

MONITORING ENVIRONMENTAL IMPACTS OF OFFSHORE WIND FARMS IN THE BELGIAN PART OF THE NORTH SEA

WHAT HAPPENS WITH THE SAND AND ITS INHABITANTS?

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Presented by Sofie Vandendriessche & Dries Van den Eynde



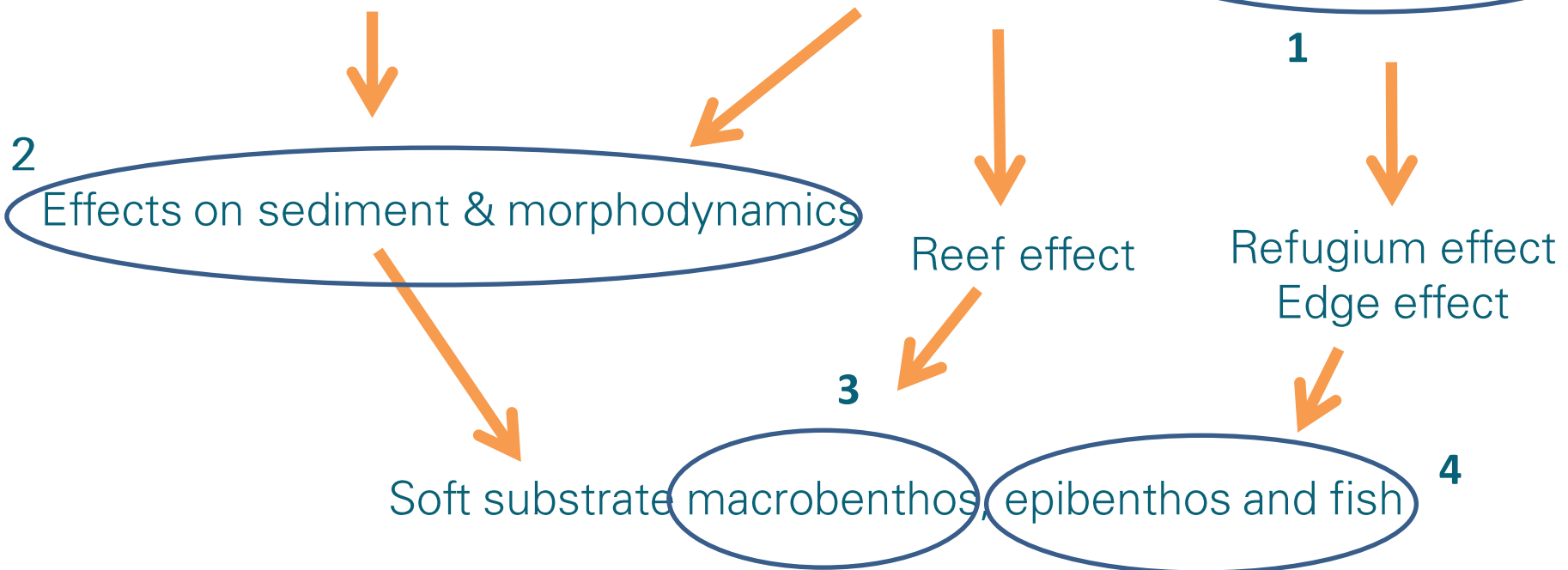
LEARNING FROM THE PAST TO OPTIMISE
FUTURE MONITORING



Construction and maintenance

Physical presence

Absence of fisheries





Construction and maintenance

Physical presence

Absence of fisheries



Effects on sediment & morphodynamics

Reef effect

Refugium effect
Edge effect



Soft substrate macrobenthos, epibenthos and fish



SAND AND ITS INHABITANTS

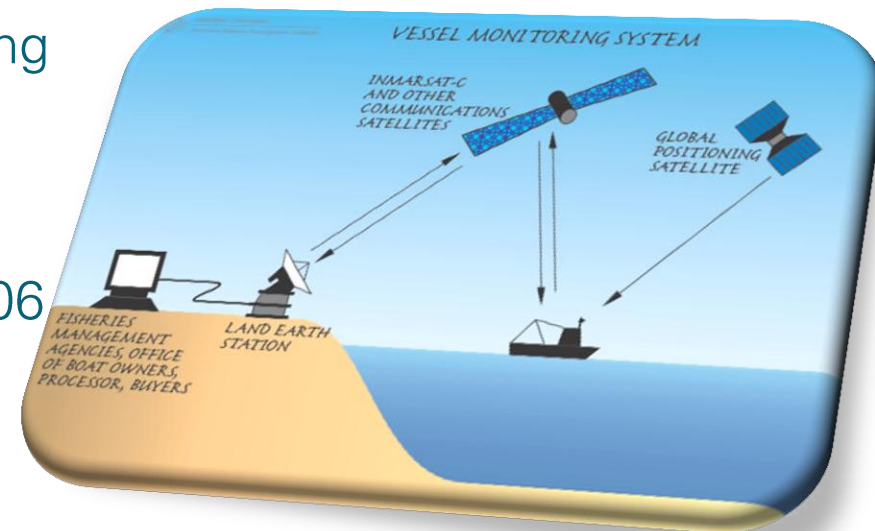


FISHERIES ACTIVITIES: WIND FARMS AS CLOSED AREAS

- recovery of spawning and nursing grounds
- the recovery of benthic communities and diversity within the area
- edge effects along the borders resulting from displacement of fisheries activities

VMS = Vessel Monitoring System = fisheries surveillance tool

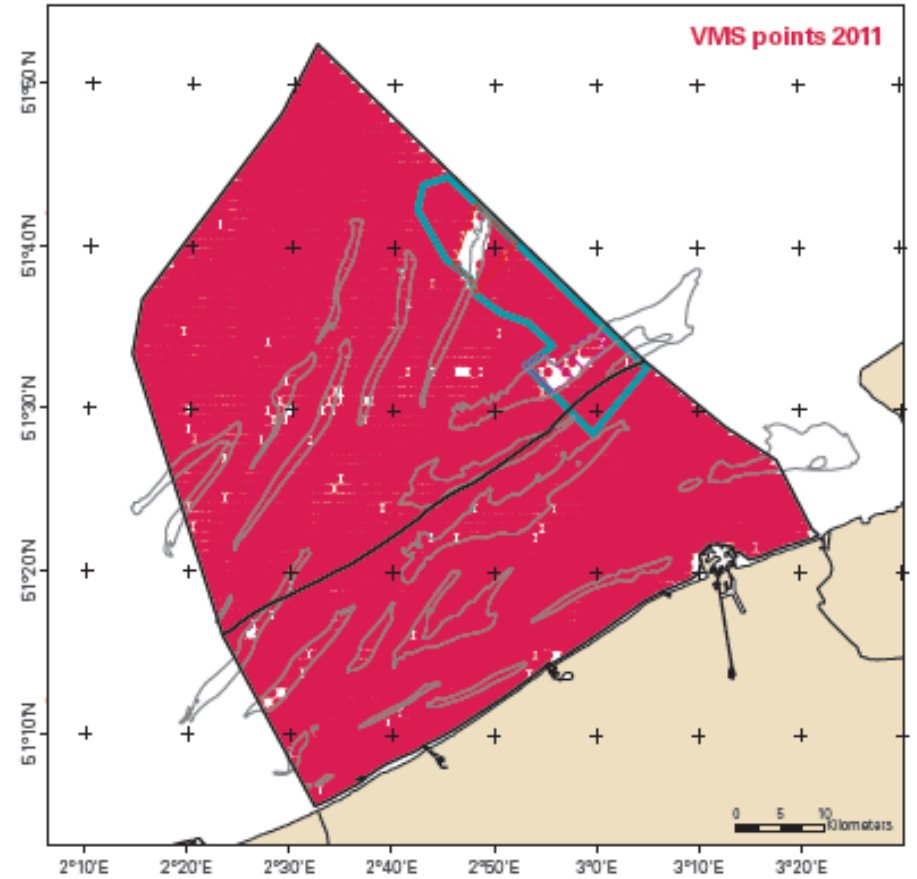
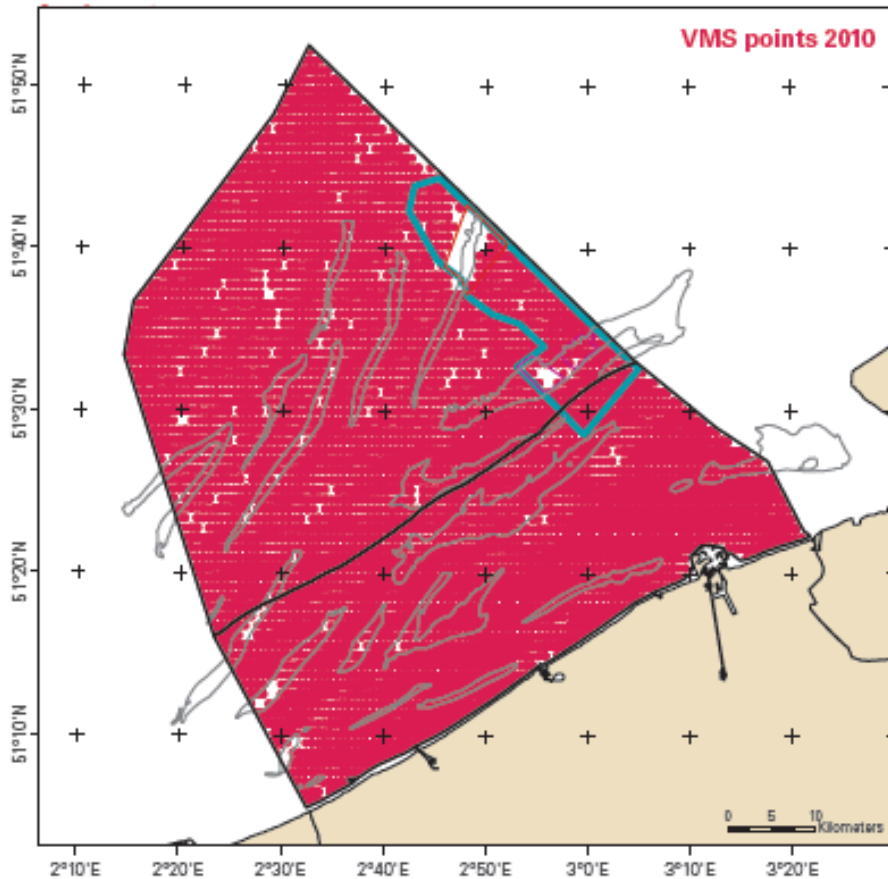
- Satellite based: position, speed, heading
- Mandatory for vessels > 15m
- Min. Registration every 2h
- BPNS:
 - ✓ B: registrations & métier since 2006
 - ✓ NL: registration 2010 - 2011
 - ✓ UK: registrations 2007 - 2011
 - ✓ DK, DE, F: /



