Cumulative effects of offshore wind farms on birds in Danish waters

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Introduction

Given that offshore wind projects have only existed some 14 years our current knowledge of the effects of offshore turbines on birds is far from conclusive. Bird collisions with wind turbines at sea seems to be a rare event, while wind farms can cause habitat loss due to disturbance and consequently exclusion. But by carefully selecting areas with minimum avian impact based on thorough field studies the negative consequences for birds of offshore wind farms can be kept at a tolerable level.

But what if another large wind farm is build nearby? What are the cumulative effects of offshore wind farm development on birds? Evidence is increasing that the most devastating effects of human modification of the natural environment may result not from the direct effects of a particular activity, such as a wind farm, but from the combination of individually minor effects of multiple actions over time.

The paper discusses the possible consequences for birds of cumulative effect of offshore developments including wind farms and proposes a possible way forward in order to address this issue.

The birds at risk

In Denmark the birds of particular concern in relation to offshore wind farms are divers, grebes, gannets, sea duck, gulls, terns and auks. These birds often occur far at sea but are mostly associated with shallow water where they congregate at sandbanks or stone revs to feed on fish and mussels. In addition to sea- and water birds, land birds migrating over the sea may locally also be of concern.

Some of the water- and land birds are present offshore in Danish waters mainly on migration or when moving along the shore between resting and feeding areas, while in particular sea ducks, divers and auks winter offshore in large numbers. The shallow waters in Denmark are uniquely important wintering grounds for 1-3 million sea duck from breeding areas in Northern

Scandinavia, Finland and Russia (Jensen 1993, Durinck *et al.* 1994). For instance, about 400.000 Eiders *Somateria mollissima* occur in Danish waters during winter while the number of Common Scoter *Melanitta nigra* varies between 360-950.000 (Bregnballe *et al.* 2003). Most of these birds have high annual survival rates and low productivity and so consequences of increased mortality from for instance collisions with wind turbines are potentially more significant than they would be for species of short longevity and high breeding productivity.

The Common Scoter breeds in both North America, Europe and across Russia to eastern Siberia and is divided into more or less separate populations with individual breeding and wintering areas. The Common Scoters that winter in Denmark belongs to a population that breed from west Siberia across Russia to Norway and winter from the southern part of the Baltic Sea south along the coasts of the North Sea and the Atlantic to Morocco. The number of birds belonging to this flyway[1] population is estimated at 1.6 million (Delany & Scott 2002). With 360-950.000 in Danish waters this implies that between 20-60% of this flyway population of Common Scoter winter in Denmark, which clearly give a special responsibility for safe guiding resting and feeding areas of this species.

The potential negative impact of offshore wind farms on birds

It is generally accepted that the main potential hazards to birds from wind farms are collision mortality, loss of or damage to habitat and disturbance.

Over the years the major concern of many impact assessments on wind energy schemes carried out in Europe and U.S.A. has been that birds should collide with the rotor blades or tower of the wind turbine and get killed. So far, relatively high collision mortality rates have only been recorded at a few sites e.g. Altamon Pass in California, USA (Orloff and Flannery 1992), Tarifa and Navarra, Spain (SEO/BirdLife 1995) and at the East dam in the port of Zeebrugge, Belgium (Everaert *et al.* 2002). The sites in California and Spain were situated in areas with large concentrations of birds of prey and resulted in deaths of significant numbers of Golden Eagle *Aquila chrysaetos* and Griffon Vulture *Gyps fulvus*. The fatalities of wind farm in Zeebrugge were mostly water birds but also included birds of prey, such as the rare Peregrine *Falco peregrinus*.

Only a limited number of studies have been carried out to assess the collision risk of birds with offshore wind turbines. However, experience from Denmark and Sweden suggest that the risk is relatively low as most birds avoid entering

[1] The "flyway" is the migration route including breeding and wintering areas of a particular population of migratory bird.

offshore wind farms and the ones that do enter move along the open corridors between turbine rows (Christensen *et al*. 2004, Dresholm & Kahlert 2005, Pettersson 2005).

Loss of or damage to habitat resulting from off shore wind farms is not generally perceived to be a major concern for birds as the direct loss is small-scale, primarily for turbine bases and cable at sea (Langston and Pullan 2003).

Displacement due to disturbance and consequently exclusion from important resting and/or feeding areas on the other hand seems to be of considerably more concern in connection with offshore wind farms. A major reason for that is that many birds favour the same offshore sandbanks for feeding as have been proposed for wind farms. This is in particular the case with sea ducks, divers, grebes and auks. Several of these birds avoid feeding and resting between the turbines inside wind farms and sometimes also considerable area around them. For instance, a comparison of the pre- and post construction distribution of Common Scoter clearly indicate that Common Scoters respond to the presence of the Horns Rev wind farm by generally avoiding the area (Petersen 2005). Also divers and auks (Guillemot *Uria aalge* and Razorbill *Alca torda*) showed an increased avoidance of the Horns Rev wind farm area after erection of the wind turbines, including also zones of 2 and 4 km around the wind farm (Petersen 2005).

