NATURA 2000-APPROPRIATE ASSESSMENT

Operational Lifetime Extension, Horns Rev 1
Vattenfall/Ørsted

VATTENFALL

Title:	NATURA 2000-APPROPRIATE ASSESSMENT - Operational Lifetime Extension, Horns Rev 1. Vattenfall/Ørsted
Authors:	Jesper Kyed Larsen, Charlotte Boesen, Emil Bødker Pedersen.
Affiliation:	Vattenfall.
Publisher:	Vattenfall and Ørsted.
Review:	DCE (Fox *et al* 2025).
Citation:	Vattenfall 2025. Natura 2000-Appropriate assessment. Operational Lifetime Extension, Horns Rev 1. Report by Vattenfall/Ørsted.

Contents

1. Summary

This report constitutes a Natura 2000 Appropriate Assessment according to Article 6 of the Habitats Directive (92/43/EEC) to support the application for a lifetime extension of the Horns Rev 1 offshore wind farm in its present form with up to 15 years, i.e. until 2042.

The assessment builds on the Natura 2000 Screening for the project that concluded that significant adverse effects could not be ruled out for the qualifying features of the Special Protection Area 113, Sydlige Nordsø (part of the Natura 2000 area N246), specifically with regards to displacement and cumulative effects with other wind farm developments. Collision risk, barrier effects, attraction, habitat loss, and disturbance (beyond what is reflected in displacement effects) were screened out as impact pathways with a potential for significant effects for the bird features.

For divers, the fact that numbers increased in the wind farm area after construction of Horns Rev 1, with the 5-year period after construction of the wind farm seeing the highest abundance of divers in the Horns Rev area during the last 24 years, strongly suggests that the wind farm is no hindrance to achieving/maintaining a favourable conservation status for divers in SPA 113.

It is concluded with a high degree of certainty that any continued minor displacement of divers resulting from a 15-year lifetime extension of Horns Rev 1 is **unlikely to cause harm** to the designation of SPA 113. As a consequence, it can also be concluded that the lifetime extension is **unlikely to cause harm** to the integrity of the N246 Natura 2000-area.

Furthermore, the assessment has clearly shown that the wind farm is unlikely to make any material contribution to cumulative effects. Despite the very extensive and unique long-term data set available from the Horns Rev area spanning the time before the construction of Horns Rev 1 and 20 years into its operation, it has not been possible to pick up displacement effects of the wind farm, suggesting that any effects will be small and well within the natural variation in diver abundance and distribution in the Horns Rev area and SPA.

It is concluded that the lifetime extension of the Horns Rev 1 wind farm is not going to make any difference to the cumulative effects of wind farm developments on divers in the SPA 113, hence it is **unlikely to cause harm** to the integrity of the Natura 2000-area N246 and by implication the Natura 2000 network and conservation status of divers.

For common scoter, the area of the wind farm saw an increase in numbers post-construction, which stayed relatively stable after that. At the same time numbers in the general area steadily increased from before Horns Rev construction to after Horns Rev 2 construction, after which it stabilised at a level markedly higher than before the construction of Horns Rev 1. It has also clearly been shown that common scoters are willing to enter Horns Rev 1 to feed in relatively large numbers, as was found to be the case for Horns Rev 2. All in all, this strongly suggests that the presence of the Horns Rev 1 wind farm is no hindrance to achieving/maintaining a favourable conservation status for common scoter in the expanded SPA 113.

It is concluded with a high degree of certainty that any continued minor displacement of common scoters resulting from a 15-year lifetime extension of Horns Rev 1 is **unlikely to cause harm** to the designation of SPA 113. As a consequence, it can also be concluded that the lifetime extension is **unlikely to cause harm** to the integrity of the Natura 2000-area. The same conclusion is reached in terms of cumulative effects with regards to the Natura 2000-area N246 and by implication the Natura 2000 network and the population of common scoters.

For little gull, for which the well-surveyed part of the SPA holding the wind farms does not hold significant numbers, it was not possible to conclude about displacement effects of Horns Rev 1. If anything there seemed to have been an increase in numbers after the construction of Horns Rev 1, and little gulls have been observed in the wind farm on more occasions. Furthermore, most little gulls have been observed in the western and central part of the surveyed area, meaning Horns Rev 1 is not within a main concentration area of the SPA.

It is concluded with a high degree of certainty that any continued displacement of little gulls resulting from a 15 year lifetime extension of Horns Rev 1 is **unlikely to cause harm** to the designation of SPA 113. As a consequence, it can also be concluded that the lifetime extension is **unlikely to cause harm** to the integrity of the Natura 2000-area The same conclusion is reached in terms of cumulative effects with regards to the Natura 2000-area N246 and by implication the Natura 2000 network and the population of little gulls.

2. Dansk resume

Denne rapport udgør en Natura 2000 konsekvensvurdering i henhold til Habitatdirektivets Artikel 6 (92/43/EEC) i forbindelse med ansøgningen om levetidsforlængelse på 15 år for Horns Rev 1 havvindmølleparken.

Konsekvensvurderingen følger efter en Natura 2000 screening der konkluderede, at det ikke umiddelbart kunne udelukkes, at der kunne være væsentlige negative effekter ved projektet for arterne omfattet af udpegningsgrundlaget for Fuglebeskyttelsesområde F113, Sydlige Nordsø (del af Natura 2000 området N246 af samme navn). Dette gjaldt specifikt for fortrængningseffekter kumulativt med andre havvindmølleparker i området. Kollisionsrisiko, barrierer effekter, tiltrækning, direkte habitat tab og forstyrrelse (udover hvad der er indeholdt i fortrængningseffekten) blev screenet ud som påvirkningsveje med et potentiale for væsentlige negative effekter for de konkrete fuglearter.

Det forhold at antallet af lommer steg i området for parken efter at den blev opført, og at der de første fem år af parkens levetid blev registreret det højeste antal lommer i Horns Rev området de sidste 24 år, peger klart på at mølleparken ikke er nogen hindring for at opnå/opretholde en gunstig bevaringsstatus for arten i Fuglebeskyttelsesområde F113.

Det kan konkluderes med en høj grad af sikkerhed, at en eventuel mindre fortsat fortrængningseffekt for lommer som resultat af en 15 års levetidsforlængelse af Horns Rev 1 havvindmølleparken ikke vil føre til skade på Fuglebeskyttelsesområde F113, og som konsekvens heraf heller ikke på Natura 2000 område N246.

Det forhold at det ikke har været muligt at påvise en fortrængningseffekt af Horns Rev 1 havvindmølleparken med det omfattende datamateriale fra Horns Rev området, dækkende perioden fra før konstruktionen til 20 år ind i driftsfasen for parken, peger på at eventuelle kumulative effekter vil være små og indenfor den naturlige variation i forekomsten af lommer i Horns Rev området. Det er dermed også godtgjort, at parken ikke vil kunne bidrage væsentligt til kumulative fortrængningseffekter for forårsbestanden af lommer i den sydøstlige Nordsø.

Det forekommer derfor at være en rimelig konklusion, at den ansøgte levetidsforlængelse for Horns Rev 1 havmølleparken ikke vil bidrage væsentligt til kumulative effekter af havvindmølleudbygning, eller andre aktiviteter, i Fuglebeskyttelsesområde F113, og derfor heller ikke medføre skade på integriteten af Natura 2000 område N246 og det videre Natura 2000 netværk.

For sortand steg antallet i området for Horns Rev 1 efter dennes opførelse, hvorefter det har holdt sig relativt stabilt. Samtidig steg antallet i Horns Rev området indtil efter opførelsen af Horns Rev 2, hvorefter det har holdt sig stabilt på et niveau langt over, hvad der sås før opførelsen af vindmølleparker i området. Det er påvist, at sortænderne er villige til at bevæge sig ind i både Horns Rev 1 og Horns Rev 2 parkerne i større antal. Alt i alt peger det klart på, at Horns Rev 1 havmølleparken ikke er nogen hindring for at opnå/opretholde en gunstig bevaringsstatus for arten i Fuglebeskyttelsesområde F113.

Det kan konkluderes med en høj grad af sikkerhed at en eventuel mindre fortsat fortrængningseffekt for sortand som resultat af en 15 års levetidsforlængelse af Horns Rev 1 havvindmølleparken ikke vil føre til skade på Fuglebeskyttelsesområde F113, og som konsekvens heraf heller ikke på Natura 2000 område N246. Den samme konklusion nås med hensyn til kumulative effekter på Natura 2000 område N246 og det videre Natura 2000 netværk.

For dværgmåge, der forekommer relativt fåtalligt i Horns Rev området, har det heller ikke været muligt at påvise fortrængningseffekter af Horns Rev 1 havvindmølleparken. Om noget blev der observeret flere fugle i Horns Rev området efter opførelsen af Horns Rev 1, og dværgmåger er lejlighedsvis observeret i parken. De største antal er observeret i den centrale og vestlige del af fuglebeskyttelsesområdet – udenfor Horns Rev 1 parkområdet.

Det kan konkluderes med en høj grad af sikkerhed at en eventuel mindre fortsat fortrængningseffekt for dværgmåge som resultat af en 15 års levetidsforlængelse af Horns Rev 1 havmølleparken ikke vil føre til skade på Fuglebeskyttelsesområde F113, og som konsekvens heraf heller ikke på Natura 2000 område N246. Den samme konklusion nås med hensyn til kumulative effekter på Natura 2000 område N246 og det videre Natura 2000 netværk.

3. Introduction

Vattenfall and Ørsted intends to extend the lifetime of the Horns Rev 1 offshore wind farm to continue the production and delivery of green electricity to the Danish grid for a longer period than foreseen in the original permit . The wind farm is located in the southeastern North Sea (see Figure 3-1) and has been operational since December 11, 2002, being the first large-scale offshore wind farm in the world.

An application has been submitted to the Danish Energy Agency for a lifetime extension of the wind farm with up to 15 years, i.e. until 2042. The lifetime extension is an extension of the electricity production permit, without any technical or physical changes to the wind farm.

This report constitutes a Natura 2000-Appropriate Assessment according to Article 6 of the Habitats Directive (92/43/EEC) to support the application for lifetime extension.

The assessment builds on the Natura 2000 Screening for the project (WSP 2025) which concluded that significant adverse effects could not be ruled out for the qualifying interest features of the Special Protection Area (SPA) 113, Sydlige Nordsø, designated under the EU's Bird Protection Directive and part of the Natura 2000 area N246, Sydlige Nordsø. For the Special Area of Conservation component (SAC 255) of the Natura 2000 area N246, no risks of significant adverse effects were identified in the Natura 2000 screening.