SAND AND ITS INHABITANTS



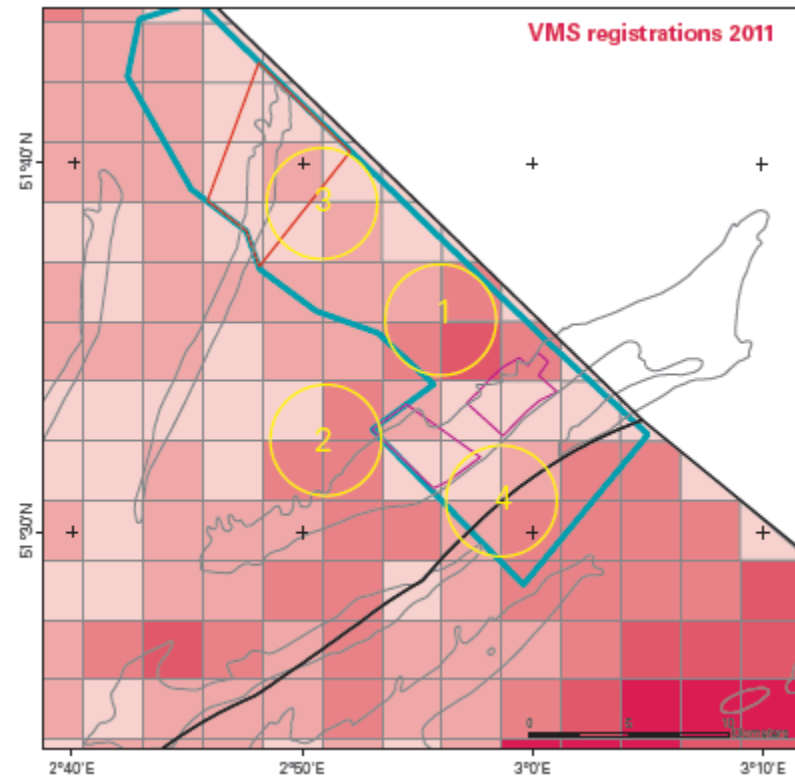
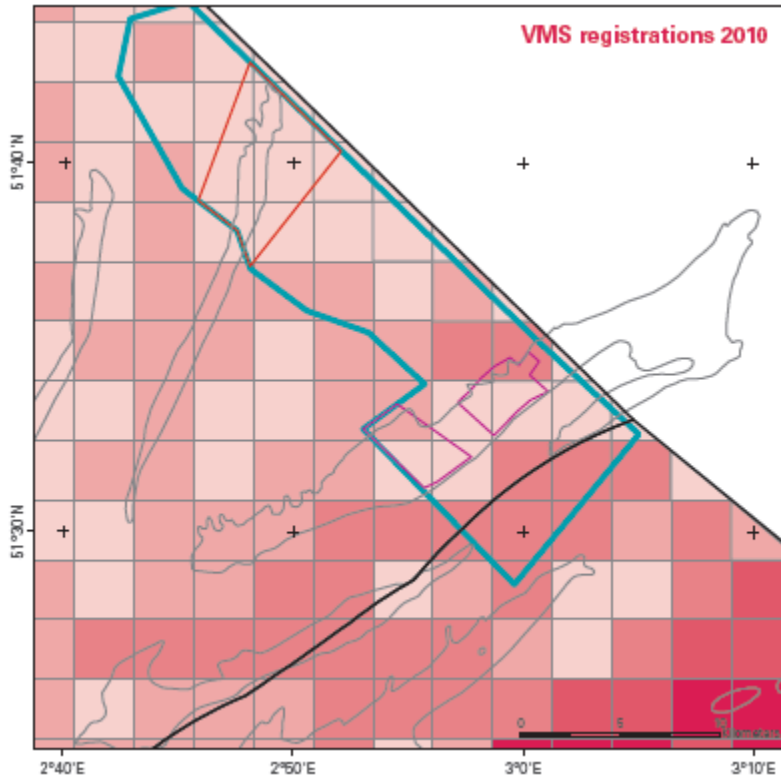
Where are the trawlers? Everywhere except...



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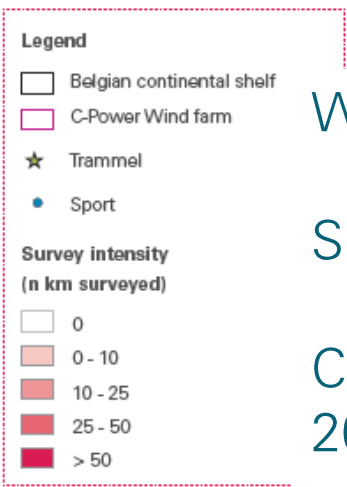
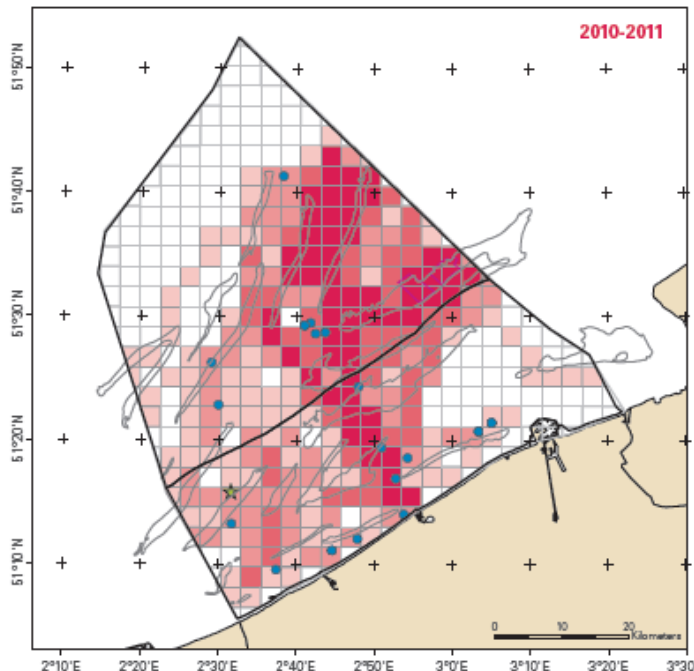
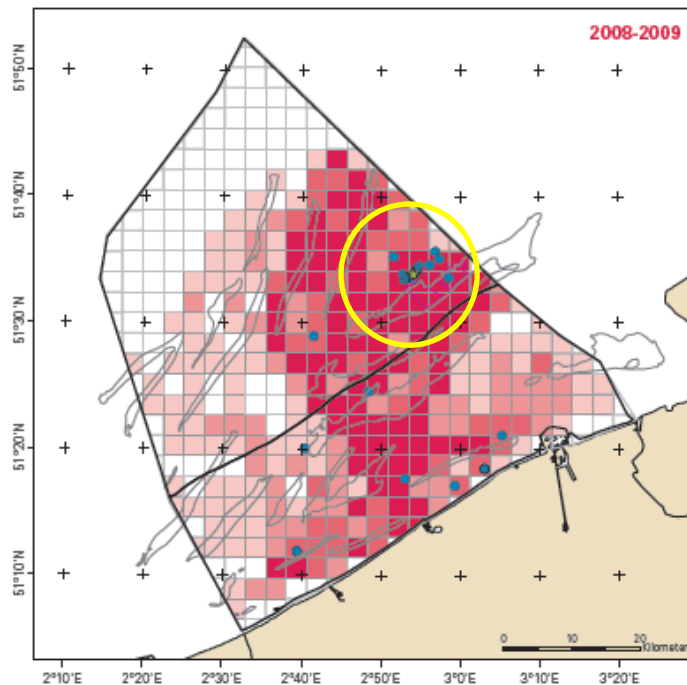
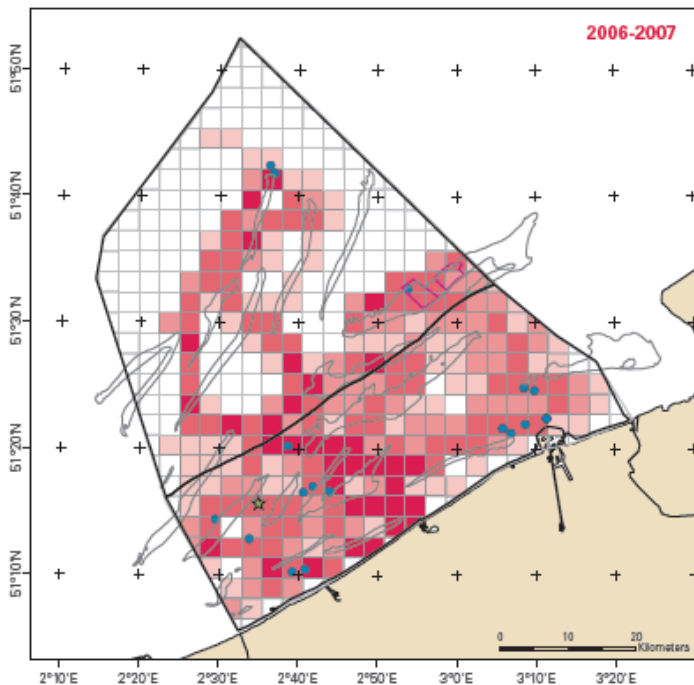
N° of VMS registrations per grid cell



Redistribution effect OR change in availability of commercially important fish?



