



Bird distribution response to offshore wind farms

Introduction

The Danish marine inshore waters constitute major staging and wintering grounds for huge numbers of migratory waterbirds. At least 5-7 million individuals of more than 30 bird species winter in these areas, and much greater numbers exploit them for staging on migration (Laursen et al. 1997).

As part of a programme to develop renewable energy sources, a government action plan launched five offshore demonstration wind farm projects in Danish waters in 1997, with the aim to provide information about their engineering and economic feasibility as well as assessing their effects on the environment, especially the potential impacts on waterbirds. All projects were obliged to undertake full Environmental Impact Assessments (EIA) prior to construction, as well as post-construction monitoring. Results from these projects should provide background information to support development of policy relating to future offshore wind farm developments.

Preliminary results concerning changes in seabird habitat utilisation in and near Horns Rev and Nysted offshore wind farms are presented here.

Method

Bird numbers and distributions were studied within survey areas of 1,850 Km² (Horns Rev) and 1,230 Km² (Nysted, Fig. 1), covering wind farm impact areas as well as reference areas. Between 1999 and 2004 a total of 29 aerial surveys were conducted at each of the two sites.

NERI undertook aerial surveys using a high winged, twin-engined Partenavia P-68 Observer, designed for general reconnaissance purposes. Survey flight altitude was 76 m (250 feet) and cruising speed approximately 185 km/h (100 knots). The whole study area was covered by north-south oriented, parallel transects, flown at 2 km intervals, covering a total linear track of 860 km (Horns Rev) and 580 km (Nysted, see Fig. 1).

For each species a selection index (D-values) for the wind farm site and its vicinity was calculated (see Fig 1), using Jacob's Index (Jacobs 1974). D-values range from -1 (total absence from area examined) to +1 (all birds within area examined). A BACI-concept (Before-After-Control-Impact) was used, comparing data from the pre-construction phase with data from the post-construction phase of the wind farm sites.

Results from Horns Rev and Nysted Offshore Wind Farms in Denmark

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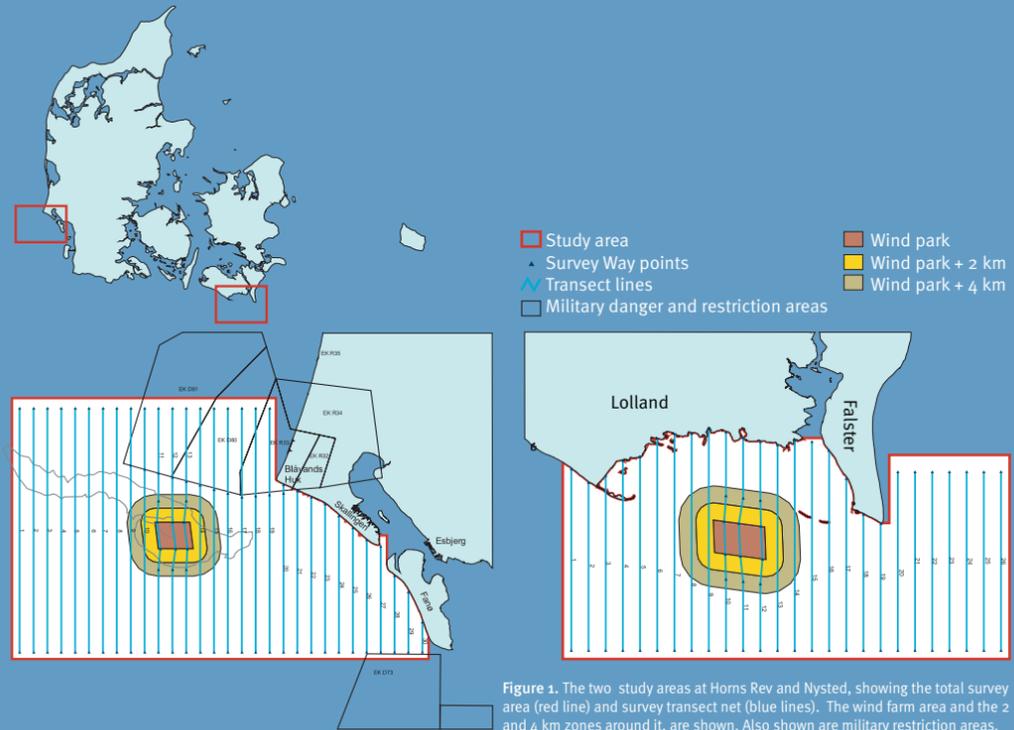


