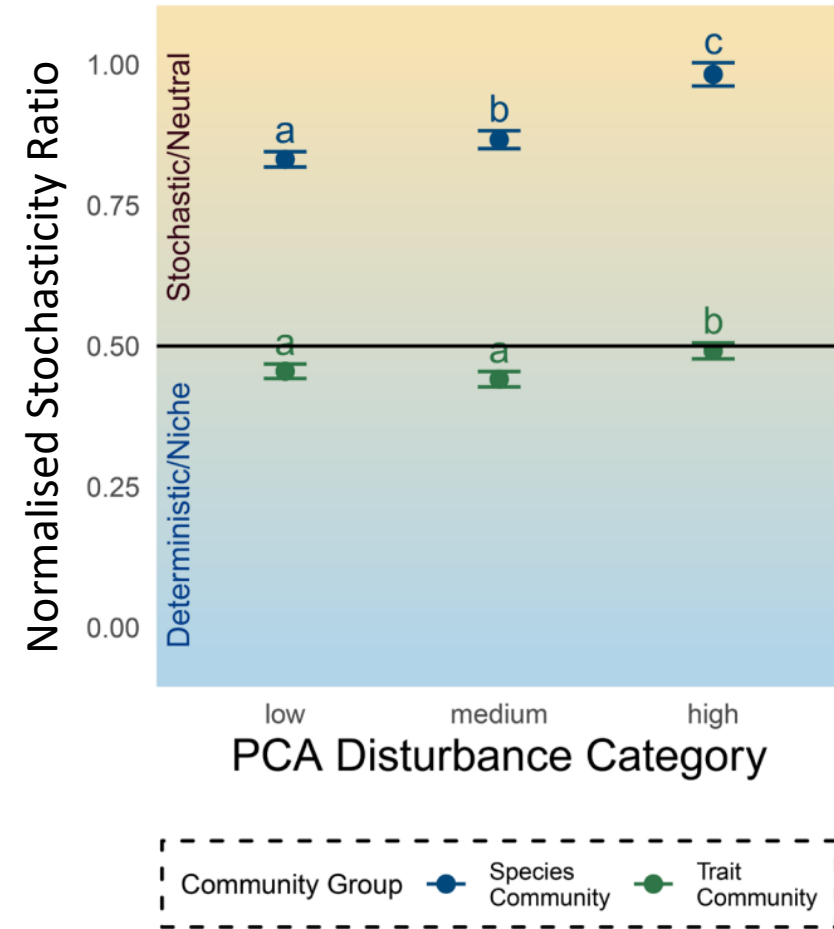
Marine Benthic Community Assembly Is Taxonomically Stochastic but Functionally Deterministic in a Dynamic Coastal Sea

Milenka Sloots¹ | Oscar Franken^{1,2} | Kasper J. Meijer¹ | Tjisse van der Heide^{1,2} | Laura L. Govers^{1,2} | Han Olff¹



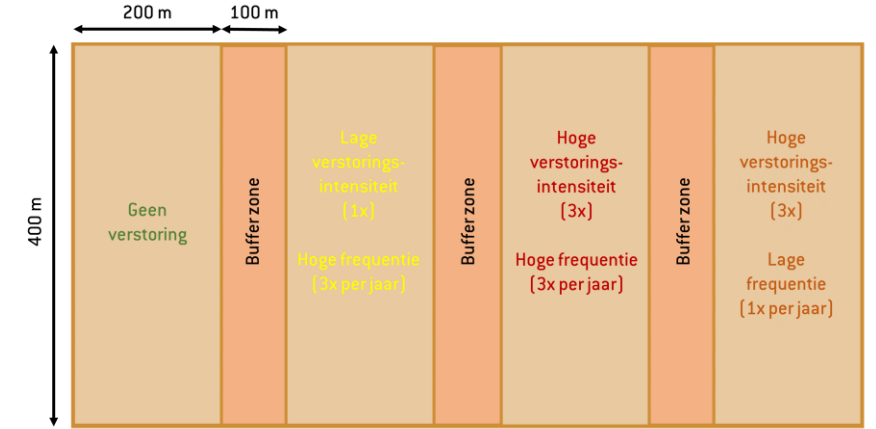
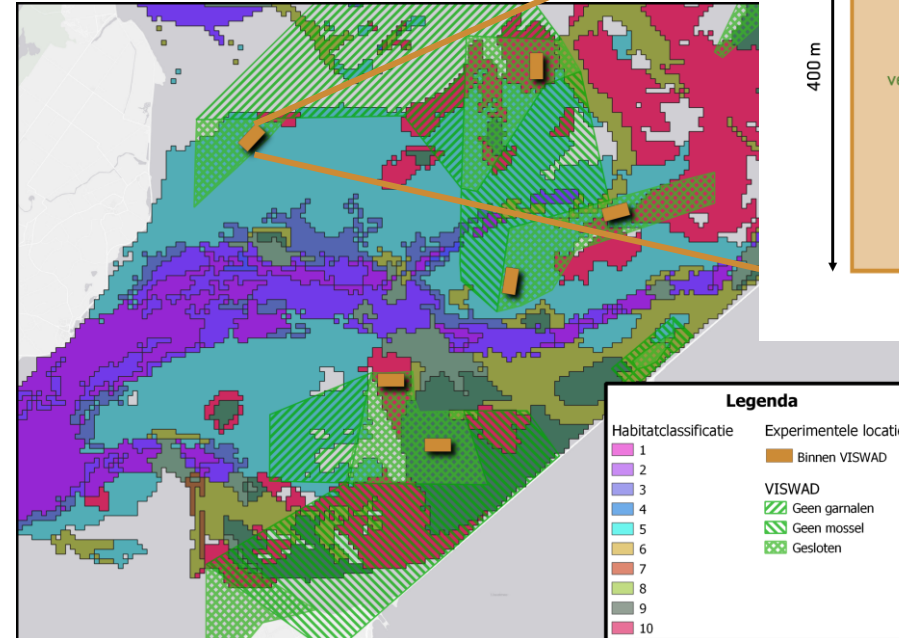
Monitoring and evaluation of conservation interventions can benefit from a trait-based perspective, as the composition of trait-based communities is more deterministic than that of species-based communities.