Need to integrate VMS data with logbook data



What about vessels < 15m?

Shipbased survey data

Changes in intensity of angling in 2008-2009 but gone afterwards

- => less fish than expected
- => wind farm too far
- = >??

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Conclusions

- ✓ Wind farms are closed areas and are (almost) trawler free
- ✓ Fisheries activities change in the vicinity of wind farms
- ✓ VMS and logbook data needed on vessels of all flag states fishing in the Belgian part of the North Sea
- ✓ VMS & shipbased surveys provide complementary data





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MORPHODYNAMIC CHANGES

- Change of turbidity
- Scour around the foundations
- Dredging and dumping activities
- Depth of burial of export cables

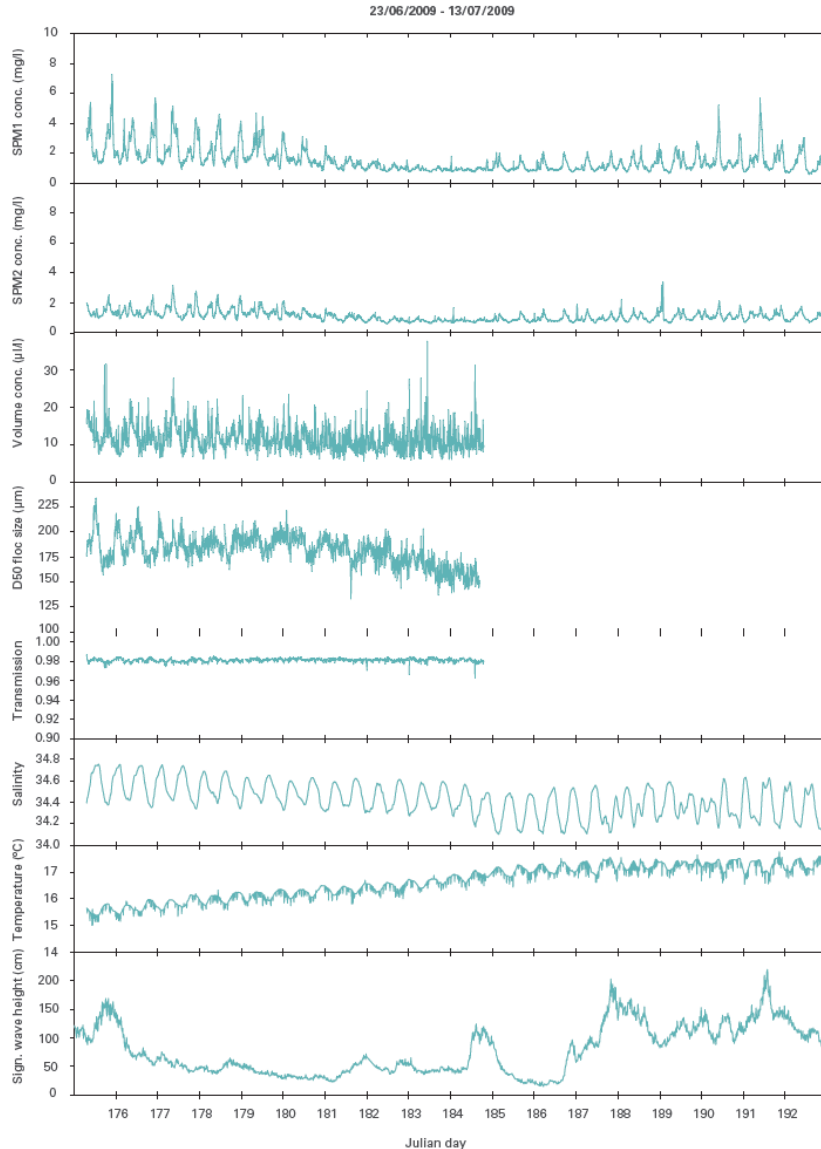
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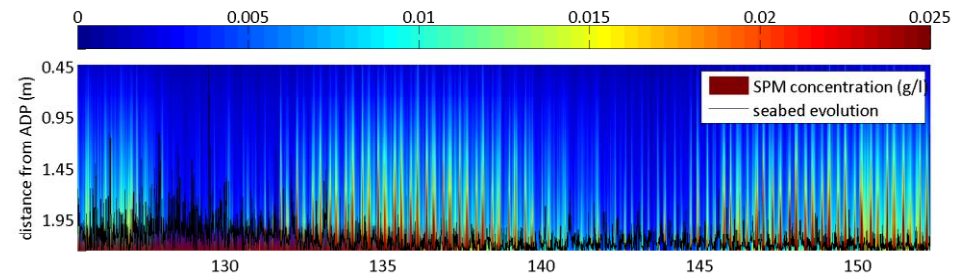
TURBIDITY CHANGES



SAND AND ITS INHABITANTS



TURBIDITY CHANGES

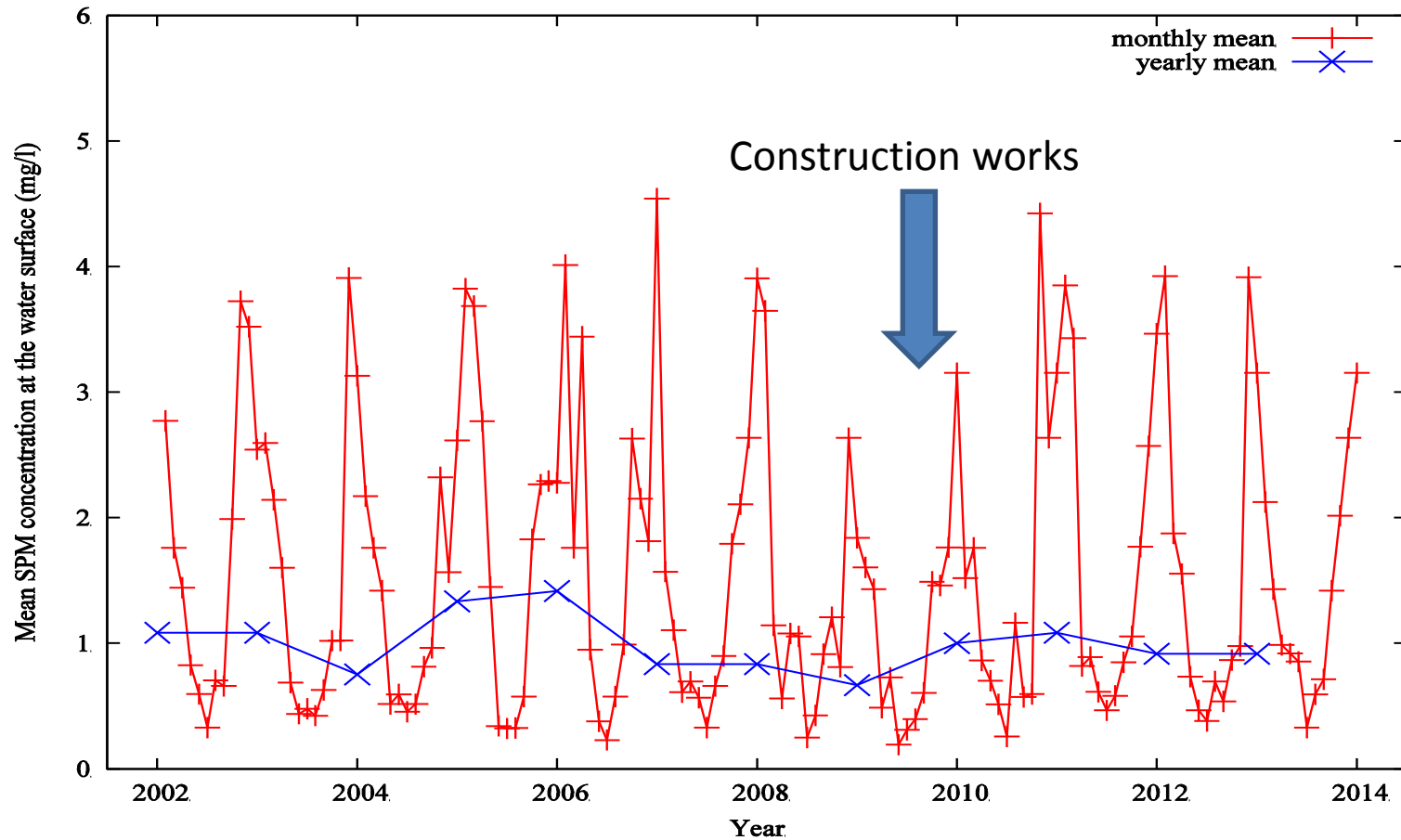


- No significant changes in turbidity detected
- Gootebank not a good reference station
- Long time series necessary

