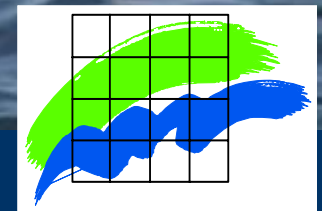


Assessing effects of the Horns Rev and Nysted offshore wind farms on birds – conclusions from 6 years' monitoring



Final Results Conference
27-29 November 2006
Helsingør, Denmark



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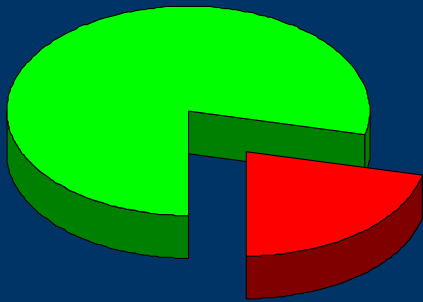
What were the hazards again?



- **Avoidance response:**
 - **Displacement to movement**
 - **Effective habitat loss**
- **Habitat loss/gain**
- **Collision rate**

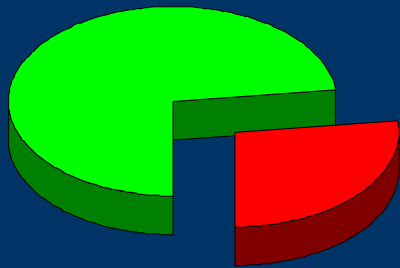


Displacement of movement



- 71-86% of bird radar tracks heading for both wind farms at 1.5-2 km distance avoided going through them
- Radar showed birds generally avoided both Danish offshore wind farms
- Responses are highly species specific

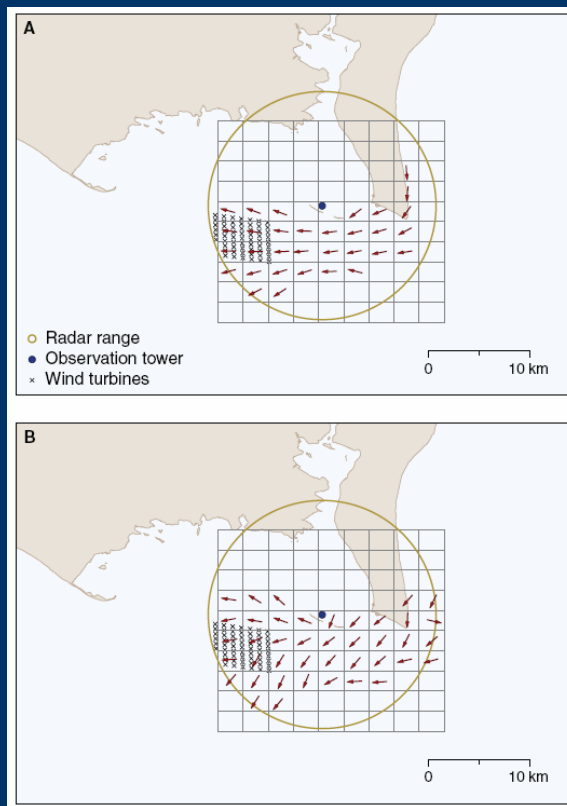
Displacement of movement



- Numbers of eiders rounding Gedser entering the Nysted wind farm decreased by 63-83% post construction
- Proportions of birds crossing the wind farm area have decreased relative to the pre-construction baseline.



Displacement of movement



Radar showed birds made:

- i) gradual and systematic modification to their flight routes in response to the visual stimulus of the wind farm**
- ii) more dramatic changes in flight deflection close (< 1 km) to the outermost turbines.**

Displacement of movement



- **Changes in flight direction occurred closer (0.5 km) to the wind farm at night than by day (1.5 km)**
- **At Nysted, 6 out of 10 flocks showed lateral avoidance of the wind farm by night compared to 9 out of 10 by day**



Displacement of movement



- At Nysted, TADS monitoring detected no birds <120 m during hours of darkness, even during heavy migration
- This supports Bioconsult radar studies that suggest these species fly higher in the area of the wind farms by night compared to in daylight



Displacement of movement



- We obtained too few observations to draw major conclusions about avoidance responses in poor visibility (e.g. fog or rain).
- However, migration movement ceased for most species in fog, precipitation and other conditions of poor visibility



Displacement of movement



- We stress that these responses were those shown by waterbirds generally, and at Nysted by eiders in particular, because they were the most abundant species present.
- Avoidance responses were highly species specific, individuals showed different responses to wind farms and that all birds can potentially enter the wind farms.