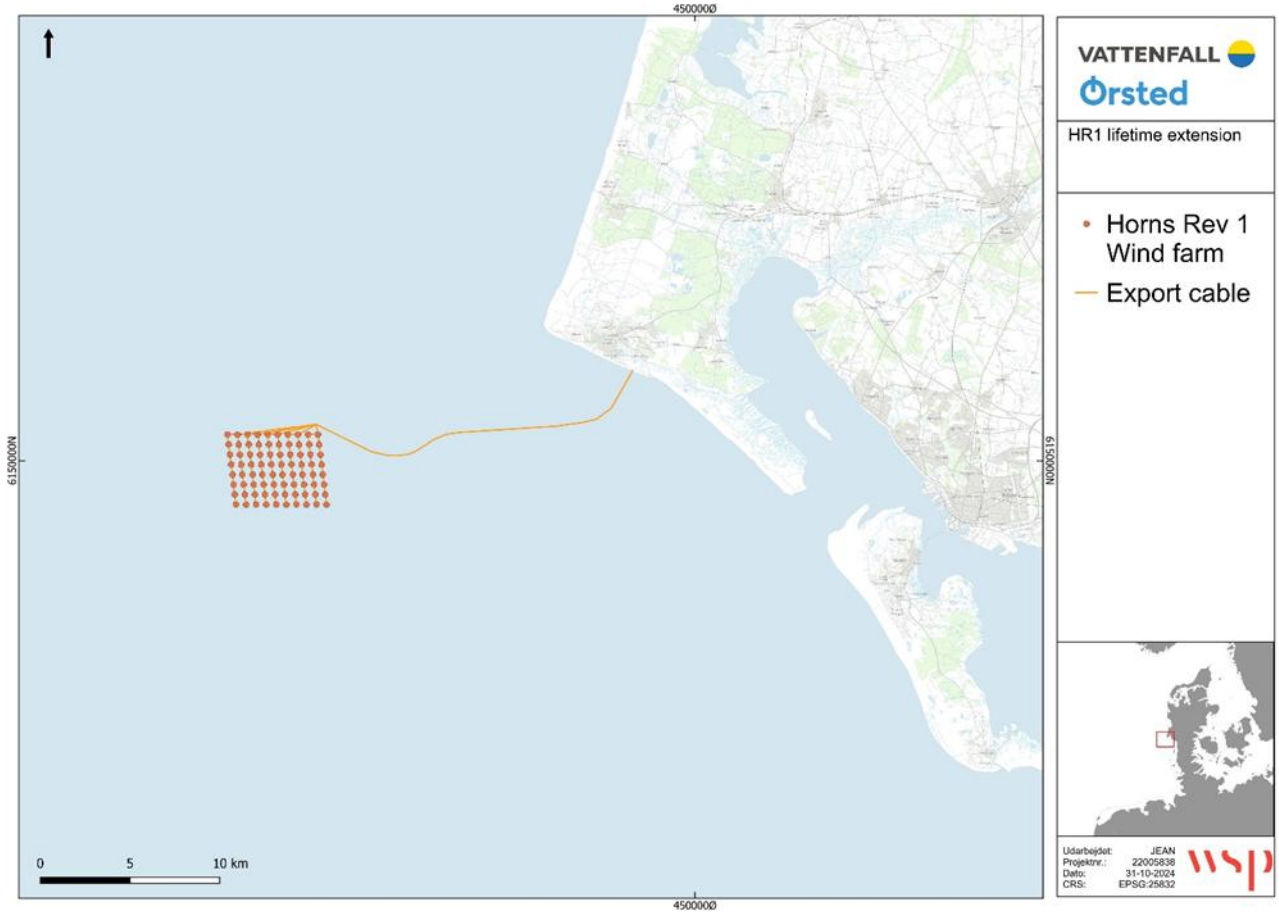

Figure 3-1. Location of Horns Rev 1 and the export cable which connects the substation to the onshore transmission grid.

4. Focus

The Natura 2000-appropriate assessment is focussed on the Natura 2000 features and impact pathways for which the Natura 2000-screening couldn't exclude significant impacts, that is displacement from potential feeding areas for the bird features of the Natura 2000 area N246 for which the constituent SPA 113 was designated (Red- and Black-throated diver, Common scoter and Little gull). Displacement can result from birds being reluctant to come near to and enter wind farms because of the presence of the structures and the disturbance caused by the associated activities. Collision risk, barrier effects, attraction, habitat loss, and disturbance (beyond what is reflected in displacement effects) were screened out as impact pathways with a potential for significant effects for the bird features.

For the other component of the Natura 2000 area N246, the SAC 255 protected for Common Seal *Phoca vitulina*, Grey Seal *Halichoerus grypus* and Harbour Porpoise *Phocoena phocoena*, as well as the habitat type marine sand banks, no risks of significant adverse effects were identified in the Natura 2000-screening, and are therefore not treated in this appropriate assessment.

5. The project

Horns Rev 1 is located 14-20 km from the Danish west coast (Figure 3-1) on the southeastern slopes of the Horns Rev sandbank at a water depth of 6.5-13.5 meter. The wind farm is made up of 80 Vestas V80 wind turbines with a capacity of 2 MW installed on monopile foundations. With today's standards, the turbines are relatively small with a rotor diameter of 80 meter and a maximum tip height of 110 meter. The distance between the turbines is 560 meter and the wind farm covers an area of about 20 square kilometres in total. In addition, a transformer substation is located close to the northeastern corner immediately outside the wind farm.

In an investigation of the current state of the turbines, TÜV SÜD has confirmed that "Within the verifications and inspections no indications have been found that contradict an operational lifetime for a total of 30 years" (TÜV SÜD 2025). Vattenfall and Ørsted as joint owners of the wind farm have applied for a lifetime extension of up to 15 years totalling the operational lifetime of Horns Rev 1 to 40 years. Vattenfall and Ørsted will need to perform and submit a new third party verified technical evaluation to the DEA before 2032 to demonstrate the continued security in the asset's technical integrity, to be able to continue the operation of Horns Rev 1 after 2032.

During the extended lifetime of the existing wind farm service and maintenance activities e.g. service vessels will continue at the current level.

Figure 5-1. The Horns Rev 1 offshore wind farm.

6. Legal framework

6.1. Renewable energy act

The Danish Renewable Energy Act regulates the production of renewable energies in compliance with climate, environmental and socioeconomic considerations. The Acts §29 subsection 1. holds the possibility to apply for a permit for lifetime extension, with reference to which the application for a lifetime extension of Horns Rev 1 has been filed.

6.2. Natura 2000

Natura 2000 is a network of nature protection sites established under the EU Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) in the form of Special Areas of Conservation (SAC's) and Special Protection Areas for birds (SPA's). The purpose of Natura 2000 sites is to ensure or restore favourable conservation status for the species and habitat types for which the sites has been designated. The basis for designation of Natura 2000 areas is regularly updated to comply with the directives and the Environmental Objectives Act. Denmark is obliged to include species and habitats designated to protect the site if there are significant occurrences.

For offshore electricity generation facilities, the Habitat Directive is implemented in Danish law through Executive Order on the Administration of International Nature Conservation Areas and the Protection of Certain Species Regarding Projects on the Establishment, etc., of Electricity Production Facilities and Electricity Supply Networks at Sea (BEK 588 of 26/05/2025).

When applying for a lifetime extension, a Natura 2000-screening (*Væsentlighedsvurdering*) is required according to BEK 588 of 26/05/2025. In the DEA's guideline for lifetime extensions it further says that for a lifetime extension without any technical and physical changes to the existing facility the owner of the offshore wind farm must submit a Natura 2000-screening, as well as an assessment of Annex IV species when applying for an extension of the electricity production permit (lifetime extension) (Danish Energy Agency, 2024).

A Natura 2000-screening was carried out to determine whether the project individually, or in combination with other plans and projects, is likely to have a significant effect on Natura 2000 sites. The Natura 2000-screening concluded that a significant impact could not be ruled out for the SPA 113 "Sydlige Nordsø" and therefore an Appropriate Assessment (*Konsekvensvurdering*) should be undertaken in accordance with BEK 588 of 26/05/2025. For the other component of the Natura 2000 area N246, the SAC 255 protected for Common Seal *Phoca vitulina*, Grey Seal *Halichoerus grypus* and Harbour Porpoise *Phocoena phocoena*, as well as the habitat type marine sand banks, no risks of significant adverse effects were identified in the Natura 2000-screening, and are therefore not treated in this appropriate assessment.

The present report constitutes that appropriate assessment, assessing in detail at the existing evidence on the effects of the Horns Rev 1 wind farm and considering the best available knowledge on impacts of offshore wind farms and population trends for the Natura 2000 features involved. In case it is concluded that adverse effects could occur, mitigating measures should be considered to avoid, reduce or neutralize such harmful impacts.

6.3. Conservation objectives

The overall conservation objective for Natura 2000 sites is to maintain a "favourable conservation status" for the habitat types and species that the site has been designated to protect (the designation basis).

According to the Habitats Directive, the following criteria must be met to achieve favourable conservation status:

- Habitat types cannot decline in spatial extend – the natural range of areas and the spaces the habitat type covers within the area must be stable or increasing in spatial extent.
- The structures and functions necessary to obtain the nature types must be continuously present.
- As for species, including birds, populations and the area of their preferred habitats must be stable or increasing in order to obtain a favourable conservation status.

In the next section the bases for the designation for SPA 113 is described together with the available information on the site specific conservation objectives and the conservation status of the features involved.

6.4. SPA 113 designation

The SPA 113 “Sydlige Nordsø” was first established in 2004 covering an area to the south and southwest of the shallow sandbank Horns Rev stretching down to the German border and covering an area of 247,314 hectares (Figure 6-1). In 2023, this area was expanded to the north to cover the entirety of the Horns Rev area as well as an area to the east towards the Danish Wadden Sea islands, joining up with the SPA 57 “Vadehavet”, now covering a total area of 502,845 hectares (figure 6-1). With this expansion, the Horns Rev 1 wind farm became included in the SPA 113, the wind farm footprint making up about 0.4% of the SPA area.

Commissioned in 2002, the Horns Rev 1 wind farm precedes the original (non-overlapping) designation and subsequent (overlapping) expansion of SPA 113 with two and 21 years, respectively.

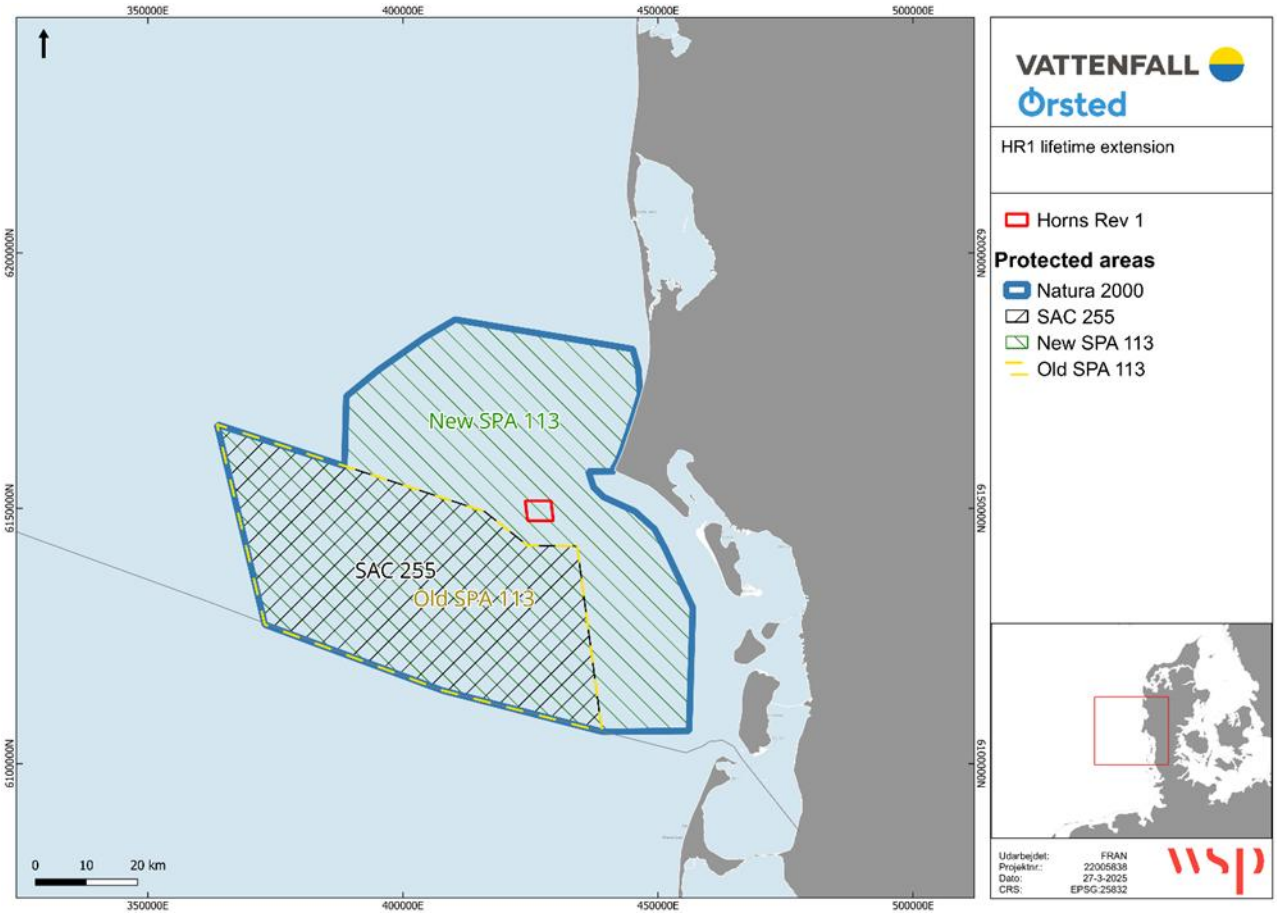

Figure 6-1. The location of Horns Rev 1 relative to the Natura 2000 area N246 Sydlige Nordsø and the constituent Special Area of Conservation (SAC) 255 and Special Protection Area (SPA) 113, the latter in its original and current form.