The number of offshore wind farms today - and tomorrow

Some16 offshore wind farms are currently operational in Europe, seven of which are in Danish waters. But this appears only to be the beginning. In Denmark the 200MW Horns Rev II was recently commissioned and more are planned. In the UK15 new offshore projects are about to proceed to the Environmental impact assessment stage as part of the “Round Two” wind farm development. And in Germany 23 wind farms are planned in its part of the North Sea and a further six in the Baltic Sea – some of them with more than 120 turbines spread over up to 100 square kilometres.

This massive development of offshore wind farms is believed to continue in the coming years as there is no doubt that the magnitude of the offshore wind resource is impressive. Although it is envisaged that in the future offshore wind farms will gradually be situated further offshore in deeper waters, many new wind farms are also believed to be built in shallow waters along the coats of northern Europe.

The protection of the marine environment

Our knowledge of the distribution of sea birds in Danish waters, the size of population, migrations routes, vulnerability to disturbance, timing of occurrence etc, has increased significantly over the last decades. However, we still lack detailed understanding about local distribution of birds at sea, variability of numbers and the underlying determinants of their timing of occurrence in a given locality. But what is clear is that seabirds are mostly associated with specific sites (in particular shallow waters) with little disturbance and the presence of abundant food resources (Jensen 1993, Durinck *et al.* 1994).

Denmark has ratified several international nature protection conventions and agreements that aim at protecting marine birds and other organisms including their habitats. As part of the ratification of the Ramsar Convention on protection of wetlands and their flora and fauna, Denmark has designated 27 "Ramsar Sites" which cover almost 6,000 sq. km of sea. In addition, 12,112 sq. km of marine area has been designated as Special Protection Area (SPAs) in accordance to the Birds Directive (all Ramsar Sites are also designates as SPAs). SPAs are designated to safe guide a favourable status of specific bird species of conservation concern listed on Annex I of the Birds Directive and/or sites where particularly large concentrations of water birds regularly occur. The marine SPAs constitutes 11.4% of the marine area of Denmark (EEZ/Fisheries territory), which is a very significant achievement from a nature conservation point of view.

There is strong consensus in Denmark that SPAs (or Ramsar Site) and the nearest surroundings are not suitable for wind farm development. This implies that a number of key areas for sea- and water birds will remain without the adverse impacts of wind energy projects. However, although the size of protected marine area in Denmark is large compared with many other countries, it still leaves nearly 90% of the marine territory unprotected. Thus very large shallow areas utilised by thousands of birds remain outside the protected area network.

Cumulative effects of wind farms

While some site-based effects from wind farms on birds have been detected, there is so far little evidence that cumulative effects from multiple wind farms and other developments have had significant effect upon birds. But a likely reason for the lacking evidence is that impact studies usually focus only on a restricted geographical area around a proposed or existing wind farm without taken a broader view and consider the impact of other wind farms and developments upon the same birds.

The number of offshore wind farms may still be relatively limited. However, when migrating from breeding grounds around the Baltic Sea to Danish waters

or further south along the coasts of the North Sea, sea ducks such as Eiders, Common Scoter, Velvet Scoter *Melanitta fusca*, Long-tailed Duck *Clangula hyemalis* and Scaup *Aythya marila*, potentially pass 4-5 offshore wind farms, several large bridges (such as the Öland Bridge, the Øresund Bridge and the Great Belt Bridge) in addition to other developments which have lead to habitat exclusion due to disturbance from core resting and feeding area.

For one or several of these bird species the cumulative adverse effects of human offshore developments could be close to crossing a threshold of acceptable effects. The key questions are at what point do accumulated habitat loss (including effective habitat exclusion due to disturbance) and collision mortality impact on population size and distribution? (Langston & Pullan 2003). There is no straightforward way to address these questions. But a way forward could be to take a flyway perspective and not just focus on possible effects of isolated developments. This could be done by undertaking a Strategic Environmental Assessment (SEA), which extends the aims and principles of Environmental Impact assessment (EIA) to decision-making at "strategic" level, where cumulative impacts of other projects are included as well as trans-boundary impacts. For species of particular conservation concern this should include an assessment of the cumulative effects along the entire flyway of planned or existing wind farms and other major offshore developments.

Conclusions and recommendations

The cumulative effects of human developments in the shallow Danish waters is reaching level where habitat exclusion due to disturbance may have significant negative impact on the population size and distribution of some seabirds. This is not to say that we should stop building offshore wind farms. Birds will probably suffer more from climatic change if we don't.

But we have to be very careful when appointing the wind farm areas, base our selection on proper knowledge and set aside key marine areas for all groups of birds that occur in our waters. Therefore it is recommended:

To undertake a Strategic Environmental Assessments of all future offshore wind farms. If migratory birds occur in the project area on a regular basis a flyway perspective should be taken for the relevant species.

To be qualified the SEA must rely on proper understanding of biology of the birds in question. Specifically, up-to-date data on population size, habitat preference, migration routes and behaviour must be available. Consequently, the national authorities should support studies that provide such vital knowledge.

To designate more marine protected areas in Danish waters to safeguard all groups of seabirds that winter in numbers of international importance. Since future offshore wind farms gradually will be situated further offshore in deeper waters, the large number of auks (including the Little Auk *Plotus alle*) that occur in some winters in Skagerak appear to be of particular concern.

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