Effects of offshore windfarms on marine wildlife – a synthesis for Swedish waters

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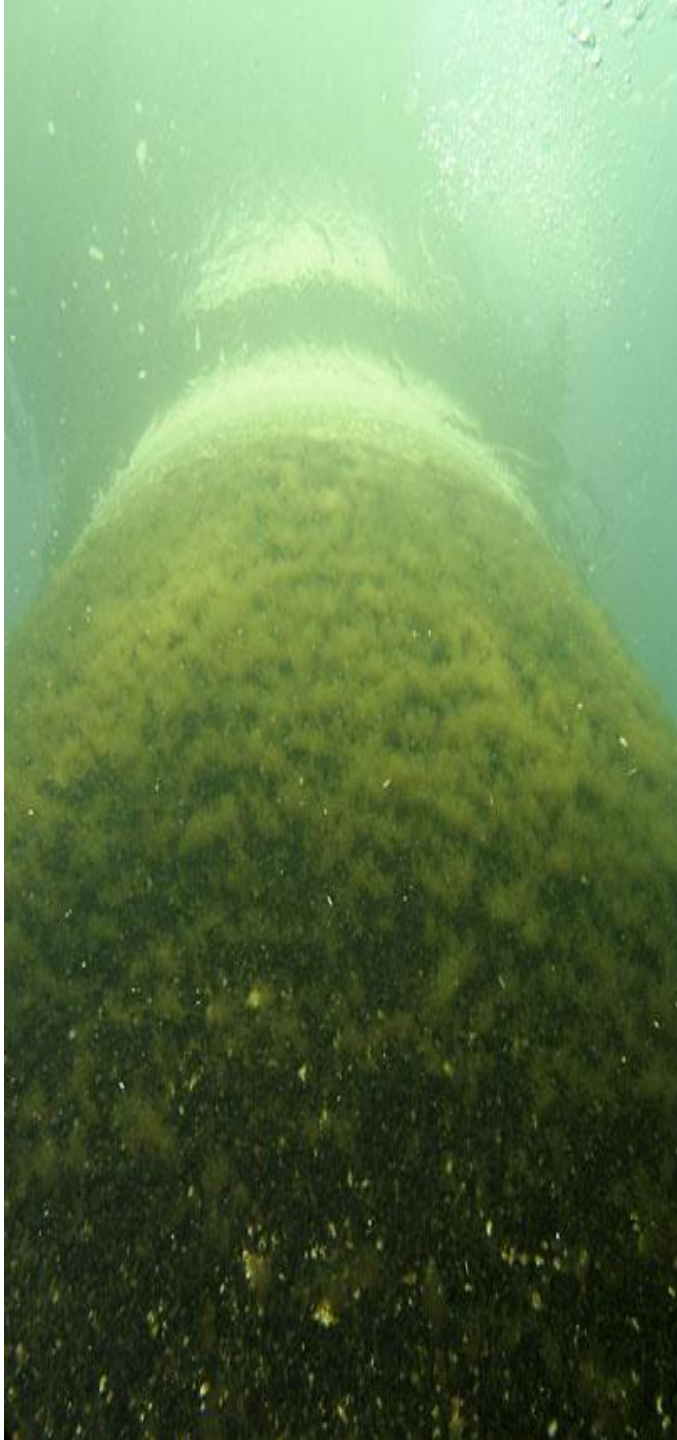
Motivation

- Establishment of offshore wind farms obviously means changes that may affect the natural environment

- Prior to an expected expansion of wind power in Swedish waters, it is necessary to investigate potential effects on marine species and the ecosystem



This study

Conducted as part of the finalizing of the Vindval programme

We synthesized over 600 available studies, mostly scientific articles, but also reports by companies and authorities, in order to identify effects on marine wildlife in Swedish waters, and gaps of knowledge.

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Main conclusions: effects on marine wildlife

- The strongest impact is to be expected during the construction phase, primarily due to noise disturbance
- The risk of negative effects during the operational phase was considered lower, provided adequate localization and techniques are used
- Changes in habitat quality are unavoidable and may have positive or negative effects
  - Habitat gain or habitat loss?
  - Positive or negative effects on biodiversity?

