

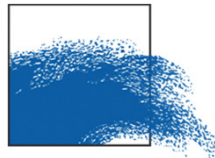
Offshore wind farms in the Belgian part of the North Sea:

Understanding environmental impacts



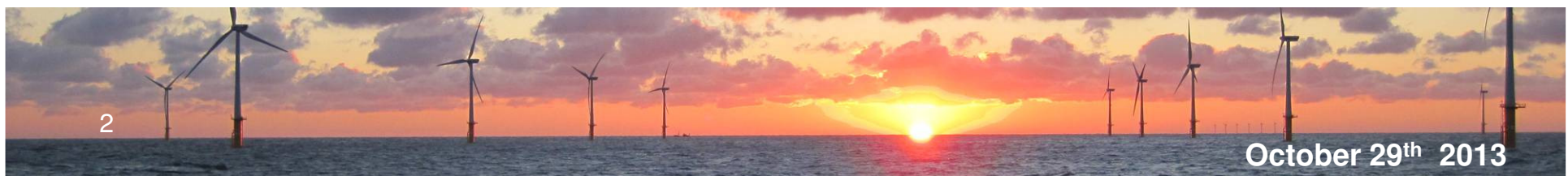
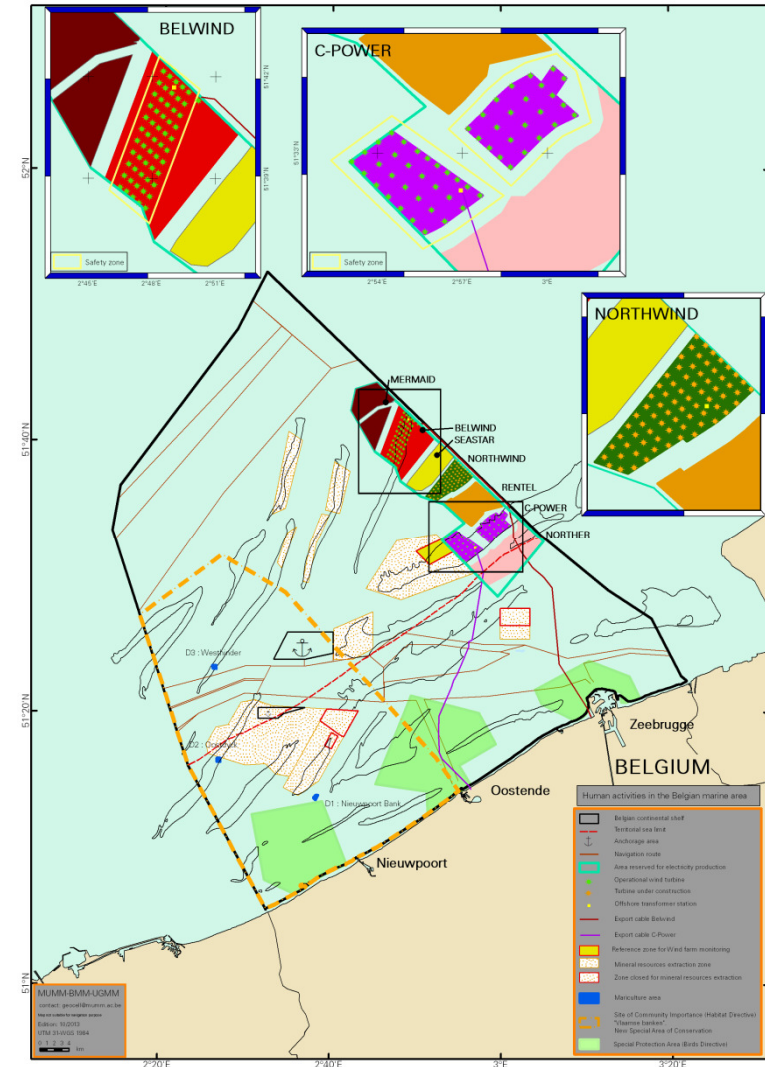
Royal Belgian Institute for Natural Sciences