B





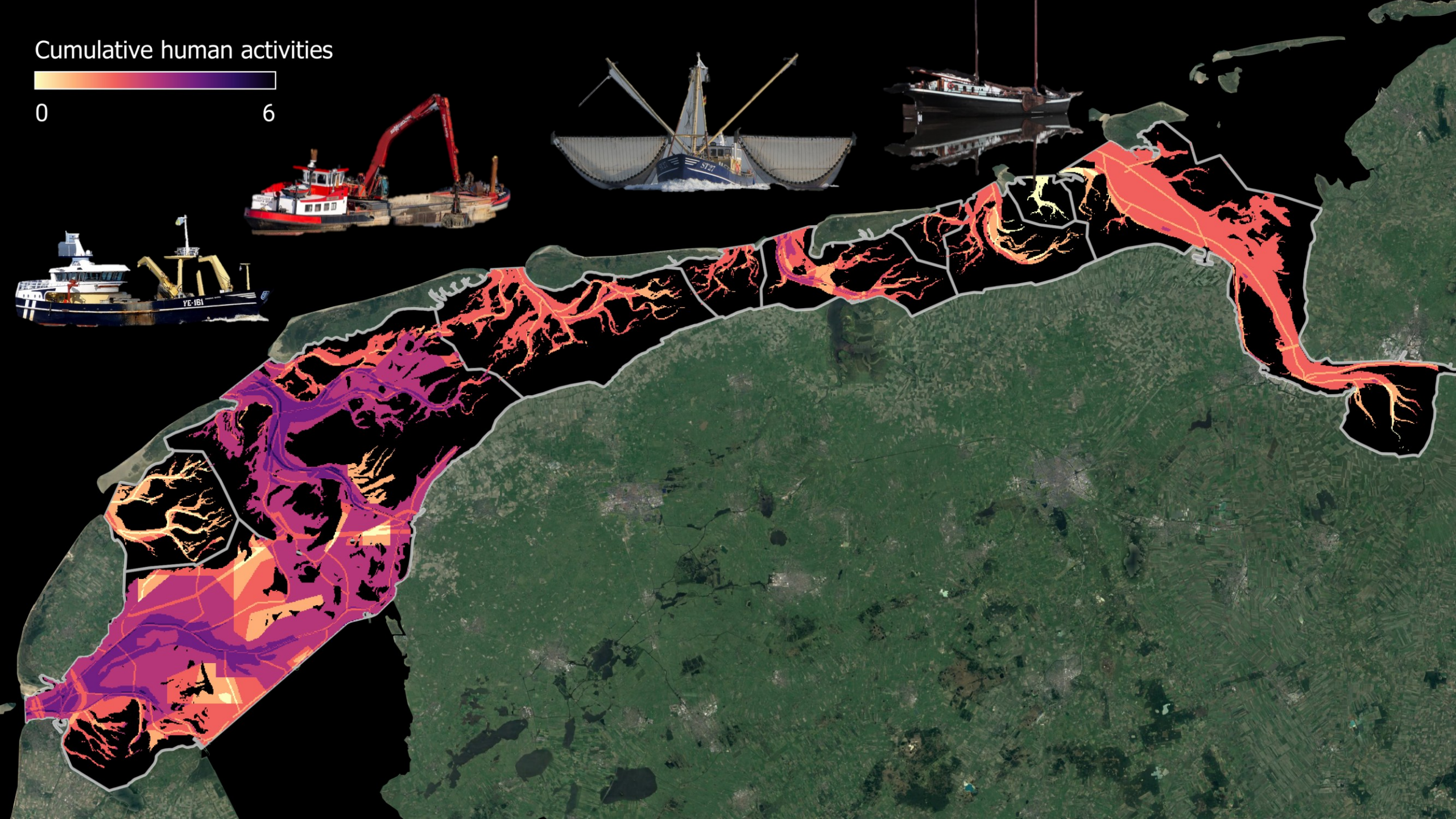
Kasper Meijer



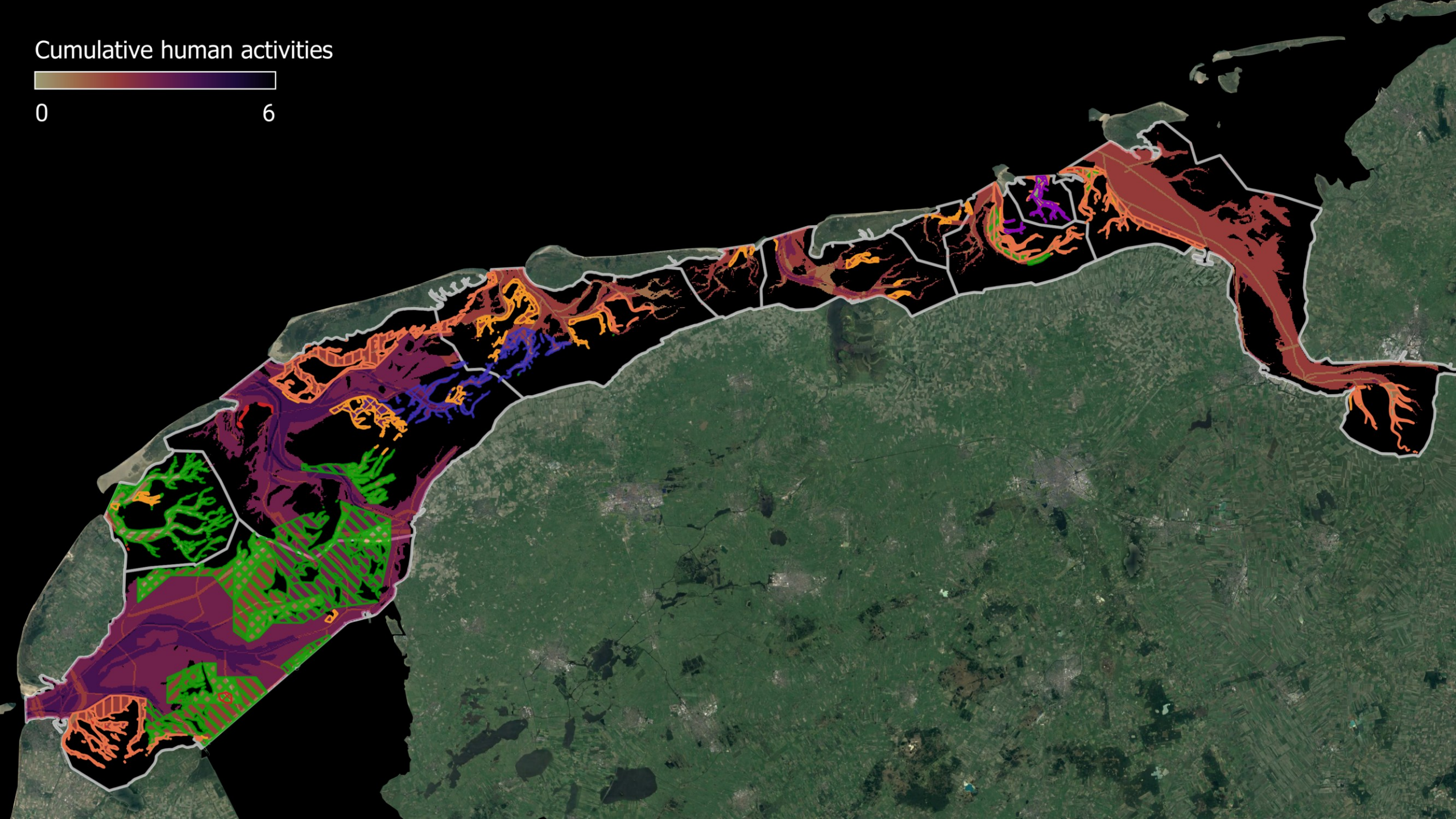
- 6 x beroering, over 2 jaar tijd voor meten langetermijnsherstel
- 4 behandelingen
