Assessing the impact of dredge disposal on three ecosystem components in the Belgian part of the North Sea

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Session 1: Sediment quality and risk assessment

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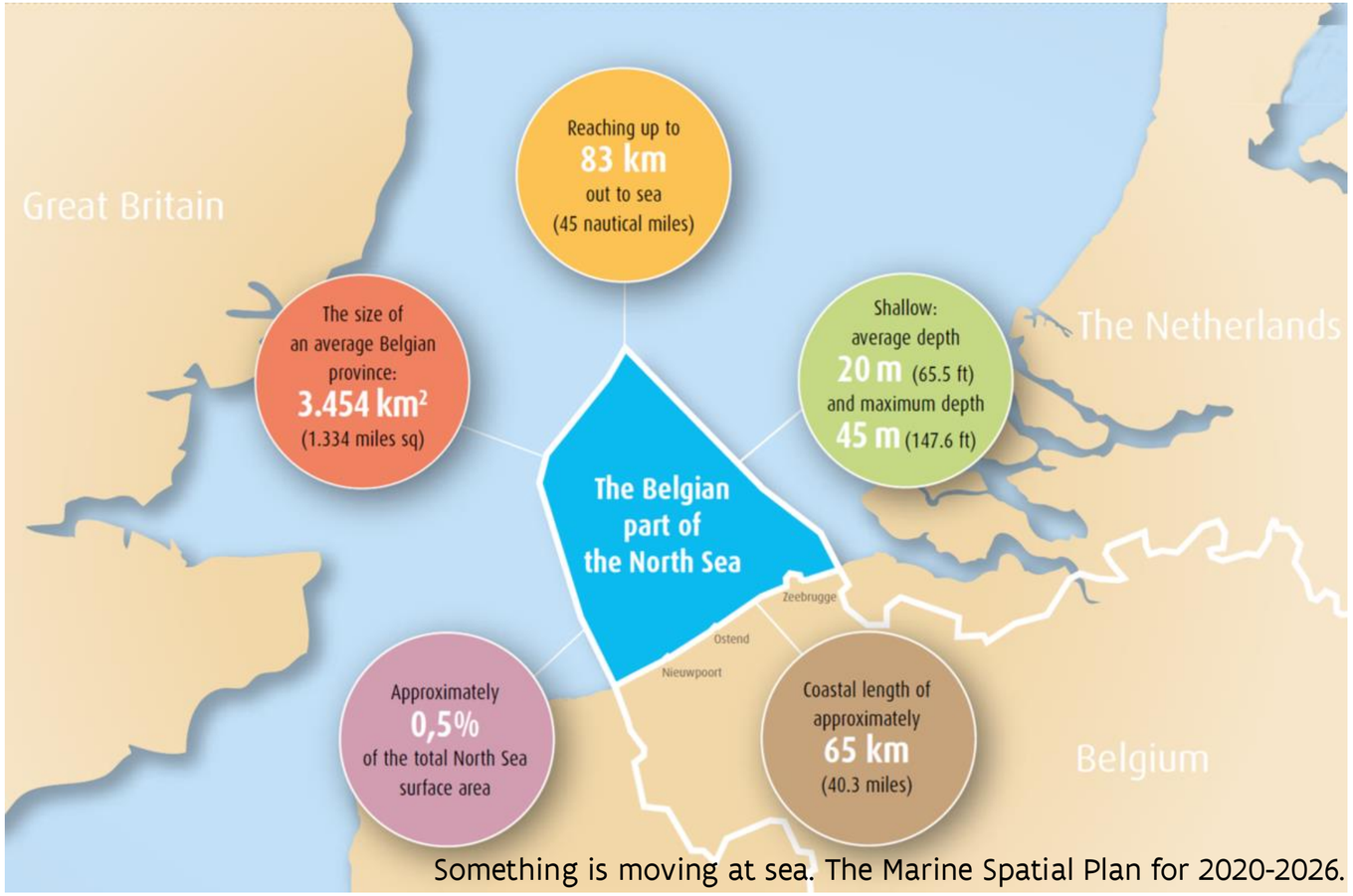
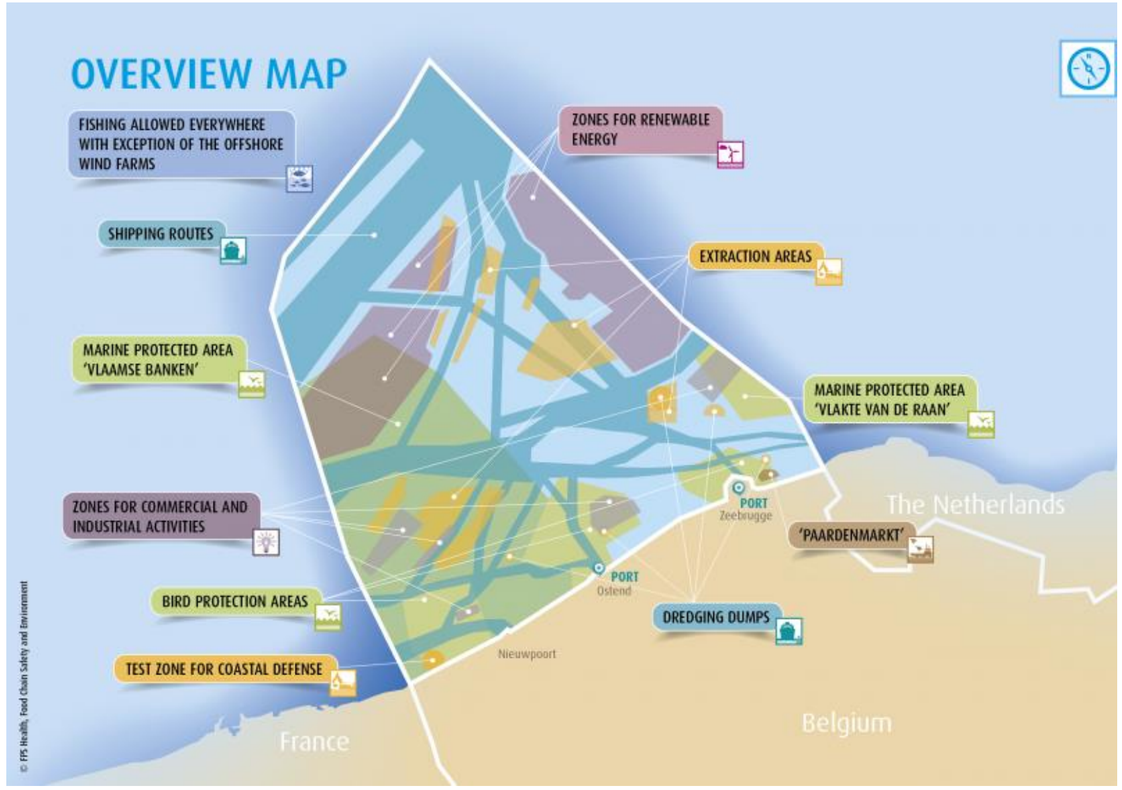
Belgian part of the North Sea (BPNS)