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TURBIDITY CHANGES

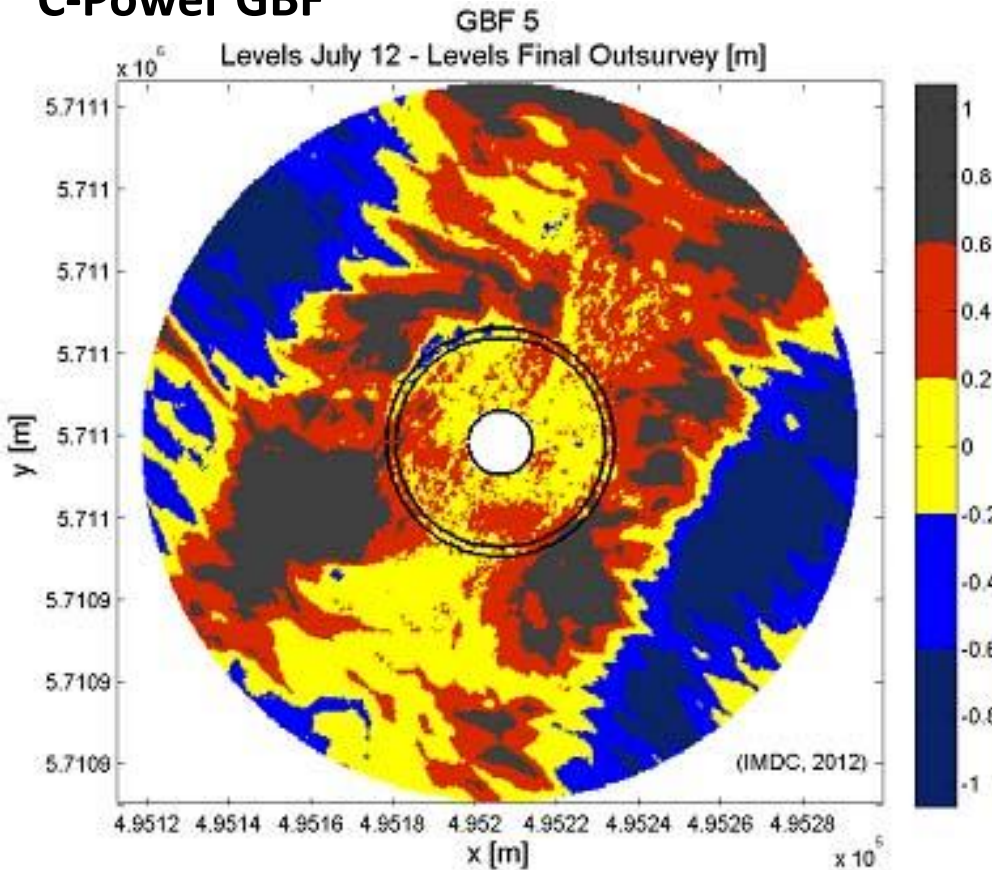


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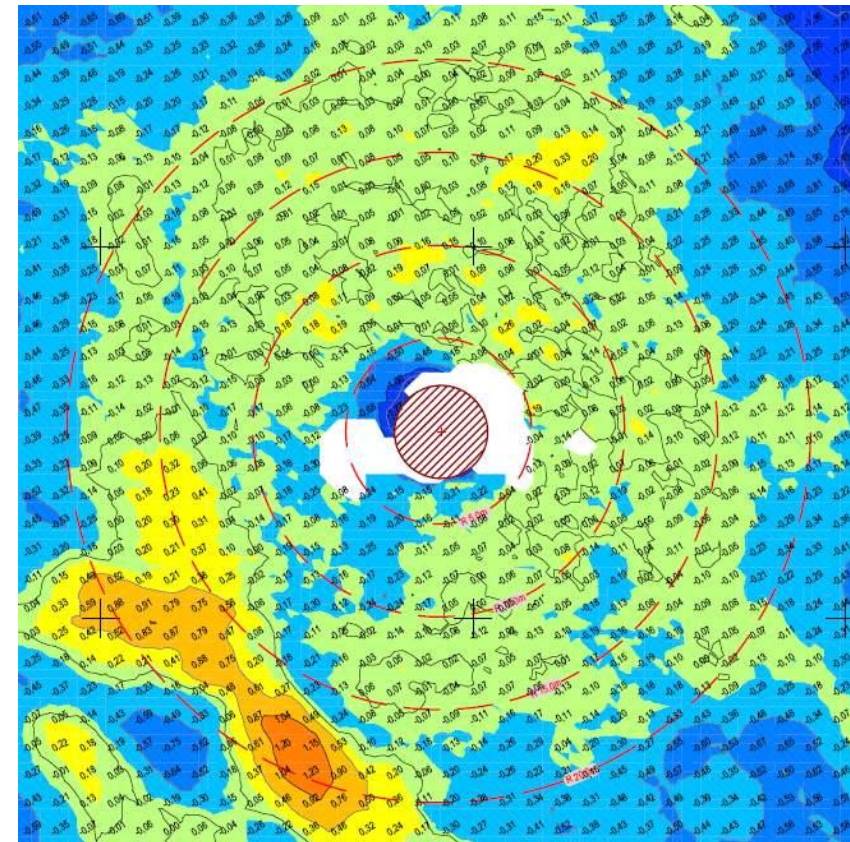