- 6 locaties
- 9 boxcores per proefvlak
→ Totaal 1512 boxcores



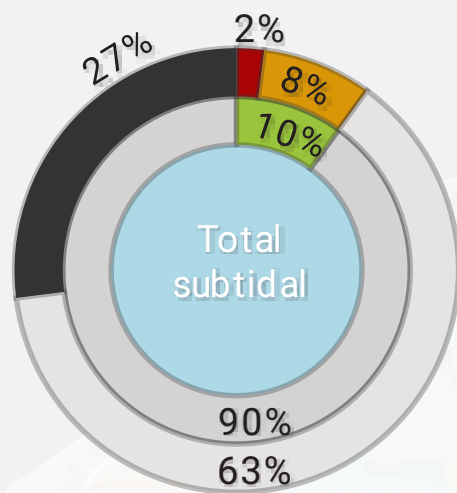
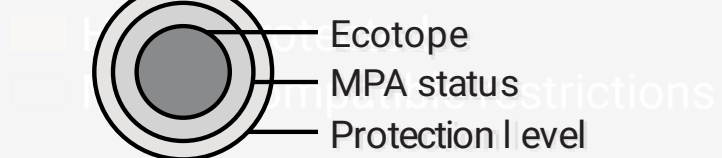
Cumulative human activities