Something is moving at sea. The Marine Spatial Plan for 2020-2026.

Impact on the marine environment in the BPNS



11 x 10^6 tonnes dry matter/ yr

67x 

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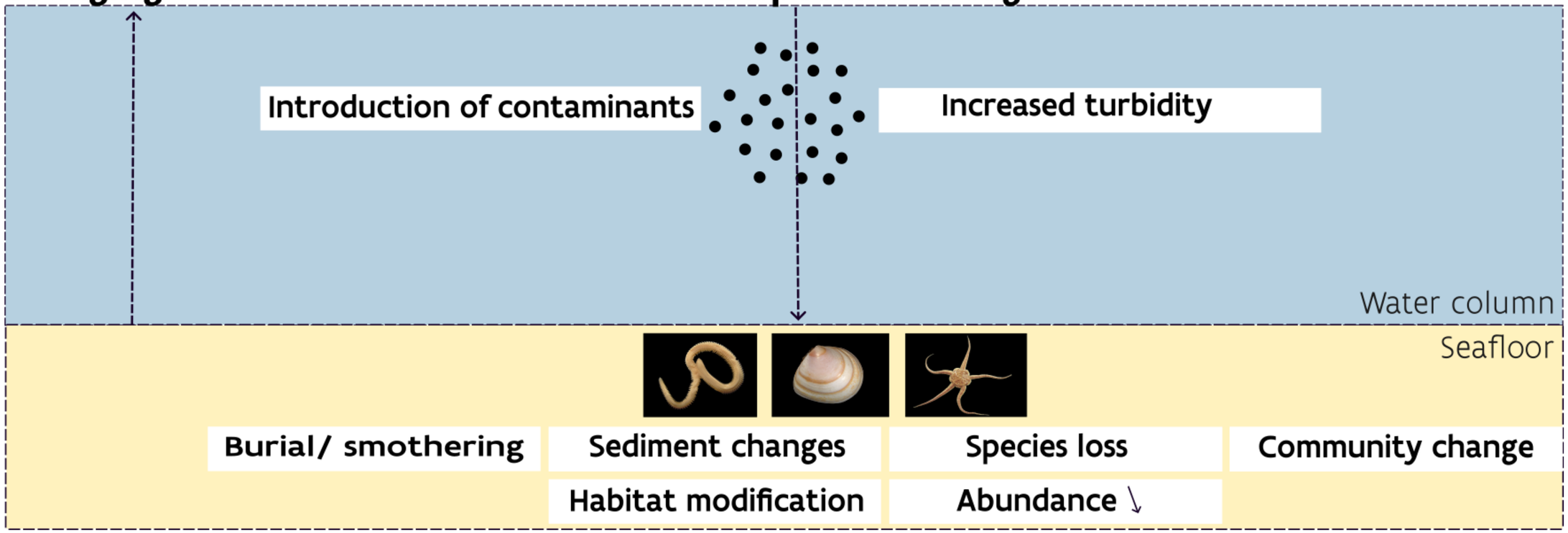
Dredging activities