Robin Brabant



Setting the scene

- Belgian coast line is only 60 km
- Belgian part of the North Sea is about 3600 km²
- In 2004, Belgium has allocated a 238 km² area to offshore renewable energy production
- This area is almost entirely in territorial waters



October 29th 2013

Setting the scene

C-Power (Thorntonbank)

- 54 turbines of 5 and 6 MW (total of 315 MW)
- Phase I: six turbines (gravity based foundations)
Phase II: 48 turbines (jacket foundations)

Belwind (Bligh Bank)

- 55 turbines of 3 MW (165 MW) on monopiles

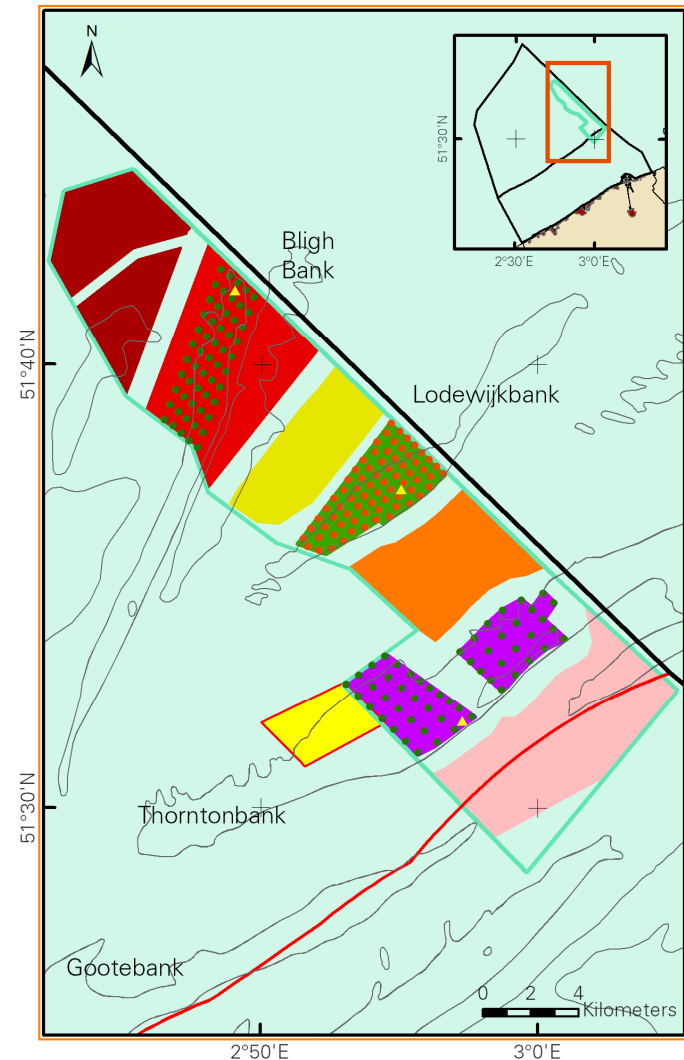
Northwind (Lodewijkbank)

- 72 turbines of 3 MW (216 MW)
- Under construction

Other consortia:

- 2000 MW of installed capacity by the end of 2020
- Ca. 500 turbines

➔ **ENVIRONMENTAL IMPACTS EXPECTED**



Environmental permit procedure

- RBINS/MUMM renders advice to the Minister during the permit procedure regarding the expected environmental impacts
- Monitoring programme integral part of the environmental permit
- Coordinated by RBINS/MUMM, paid by the developer

Mandatory monitoring programme to ensure...

1. possible mitigation or halting of activities
2. understanding of impact processes to support future policy and management



Environmental issues to consider

- Underwater noise
- Hydrodynamics and sedimentology
- EMF
- Hard substrate epifouling organisms
- Hard substrate-associated fish
- Soft substrate macrobenthos
- Soft substrate epibenthos and fish
- Seabirds
- Marine mammals (focus: harbour porpoise *Phocaena phocaena*)
- Social acceptance



The partnership

- RBINS
- Ghent University, Marine Biology Section
- Research Institute for Nature and Forest (INBO)
- Fisheries Research Institute (ILVO-Fisheries)



More than 40 scientist involved!