Figure 1. The two study areas at Horns Rev and Nysted, showing the total survey area (red line) and survey transect net (blue lines). The wind farm area and the 2 and 4 km zones around it, are shown. Also shown are military restriction areas.

Results

Diving ducks and gulls were dominant species groups at the two study areas, but at the Horns Rev study area also Divers *Gavia* sp., Razorbill *Alca torda* and Guillemot *Uria aalge* were found (Petersen 2005). At the Nysted study area Long-tailed Duck *Clangula hyemalis* and Eider *Somateria mollissima* were found to dominate the offshore areas (Kahlert et al. 2005).

A number of species or species groups showed changes in their distribution after the establishment of the wind farm, either by a reduced or increased utilisation of the wind farm sites and their near surroundings.

At Horns Rev Divers *Gavia* sp. (mainly Red-throated Diver *Gavia stellata*) was found in slightly greater than expected numbers out to a distance of 2 km from the planned site during the pre-construction phase, when assuming a random distribution of the birds over the study area. Data from the post-construction period show a marked reduction of divers utilising the wind farm sites and 2 and 4 km zones around the site (Table 1).

Herring Gull *Larus argentatus* increased their utilisation of the Horns Rev wind farm area after the construction, while only minor changes was seen for this species at the Nysted wind farm site (Table 1).

Long-tailed Duck are using the Nysted study area as staging area during winter and spring. The utilisation of the wind farm site and its near surroundings was reduced after the erection of the wind turbines (Table 1). Pre- and post-construction distribution of Long-tailed Duck is shown in Figure 2.

Common Scoter *Melanitta nigra* was found in high numbers in the Horns Rev study area. During the pre-construction period Common Scoters were mainly found along the coast and only found in the wind farm area in small numbers. There were no significant differences between the pre- and post-construction D-values for this species (Table 1), but overall distribution changes within the study area was found, changes not supposed to relate to effects from the presence of the wind turbines. However, pre- and post-construction distribution maps for Common Scoter do strongly indicate that birds did avoid the actual wind farm site (Figure 3). This issue remains to be analysed in greater detail. Investigation of bird flight paths around the wind farm showed that approaching Common Scoters avoid entering the wind farm (Christensen & Hounisen 2005).

Razorbills and Guillemots generally avoided the wind farm site at Horns Rev and its surroundings during the pre-construction phase (Table 1). In the post-construction phase the degree of avoidance increased.

Table 1. Jacobs Index values (Df-values) for bird flocks (clusters) encountered in the Horns Rev and Nysted wind farm areas (MA+0) pre- and post-construction respectively. Similarly D-values for the wind farm areas plus zones of 2 and 4 km radius from the wind farm site (MA+2 and MA+4). Data origin is given in column "Data origin", "HR" = Horns Rev, "Ny" = Nysted. Also shown are the total numbers of clusters recorded pre- and post-construction throughout the surveys from the total study area (N Pre-construction and N Post-construction). Jacobs index varies between -1 (complete avoidance) and +1 (complete selection).

Species	Data origin	D for MA+0 Pre-construct	D for MA+0 Post-construct	D for MA+2 Pre-construct	D for MA+2 Post-construct	D for MA+4 Pre-construct	D for MA+4 Post-construct	N Pre-construct	N Post-construct
Diver sp.	HR	0.10	-1	0.04	-0.91	-0.13	-0.69	734	924
Long-tailed Duck	Ny	0.64	0.29	0.68	0.35	0.65	0.29	939	648
Common Scoter	HR	-0.45	-0.57	-0.16	-0.03	0.06	-0.15	1327	4885
Herring Gull	HR	-0.66	0.04	-0.63	-0.04	-0.41	0	1529	1680
Herring Gull	Ny	-0.29	-0.14	-0.28	-0.24	-0.15	-0.33	1416	1058
Razorbill/Guillemot	HR	-0.12	-1	-0.14	-0.61	-0.34	-0.62	164	182

Figure 2. Distribution of Common Scoter in the Horns Rev study area, based on 18 surveys performed during the pre-construction phase (Pre-construction) and 9 surveys performed during the post-construction phase (Post-construction). Notice the low number of surveys from the post-construction phase as compared to the pre-construction phase.