In its original form, the SPA 113 was designated for red-throated diver, black-throated diver and little gull. With the expansion of the area in 2023 the common scoter was included as a feature. In the hearing material issued by the Danish Environmental Agency in 2019 on an update of the designation basis for the Danish Natura 2000 areas it was concluded that black-throated diver and little gull did not qualify under the criteria for designation. However, due to discussions with the EU commission on requirements on documentation to take a species off the list, they remained part of the designation in the issued update, though with a note stating it being expected to be removed (opdateret UPG for fuglebeskyttelsesområder 2023-11-06 med nye F-omr fra 2021+2023.xlsx). See table 6-1 for an overview of the current designation basis.

Species	Category	Article 4	Criteria
Red-throated diver (A001)	Migratory	4.1	F2
Black-throated diver (A002)*	Migratory	4.1	
Common scoter (A065)	Migratory	4.2	F3, F4
Little gull (A177)*	Migratory	4.1	

Table 6-1 Designation basis for SPA 113 Sydlige Nordsø. An asterix denotes the listing is up for review.

The red-throated diver, listed on the EU Birds directive Annex 1, is included in the designation based on regularly occurring internationally important numbers exceeding 1% of the flyway population (criterium F2; Petersen *et al*. 2019a). The common scoter is included based on both regularly occurring internationally important numbers exceeding 1% of the flyway population (criterium F3) and an occurrence that contributes significantly to the survival of the species during critical periods of its life-cycle (criterium F4).The latter does not include the moulting period, with moulting scoters mainly being found in the SPA 57 neighbouring the area to the east (Petersen *et al*. 2019a).

There is currently no Natura 2000 plan for the Natura 2000 area N246 in its updated from, i.e. including the expanded SPA 113 and the addition of common scoter, the latest plan covering 2022—2027 being published before the changes to the SPA (Danish Environmental Protection Agency (2023). This also means there are no assessments of conservation status available for the designated species within the expanded SPA. For the previous version of the SPA, the conservation status for the diver (the two species combined) was assessed to be favourable in connection with the Natura 2000 plan for 2010-2015, while the status was deemed unknown for the little gull (Danish Nature Protection Agency 2011 - https://mst.dk/media/yt1mf2xn/246plan.pdf). To the knowledge of the authors, the closest to an assessment of the conservation status since then is this for red-throated diver (black-throated diver and little gull considered not present) from the SEA of the Natura 2022-2027 plan (Danish Environmental Protection Agency 2021):

"*Rødstrubet lom forekommer i området som trækfugl og det har vist sig svært, at estimere bestanden inden for fuglebeskyttelsesområdet, men det vurderes af DCE Aarhus Universitet, at bestanden er fluktuerende og benytter et større område end det konkrete fuglebeskyttelsesområde. Det vurderes at området giver arten udmærkede muligheder for at raste og fouragere forstyrrelsesfrit, og der vurderes ikke umiddelbart, at være aktuelle trusler for arten i området. I henhold til NOVANA-afrapporteringen for fugle fra DCE Aarhus Universitet er bestanden af rastende rødstrubet lommer på nationalt plan på ikke opgjort på artsniveau. Bestanden for lommer (rødstrubet lom og sortstrubet lom) er vurderet til at være stabil*."

Below are listed the generic conservation objectives for Natura 2000 areas as laid out in the 2022-2027 Natura 2000 plan for area N246 (Danish Environmental Protection Agency 2023). For the purpose of this assessment it will be assumed that these objectives holds for the extended Natura 2000 area as well with the addition of common scoter to the species listed.

The habitats and species listed in the designation basis should contribute to achieving a favourable conservation status at the biogeographical level, and the birds listed in the designation basis should help ensure population sizes at the national level. The goal is to ensure that the area's marine habitats support a rich diversity of plant and animal life, including the characteristic species of the designation basis.

The overall conservation objectives for the Natura 2000 area N246 are furthermore:

- The marine habitat type sandbank (1110), which has an unfavorable conservation status, should be ensured a well-developed fauna and bottom vegetation.
- The area should be secured as a good habitat for harbour porpoises, grey seals, harbour seals, red-throated divers.
- The ecological integrity is secured through good water quality, the levels of nutrients and environmentally harmful substances being reduced by means of the so called "*Vandområdeplaner*".

The specific objectives are[1]:

[1] Translated from Danish.

- The overall occurrence of habitats, species and their habitats in the Natura 2000 area, regardless of whether they are mapped or not, must be stable or improving, provided that natural conditions allows for it.

- For species without a condition assessment system, the goal is to contribute to achieving a favourable conservation status at the biogeographical level. The condition of the habitats (assessed in terms of occurrence and distribution) and the total area must be stable or improving
- For migratory birds, that may appear with nationally significant numbers within the bird protection area, their resting and night roosting areas must be secured or improving, so that the area can continue to hold a population of national significance in the future.

- For marine habitat types reference is made to the targets set out in the ”*Vandområdeplaner”*.

- The condition and extent of marine habitat types must be stable or increasing and contribute to a favourable conservation status at a biogeografical level.

6.5. Significance

Article 6(2) of the Habitats Directive (92/43/EEC) states that “*Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive*.”

In the Danish Environmental Agency's guidelines to the Habitat Order (The Danish Environmental Protection Agency 2020), it is stated that "*The assessment of whether a plan or a project has a significant impact on the conservation objectives of a Natura 2000 site is aimed at the impact on the characteristics and environmental conditions that characterise the specific Natura 2000 site, and in particular the specifically determined conservation objectives for the species and habitat types that are on the Natura 2000 site's designation basis.*

The European Court of Justice has ruled that it must be considered a significant impact if a plan or project risks harming the conservation objective of the Natura 2000 site. The European Court of Justice has thus emphasised that the impact must be assessed on the basis of whether it is so significant that the conservation objectives set out in the Natura 2000 plan cannot be achieved, according to which the habitat types and species must be stable or increasing.

What can be considered a significant impact is further elaborated by the European Commission’s guideline on *Managing Natura 2000 sites - The provisions of Article 6 of the Habitats Directive 92/43/EEC (2019/C 33/01)*: “*Significance will vary depending on factors such as magnitude of impact, type, extent, duration, intensity, timing, probability, cumulative effects and the vulnerability of the habitats and species concerned*.”

It goes on to elaborate: "*For example, a loss of a hundred square metres of habitat may be significant in relation to a small rare orchid site, while a similar loss in a large steppic site may be insignificant if it does not have implications for the site conservation objectives*.”

On significance the Danish guidance to the Habitats directive *Habitatvejledningen* (Danish Environmental Protection Agency 2020), further says[2]: “The EU Court of Judgement has ruled that a small, but permanent and irreversible reduction of a prioritised habitat type can constitute a significant impact and thus be considered as damage to the integrity of a Natura 2000 site. For the designated species, impacts can be considered significant if they involve habitat loss or degradation, levels of disturbance affecting the normal behaviour of the species or pollution and deterioration of habitats. At the other end of the scale, it must be assumed that an impact is not significant, if:

- the impact is estimated to involve negative fluctuations in population sizes that are smaller than the natural fluctuations considered to be normal for the species or habitat type.

- it is assessed that the protected habitat type or species is deemed to quickly recover without human intervention.”

[2] Translated from Danish

7. Method

7.1. Assessment

A Natura 2000-screening was carried out to determine whether the project individually, or in combination with other plans and projects, is likely to have a significant impact on Natura 2000 areas. The Natura 2000-screening concluded that a significant impact could not be ruled out for the SPA 113 *Sydlige Nordsø*, part of Natura 2000 site N246, and therefore an appropriate assessment should be undertaken in accordance with BEK 588 of 26/05/2025.

The aim of the Natura 2000 Appropriate assessment is to provide a detailed analysis whether any possible impacts of the project can harm the integrity of the Natura 2000 area.

A Natura 2000-appropriate assessment is to be based on the precautionary principle. This means the conclusion of no harm to the integrity of the Natura 2000 area must be without reasonable doubt and draw on the best available scientific evidence.

The Natura 2000-appropriate assessment is conducted considering the risk of direct loss of habitat, deterioration of the protected habitats, disturbance of species, fragmentation of habitats and other indirect effects that can harm the integrity of the Natura 2000 area.

The potential effects of the Horns Rev 1 lifetime extension is assessed in relation to the designation and the specific conservation objectives of SPA 113. Ultimately it is concluded if it will be possible to realise the project without harming the integrity of the Natura 2000 area N246.

As mentioned in chapter 4 the Natura 2000-appropriate assessment is focussed on the Natura 2000 features and impact pathways for which the Natura 2000-screening couldn't exclude significant impacts, that is displacement from potential feeding areas for the bird features of the Natura 2000 area N246 for which the constituent SPA 113 was designated (Red- and Black-throated diver, Common scoter and Little gull). Collision risk, barrier effects, attraction, habitat loss, and disturbance (beyond what is reflected in displacement effects) were screened out as impact pathways with a potential for significant effects for the bird features.

For the other component of the Natura 2000 area N246, the SAC 255 protected for Common Seal *Phoca vitulina*, Grey Seal *Halichoerus grypus* and Harbour Porpoise *Phocoena phocoena*, as well as the habitat type marine sand banks, no risks of significant adverse effects were identified in the Natura 2000-screening, and are therefore not treated in this appropriate assessment.

7.2. Documentation

The Horns Rev 1 wind farm has been subject to an extensive environmental monitoring programme from 2000-2010 including the period before construction and seven years into operation. The programme covered a wide range of environmental aspects including birds with the results summarized in two books published by the Danish Energy Agency (2006, 2013). Together with Nysted, Horns Rev 1 is the most well-studied offshore wind farm in Denmark and possibly in the world in terms of impacts on the environment.

With bird surveys continuing for the Horns Rev 2 wind farm and subsequently as part of baseline surveys for further offshore wind farm planning, this amounts to an extraordinary 25 year dataset on the presence of birds in the Horns Rev area, presenting a unique opportunity to study the effects of wind farm developments, including Horns Rev 1, on the distribution and abundance of birds in this area – this has recently been analysed and reported in Scott-Hayward *et.al*. (2024).

This is supplemented with reports and scientific literature on the designated species and studies on the effects of offshore wind farms elsewhere for context – all as referenced in the text.