Cumulative human activities



Fully Protected



MPA status

MPA No MPA



Protection level

Fully protected

Highly protected

No restrictions

MPA incompatible restrictions

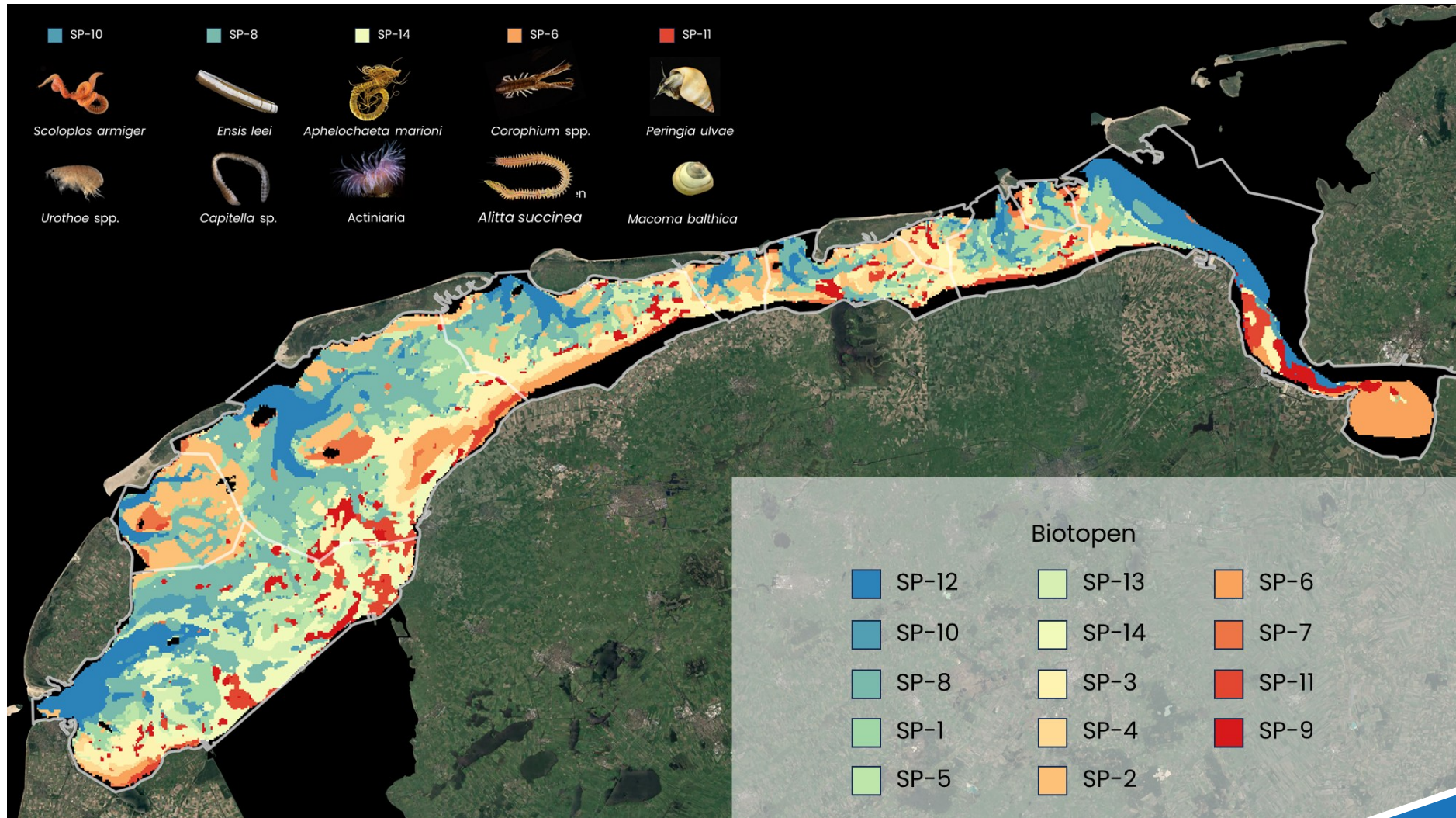




2



3



WADDEN
MOZAÏEK





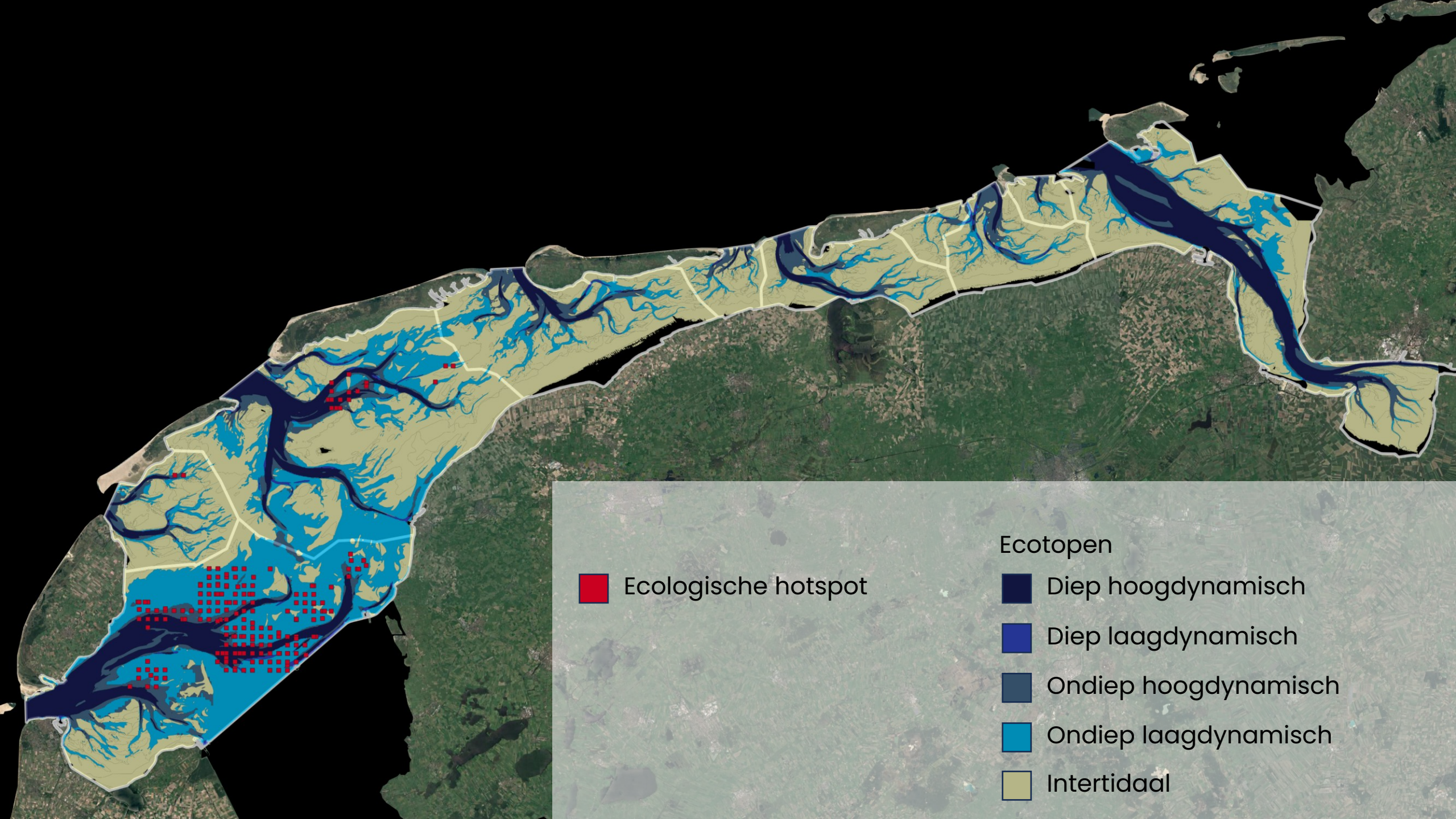


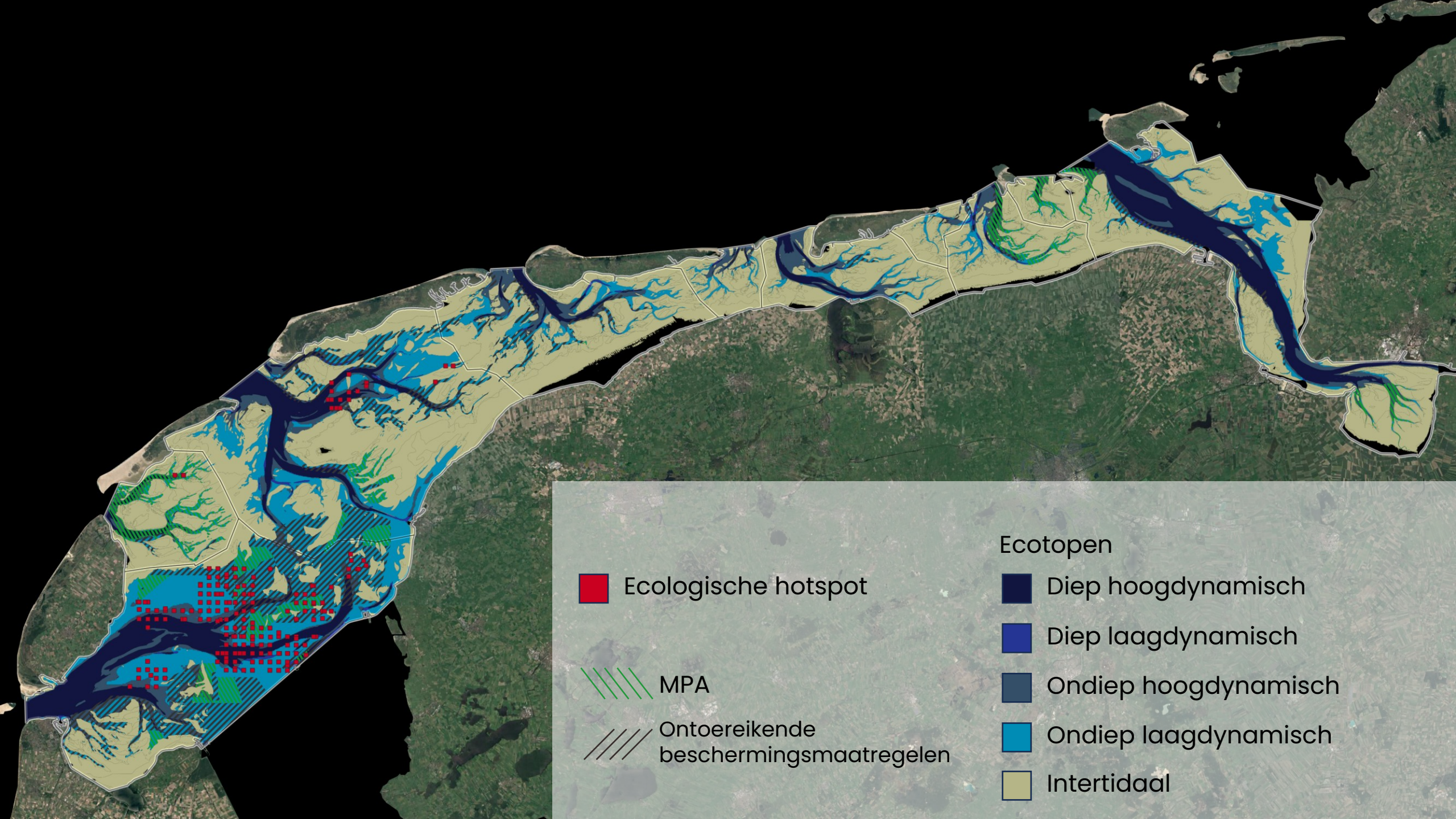
- AZTI's Marine Biotic Index
- Benthic Ecosystem Quality Index 2 (BEQI2)
- Benthic Quality Index (BQI)