Dredging of harbours → **Disposal of dredged material**



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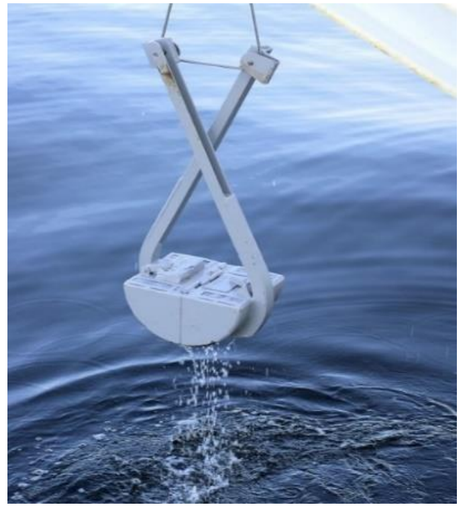
1. What is the impact of dredge disposal on 3 ecosystem components in 3 different habitat types?
Indicator approach

2. What is the relationship between the response of the benthic ecosystem (impact) and disposal intensity (pressure)?
3. Does the impact of dredge disposal differ between the 3 habitat types?
Linear mixed effects models

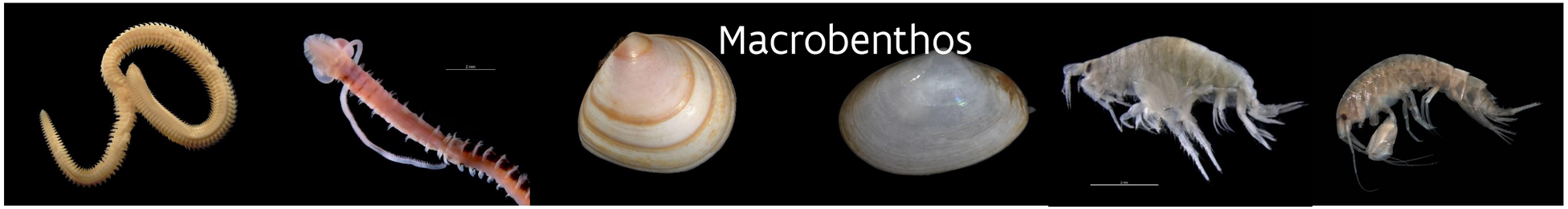
Research questions

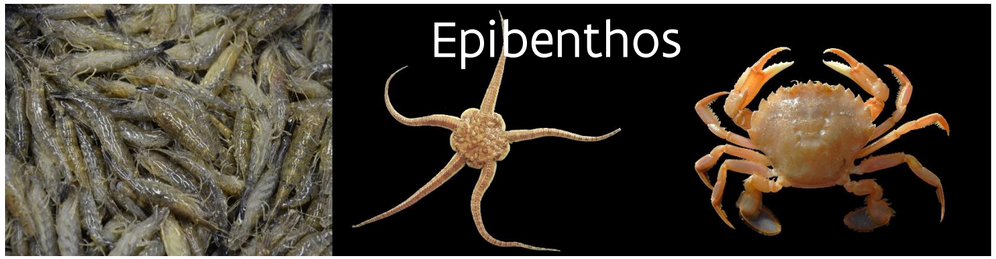
- 15 years sampling (2005-2019) – autumn & spring
- Control – impact design

- Van Veen grab
- 8-m beam trawl with shrimp net



- 3 ecosystem components





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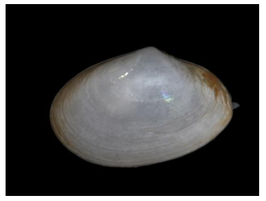
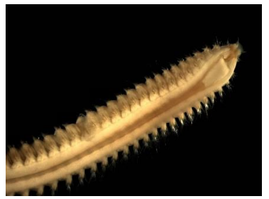
Sampling scheme in the Belgian coastal zone

Abra alba – fine muddy sand



Nephtys cirrosa – sandy



Macoma balthica – muddy

Dredge disposal site

Van Veen grabs
- Impact
- Control

Trawls
- Impact
- Control

- *Abra alba*
- *Macoma balthica*
- *Nephtys cirrosa*
- *Hesionura elongata*
- *Magelona - Ensis*
- BPNS boundary