8. Project alone effects

8.1. Existing conditions

In this section a short introduction to the individual species is given outlining their population trends and status at national and international levels (see table 8-1) while going into more detail on the occurrence in SPA 113 for the individual species and what existing data suggests in terms of effects of the construction of the Horns Rev 1 wind farm in the following subsections.

Species	National trend		Flyway population		IUCN
	2013-2023	1980-2023	Size	Trend	
Red-throated diver	Stable	Unknown	210,000-340,000	Decreasing	Least concern
Black-throated diver	Unknown		390,000-590,000	Decreasing	Least concern
Common scoter	Stable	Unknown	687,000-815,000	Unknown	Least concern
Little gull	Fluctuating	Unknown	47,400-90,500*	Increasing	Least concern

Table 8-1. Population trends at national level short-term and long-term (Fredshavn *et al.* 2025), flyway population size and trend (Wetlands International 2024) and European vulnerability status under the IUCN classification (Birdlife International, 2021). *(mature individuals)

8.1.1. Divers

Red-throated diver and black-throated diver are both found in Denmark during migration periods and wintering – neither of the two species breed in Denmark. The red-throated diver, the most common of the two species in Denmark, is most abundant in the North Sea, Aalborg Bay and Kattegat. The black-throated diver is most abundant in the eastern parts of the country. They both feed on small fish which they find diving in water depths of up to about 40 meters (Nielsen *et al.* 2024).

As it is difficult to distinguish red-throated divers and black-throated divers during aerial surveys the two species will be lumped into “divers” in the following account. For the Horns Rev area it is assessed though that red-throated divers makes up at least 90% of the divers observed (Petersen *et al.* 2019a).

The winter population of divers in Denmark was estimated to 10,000-15,000 individuals in 2008, while the population during the spring migration was estimated to about 20,000 birds (Petersen & Nielsen 2011). Later counts and estimates suggests that the numbers of wintering and spring staging divers have been largely stable since then (Nielsen *et al.* l 2024). The mid-winter count of 2023 confirmed that the Southern North Sea was still very important for wintering divers (Nielsen *et al.* 2024).

An extensive environmental monitoring programme was conducted for Horns Rev 1, which included aerial bird surveys both before and after the construction of the wind farm; in total 16 surveys during the pre-construction period from August 1999 until August 2002 and 15 surveys during the post-construction phase between January 2003 and November 2005 (see Christensen *et al.* 2006). The pre-construction surveys showed that the area of the wind farm, as well as its immediate surroundings, did not hold large numbers of divers during the years covered by these surveys (Figure 8.1). In the before and after surveys, the largest concentrations were observed in the northwestern and southwestern parts of the study area, with more temporary concentrations around Blåvands Huk with no prominent distributional differences between years (Petersen *et al.* 2006).

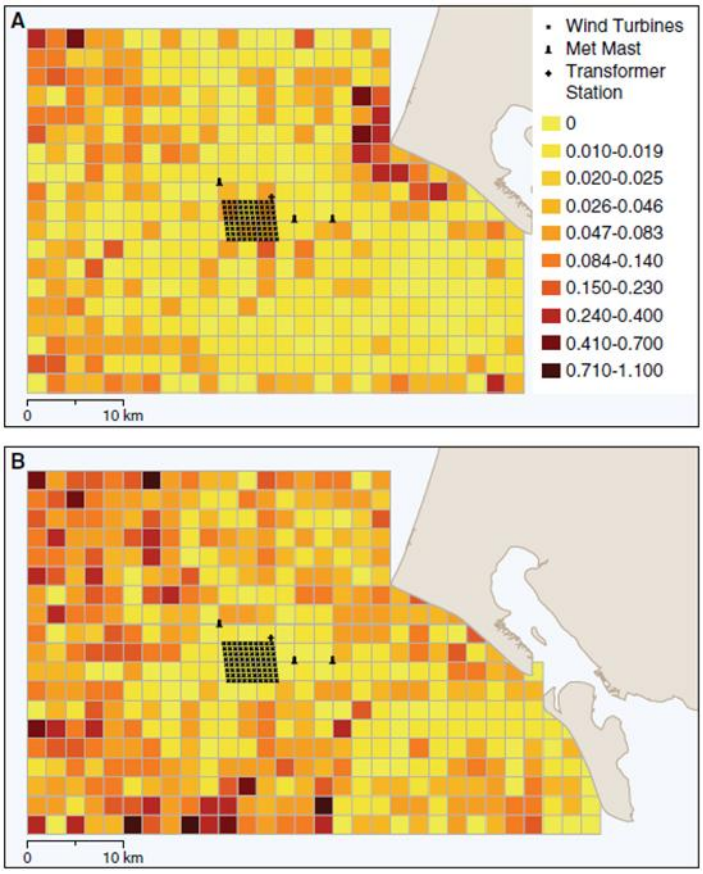

Figure 8-1. Relative density of divers in the Horns Rev study area, based on 16 surveys performed before (A) and 15 surveys performed after (B) the construction of Horns Rev 1 in 2003. Data expressed as number of observed birds per kilometer of flown transect coverage in each 2 x 2 km grid square. Illustration from Petersen *et al.* (2006).

Further analysis of these data focused on establishing displacement effects of the wind farm found significant reductions in densities of divers within the wind farm and in a 2 km buffer zone around the wind farm (Figure 8-2; Fox *et al.* 2006). The analyses further indicated that the total number of divers within the surveyed area increased in the period after construction of the wind farm, although this was not statistically significant. The area covered by these surveys was approximately 1700 square kilometres, making up the majority of the more shallow part of the present SPA 113.

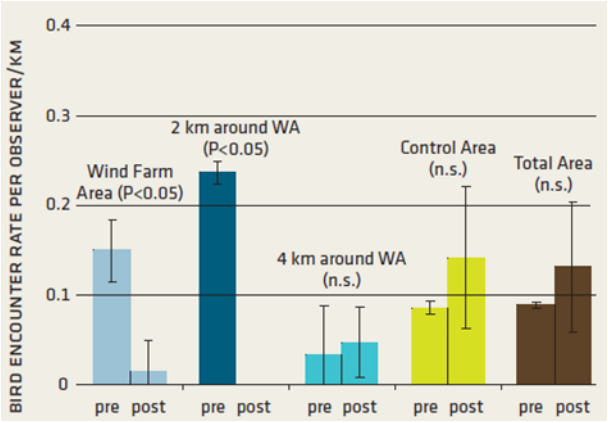

Figure 8-2. Comparisons of the diver densities inside the area of the Hors Rev 1 wind farm (pale blue columns), an area 2 km outside of the outer edge of the turbines (dark blue) and 2–4 km outside of the outermost turbines (light blue) before and after construction of the wind farm. Comparisons are given for the remainder of the area (green) and the total areas including all areas (brown). Values are the means for the pre- and post-construction periods for the month of the year with the highest count, which was March for divers. The 95% confidence intervals are shown for each value, and the statistical

probability level obtained from the results of students' t-tests for each comparison are given above the columns (n.s. represents no significant difference). Illustration from Fox *et al.* (2006).

Follow-up aerial surveys conducted during the winter of 2006/2007 confirmed the above picture in terms of distribution pattern of divers in the general area and a local displacement effect around the Horns Rev 1 wind farm (Petersen & Fox 2007). Where few divers were observed within the wind farm in the previous post-construction surveys, none was during that winter's surveys and a decreasing gradient in displacement was observed out to the 2-4 km distance zone.

Since then a large number of surveys have been conducted in the Horns Rev area in the context of the Horns Rev 2 wind farm (Petersen *et al.* 2014) and more recently to inform future offshore wind planning. The combined data from the aerial surveys covering the Horns Rev area conducted over the years, 56 in total during the period 2000-2024, has recently been analysed by Scott-Hayward *et al.* (2024) for changes in distribution and abundance for divers and common scoters in relation to the three wind farms developed in the area, i.e. Horns Rev 1, Horns Rev 2 and Horns Rev 3.

The surveys were classified into four phases according to the wind farm development stages:

- Phase 0 including 15 surveys prior to any wind farm construction.
- Phase 1 including 25 surveys post-construction Horns Rev 1 and pre-construction Horns Rev 2 and Horns Rev 3.
- Phase 2 including 10 surveys post-construction Horns Rev 1 and Horns Rev 2, but pre-construction Horns Rev 3.
- Phase 3 included six surveys post-construction of all three offshore wind farms.

The area covered by these surveys relative to the extent of the SPA 113 is shown in Figure 8-3. It represents almost the entire extension to the SPA and a good deal of the original SPA area – in total a good third of the total area of the expanded SPA.

Figure 8-3. The area covered by aerial surveys at Horns Rev (dark blue line), the general survey transects (grey lines), and the turbine positions of the three offshore wind farms, Horns Rev 1 (southeast), Horns Rev 2 (southwest) and Horns Rev 3 (north). Also shown, the extent of the EU Birds Directive SPA 113 (ochre line). Illustration from Scott-Hayward *et al.* (2024).

The analysis showed that the pattern of diver distribution in overall area varied considerably across the four phases with the main concentration area moving around from phase to phase (Figure 8-4).

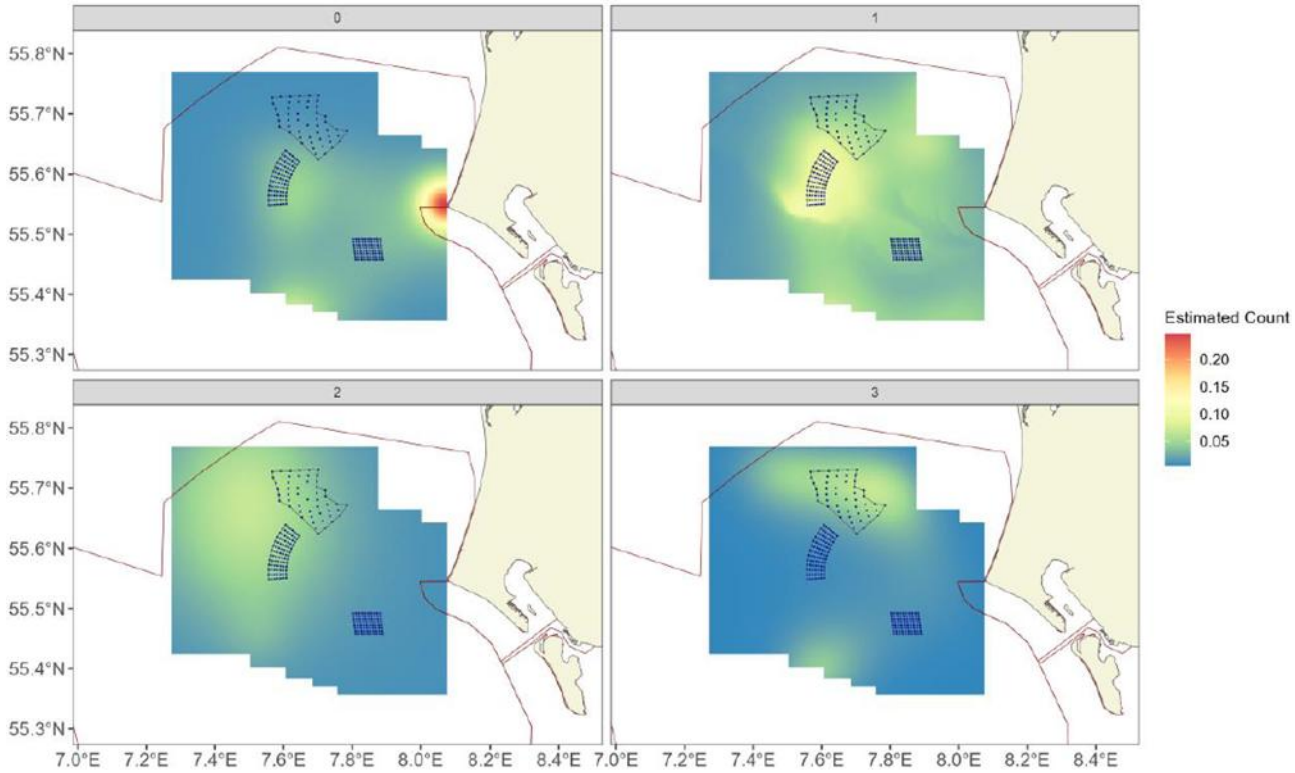

Figure 8-4. Estimated diver abundance across the study site for each of the surveys in Phase 0. The estimated counts are per 500 m x 500 m grid cell. The open circles show the corrected counts. The coloured graphics represent the predicted counts in each location. Illustration from Scott-Hayward *et al.* (2024).