Research started in 2008

Some selected findings from six years of research



Increased noise levels

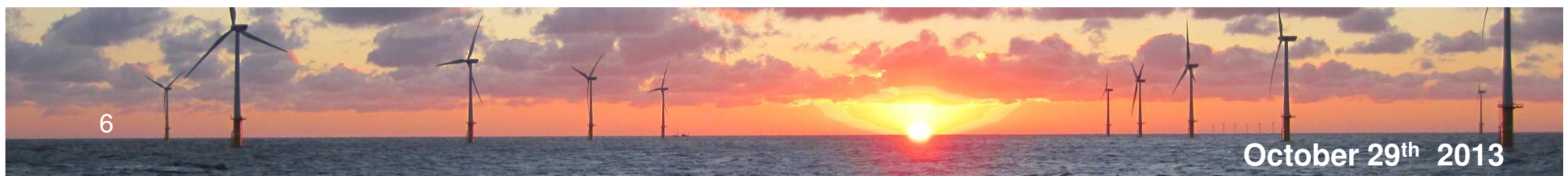
The operational sound pressure level mainly amounted to 105-115 dB(A) at wind speeds higher than 12 m/s and could hence be detected up to a distance of 10 km.

Construction: piling of mono- and pinpiles

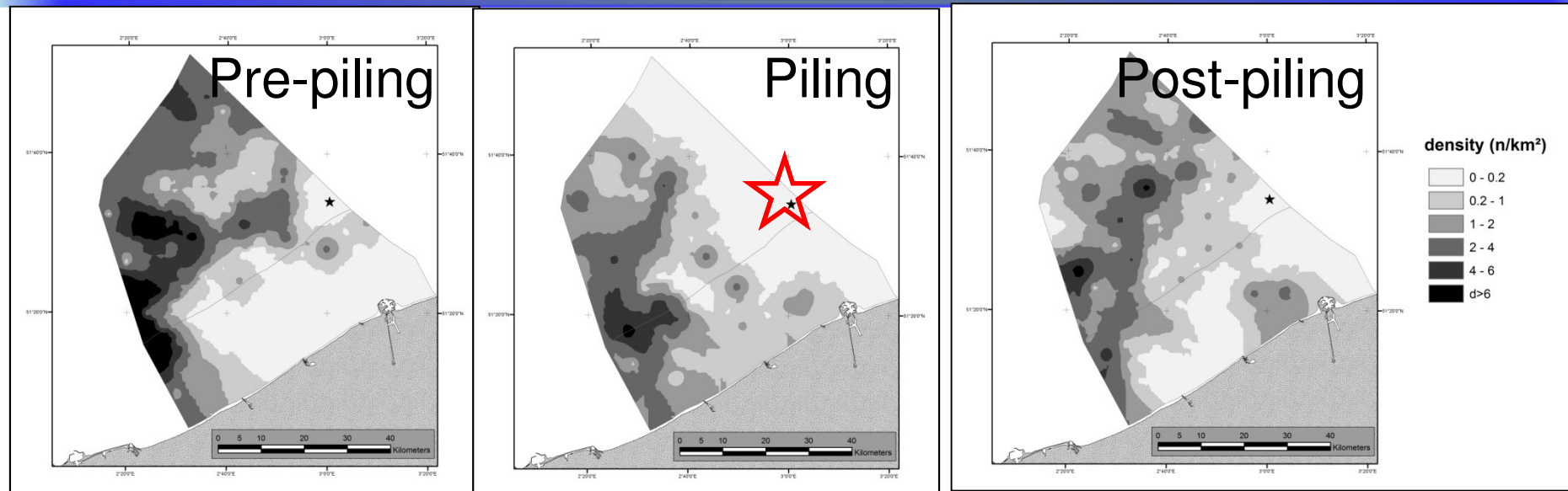
- excessive underwater noise levels of 179-194 dB re 1 μ Pa (zero to peak level at 750 m)
- attenuating to ambient noise levels at a distance of up to 70 km
- pin piling lower noise levels (172-189 dB re 1 μ Pa), but the total number of blows per megawatt installed is 57% higher than for a MP