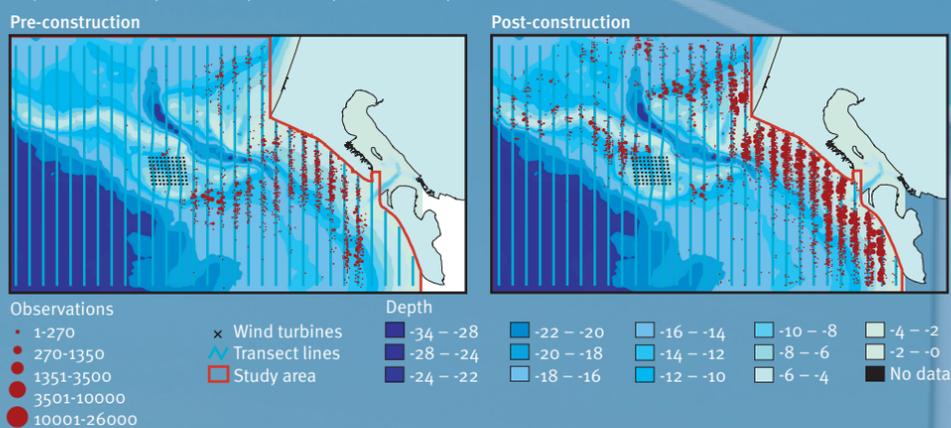
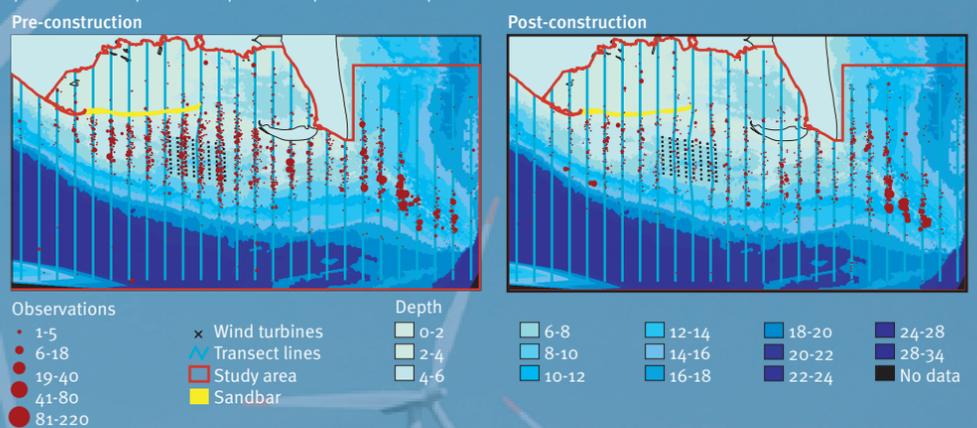


Figure 3. Distribution of Long-tailed Duck in the Nysted study area, based on 21 surveys performed during the pre-construction phase (Pre-construction) and 5 surveys performed during the post-construction phase (Post-construction). Notice the low number of surveys from the post-construction phase as compared to the pre-construction phase.



Conclusion

Aerial surveys of birds around the Horns Rev and Nysted offshore wind farms showed that relatively few species were abundant at the wind farm sites. A comparison between pre- and post-construction distribution patterns for selected bird species was done. Based on this preliminary analysis it was indicated that Divers, Long-tailed Duck, Common Scoter and Razorbill/Guillemot reduced their utilisation of the wind farm area after the erection of the wind turbines. On the contrary, at Horns Rev, Herring Gull increased their utilisation of the wind farm site.

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Figure Captions

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