At the same time diver abundance in the overall area increased moderately between Phases 0 and 1, i.e. from before to after Horns Rev 1 was constructed, but then decreased through Phases 2 and 3. In the Horns Rev 1 area, diver density increased (but non-significantly) between Phases 0 and 1 and then decreased through Phases 2 and 3 in line with what was seen in the general study region (Figure 8-5).

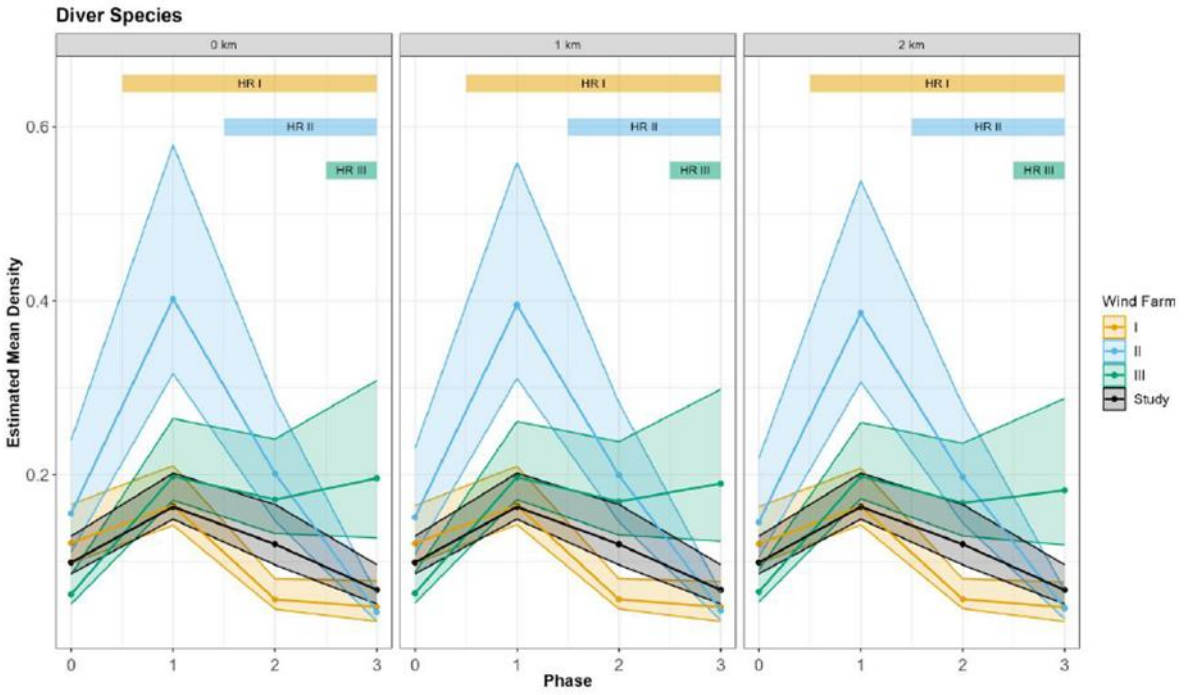

Figure 8-5. Estimated mean density of divers in the footprint, footprint + 1 km buffer and footprint + 2 km buffer of each wind farm for all phases. The bars at the top show the post-construction periods for each wind farm. Illustration from Scott-Hayward *et al.* (2024).

A closer look at the distribution patterns around the wind farms showed there to be "*little significant change in the Horns Rev 1 footprint*" before and after construction of the wind farm, i.e. comparing Phase 0 and Phase 1 (Figure 8-6). In absolute terms the mean abundance, i.e. total number, of divers within the Horns Rev 1 footprint was 2.5 individuals in Phase 0, before the wind farm construction, and varied between 1.0 and 3.3 in subsequent phases. Looking at the changes in distribution patterns across all phases, it is further concluded that "*In general, these difference plots show that there is no clear pattern of displacement around the Horns Rev 1 or Horns Rev 3, but that despite widespread decreases there is compelling evidence of a larger decline in and around the footprint of Horns Rev 2*."

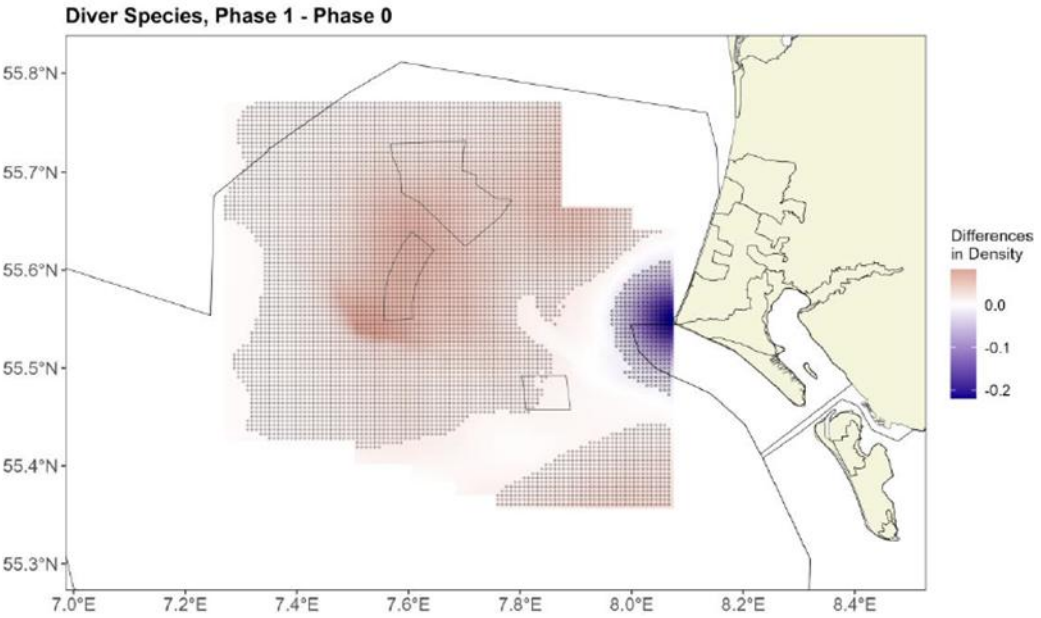

Figure 8-6. Figure showing the estimated differences in diver distribution between Phase 1 and Phase 0. Positive differences indicate more birds in Phase 1. A "+" sign in the bluish background colours indicates a significant positive

difference and a "o" in reddish background colours a significant negative difference. Illustration from Scott-Hayward *et al.* (2024).

Scott-Hayward *et al.* (2024) concludes with respect to Horns Rev 1 that "*We found equivocal evidence for displacement of divers and common scoter after the construction of the first windfarm Horns Rev 1 perhaps because of changes in distribution of both species in the study area and low densities of both species in and around Horns Rev 1*." Equivocal meaning the evidence not allowing for clear conclusions to be drawn.

8.1.2. Common scoter

Common scoter is found in Danish waters during most of the year as wintering, passing through on migration and moulting – it does not breed in Denmark though. It is mainly found in shallow waters at sea, feeding on mussels and other shellfish at the seabed. The largest numbers are found in the southern part of the North Sea, in the Aalborg Bay and the Sejerø Bay (Nielsen *et al.* 2024).

For the latest national mid-winter waterbird surveys carried out in 2020 and 2023 the estimated total number of common scoters was 220,800 and 239,500 individuals, respectively (Nielsen *et al.* 2024). As the 2020 survey didn't cover the Southern North Sea, the total numbers will be underestimated. The survey in 2023 including the Southern North Sea showed this to still be a very important wintering area for common scoters. The assessment is that the national numbers might have been stable in the short term between 2013-2023 (Nielsen *et al.* 2024).

The latest national survey of moulting waterbirds carried out in 2018 recorded 93,540 common scoters. This was a marked as an increase compared to previous surveys in 2006 and 2012, also considering the 2018 surveys were transect surveys compared to the previous "total survey". Even higher numbers were recorded in the Aalborg Bay only in 2023 with 214,000 recorded individuals (Nielsen *et al.* 2023). Aalborg Bay is the core Danish moulting area for the common scoter, followed by the Southern North Sea.

During the extensive monitoring programme for Horns Rev 1, the pre-construction surveys found very few common scoters within the later wind farm area and its immediate surroundings (Figure 8-7; Petersen *et al.* 2006). The overall number of common scoter in the study area increased during the years of investigation, with higher numbers in the post-construction surveys. Areas along the coast holding the largest concentrations throughout, but with the birds increasingly also using the western and northern parts of the reef beyond the Horns Rev 1 wind farm.

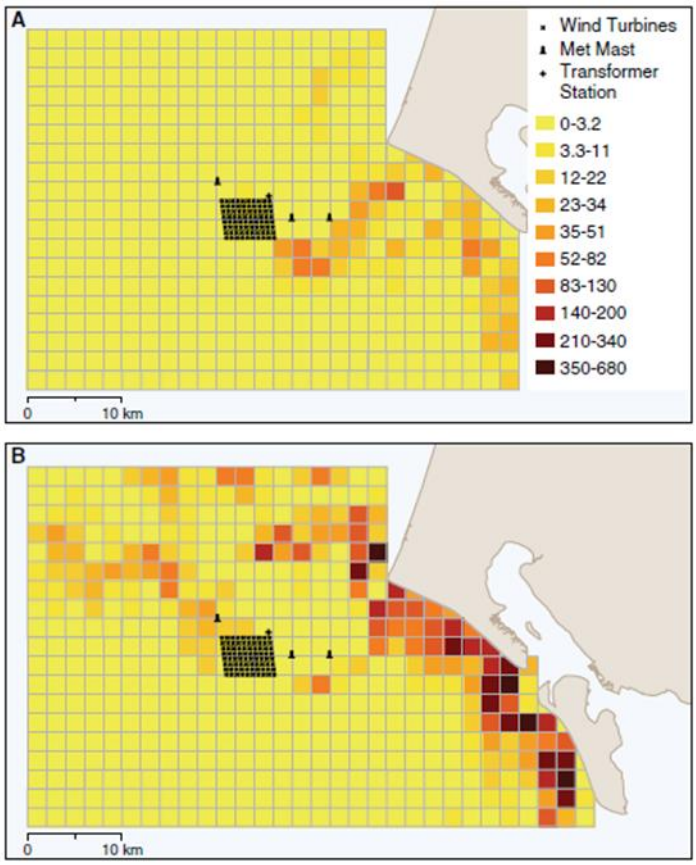

Figure 8-7. Relative density of common scoters in the Horns Rev study area, based on 16 surveys performed before (A) and 15 surveys performed after (B) the construction of Horns Rev 1 in 2003. Data expressed as number of observed birds per kilometer of flown transect coverage in each 2 x 2 km grid square. Illustration from Petersen *et al.* (2006).