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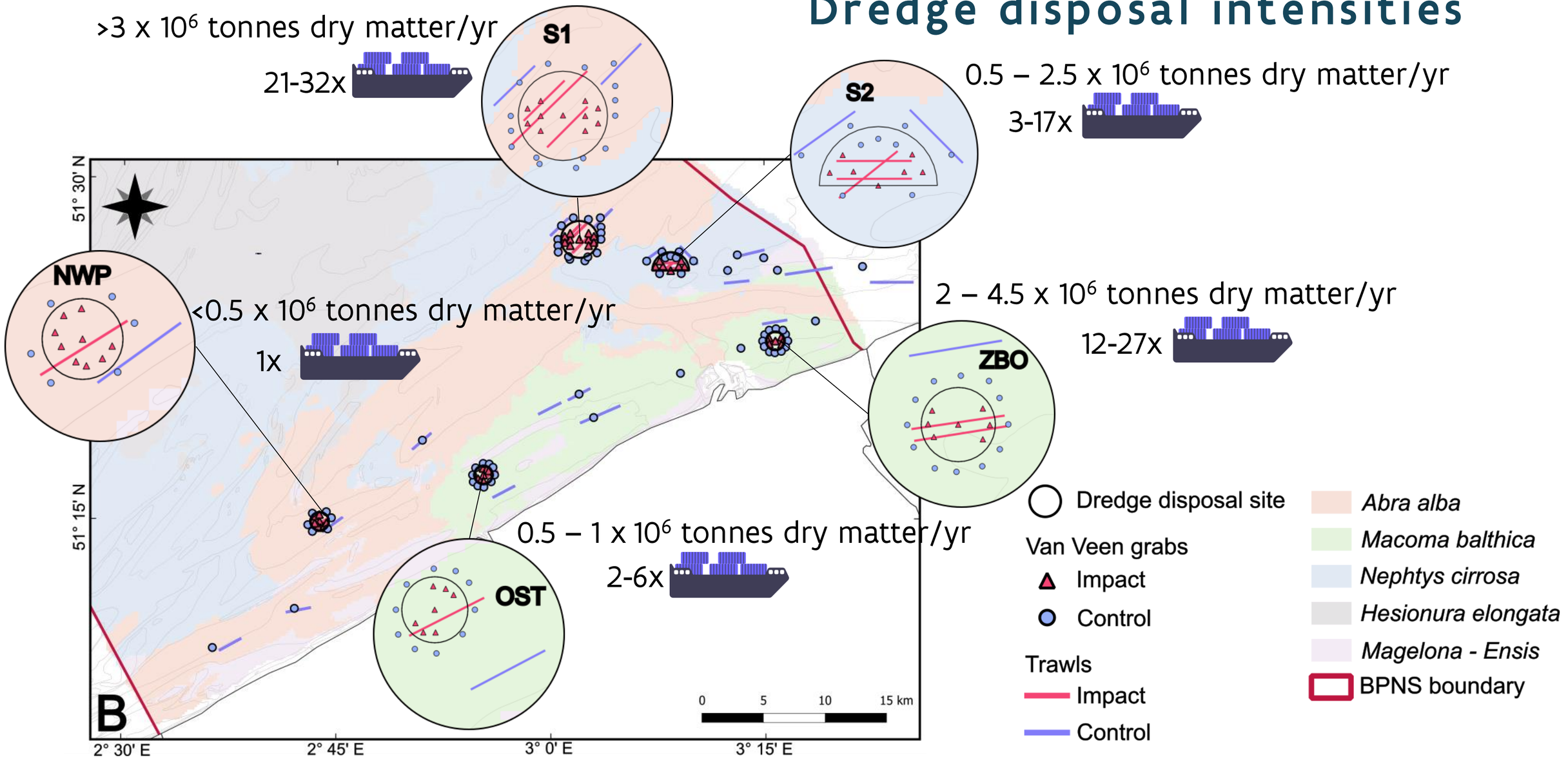
Dredge disposal intensities



Benthic Ecosystem Quality Indicator (BEQI)

- Ecological quality (EcoQ)
- Control – impact design
- Water Framework Directive
- Marine Strategy Framework Directive

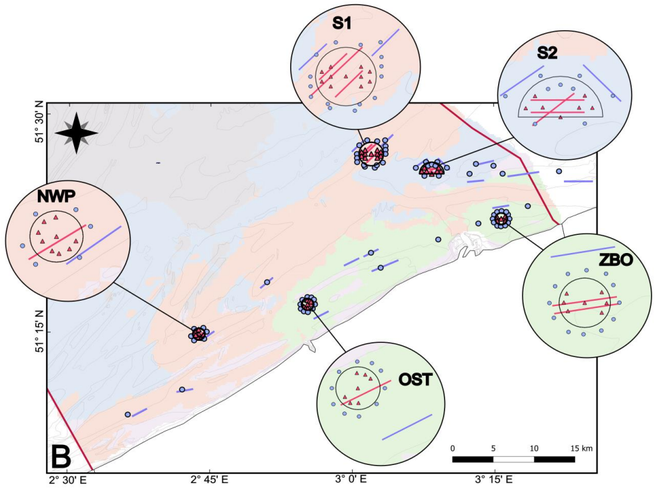
BEQI method (Van Hoey et al., 2007)

Ecosystem component	Impact locations per year or season	Control locations per year or season
Macrobenthos	7	6-12
Epibenthos	1-2	1-2
Demersal and benthopelagic fish	1-2	1-2

→ Per year — Autumn

→ 2005-2009 — Autumn
2010-2015 — Spring
2016-2019

Indicator approach



Average BEQI scores (period 2005-2019).