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Conclusions on the research aspect

- The reviewed studies covered a fairly limited range of topics, and mainly a local scale. Only few studies at larger scale (wind farm level, landscape level)
- Studies were typically performed by research consultants and early career researchers. Experienced researchers were only rarely involved
- Research was typically initiated by needs of the sector itself, which may also explain a lack of studies involving multi-sectorial aspects
- Mainly national studies: International studies could be useful to combine experiences

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Criteria for risk assessment

Category	Risk assessment			Certainty
	Spatial	Temporal	Level of impact	
1 – Low	<100 m	Only during construction	Minor/no effects on structure	Limited or no documentation
2 – Moderate	<1000 m	Throughout operational phase	Effects on structure, minor effects on function	Documented, but results may be contradictory
3 – High	>1000 m	Permanent	Effects on structure and function	Documented, results mainly agree among studies

Geographical aspects

- In general, expected impact depends on local environmental conditions (meaning that local biodiversity structure should always be well known)

- Assessment was made separately for the following three areas:
  - the Swedish West Coast (Kattegat and Skagerrak)
  - the Baltic Proper
  - the Gulf of Bothnia (Bothnian Sea and Bothnian Bay).

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A strong salinity gradient influences the distribution of species

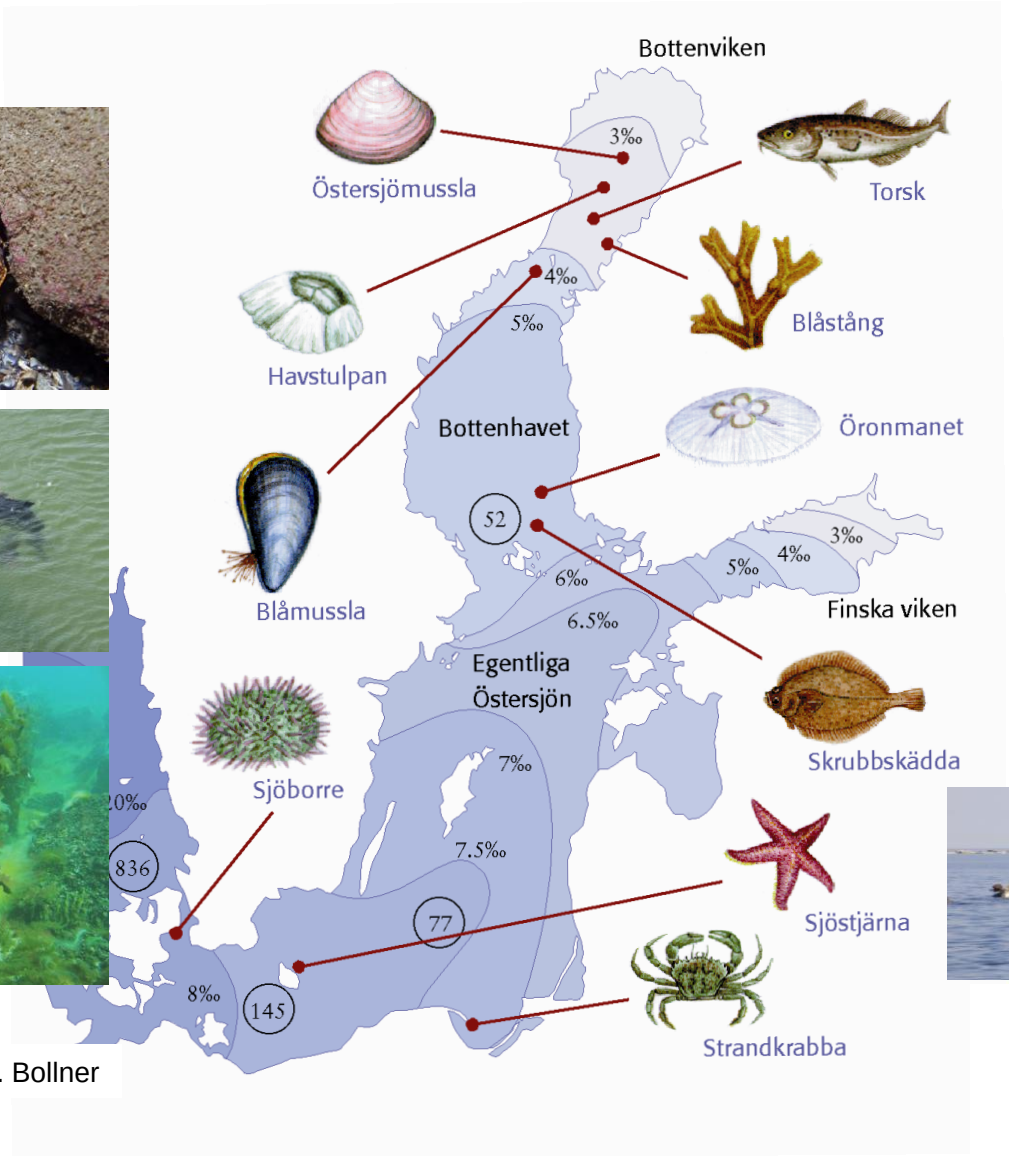
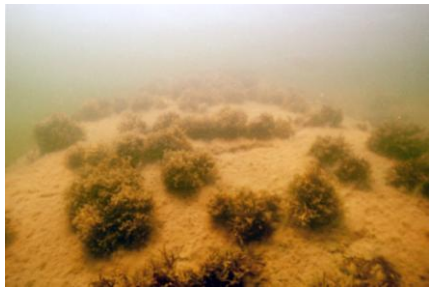
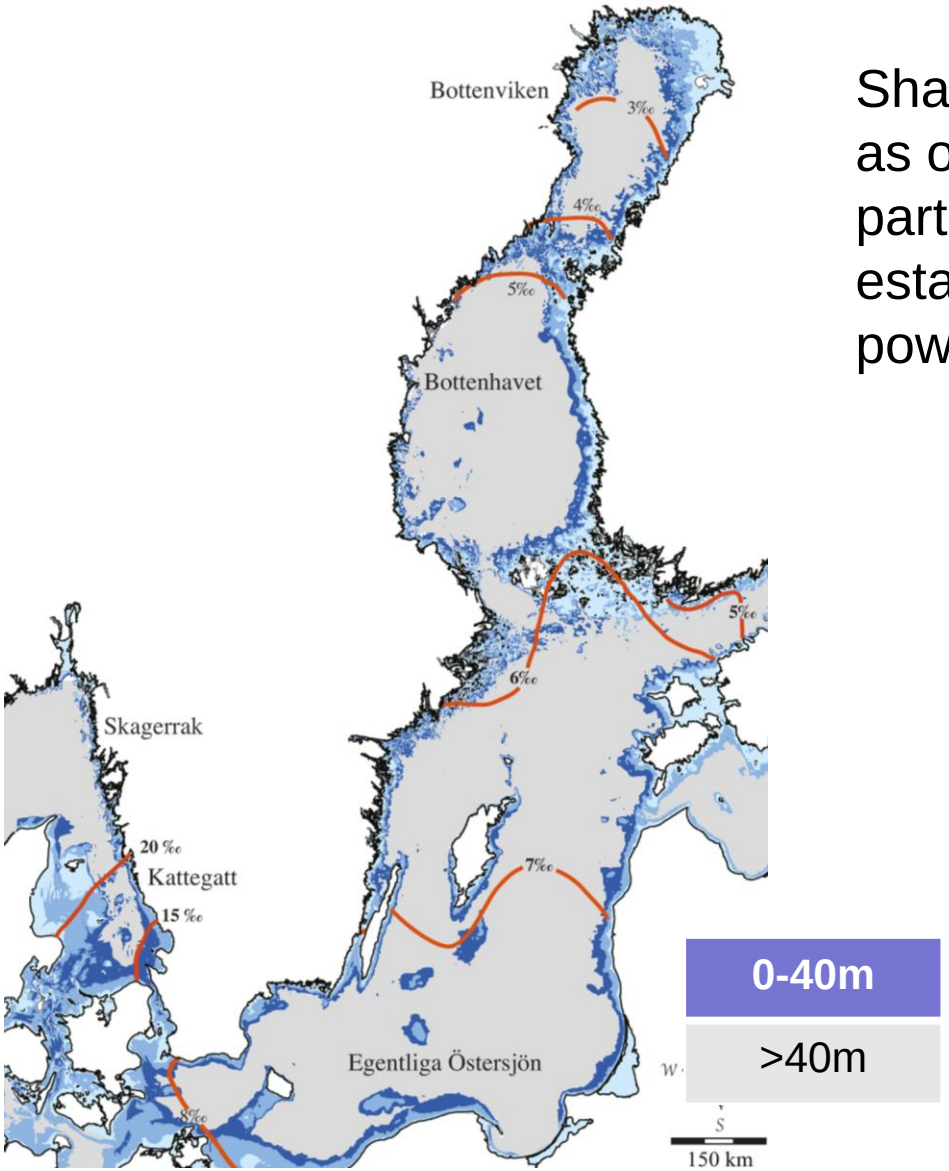