Further analysis of these data focusing on establishing displacement effects of the wind farm was made difficult by the few birds in the wind farm area pre-construction and further complicated by the major changes in distribution patterns in the general area during the study period. The analyses of densities of common scoters within the wind farm and in buffer zones of 2 km and 4 km, respectively, did not find any significant differences between before and after surveys (Figure 8-8; Fox *et al.* 2006). Still the authors suggested that "*The extreme scarcity of visual observations of scoters flying in between turbines and the lack of observations during aerial surveys post construction (when up to 381,000 were present in the general area) confirm that this was also amongst the species that showed almost complete avoidance of flying or swimming between the rows of turbines, despite very large concentrations in the surrounding waters…*" The analyses further indicated a marked increase in abundance of scoters in the general area, although this was not found to be statistically significant.

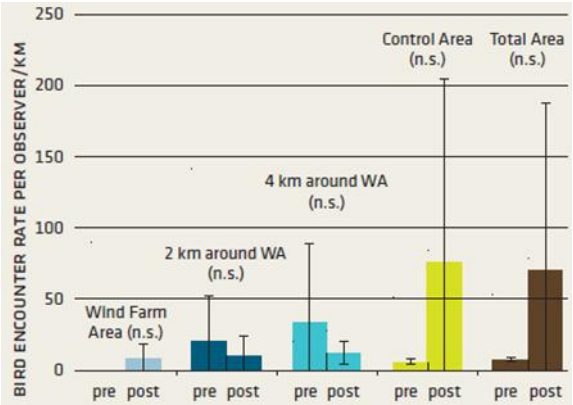

Figure 8-8. Comparisons of the common scoter densities inside the area of the Hors Rev 1 wind farm (pale blue columns), an area 2 km outside of the outer edge of the turbines (dark blue) and 2–4 km outside of the outermost turbines (light blue)

before and after construction of the wind farm. Comparisons are given for the remainder of the area (green) and the total areas including all areas (brown). Values are the means for the pre- and post-construction periods for the month of the year with the highest count, which was March for common scoters. The 95% confidence intervals are shown for each value, and the statistical probability level obtained from the results of students' t-tests for each comparison are given above the columns (n.s. represents no significant difference). Illustration from Fox *et al.* (2006).

Follow-up aerial surveys conducted during the winter of 2006/2007 found common scoters to be present in large numbers within the Horns Rev 1 wind farm, peaking with 4624 individuals recorded mid-February (Figure 8-9; Petersen & Fox 2007). Numbers were also high in the immediate vicinity of the wind farm and the analyses conducted did not find any difference in densities within and immediately around the wind farm. Also when looking at the cumulative distribution with increasing distance from the centre of the wind farm out to 6 km distance this did not seem to differ from what would be expected from an even distribution of the birds, meaning no displacement effect being evident that winter.

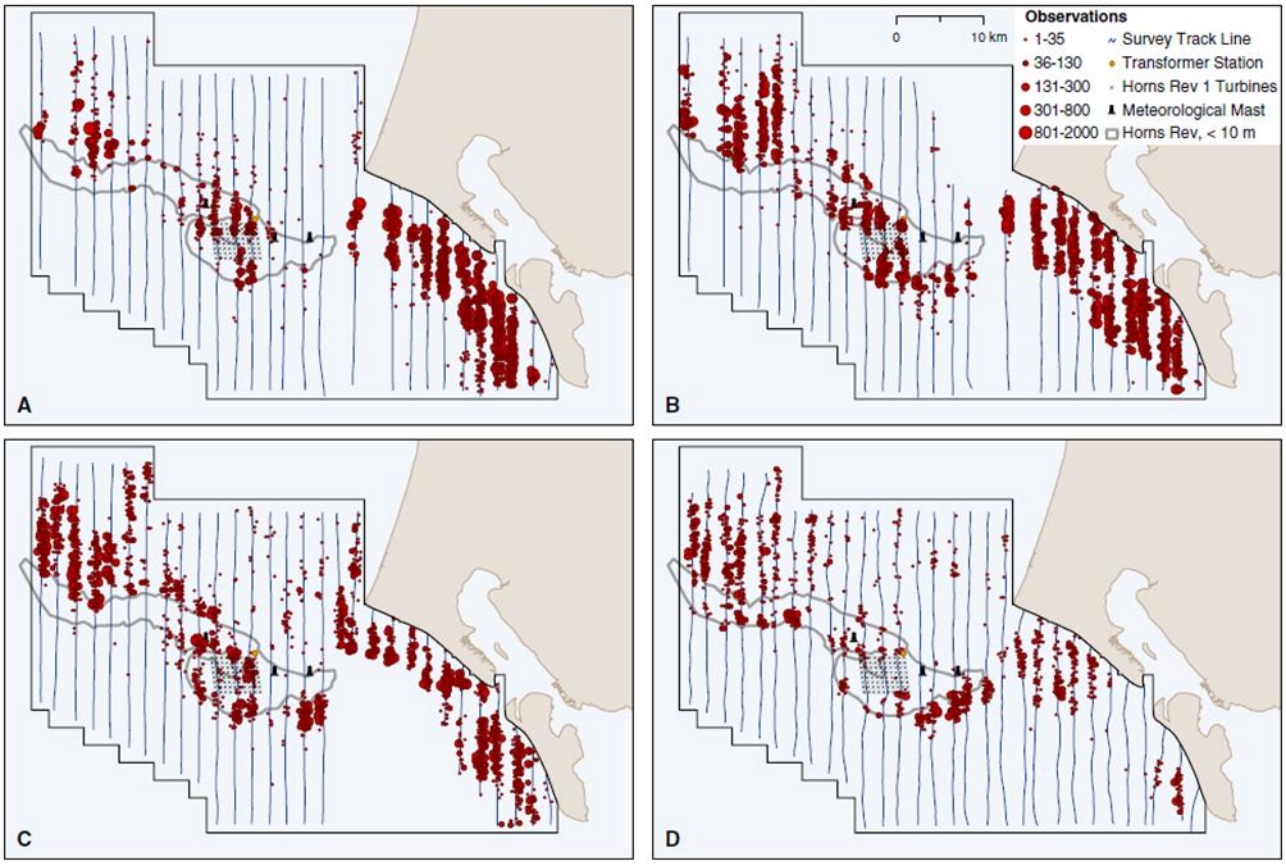

Figure 8-9. Distribution map of 106,113 Common Scoters observations in the study area, 25 January 2007 (A), of 133,262 Common Scoters observations in the study area, 15 February 2007 (B), of 87,890 Common Scoters observations in the study area, 3 March 2007 (C) and of 29,370 Common Scoters observations in the study area, 1 April 2007 (D). Turbine positions and the extension of the reef with water depth of less than 10 m are shown. Thin blue lines identify track lines. Illustration from Petersen & Fox (2007).

The analysis of Scott-Hayward et al. (2024), including post-construction surveys for Horns Rev 2 (Petersen *et al*. 2014) and later surveys, showed a large expansion of common scoters towards the north and west in Phase 1 with the distribution pattern varying quite a lot between Phases 1-3 in terms of the main concentration areas and how spread out the birds were (Figure 8-10).

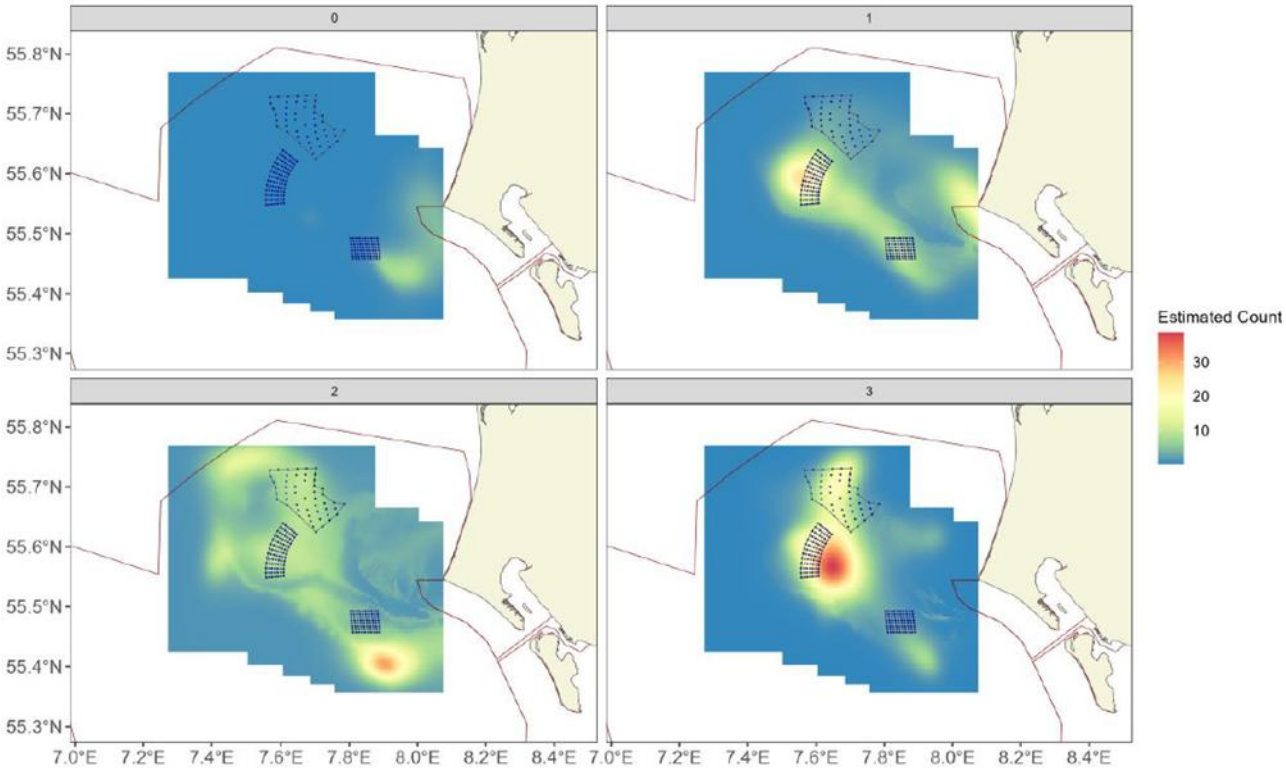

Figure 8-10. Estimated common scoter abundance across the study site for each of the surveys from Phase 0 to Phase 3. The estimated counts are per 500 m x 500 m grid cell. The open circles show the corrected counts. The coloured graphics represent the predicted counts in each location. Illustration from Scott-Hayward *et al.* (2024).

The overall abundance of common scoter in the surveyed area increased from Phase 0 to Phase 2 with some levelling off in Phase 3 (Figure 8-11). Post-construction of Horns Rev 1 (Phase 1) an increased density was observed within the wind farm area compared with Phase 0. It is suggested that rather than being a result of the wind farm this might be explained by the overall increase in common scoter numbers combined with the changes observed in the general distribution pattern in the survey area. The density within the Horns Rev wind farm decreased to Phase 0 levels in Phase 3 though stays at the mean density of the general area. In absolute terms the mean abundance of scoters within the Horns Rev 1 footprint was 92 individuals in Phase 0, before the wind farm construction, and varied between 218 and 697 in subsequent phases.