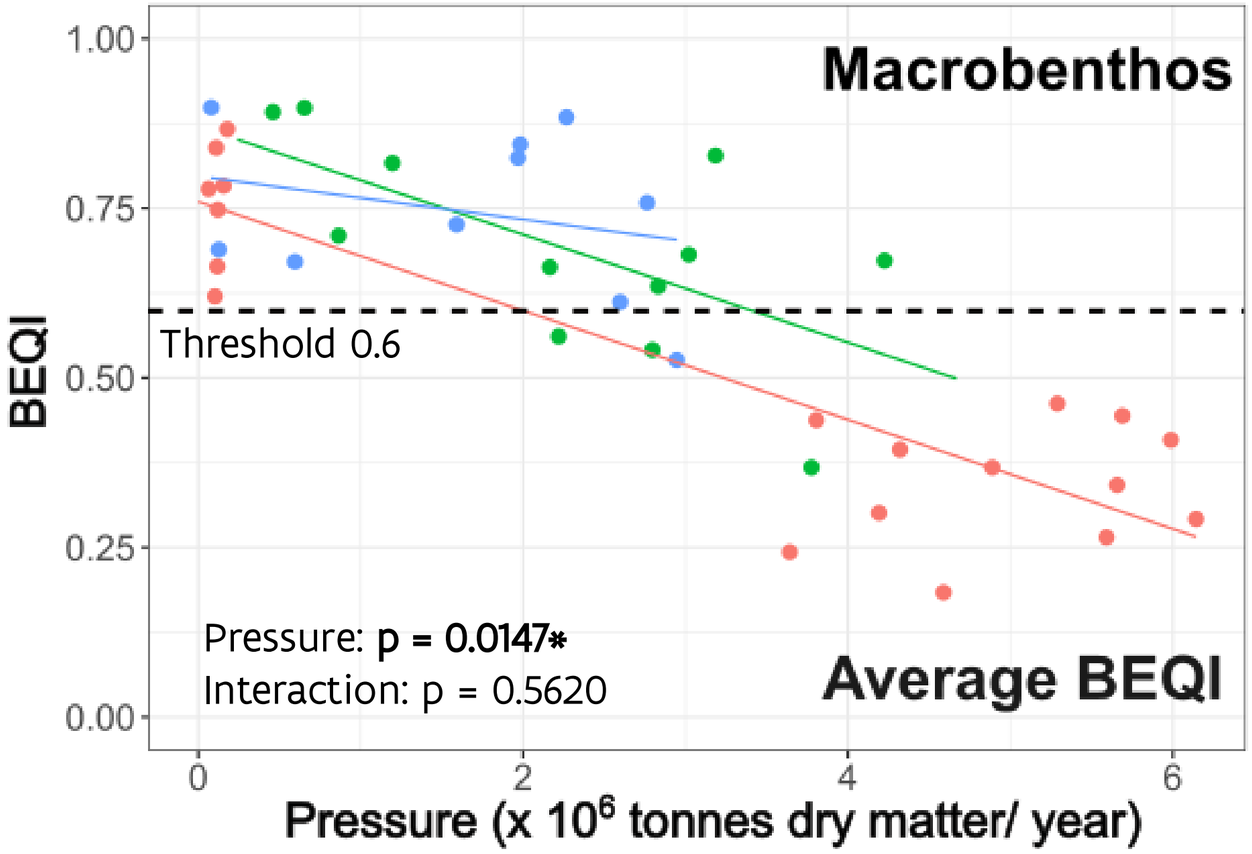
Habitat	Disposal site	Disposal intensity (tonnes dry matter/ year)	Macrobenthos	Epibenthos		Demersal and benthopelgic fish	
			Autumn	Spring	Autumn	Spring	Autumn
Abra alba	NWP	157.422	0.771	0.805	0.786	0.757	0.803
	S1	5.338.987	0.338	0.497	0.587	0.765	0.696
Macoma balthica	OST	551.799	0.833	0.607	0.779	0.755	0.848
	ZBO	3.121.180	0.669	0.713	0.777	0.668	0.710
Nephtys cirrosa	S2	1.822.327	0.761	0.822	0.798	0.785	0.760

Benthic Ecosystem Quality Index (BEQI) scale:

0 - 0.2	0.2 - 0.4	0.4 - 0.6	0.6 - 0.8	0.8 - 1
BAD	POOR	MODERATE	GOOD	HIGH

Linear mixed effects models – impact vs. pressure

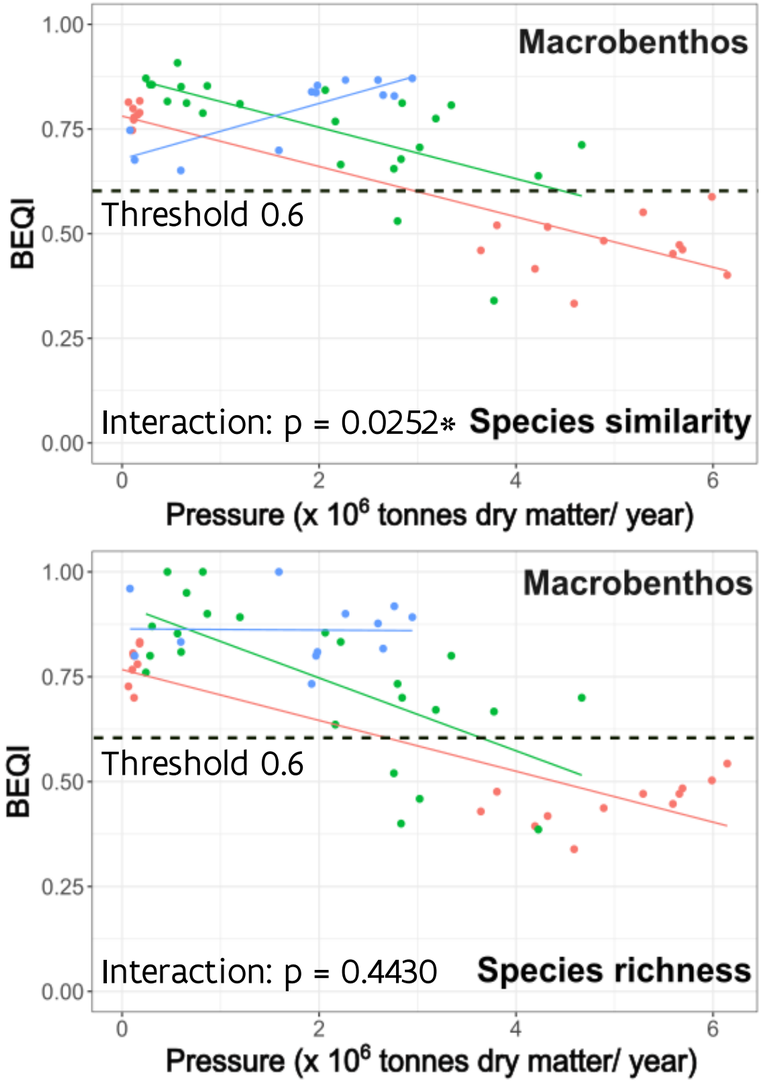
BEQI in function of the disposal intensities for macrobenthos (period 2006-2019).



BEQI ~ Pressure * Habitat + (1 | Year) + (1 | Disposal site)

Abra alba
Macoma balthica
Nephtys cirrosa

Linear mixed effects models – impact vs. pressure



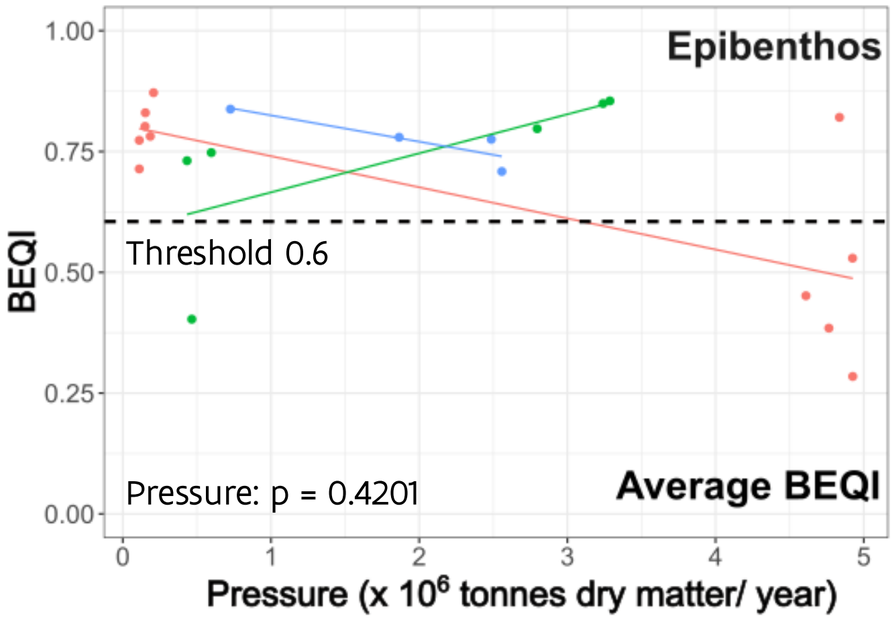
BEQI in function of the disposal intensities for macrobenthos (period 2006-2019).