major concern to marine mammals and fish



Impact of piling noise on harbour porpoise



Aerial survey results

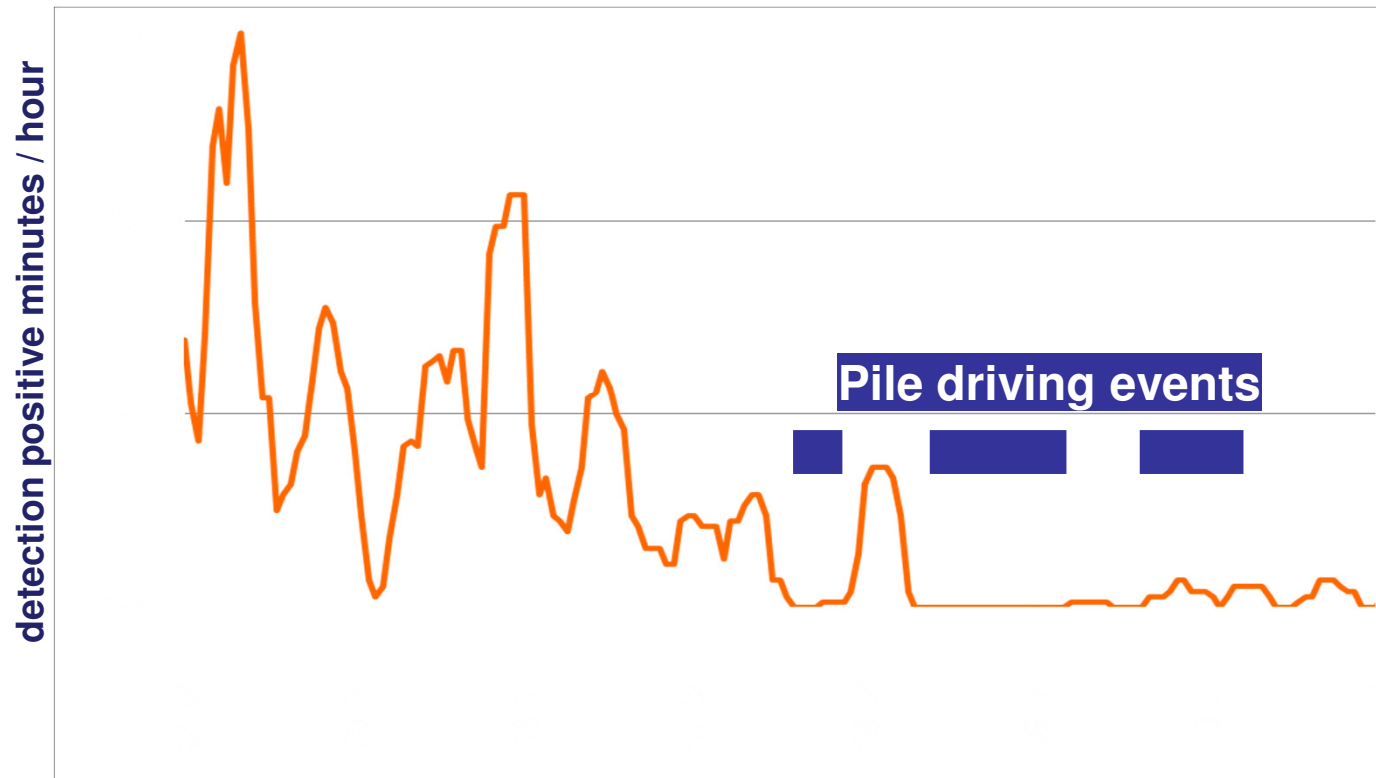


- complete disappearance of harbour porpoises in close vicinity of the piling location
- a distance of disturbance of porpoises of about 20 km

