ECOLOGICAL PROCESSES

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Not dealt with in this overview

Adopted from the ICES Workshop on Effects of Offshore Wind farms on Marine Benthos (WKEOMB) (ICES, 2012b)
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Mechanisms / Processes
1. Food availability and feeding efficiency
2. Shelter from currents or predators
3. Suitable habitat for settling and immigrating individuals
4. Stress
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Small-scale study of the soft sandy sediments and macrobenthic communities around one foundation (gravity based)

- Changing hydrodynamics → sedimentological changes?
- Colonisation of the foundation and fish attraction → organic enrichment?

⇒ Scuba Dive and Grab samples
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SEDIMENTOLOGICAL CHANGES

[Graphs showing sediment grain size and total organic matter (%) changes across different Southwest gradients for the years 2010, 2011, and 2012.]
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SPECIES COMPOSITION AT 1 & 7 M

![Graph showing species composition at 1 and 7 m depth in Southwest and Northwest regions over the years 2010 and 2012.](image)

Legend:
- Asteriidae juv.
- Lanice conchilega
- Spiophanes bombyx
- Echinioidea juv.
- Jassa herdmani
- Monocorophium acherusicum
- Ophiura juv.
EXPANDING BENTHIC ENRICHMENT

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No changes

Repulsion

Attraction/production
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SAMPLING TECHNIQUES

• Demersal fish
  > 180 m from turbines
  trawl catches
  numbers/1000 m²

• Benthopelagic fish
  on the scour protection
  line fishing
  Catch per unit effort (CPUE)
Sole density - spring

Graph showing the density of sole species from 2008 to 2012. The impact and reference data are indicated. The impact shows a significant increase in density in 2010 and 2011, while the reference remains relatively stable.
WHICH MECHANISMS PLAY?

• Several mechanisms possible
  * Food availability/feeding frequency
  * Provision of shelter against currents or predators
  * Presence of suitable habitat for settlers or

→ Stomach content analysis
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FOOD
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BEHAVIOURAL ECOLOGY
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SITE FIDELITY
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HABITAT USE

![Diagram of habitat use with various symbols and labels: Positioning range, Hard substrate, Receiver, Detection.](image-url)
TOP PREDATORS

BIRD MONITORING: Methods

Ship-based seabird surveys
BACI-densities of herring and lesser black-backed gulls in the study area: significant attraction!

But also numerous observations of common gull, great black-backed gull, black-legged kittiwake, sandwich tern, common guillemot and razorbill...
Possible explanations:

- Increased roosting possibilities
  
  → most birds inside the wind farms are indeed observed resting

- Stepping stone
  
  → cfr. great cormorants in the Dutch part of the North Sea

- Increased food availability following underwater reef effects
  
  → e.g. in the control area 0.3% of the observed kittiwakes are busy feeding opposed to 5.9% inside the wind farm!
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- Aerial surveys
- Passive acoustic monitoring
Aerial surveys: absolute density
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FUTURE MONITORING

• In general: too early to be conclusive

• Longer term and extended spatial scale
FISH

• Expand the mechanisms investigated: shelter, habitat suitability and stress → e.g. impact of noise on fish larvae

• Expand number of fish species investigated to assess impact on ecosystem level

• Investigate in more detail the effect of ‘fisheries exclusion’
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BIRDS

• As for now, it seems unlikely that the benefits gained from the hypothesised increase in food availability can weigh up to the costs of increased mortality due to attraction effects… (an estimated 134 gull victims per year at the Blighbank alone)

• Future monitoring will have increased attention to the behavioural aspects of birds observed inside the wind farms, and should further include research on pelagic fish communities
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HARBOUR PORPOISES

• Small scale effects expected during operational phase (vs. large scale effects piling)

• For small scale effects current monitoring is not in a sufficiently fine spatial and temporal resolution

• What resolution would be needed to find out?

• Underwater noise levels seem not to be of concern?

• Attraction due to increased prey density?

• Wind farm areas vs. naturally important feeding grounds?