SCOUR AROUND FOUNDATIONS

C-Power GBF



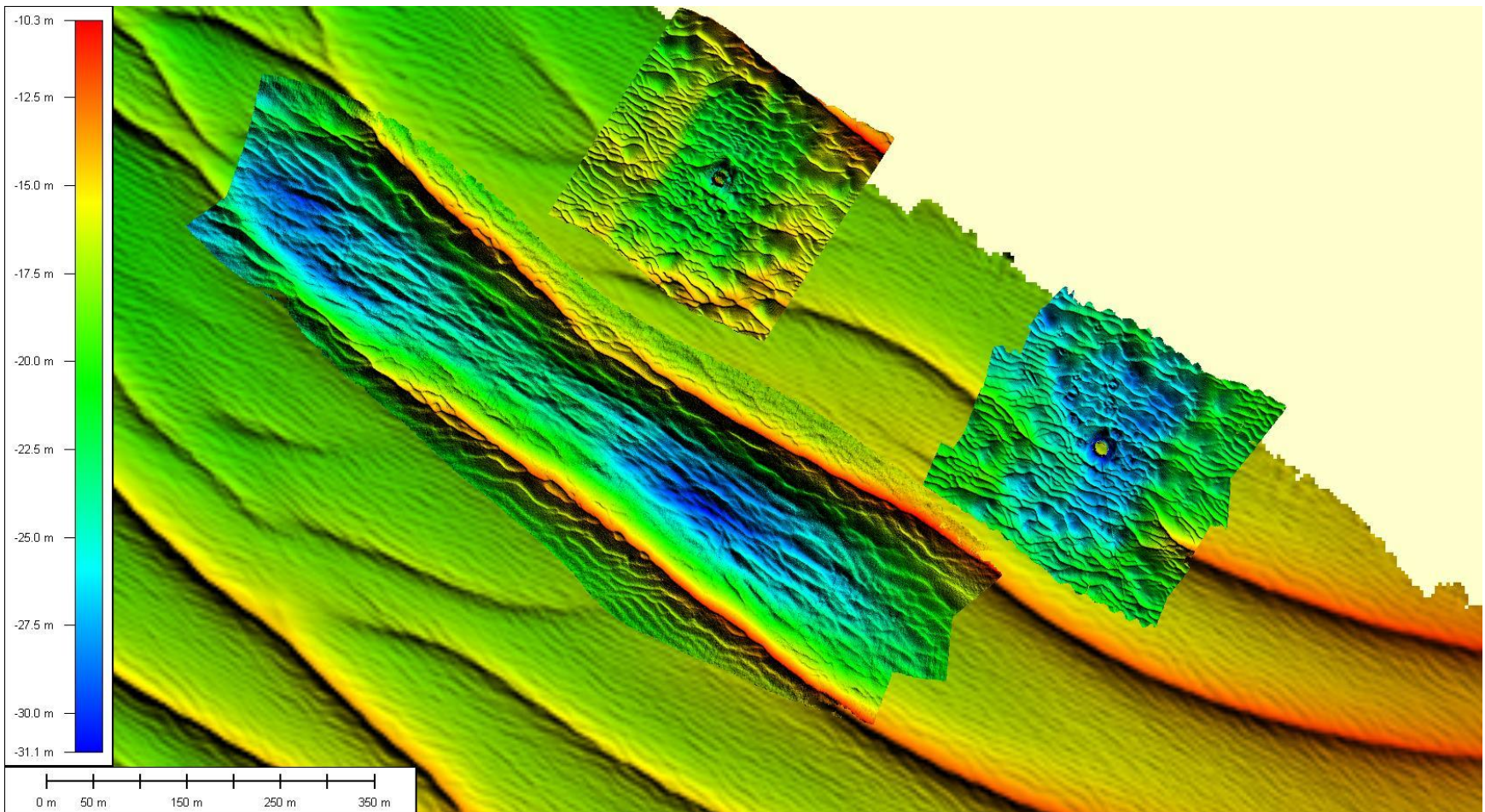
Belwind monopile



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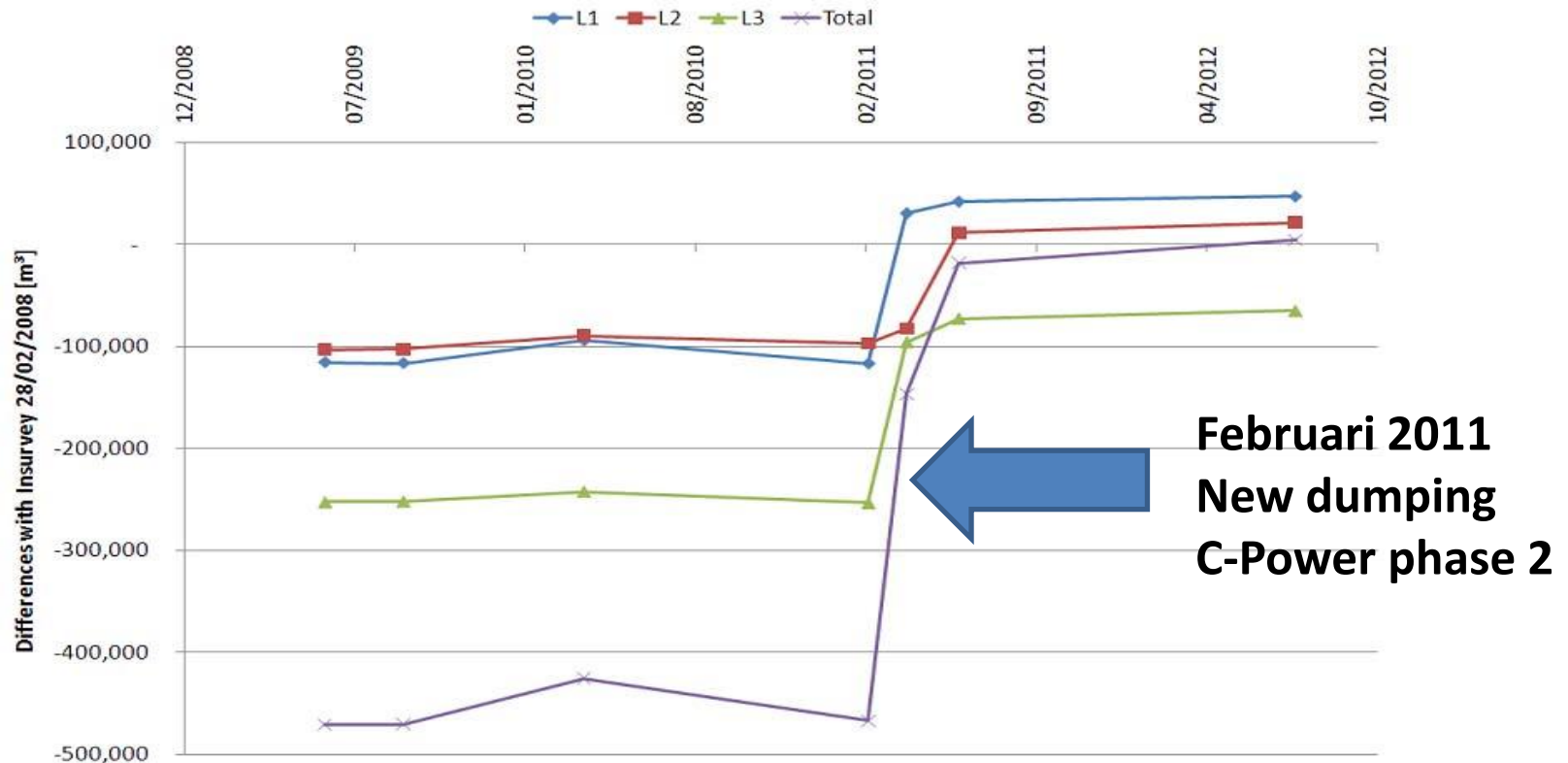
DUMPING AND DREDGING



SAND AND ITS INHABITANTS



DUMPING AND DREDGING





Construction and maintenance

Physical presence

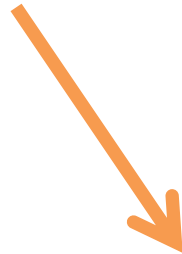
Absence of fisheries



Effects on sediment & morphodynamics

Reef effect

Refugium effect
Edge effect



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Soft substrate macrobenthos, epibenthos and fish

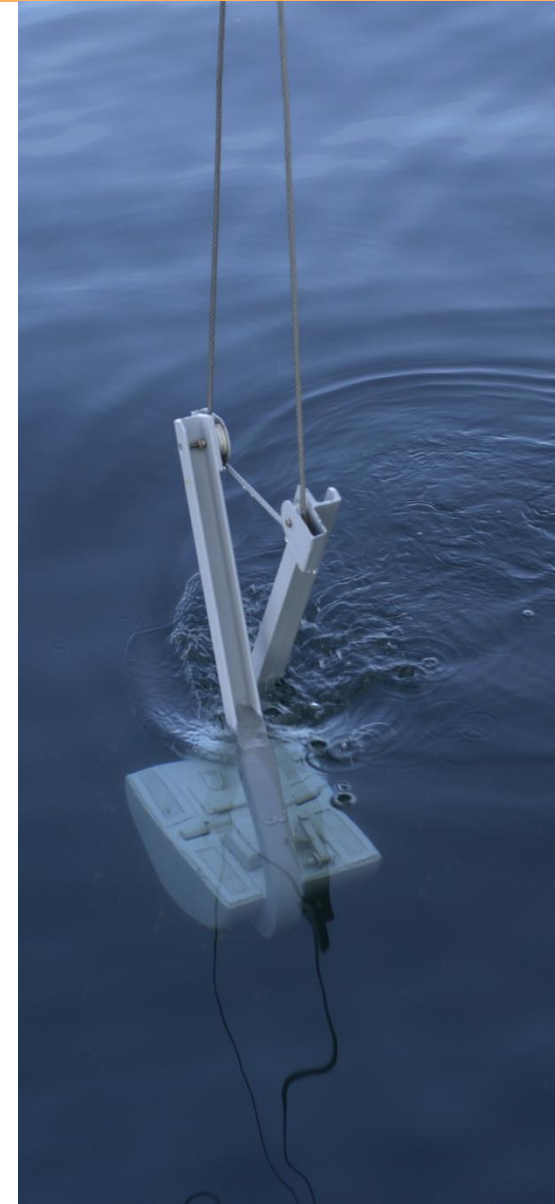


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MACROFAUNA

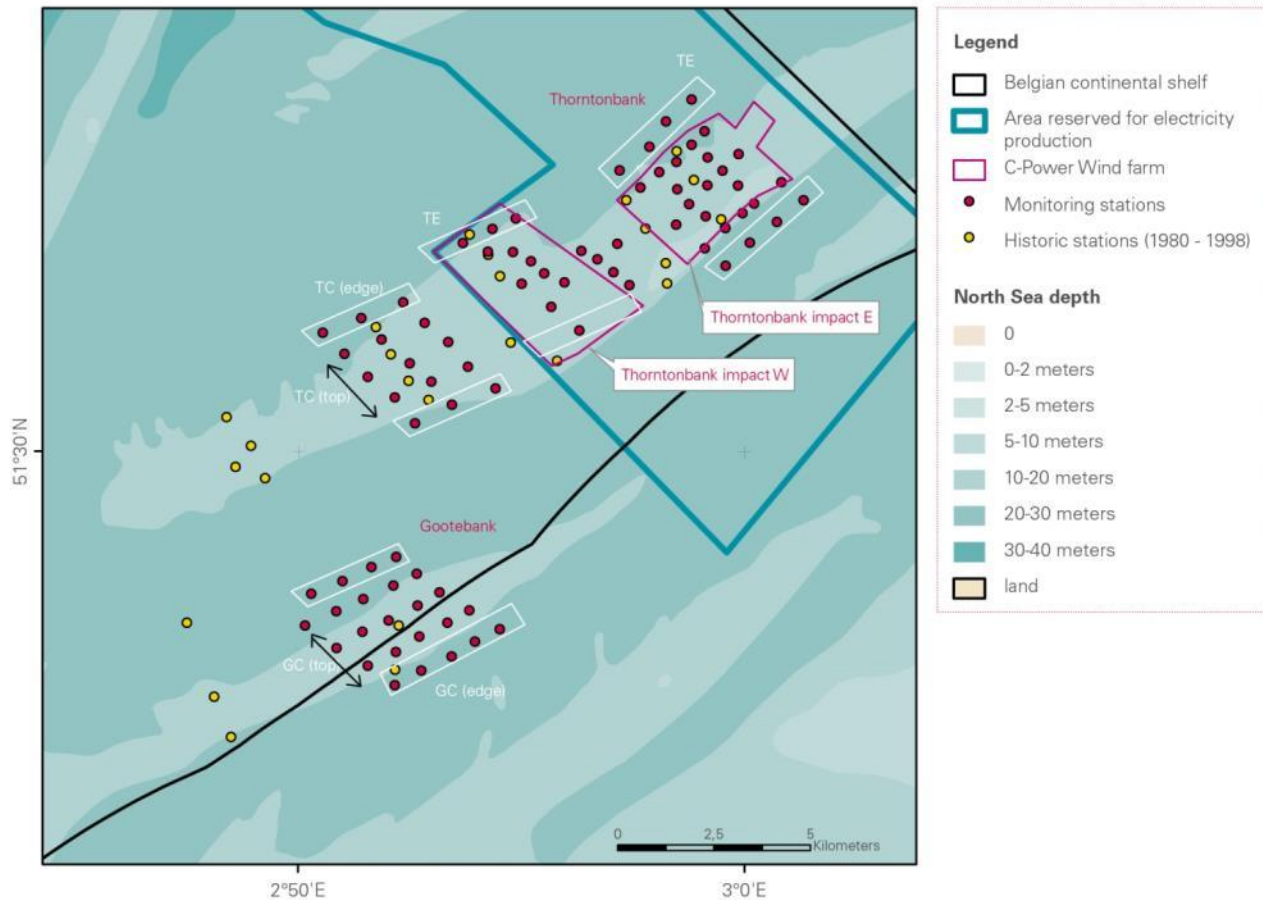
- Fauna > than 1mm living in the seabed
- Essential link in the marine food web
- Closely related to the sedimentological characteristics of the seabed
 - Turbidity changes
 - Grain size composition
- sampled with a Van Veen grab