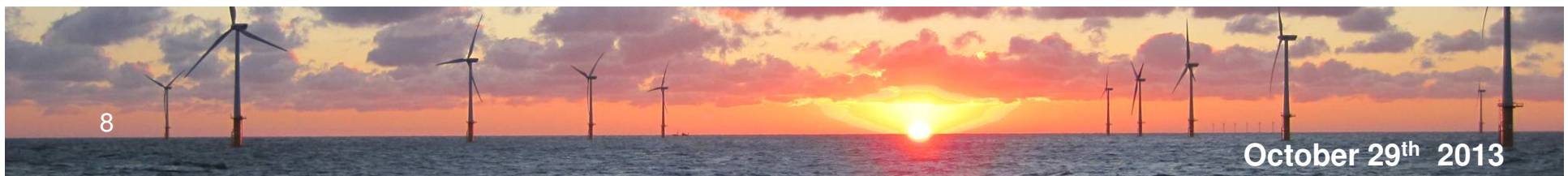


Impact of piling noise on harbour porpoise

Confirmed by passive acoustic monitoring



Future experimental research will also target the impact of construction and operational noise on fish eggs and larvae development, since these 'passive drifters' cannot actively escape the exposure to noise.



Impact of operational wind farms on birds

Wind farms have three possible impacts on birds (Exo et al., 2003; Desholm et al., 2006; Drewitt & Langston, 2006):

1. collision of birds with the structures (direct impact);
2. barrier effect, i.e. the disturbance of flying birds by the presence of the wind farms (indirect impact);
3. local birds can be disturbed during foraging and resting (indirect impact) and show altered behaviour/distribution → displacement effect

Studied by monthly ship-based counts and by bird-radar (installed on transformer platform)

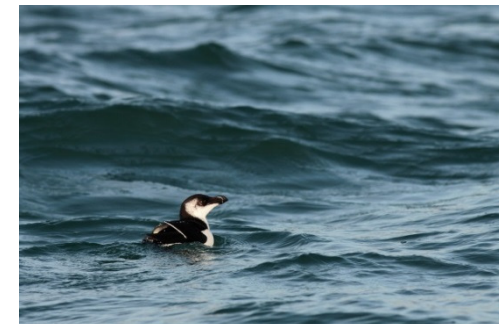


Displacement of birds

✧ Monthly ship-based counts suggest:

	attraction	avoidance
Thorntonbank	little gull (annex I) sandwich tern (annex I) common tern (annex I) black-legged kittiwake great black-backed gull	common gull
Bligh Bank	Lesser black-backed gull herring gull	common guillemot razorbill northern gannet

✧ Attraction because of resting places or increased food availability?



Bird collisions

- ✦ an estimated number of 1 to 1.3 million seabirds migrate through the southern North Sea corridor (Stienen et al., 2007).
- ✦ a lot is still unknown about migration at night and intensive migration events at sea
- ✦ Wind farm area (35 km wide) is perpendicular on the migration direction
- ✦ increased activity of annex I species sandwich and common tern and little gull



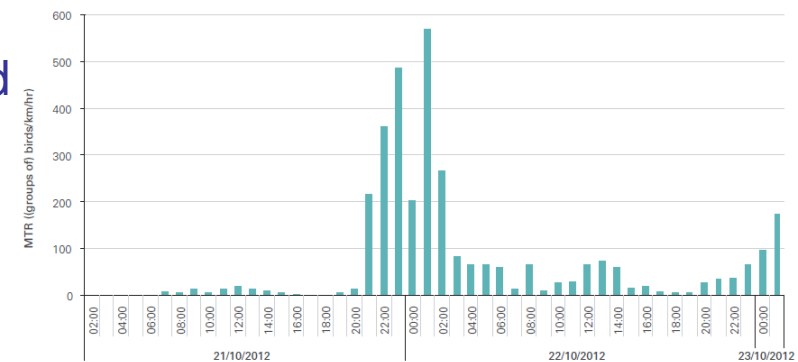
concern about additional mortality due to collisions