Displacement of movement



Some species:

- (i) were almost never witnessed flying between the turbines despite their abundance outside (e.g. divers and gannets),**
 - (ii) rarely did so (e.g. common scoters)**
 - (iii) avoided flying far into the wind farm (e.g. terns)**
 - (iv) showed no avoidance (e.g. gulls)**
- ...so responses are highly species specific**

Displacement of movement



Observations did not strongly support the alternative hypothesis that some flying birds of certain species show a lateral attraction response to the wind farm.



Habitat loss/gain



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- Comparing pre- and post construction aerial survey distributions of birds, the most numerous species generally showed avoidance behaviour in their distribution patterns at both Danish offshore wind farms
- Displacement was most notable amongst divers, common scoter and long-tailed ducks, although responses are highly species specific.

Habitat loss/gain



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Comparing pre-construction aerial survey distributions of birds with those post construction, no bird species demonstrated enhanced use of the waters within the two Danish offshore wind farms.

Habitat loss/gain



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- Behavioural avoidance of the wind farms causes effective habitat loss
- BUT: this must be assessed in terms of the potential feeding habitat affected relative to areas outside of the wind farm.
- For species considered here, that proportion is small and therefore likely of little biological consequence.
- Additional costs of many such wind farm effects may, however, constitute a more significant effect
- Measurement of such cumulative effects is a high priority when considering the effects of many such developments along an avian flyway in the future.

Collision rate

Although avoidance responses mean that turbines erected at sea do affect the local distribution, abundance and flight patterns of birds in the immediate vicinity, the corollary is that fewer birds come within the risk zone of the rotor blade sweep area, reducing collision probabilities.



Photo: Gunnar Britse
Courtesy Nysted Havmøllerpark website



Collision rate

Radar studies provided evidence that many bird species showed avoidance responses at distances of up to 5 km (and potentially more) from the turbines, and within a range of 1-2 km, that more than 50% of birds heading for the wind farm avoid passing within it.



Photo: Gunnar Britse
Courtesy Nysted Havmøllerpark website



Collision rate

The radar studies also confirm that many birds entering the wind farm re-orientate to fly down between turbine rows, frequently equidistance between turbines, further minimising their risk of collision.



Photo: Gunnar Britse
Courtesy Nysted Havmøllerpark website

Collision rate

- Results from TADS confirms that waterbirds (mostly common eider) lose height in the wind farm, flying more below rotor height than they do outside the wind farm.
- They also appear to fly above turbine height at night.



Photo: Gunnar Britse
Courtesy Nysted Havmøllerpark website

Collision rate

- Modelling estimated numbers of common eiders likely to collide with the sweeping turbine blades each autumn at the Nysted offshore wind farm.



Photo: Gunnar Britse
Courtesy Nysted Havmøllerpark website

Collision rate

- Parameters were derived from radar investigations and TADS
- 1,000 iterations of the model predicted with 95% confidence that out of 235,000 passing birds, 0.018-0.020% would collide with the turbines in a single autumn (41-48 individuals).



Photo: Gunnar Britse
Courtesy Nysted Havmøllerpark website

Collision rate

- It was predicted that, with such a low level of probability of collision at any one turbine, the TADS monitoring system would fail to detect a single collision of a water bird during more than 2,400 hours of monitoring
- This proved to be the case during the periods of most intense migration.



Photo: Gunnar Britse
Courtesy Nysted Havmøllerpark website



Collision rate

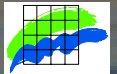
- No bird species came anywhere near the increase in annual mortality of 1% caused by wind turbine collisions at Nysted necessary to trigger mitigation mechanisms to reduce the effects of this impact.
- Most probably this was also the case at Horns Rev as well.



Photo: Gunnar Britse
Courtesy Nysted Havmøllerpark website

- **Finally: a huge THANK YOU to very many folk!**

- To the electricity and associated companies, various departments in the energy and environment ministries, “miljøgruppen” and all the specific members of staff with whom our group has worked (both scientifically and logistically) over recent years for their support, advice, help and funding, as well as for arranging this conference
- To all the pilots and aircraft owners involved with surveys
- To the international expert panel that has been so helpful in providing a steer on the work
- To our many friends, colleagues and contacts with whom we have worked in recent years, including our colleagues Ib Clausager who initiated much of this work and Karsten Laursen who has coordinated the recent contracts



• Thank you very much for listening!