- BISI
- Connectance (voedselweb)
- Hill's diversity
- Infaunal trophic index (ITI)

- Margalef Diversity
- Rao's Q (Functional diversity)
- Sensitiviteit
- Shannon diversity
- Soortenrijkdom

Kwaliteitsmaten

Diversiteitsmaten





Sublitorale Waddenzee

Hotspot

19%

MPA

10%

2%

Ecologische hotspot

MPA

Ontoereikende
beschermingsmaatregelen

Ecotopen

Diep hoogdynamisch

Diep laagdynamisch

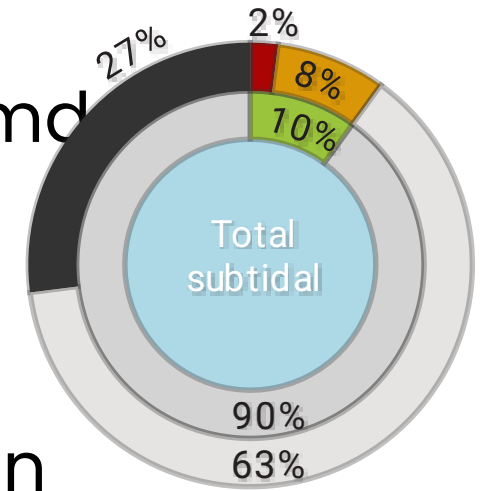