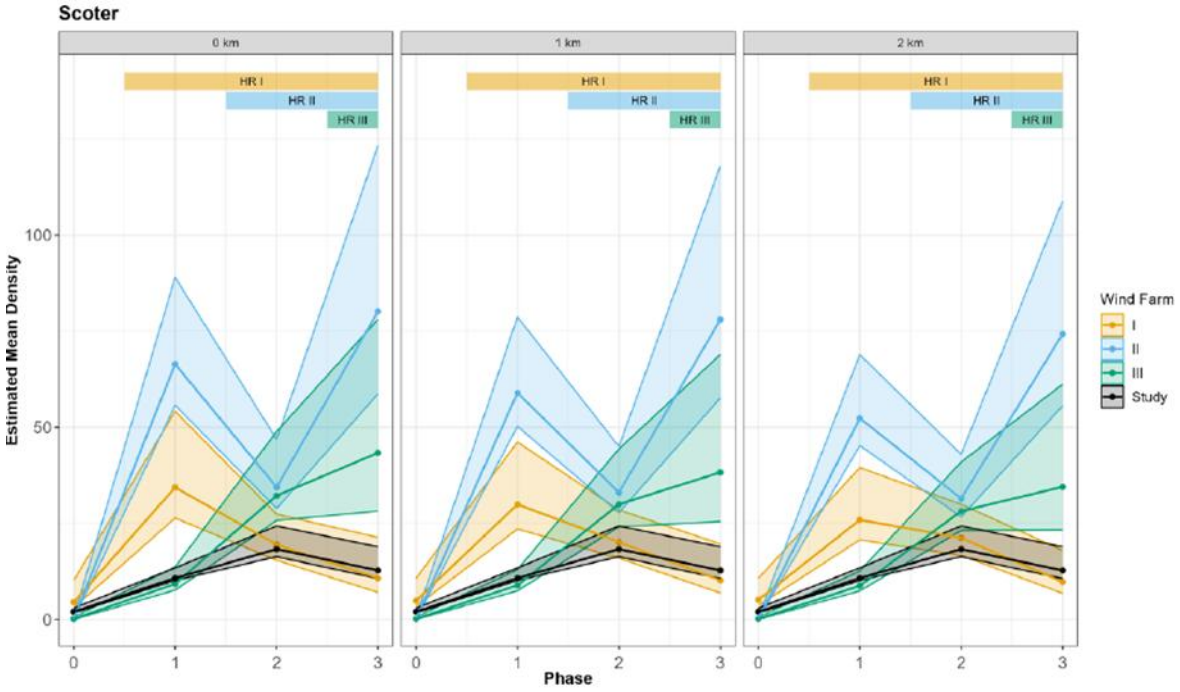

Figure 8-11. Estimated mean density of common scoter in the footprint, footprint + 1 km buffer and footprint + 2 km buffer of each wind farm for all phases. The bars at the top show the post-construction periods for each wind farm. Illustration from Scott-Hayward *et al.* (2024).

A more detailed look at the change in the general distribution pattern between Phase 0 and Phase 1 clearly illustrates the shift in common scoter numbers from the southeastern edge of the area into the centre, including the area of the Horns Rev 1 wind farm (Figure 8-12). The increase in bird numbers in Phase 1, compared to Phase 0, is also evident with significant increases in most locations in Phase 1 compared with Phase 0, including the Horns Rev 1 wind farm.

Looking at the changes in distribution patterns across all phases, it is further concluded that ”*In general, these difference maps show that the area in and around HR I supported few birds pre-construction but showed an increase to relatively stable densities thereafter. It is hard to know if the birds showed low levels of displacement response to this wind farm and have always been present at low density in the area, or if the construction has kept numbers low within and around HR I*.”

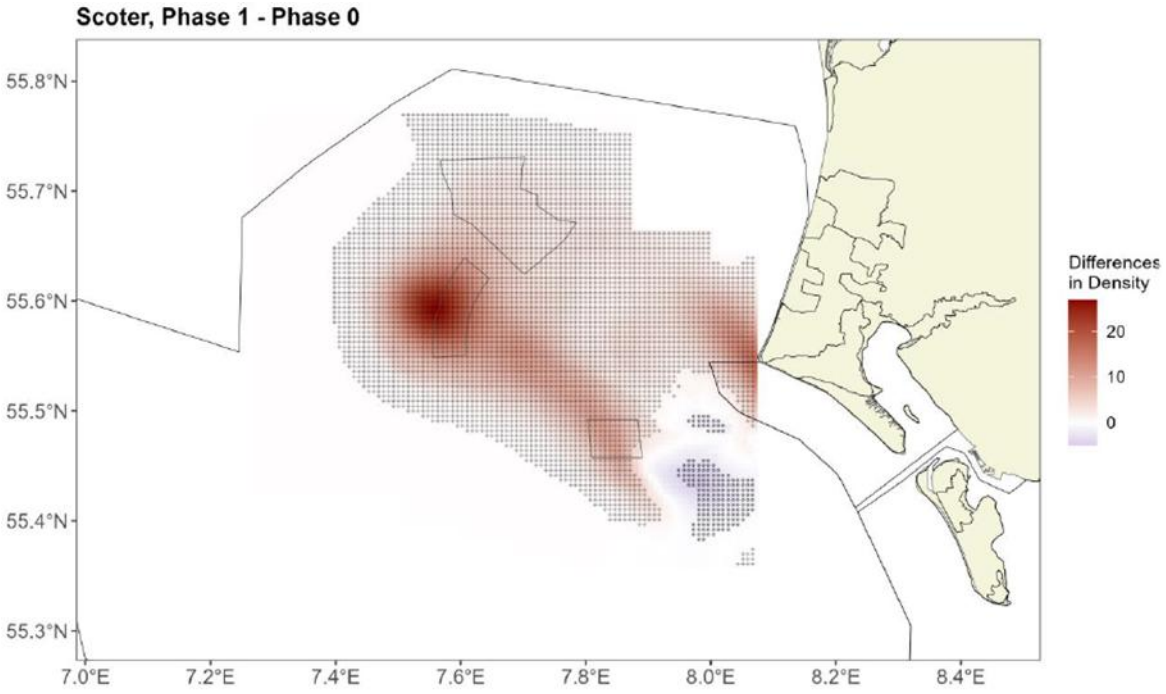

Figure 8-12. Figure showing the estimated differences in common scoter distribution between Phase 1 and Phase 0. Positive differences indicate more birds in Phase 1. A "+" sign in the bluish background colours indicates a significant positive difference and a "o" in reddish background colours a significant negative difference. Illustration from Scott-Hayward *et al.* (2024).

Scott-Hayward *et al.* (2024) concludes with respect to Horns Rev 1 that "*We found equivocal evidence for displacement of divers and common scoter after the construction of the first windfarm Horns Rev 1 perhaps because of changes in distribution of both species in the study area and low densities of both species in and around Horns Rev 1*." Equivocal meaning the evidence not allowing for clear conclusions to be drawn.

8.1.3. Little gull

In Denmark the little gull is mainly observed during migration periods in the spring and autumn, but can also be found wintering at sea. Until a few years ago, Denmark also had a few breeding pairs. At sea the little gull feeds on zooplankton it picks from the water surface.

Fredshavn *et al* (2025) estimated the numbers of wintering little gulls in Denmark to be between 50-1000 individuals, with 1-30 individuals within N2000 areas, and in the short term having a fluctuating trend. During a large-scale aerial survey covering the entire Danish North Sea in April – May 2019 a total of 24 little gulls were observed (Petersen *et al.* 2019b).

During the monitoring programme for Horns Rev 1, very few little gulls were observed in the wind farm area and its immediate surroundings in the pre-construction surveys (Figure 8-13; Petersen *et al.* 2006). Numbers increased in the post-construction surveys for the area as a whole as well as for the wind farm area. The little gull was most abundant during March-April and was found scattered throughout the area with the exception of the most eastern parts, where few birds were observed.

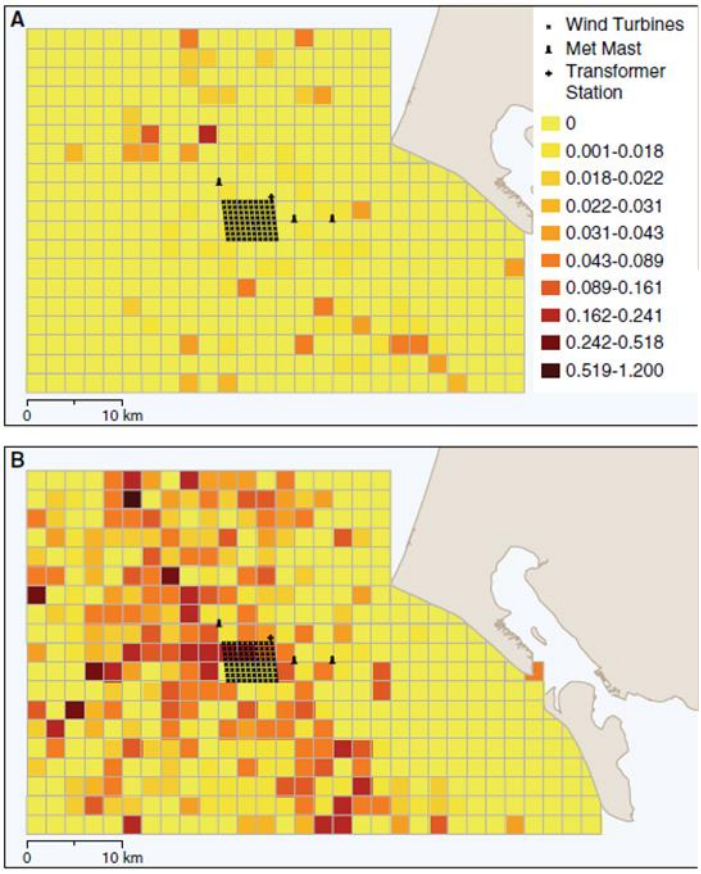

Figure 8-13. Relative density of little gulls in the Horns Rev study area, based on 16 surveys performed before (A) and 15 surveys performed after (B) the construction of Horns Rev 1 in 2003. Data expressed as number of observed birds per kilometer of flown transect coverage in each 2 x 2 km grid square. Illustration from Petersen *et al.* (2006).

Further analysis of these data focusing on establishing displacement effects of the wind farm did not find any significant change in distribution for little gull (Figure 8-14; Fox *et al.* 2006). Numbers increased significantly in the 2 kilometre zone around the wind farm, but this might have been co-incidental and a reflection of the observed (though non-significant) increase in abundance in the general area post-construction.

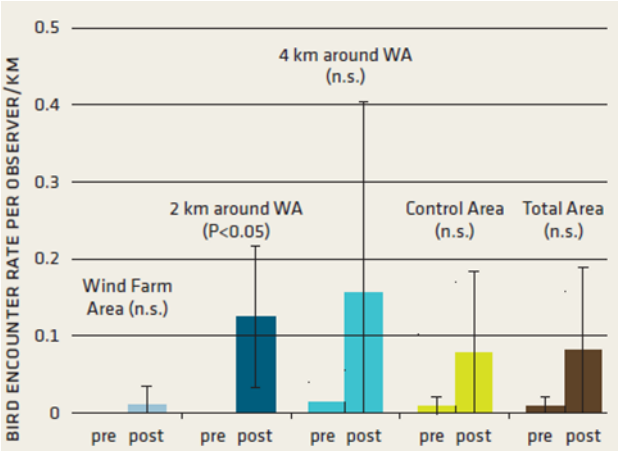

Figure 8-14. . Comparisons of the little gull densities inside the area of the Hors Rev 1 wind farm (pale blue columns), an area 2 km outside of the outer edge of the turbines (dark blue) and 2–4 km outside of the outermost turbines (light blue) before and after construction of the wind farm. Comparisons are given for the remainder of the area (green) and the total areas including all areas (brown). Values are the means for the pre- and post-construction periods for the month of the year with the highest count, which was March for little gulls. The 95% confidence intervals are shown for each value, and the

statistical probability level obtained from the results of students' t-tests for each comparison are given above the columns (n.s. represents no significant difference). Illustration from Fox *et al.* (2006).

