From effects to impacts: Analysing displacement of Red-throated Divers in relation to their wintering home ranges

Georg NEHLS[1], Claudia BURGER[1], Birgit Kleinschmidt[2], Petra QUILLFELDT[2], Stefan HEINÄNEN[3], Julius MORKUNAS[2], Ramunas ZYDELIS[3, 4]

[1] BioConsult SH

[2] Justus-Liebig Universität Gießen. b.kleinschmidt@bioconsult-sh.de

[3] DHI

[4] Ornithela

Télécharger le diaporama

Abstract

Several seabird species show marked avoidance behaviour to offshore wind farms (OFWs) and in the light of this new and strongly expanding industry, it is of highest interest to examine how the resulting habitat loss might affect their populations and how possible adverse effects can be avoided in marine spatial planning.

Red-throated Divers (*Gavia stellata*) wintering in European marine waters are amongst the most sensitive species to anthropogenic disturbances and known to show strong avoidance of OWFs. As the species is highly mobile, individuals are likely to encounter OWFs frequently during migration and wintering and are thus affected in several staging areas. For the conservation of this red-listed species it is crucial to understand how displacement effects relate to individual movements and winter home ranges.

Diver displacement from offshore wind farms in a main staging area in the German Bight, partly declared as SPA, was studied by large-scale digital aerial video surveys and satellite tracking of individuals caught at site. Specifically, the study aimed to relate displacement effects to diver home range sizes and how OWFs affect movement patterns (e.g. relocation distances) in detail. From tracking data home ranges are calculated using kernel density estimates for areas with and without OWFs and it is analysed whether an overlap with OWFs leads to changes in usage patterns.

Initial results from aerial surveys and individual movements indicate a large-scale displacement response of Red-throated Divers following a gradient of reduced densities extending 10 km. Although 95 % kernel home ranges frequently overlap with OWF-areas, also tracking data detailed investigations of individual tracks reveal clear avoidance of OWFs and suggest a change in movement patterns depending on the distance to the closest wind farm. Tracking data revealed large home ranges of several thousand square kilometre of Red-throated Divers in the German North Sea and though displacement effects of wind farms are rather large, they affect only part of individual home ranges.

Displacement effects from offshore wind farms are related to population development in the area and discussed in the context of species conservation and future OWF planning decisions. It is concluded that approaches to monitor wind farm effects should consider both large-scale movement patterns of mobile seabirds as well as large-scale effects from offshore wind farms. Understanding how displacement of windfarms may lead to impacts on populations of seabirds requires sound knowledge of individual behaviour.

Motivation – purpose

Several seabird species show marked avoidance behaviour to offshore wind farms (OWFs) (Leopold *et al.* 2011, Mendel *et al.* 2008, Petersen *et al.* 2006) and in the light of this new and strongly expanding industry, it is of highest interest to examine how the resulting habitat loss might affect their populations and how possible adverse effects can be avoided in marine spatial planning.

The red-throated diver (Gavia stellata) is a protected migratory waterbird species occurring along the coasts of all countries in Northern Europe during the non-breeding period (Dierschke *et al.* 2012). Knowledge about diver ecology is highly fragmented. However, the species is considered being one of the most sensitive waterbird species to human disturbances including presence of offshore wind farms (Schwemmer *et al.* 2011, Dierschke *et al.* 2012) and wintering divers in the North and Baltic Sea are known

to show strong avoidance of OWFs (Petersen *et al.* 2006, Dewar 2011, Petersen at al. 2014, Welcker & Nehls 2016). As the species is highly mobile, individuals are likely to encounter OWFs frequently during migration and wintering and are thus affected in several staging areas. For the conservation of this red-listed species it is crucial to understand how displacement effects relate to individual movements and winter home ranges.

Diver displacement from offshore wind farms in a main staging area in the German Bight, partly declared as SPA, was studied by large-scale digital aerial video surveys and satellite tracking of individuals caught at site. Specifically, the study aimed to relate displacement effects to diver home range sizes and how OWFs affect movement patterns (e.g. relocation distances) in detail.

Methodology

Using ARGOS satellite transmitters (platform terminal transmitters PTTs), we tracked red-throated Divers throughout their annual cycle. Birds were captured during winter and spring 2015, 2016 and 2017 in the German North Sea and implanted with Argos transmitters which allowed tracking them for up to two years.

In addition, digital aerial video surveys using HiDefs Ltd technology were conducted for documenting species distribution and abundance in the Eastern German Bight. From tracking data individual home ranges are calculated using 95 % and 50 % kernel density estimates. Daily movements were analysed in order to investigate whether proximity of OWFs leads to changes in usage patterns.