Ondiep hoogdynamisch

Ondiep laagdynamisch

Intertidaal

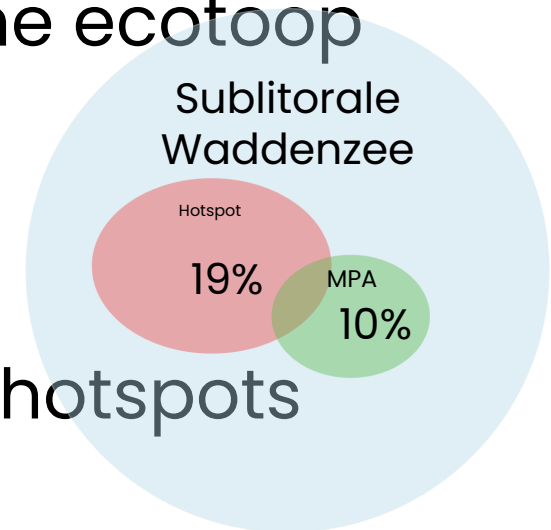
Ontoereikende beschermingsmaatregelen

Van het sublitoraal is maar 2% strikt beschermd
In totaal maar 10% aangewezen tot MPA



Beschermingsmaatregelen en hotspots liggen
voornamelijk in het ondiepe laagdynamische ecotoop

Minimale overlap (2%) tussen effectieve
beschermingsmaatregelen en ecologische hotspots