Illustration by C. Bollner



Focus on shallow offshore areas



Shallow areas at sea, known as offshore banks, are of particular interest for the establishment of offshore wind power in Sweden

- Good wind conditions
- Feasible depth conditions
- Low level of conflicting interests with other human activities
- Effects on biodiversity?

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Summary of risks during construction

	Marine mammals	Fish	Sessile animals
Noise disturbance (-)			
Total	5-7	5-7	4
Certainty	2	3	2
Sediment dispersal (-)			
Total	4	5-6	4
Certainty	3	3	3

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Summary of risks during operation

	Marine mammals	Fish	Sessile animals
Habitat changes (+/-)			
Total	4	5	5
Certainty	3	3	3
Fisheries exclusion (+)			
Total	3	6-7	6-7
Certainty	1	2	3
Noise disturbance (-)			
Total	5	5-6	5
Certainty	2	2	3
Elecromagnetic fields (-)			
Total	4	4-5	4
Certainty	1	2	3

Habitat gain

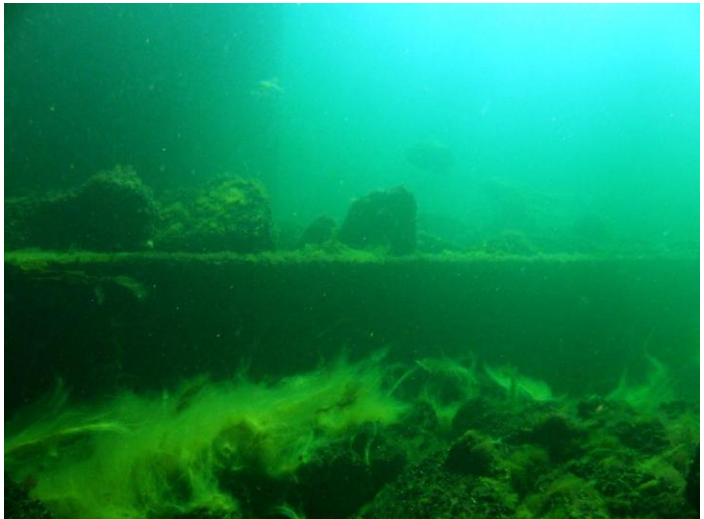
- Added habitat represents only minor part of the total wind farm area (<1%)
- Level of effect depends on foundation type
- Positive effect if the added habitat supports species with weak population structure
- Negative effect if it supports the dispersal of invasive species

Habitat loss

- Negative effect on species that are deterred from the area (e.g. due to noise, presence of turbines)

- Migrating sea birds are a special concern (loss of feeding areas)

- Potental positive effects on local biota due to predatory release (e.g. blue mussels and diving ducks; one clear example: fisheries exclusion)



How to minimize risks to marine wildlife

- Avoid areas important for biodiversity and habitat conservation
- Plan construction phase outside of the recruitment and feeding season of endangered mammals and fish
- Strong effects are to be expected during construction. These can, and should, be mitigated to large part

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How to support a safe future expansion in offshore wind energy

- Include risks to biodiversity and marine wildlife as a routine aspect when implementing marine spatial planning
- Conduct surveillance programs in all developing wind farms with a focus on monitoring potential cumulative effects.
- Initiate collaborative research studies to support these aspects at multidisciplinary and preferably international level

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