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SAMPLING DESIGN THORNTONBANK



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Thorntonbank soft benthic windfarm monitoring data

2005 (T ₀)	2008 (T ₁)	2009 (T ₂)	2010 (T ₃)	2011 (T ₄)	2012 (T ₅)
Baseline monitoring	Construction Phase I (6 GBF at TIW)	Operational Phase I	Operational Phase I	Construction Phases II & III	Construction & Operational Phases I - III
GC - TC - TE - TI E - TIW	GC - TC - TE - TI E - TIW	GC - TC - TE - TI E - TIW	GC - TC - TE - TI E - TIW	No monitoring data	GC - TC - TE

Construction effects

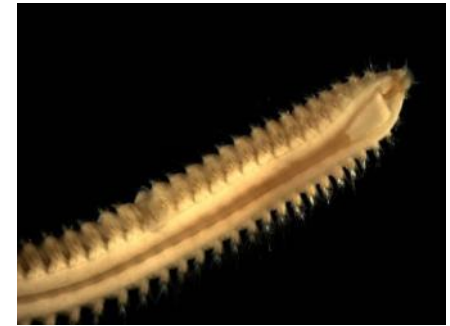
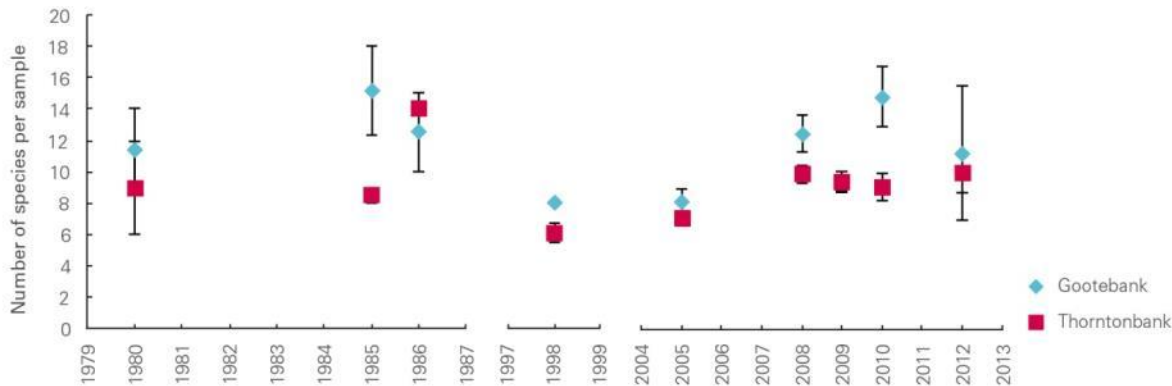
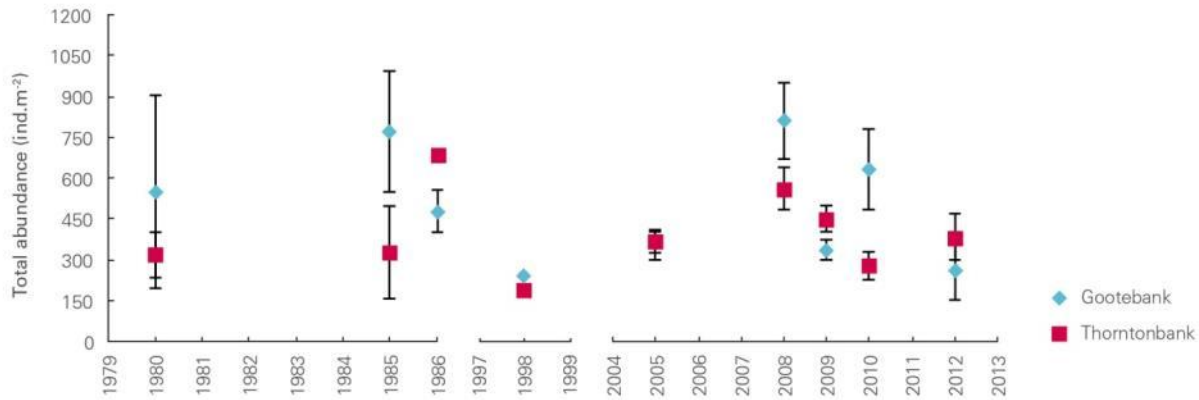


Operational effects

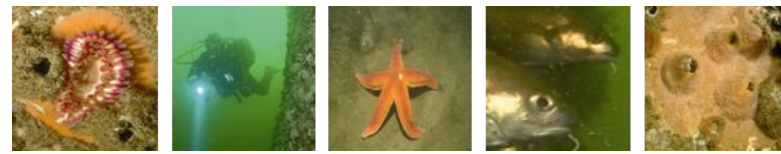
SAND AND ITS INHABITANTS



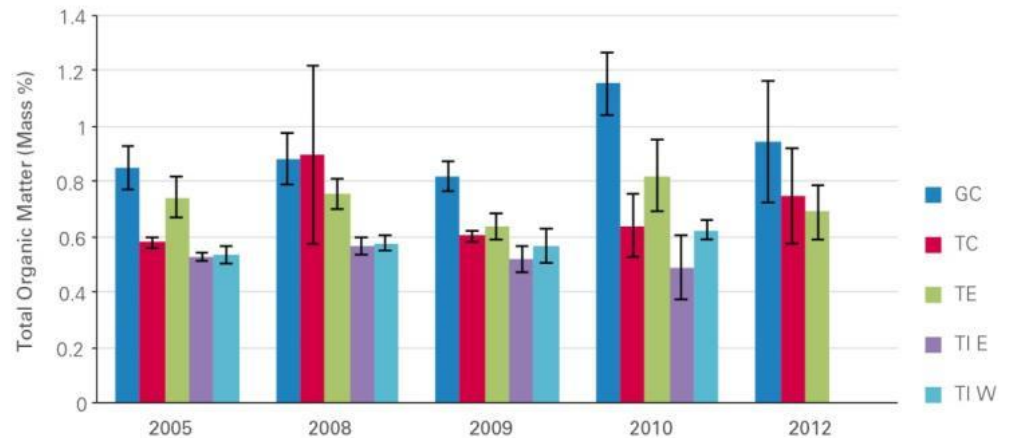
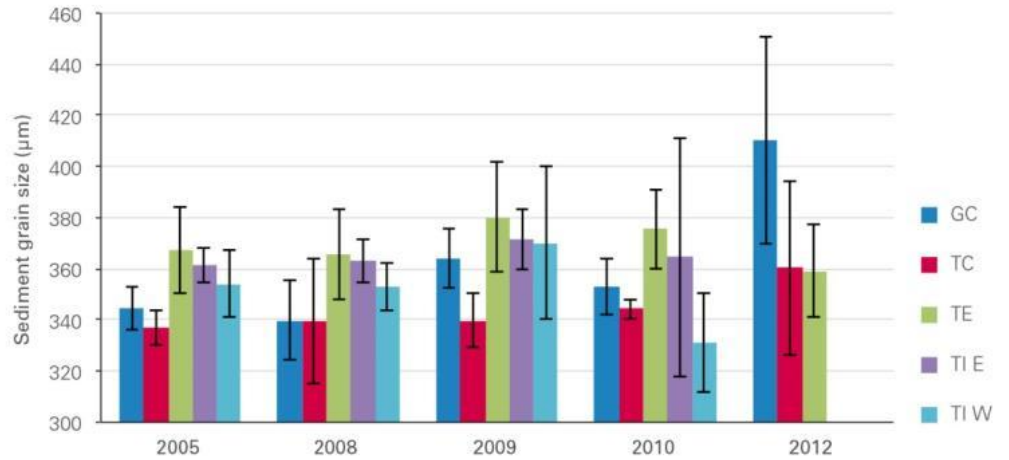
MACROBENTHIC COMMUNITY 1980 - 2012



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SEDIMENT COMPOSITION



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MACROBENTHIC COMMUNITY



	1980	1985	1986	1998	2005	2008	2009	2010	2012
TB vs. GB	Green					Red			Green

		Phase II & III	Phase I
2005	GC	Red	Green
	TC	Red	Green
	TE	Green	Green
2008	GC	Red	Red
	TC	Green	Red
	TE	Red	Red
2009	GC	Red	Green
	TC	Green	Green
	TE	Red	Green

Construction year



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BENTHIC ECOSYSTEM QUALITY INDEX BEQI