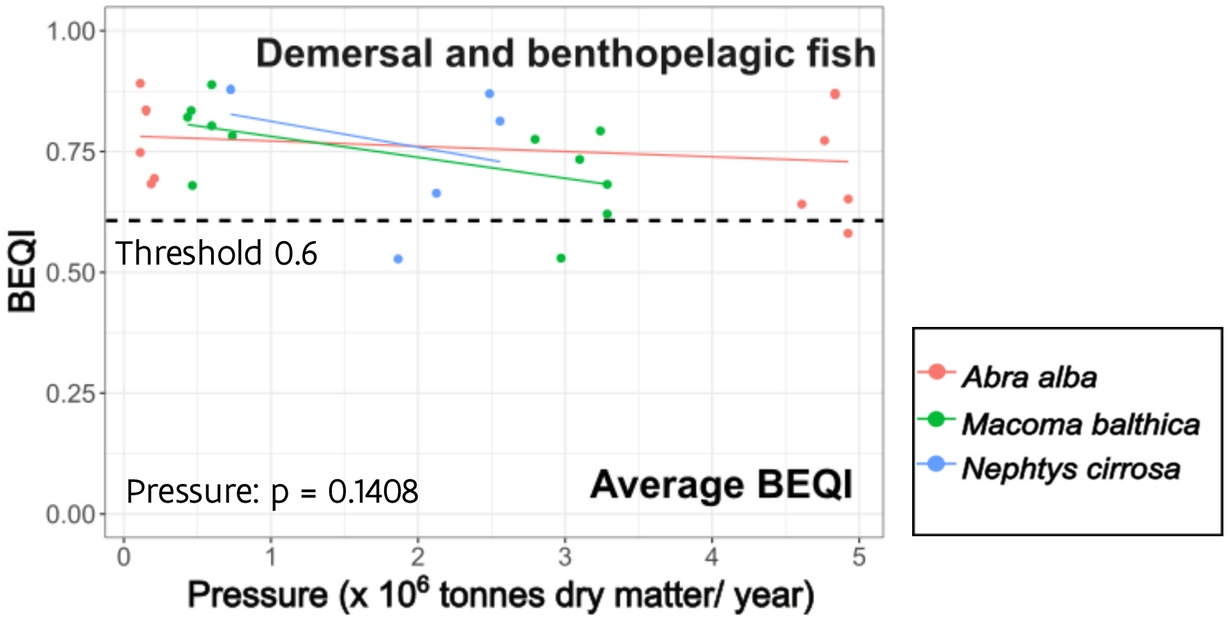
- Species composition at the impact and control site more similar in the *Nephtys cirrosa* habitat

- Higher species richness at the impact site vs. control site in the *Nephtys cirrosa* habitat (high EQR scores)
- Attraction of species

Linear mixed effects models – impact vs. pressure

BEQI in function of disposal intensities for epibenthos and demersal fish (period 2005-2019).





Take home messages

1. What is the impact of dredge disposal on 3 ecosystem components in 3 different habitat types?

- **Highest impact** at site with **highest dumping.**
- Most pronounced for **macrobenthos** due to the **restricted mobility.**
- **Indirect** effect on **epibenthos** and **demersal fish** due to **sedimentological** changes and/ or changes in the **macrobenthic community.**

2. What is the relationship between the response of the benthic ecosystem (impact) and disposal intensity (pressure)?

- Significant **pressure effect** (for **macrobenthos**).

Take home messages

3. Does the impact of dredge disposal differ between the 3 habitat types?

- **Impact not** significantly **different** between the **3 habitat** types.
- But: **Absence of evidence is not evidence of absence.**
  → This does not imply an **equal response** between the **3 habitat** types.
- **Limitation** in the **number of observations**, especially for **intermediate** and **high** pressure.

Thank you for your attention!

Questions?

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Seghers S., Ampe B., Buyse J., Hostens K., Van Hoey G. Assessing the impact of dredge disposal on three ecosystem components. Marine Pollution Bulletin (under review).