Bird collisions

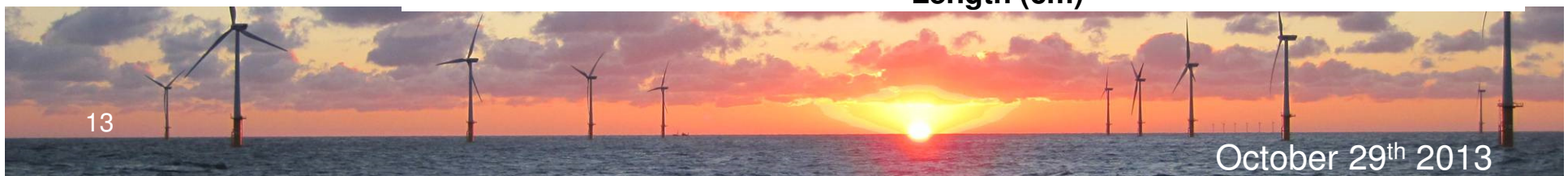
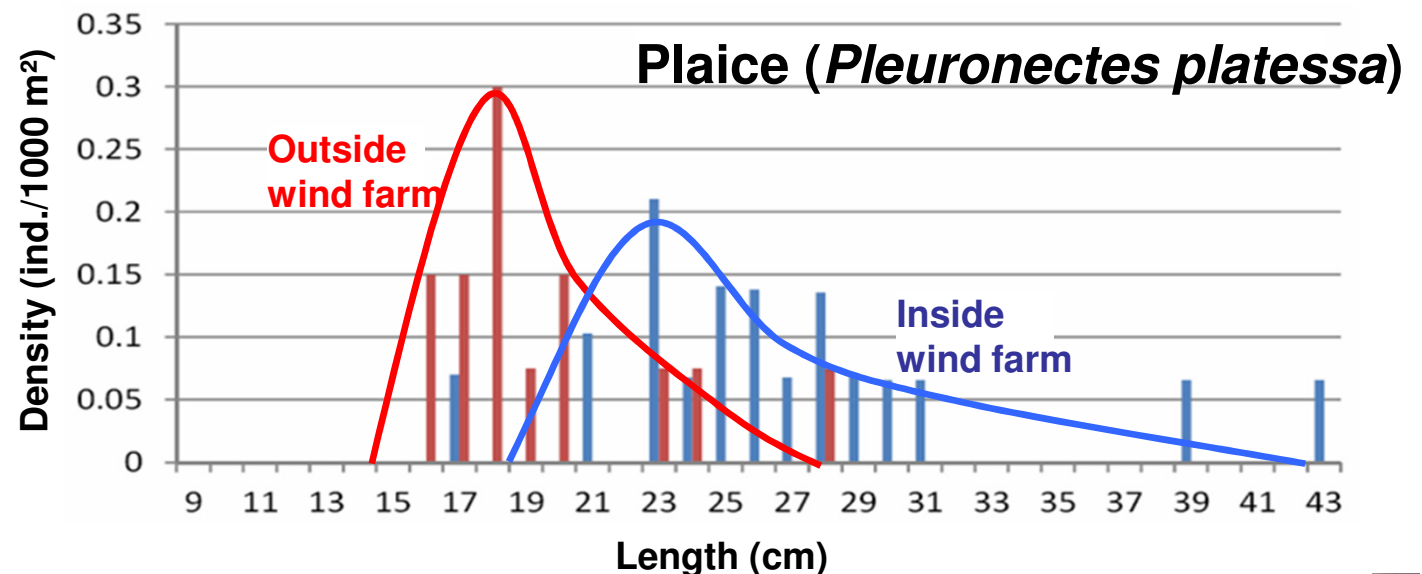
Collisions estimated through model calculations (Band, 2012) based on visual and radar flux data:

- ✦ visual: high resolution, species specific, but only daytime
- ✦ radar: continuous but not species specific
- ✦ 2,4 collisions of gulls / turbine / year at the Bligh Bank
 - ✦ Less than $\frac{1}{2}$ of the estimated collisions at OWEZ
- ✦ during massive songbird migration, collisions would raise as high as 20 victims during a single night in one
- ✦ extrapolation (10,000 WTs) showed that additional adult mortality for lesser and great black-backed gull possibly exceeds the accepted threshold of 5%
- ✦ Future research is needed
 - ✦ to determine actual number of collisions
 - ✦ to upscale to population level



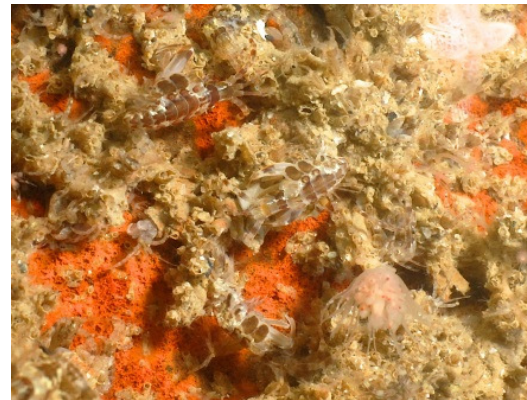
Exclusion of fishing activities

- ✦ fishing vessels (mostly trawlers) are virtually everywhere, except in the wind farms
- ✦ protection of soft bottoms against fishing activities inside the wind farms is probably the main anticipated positive environmental impact of offshore wind farms
- ✦ Several epibenthic species and demersal fish species were found to be larger and in higher numbers present inside versus outside the wind farm (e.g., common ...)
- ✦ a continued monitoring is needed to ensure an increased power of impact detectability



Reef effect: epifauna

- new hard substrates (i.e. wind turbines and scour protection) form an artificial reef in a sandy environment
- are readily colonised by epifauna
- dominant organisms are barnacles, mollusks and crustaceans
- ecological succession to a rich and diverse community (**101 species**)
- Clear zonation (*Telmatogeton japonicus* dominating the splash zone, intertidal fringe characterised by barnacles and the blue mussel *Mytilus edulis*; a Jassa-Tubularia-Actiniaria community in the subtidal zone)



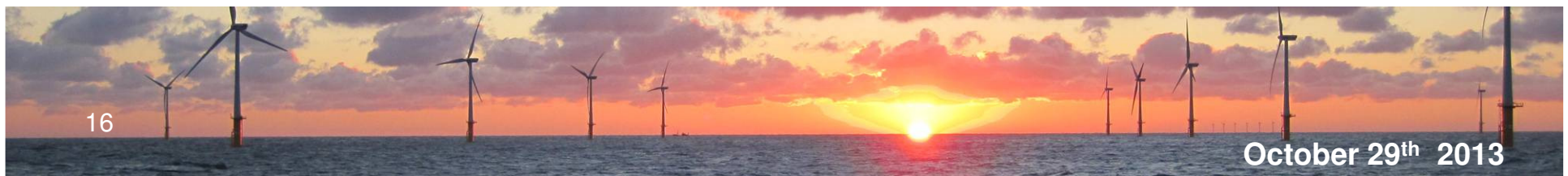
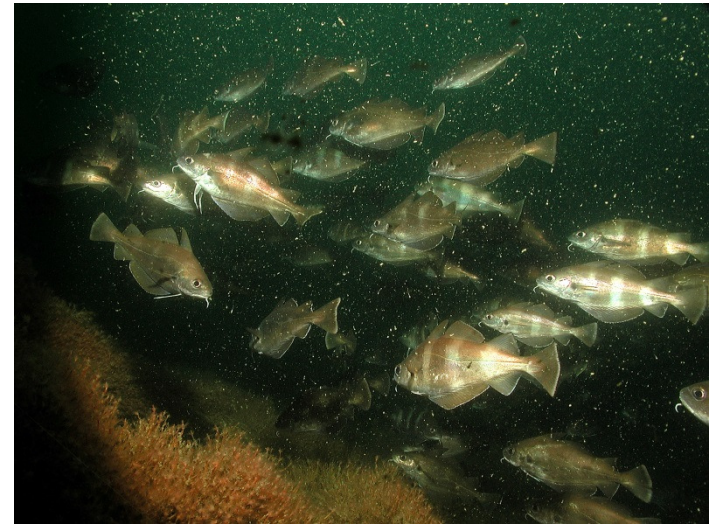
Reef effect: epifauna