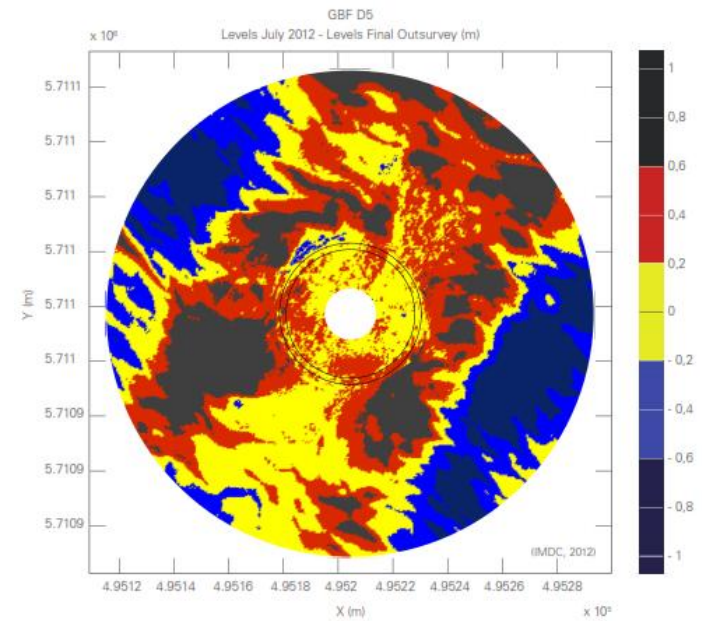
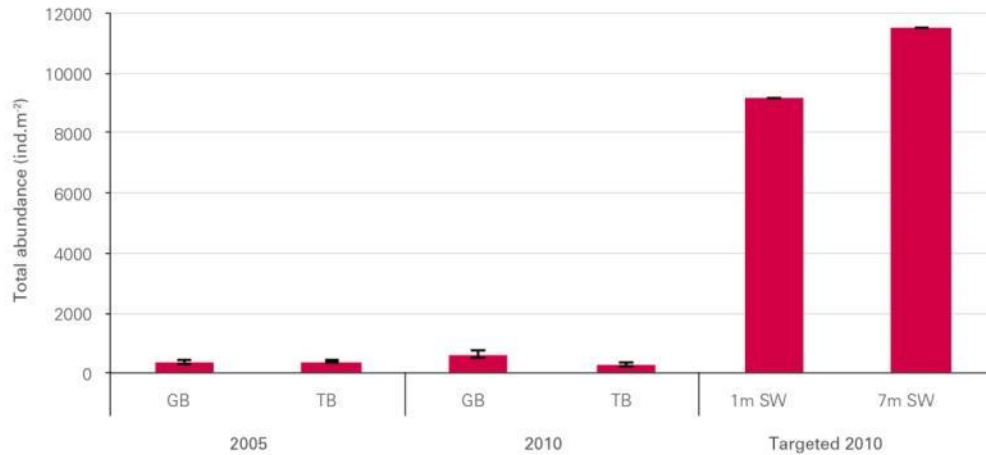
Design	Control	Area	Zone	2008	2009	2010	2012
1a	within year	Thornton impact zone	Top + Edge	0.628	0.802	0.695	0.698
1b	<2005	Thornton impact zone	Top + Edge	0.553	0.743	0.676	0.677
1b	2005	Thornton impact zone	Top + Edge	0.611	0.708	0.637	0.664
2a	within year	Eastern impact zone	Top	0.628	0.731	0.764	
2b	<2005	Eastern impact zone	Top	0.588	0.687	0.607	
2b	2005	Eastern impact zone	Top	0.542	0.764	0.691	
2a	within year	Western impact zone	Top	0.674	0.789	0.653	
2b	<2005	Western impact zone	Top	0.618	0.716	0.728	
2b	2005	Western impact zone	Top	0.676	0.697	0.769	
2a	within year	Eastern impact zone	Edge	0.666	0.701	0.641	0.713
2b	<2005	Eastern impact zone	Edge	0.57	0.608	0.625	0.699
2b	2005	Eastern impact zone	Edge	0.598	0.636	0.6	0.699
2a	within year	Western impact zone	Edge	0.45	0.671	0.44	0.414
2b	<2005	Western impact zone	Edge	0.616	0.609	0.538	0.511
2b	2005	Western impact zone	Edge	0.609	0.625	0.576	0.524

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LARGE SCALE VS. SMALL SCALE

Operational effects → Too early at large scale





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Refugium effect
Edge effect

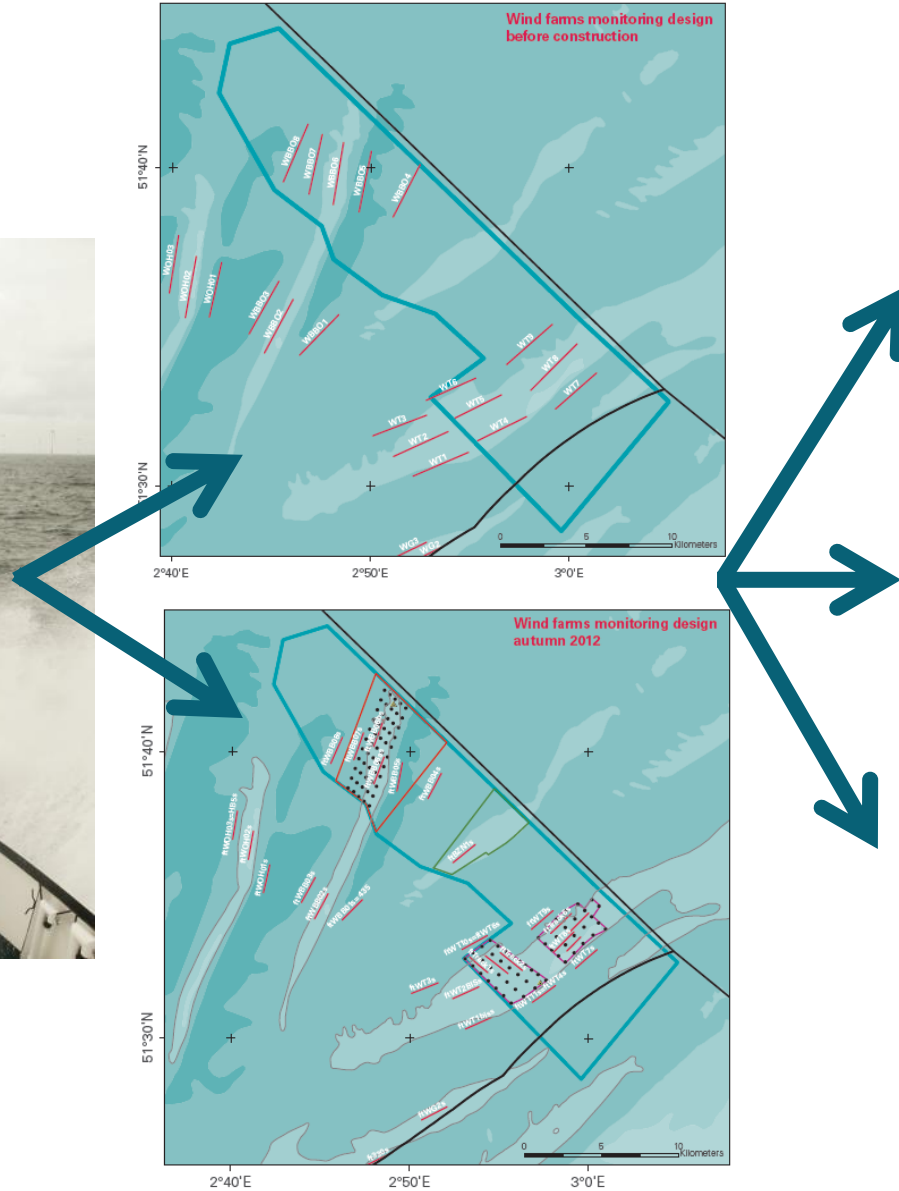


Soft substrate macrobenthos, epibenthos and fish

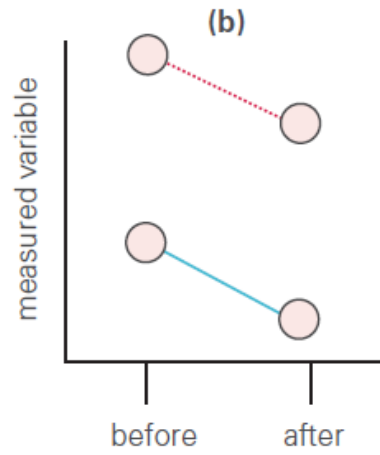
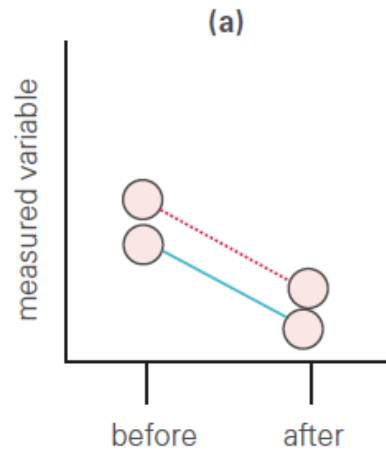
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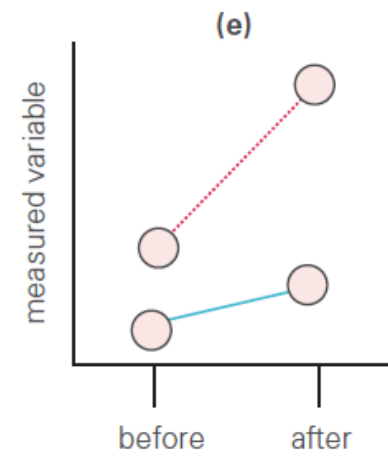
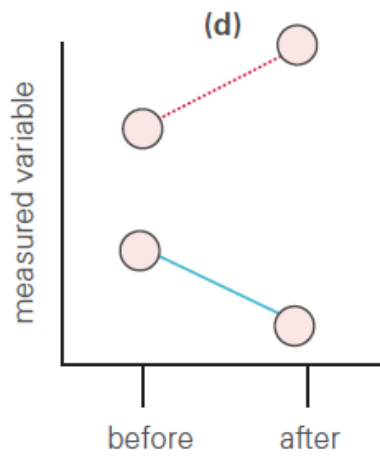
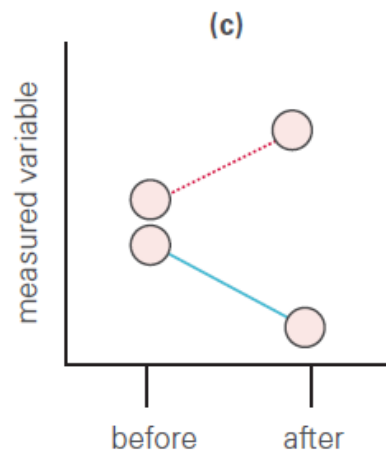
SAND AND ITS INHABITANTS