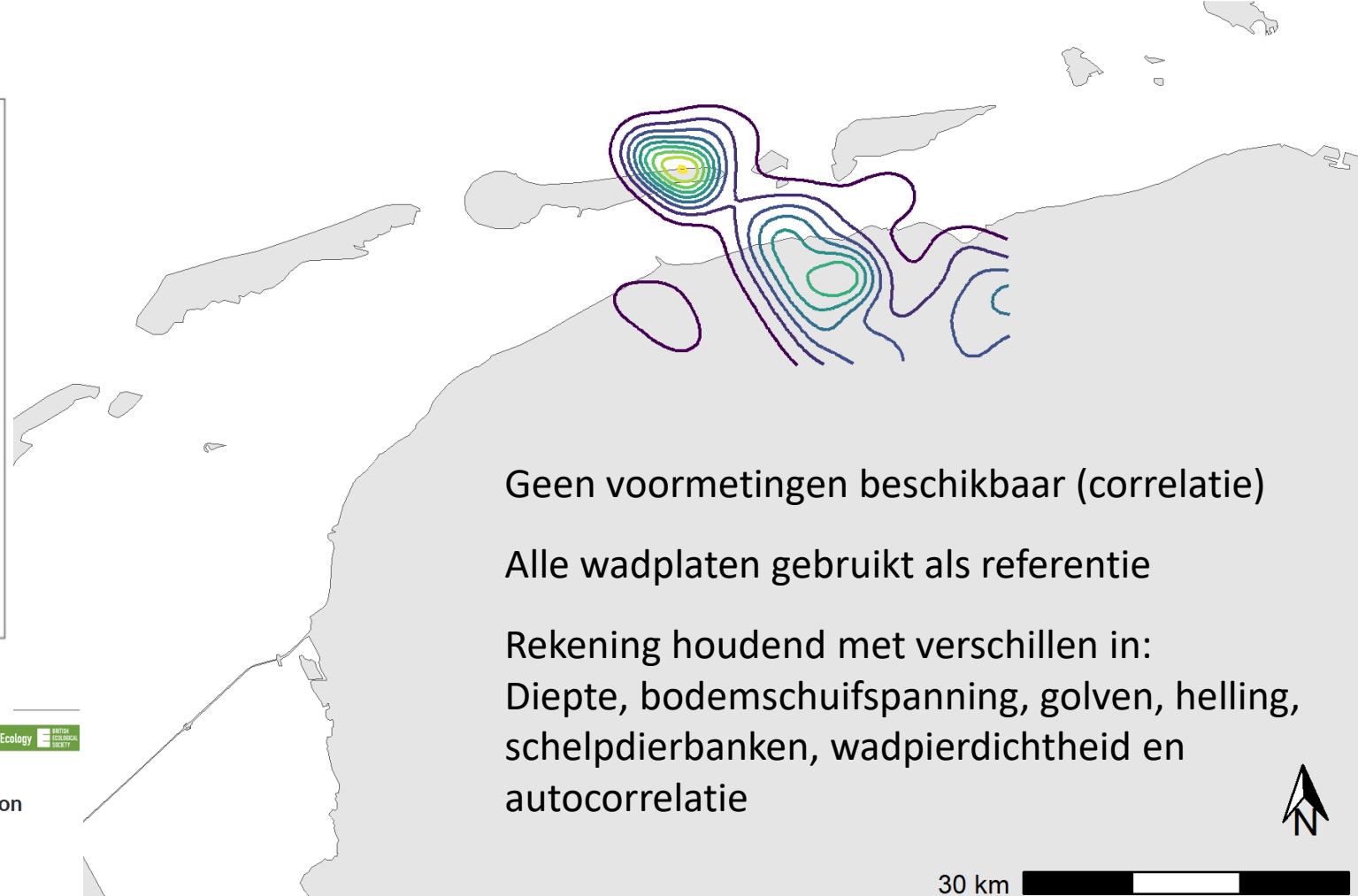
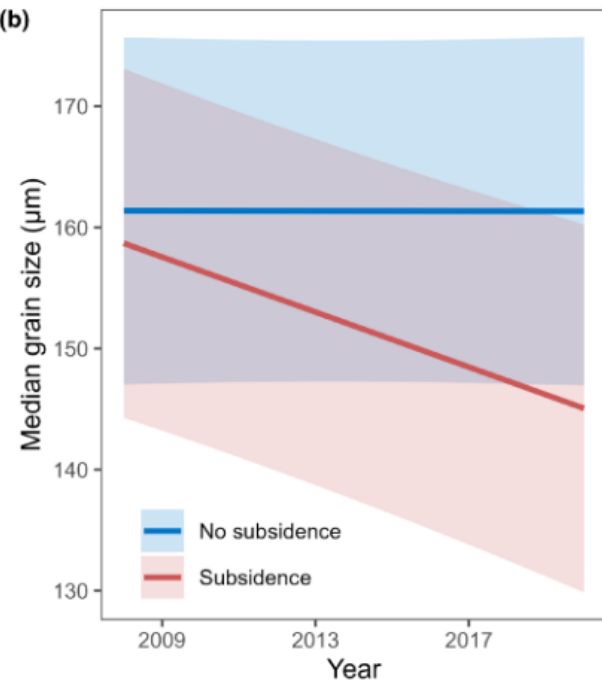




SIBES: Is het wad in het gaswinningsgebied anders?