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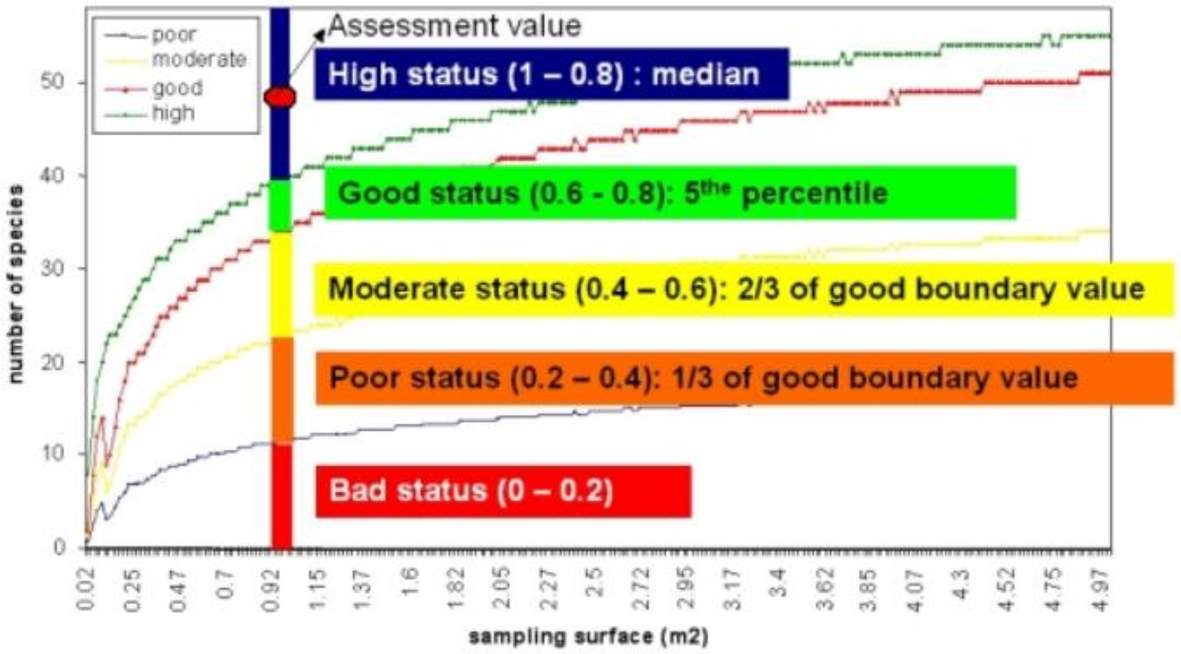
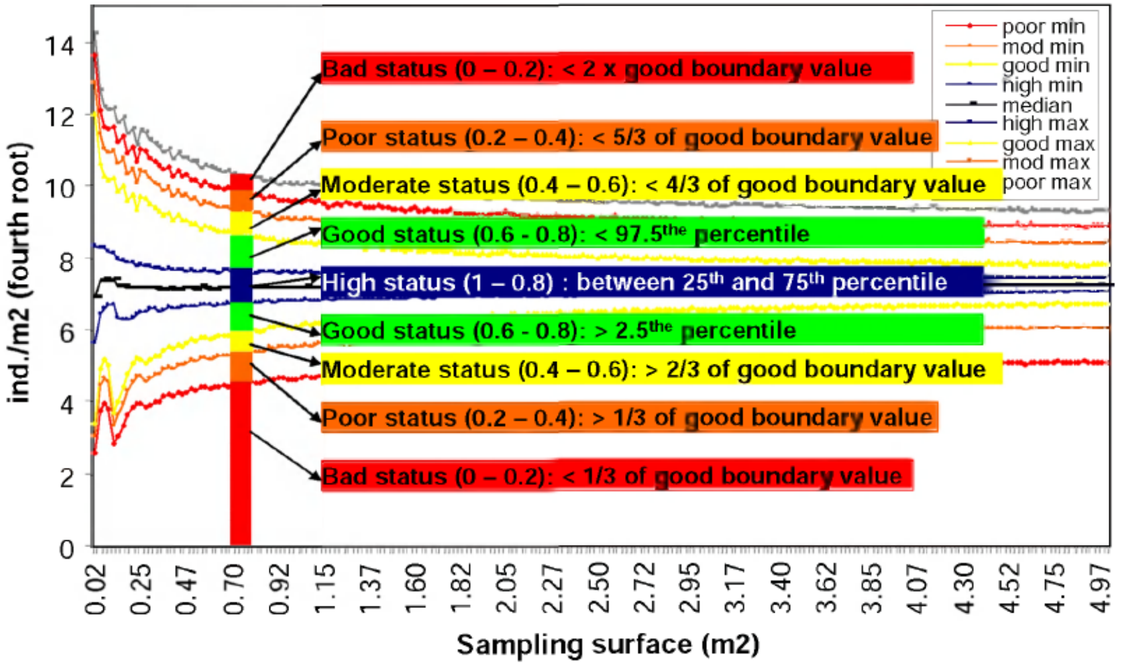
Indicator approach



Species richness
Species similarity



Density
Biomass

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Linear mixed effects modelling

- Correlation between response of the benthic ecosystem (BEQI) and the dumping intensity (pressure)

BEQI ~ Pressure * Habitat + (1 | Year) + (1 | Disposal site) — Macrobenthos

BEQI ~ Pressure * Habitat + (1 | Period) + (1 | Disposal site) + (1 | Season) — Epibenthos/ demersal and benthopelagic fish

Response variable | Fixed effects | Random effects

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