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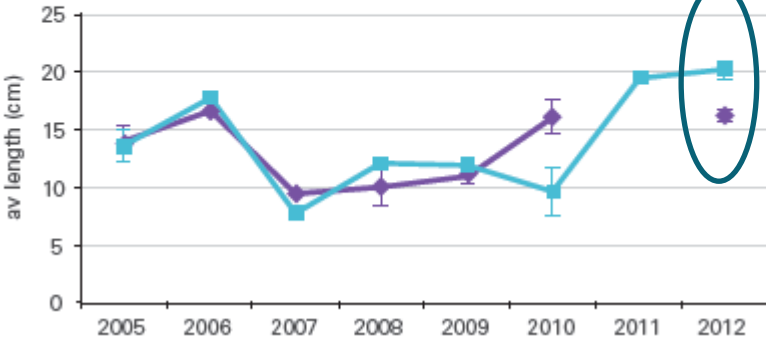
--- impact
— control



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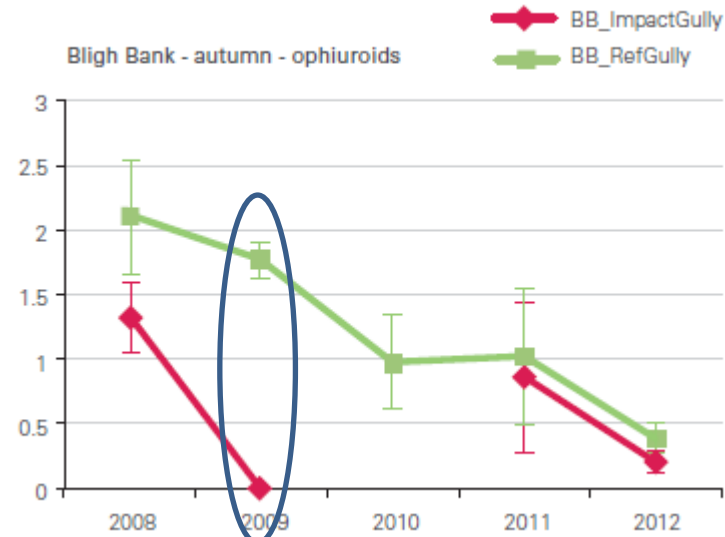
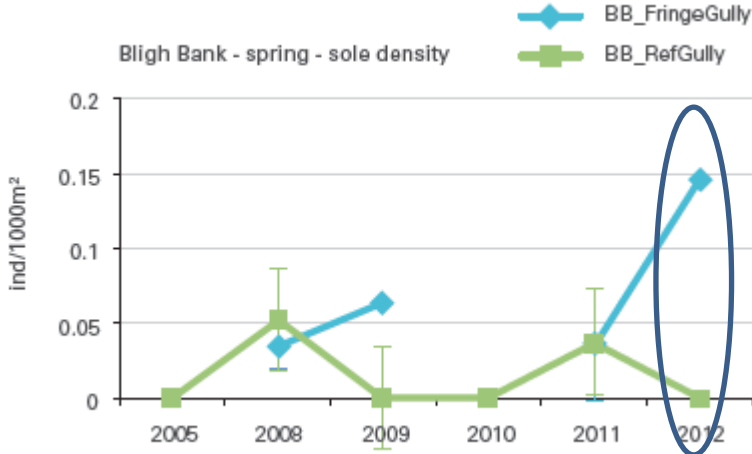
Thorntonbank - autumn - dab length



THORNTONBANK WIND FARM

		THORNTONBANK WIND FARM					
		Spring			Autumm		
		Wind farm effect		Fringe effect	Wind farm effect		Fringe effect
		top	gully	gully	top	gully	gully
COMMUNITY LEVEL	Density						
	Biomass			epibenthos (BACI) ↑	epibenthos (2009) ↑		
	Species number					demersal fish (2008) ↓	
	Species composition						
SPECIES LEVEL	Density						
	Mean length			whiting (BACI) ↑	dab (2012) ↓		

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Mean length

BLIGH BANK WIND FARM

BLIGH BANK WIND FARM					
Spring			Autumm		
Wind farm effect		Fringe effect	Wind farm effect		Fringe effect
top	gully	gully	top	gully	gully
epibenthos (BACI) ↑			epibenthos (BACI) ↑		
				demersal fish (2012)	
Sea star, sole (BACI) ↑		sole (2012), dab (2012) ↑	sole (2012), dab (2012) ↑	sandeel (2012), ophiuroids (2009), urchin (2009) ↓	

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Construction effects

- decreases in dab, ophiuroids, squid, dragonet,
- increase in sandeel

Fringe / edge effects

?

Reef / refugium effects

- increase in epibenthos biomass
- changes in demersal fish composition & species number,
- changes in length distributions of dab and plaice

BUT

Results not consistent between wind farms

Few significant results

Samples far from turbines (>180m)

SO.... Future monitoring?

Extend time series

Replicate along identified gradients

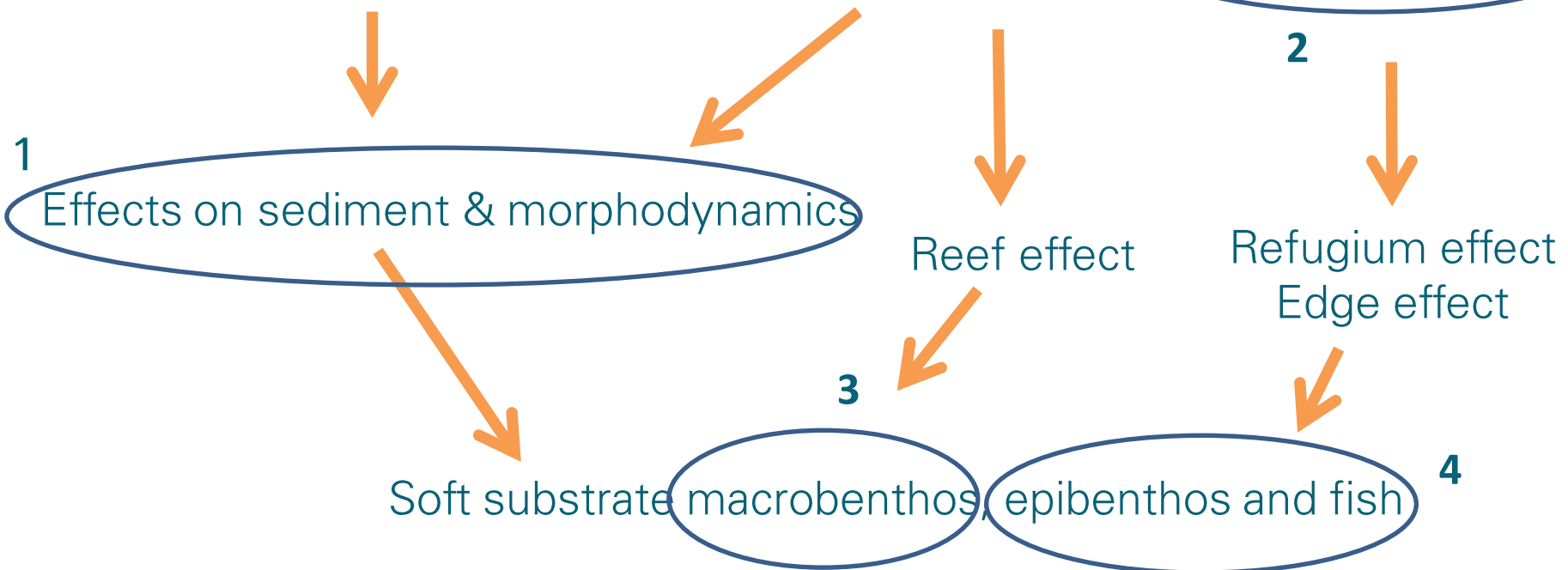
Keep an eye on epibenthos, demersal flatfish and sandeel

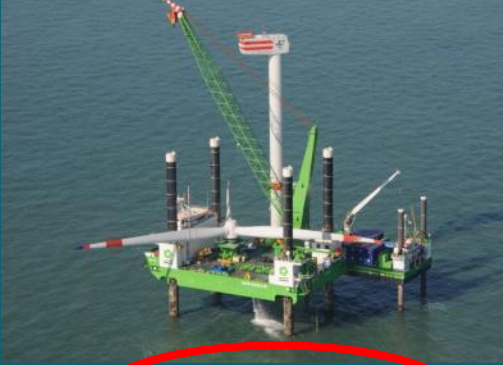


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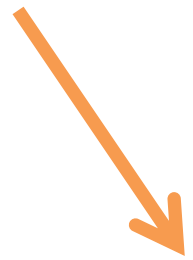
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