- ~ 50 % non-indigenous species (NIS), e.g. the pacific oyster *Crassostrea gigas*
 - some NIS are superabundant in the fouling community
 - by strengthening the competitive position of NIS in the North Sea, offshore wind farms may increase the risk of invasiveness!
-
- Future research
 - biological processes that shape these communities and the position of NIS
 - the use of the artificial reefs by larger animals, such as crabs and lobsters.



Reef effect: Attraction of fish

- Some fish are directly attracted to the artificial hard substrates in search for e.g. food or shelter
- Cod (*Gadus morhua*) and pouting (*Trisopterus luscus*) catches at the hard substrates were up to 100 times higher compared to sandy areas
- up to 29.000 individuals of pouting per wind turbine!
- Stomach analysis: Hard substrate epifauna is an important food source for pouting and cod
- Mainly young individuals
- show high residency
- Future research: is the higher number of fish attracting seabirds and porpoises?



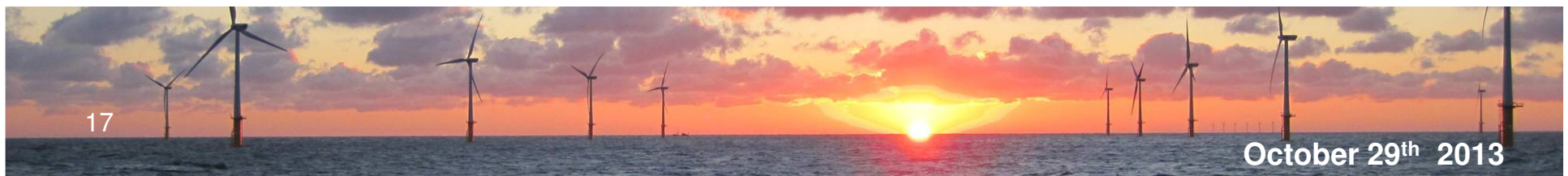
Learning from the past to optimise future monitoring

Need for basic and targeted monitoring

- Basic monitoring to detect the impact and assess impact size
- Targeted monitoring to further focus on various cause-effect relationships (e.g. attraction-production hypothesis)
 - Gain more generic knowledge about the impact of OWFs
 - preferably through international scientific collaboration

Reliable assessment of cumulative impacts

- upscale locally observed impacts to the larger scale
- close collaboration between scientists and administrators, preferably through international collaboration



Learning from the past to optimise future monitoring

Reaching out to stakeholders and strengthening international network

- Open communication about research results
 - Yearly reports
 - Integrated report after phase 1
 - International conference 26-28 November in Brussels

www.mumm.ac.be

R.Brabant@mumm.ac.be



The image is a conference announcement poster. It features a photograph of offshore wind turbines at sea. The 'museum' logo is in the top left. The text reads: 'Conference announcement: Environmental impact of offshore wind farms "Learning from the past to optimise future monitoring programmes"'. It provides details on when (26, 27, and 28 of November 2013), where (Royal Belgian Institute of Natural Sciences, Brussels), and the scope of the conference. The scope includes lessons learned from six years of monitoring, state-of-the-art knowledge on environmental impacts, and a side event on Belgian offshore wind farms. Contact information for abstracts and questions is provided at the bottom right, along with the logo of the Management Unit of the North Sea Mathematical Models.