To quantify displacement effects, telemetry data and survey data were analysed separately using species distribution modelling. We used generalized additive mixed models (GAMMs) for identifying factors describing distribution patterns of divers. The offshore environment is dynamic and constantly changing and we accounted for this by including hydrographic variables and water depth in the models. To be able to assess the displacement effect, the distance to the nearest windfarm was included as a parameter in the models.

Outputs summary

Telemetry and survey data yielded very similar modelling results. Divers aggregated in the frontal zone created by Elbe river outflow and tidal currents, and showed preference towards shallower depths. Red-throated Divers showed clear avoidance of offshore wind farms as both the probability of presence and predicted densities increased with increasing distance from wind farm perimeters. Modelling results from aerial surveys and individual movements indicate a large-scale displacement response of Red-throated Divers following a gradient of reduced densities extending 10 km.

Initial results indicate that home ranges of red-throated divers in the German North Sea are generally large and show high individual variability. In some cases, individual home ranges contain several 'hot spots', indicating a patchy habitat use in space and time.

The large home ranges of red-throated divers include several thousand square kilometres in the German North Sea. Even though 95 % kernel home ranges frequently overlap with OWF-areas, detailed investigations of individual tracks reveal clear avoidance of OWFs and show larger daily movements when birds are close to the wind farms.

Interpretation, findings, prospects and possible developments

We found that red-throated divers are highly mobile within their wintering area and show strong displacement from offshore wind farms in the Eastern German Bight. Changes in movement patterns in the vicinity of OWFs might suggest that additional fitness costs might occur due to increased disturbance. Aerial surveys indicated changes in the distribution of divers within the main staging area, which are related to the presence of wind farms. However, it is still unknown whether this redistribution has consequences on population level. More research on individual behaviour and on the additional energetic costs due to human disturbances is needed in order to investigate the impacts of offshore wind farms on populations of seabirds.

References

Dewar, R. 2011. Galloper wind farm ornithological technical report. SGP6514 Galloper HRA Report. (available here).

Dierschke, V., K.-M. Exo, B. Mendel & Garthe 2012: Threats for Red-throated Divers Gavia stellata and Black-throated Divers G. arctica in breeding, migration and wintering areas: a review with special reference to the German marine areas. Vogelwelt 133: 163-194.

Garthe S, Schwemmer H, Markones N, Müller S & Schwemmer P 2015: Distribution, seasonal dynamics and population trend of divers Gavia spec. in the German Bight (North Sea). Vogelwarte 53: 121-138.

Leopold, M.F., Dijkman, E.M., Teal, L. & the OWEZ-Team. (2011). Local birds in and around the offshore wind farm Egmond aan Zee (OWEZ) (T-

0 & T-1, 2002-2010). Report nr. C187/11. NoordzeeWind Rapport OWEZ_R_221_T1_ 20111220_local_birds. IMARES Wageninen UR, Texel, Netherlands.

Mendel, B., Sonntag, N., Wahl, J., Schwemmer, P., Dries, H., Guse, N., Müller, S. & Garthe, S. (2008). Artensteckbriefe von See- und Wasservögeln der deutschen Nord- und Ostsee – Verbreitung, Ökologie und Empfindlichkeiten gegenüber Eingriffen in ihren marinen Lebensraum. Naturschutz und Biologische Vielfalt, 59, BfN, Bonn, Germany.

Petersen, I.K., Christensen, T.K., Kahlert, J., Desholm, M. & A.D. Fox (2006): Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. Report request. Commissioned by DONG Energy and Vattenfall A/S. – NERI, National Environmen-tal Research Institute: 166 pp.

Petersen, I.K., Nielsen, R.D., Mackenzie, M.L: (2014). Post-construction evaluation of bird abundances and distribution in the Horns Rev 2 offshore wind farm area, 2011 and 2012.

Schwemmer P., Mendel B., Sonntag N., Diersche V. & S. Garthe S (2011): Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21: 1851-1860.

Welcker, J. & Nehls, G. (2016): Displacement of seabirds by an offshore wind farm in the North Sea. Marine Ecology Progress Series. Vol. 554: 173–182.

Acknowledgements

The work presented in this presentation constitutes part of a 4- year collaborative project between BioConsult SH, Justus Liebig University and DHI Hørsholm, Denmark. The project is funded by the German Federal Ministry for Economic Affairs and Energy represented by PTJ Funding.