- Kleiner wordende zandkorrels
- Groter percentage modder
- Geen significante afname in totale biomassa bodemdieren



Geen voormetingen beschikbaar (correlatie)

Alle wadplaten gebruikt als referentie

Rekening houdend met verschillen in:
Diepte, bodemschuifspanning, golven, helling,
schelpdierbanken, wadpierdichtheid en
autocorrelatie

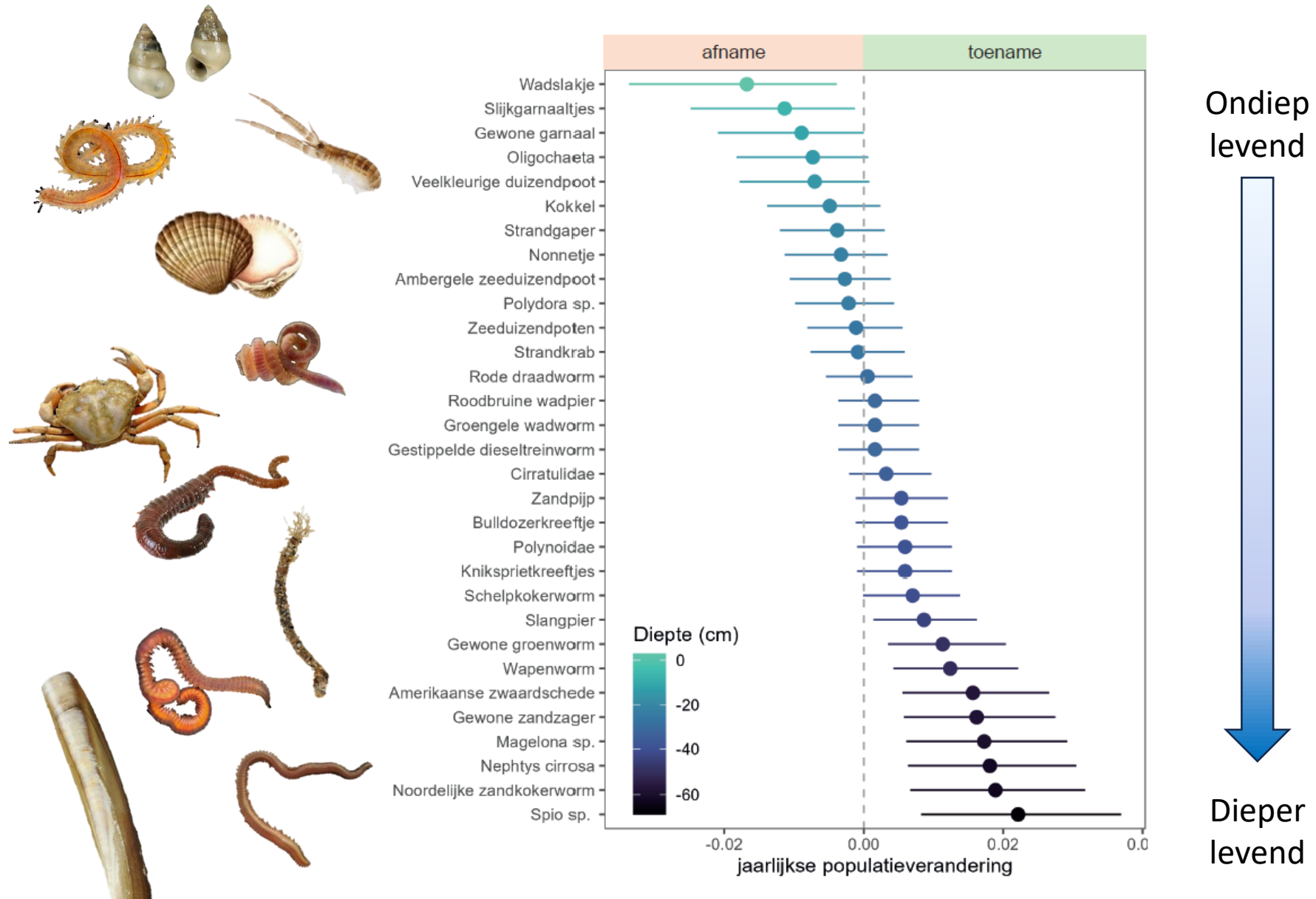
de la Barra et al. (2024) Journal of Applied Ecology

RESEARCH ARTICLE

The effects of gas extraction under intertidal mudflats on sediment and macrozoobenthic communities

Paula de la Barra¹ | Geert Aarts^{1,2} | Allert Bijleveld¹

Veranderende samenstelling bodemdieren



Importance of the Wadden Sea



- Largest intertidal mudflat system of the world
- Essential for many species
 - Sea mammals
 - (Migratory) birds
 - Fish
- Economic importance
- The food web depends on species on and in the sediment (epi- and endobenthos)



wadden sea benth* communit* intertidal: ~ 1480 results

wadden sea benth* communit* subtidal: ~ 226 results

~ 15% of studies subtidal