During the follow-up aerial surveys for Horns Rev 1 winter and early spring of 2006/2007 between 12-79 little gulls were recorded on the four surveys conducted, the most on the 1 April survey (Petersen & Fox 2007). Most birds were observed in the western part of the area and a single bird was observed within the wind farm (Figure 8-15).

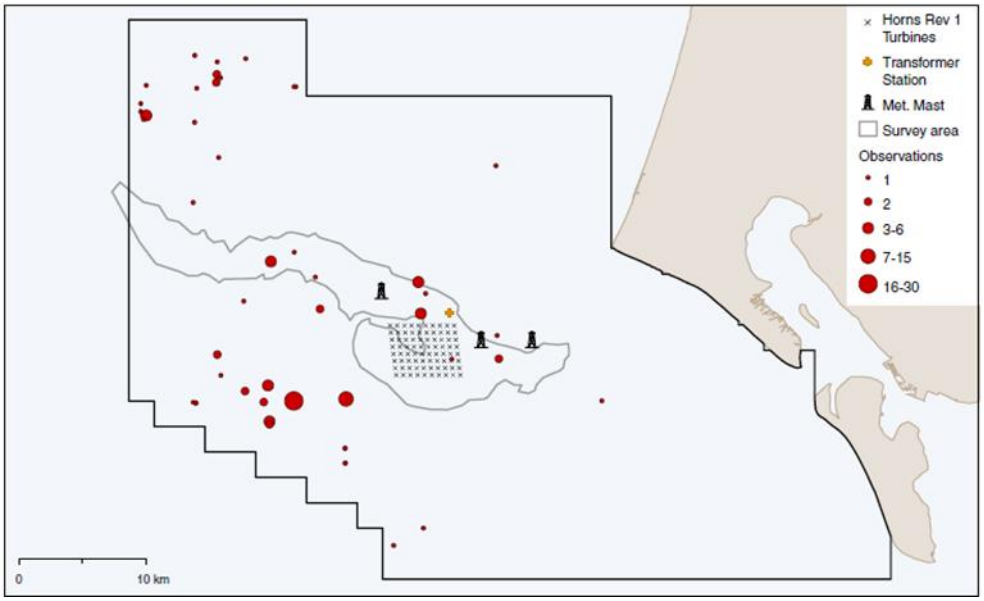

Figure 8-15. Distribution map of 116 Little Gulls observed in the study area during four surveys, 25 January, 15 February, 3 March and 1 April 2007. Turbine positions and the extension of the reef with water depth of less than 10 m are shown. Illustration from Petersen & Fox (2007).

During the 10 aerial surveys conducted in 2011-2012 for the post-construction monitoring for Horns Rev 2 (the Phase 2 surveys in Scott-Hayward *et al.* 2024), little gulls were the most abundant during spring with maximum numbers reaching around 70 birds each year (Petersen *et al.* 2014). The birds were concentrated in the western and central part of the study area with a single observation within the Horns Rev 1 wind farm (Figure 8-16). The report concluded that the area in general was of no particular importance to the species.

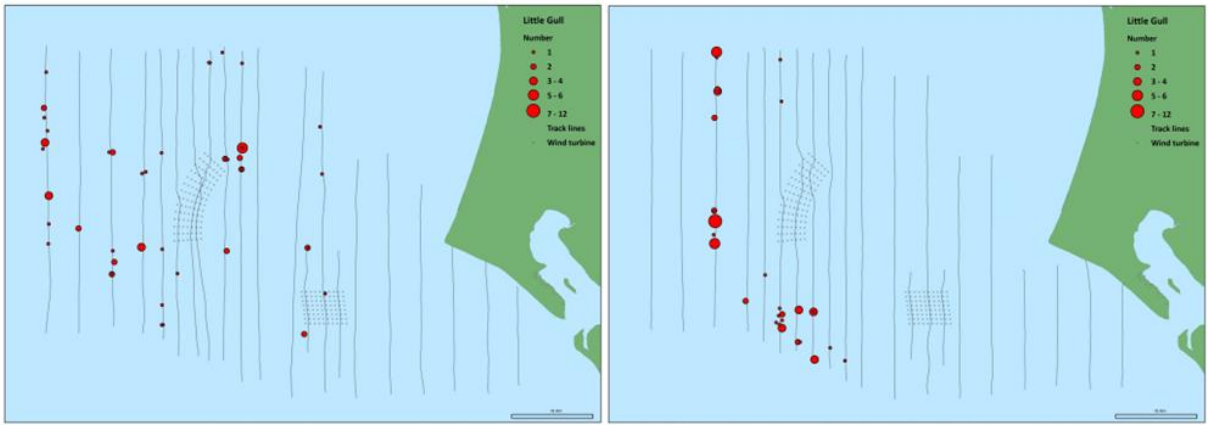

Figure 8-16. Distribution of 75 and 64 little gulls observed during aerial surveys 11 April 2011 and 22 March 2012, respectively. Illustration from Petersen *et al.* (2014).

In connection with the latest update to the Danish Natura 2000 designation, where the SPA 113 was expanded to include Horns Rev 1, it was assessed that the little gull didn't qualify under the Natura 2000 criteria and noted that they was expected to be removed at the next update (opdateret UPG for fuglebeskyttelsesområder 2023-11-06 med nye F-omr fra 2021+2023.xlsx).

8.2. Assessment of effects

In this section the existing information on the presence of the designated species in the Horns Rev area and the potential effects of the Horns Rev 1 wind farm is put into wider perspective of knowledge on wind farm displacement effects and population trends to conclude on the impact of the project in isolation (cumulative effects being treated in the subsequent chapter). The focus is displacement effects, which was the one impact pathway that was assessed in the screening to involve a potential risk for significant effects for the Natura 2000 area bird features. Collision risk, barrier effects, attraction, habitat loss, and disturbance (beyond what is reflected in displacement effects) were screened out as impact pathways with a potential for significant effects for the bird features.

8.2.1. Divers

Internationally, studies have generally found strong diver displacement from wind farms, even with quite a span in the rate and distance of displacement: ranging from no apparent effects (Lindeboom et al 2011) over displacement distances of 0-2 kilometres (Percival 2013, Percival 2014) and 4-7 kilometre (Rexstadt & Buckland 2012, Webb *et al*. 2017, MacArthur Green/Royal Haskoning DHV 2021) to effects at distances of 15 kilometres or more (Mendel et al. 2019, Heinänen *et al.* 2020, Garthe *et al.* 2023). Apart from potentially being influenced by survey design and the analytical approaches these differences could also be speculated to be influenced by divers responding differently to wind farms in different areas and/or seasons (Vivela *et al.* 2020), wind farms of different turbine size and layout affecting divers differently (Scott-Hayward *et al.* 2024) and divers potentially becoming habituated to wind farms over time, though there has been no published support for that yet.

The strongest responses of divers to offshore wind farms have been reported from German North Sea wind farms, where studies have found very large displacement distances for the spring period, where the birds are the most abundant there (Mendel et al. 2019, Heinänen *et al.* 2020, Garthe *et al.* 2023). This in turn has led to concerns about impacts on the conservation of divers, especially in light of plans for further offshore wind farm expansion in the German Bight (Garthe *et al*. 2023).

It is worth noting that despite the large displacement distances, the numbers of divers staging in the German Bight during spring seems to have remained relatively stable over the period during which the large wind farm expansion has happened in that area. Based on an analyses of a 16 year data set spanning 18 years covering a large part of the German Bight Vivela *et al.* (2021) concluded there were no indications that overall diver numbers had declined. This analysis was later extended with a further three years of data, taking it up to 2021, and the conclusion remained the same (Figure 8-17, Vivela *et al.* 2022). While it is evident that there has been large-scale displacement of divers in the German Bight looking at the long time series of data available, allowing for natural variation to be captured, all points to the population being stable.

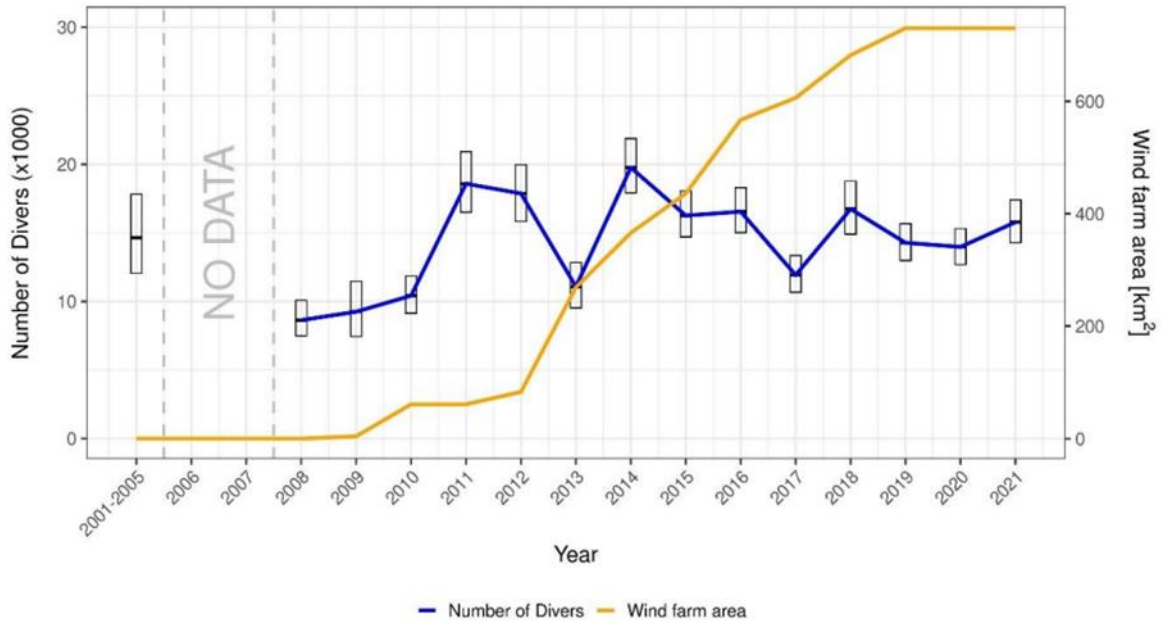

Figure 8-17. Diver abundance during spring for the total study area. Error-bars show 95% confidence intervals given by the model. For reference, the total wind farm area (km²) was included for each year. Illustration from Vivela *et al.* (2022).

Something similar has been observed for divers wintering in the Outer Thames Estuary in England, which may involve birds that might later be found in the Horns Rev area during spring (Dorsch *et al.* 2020). More offshore wind farms have been constructed within and in the vicinity of the area of the Outer Thames Estuary designated as an SPA, with wind farm displacement distances visible out to 7 kilometres in a large-scale analysis of diver distribution in the area (MacArthur Green/Royal Haskoning DHV 2021). At the same time the number of divers wintering in the area have been stable if not increasing (Irwin *et al.* 2019).

Nonbreeding red-throated divers tend to occur at relatively low densities (typically less than 4 birds/km2) and not in large aggregations (Dierschke *et al.* 2017). They are also known to feed on a wide variety of prey (Kleinschmidt *et al.* 2019). The possibility therefore exists that displaced divers might have plenty of other feeding opportunities away from wind farms – the displacement observed reflecting a luxury of choice. This would imply that the overall number of birds would be well within the carrying capacity of the feeding habitat available to them. Whether this is currently the case for the German Bight and wider southeastern North Sea remains speculative, and clearly something that would only hold to a certain point of expansion of offshore wind and other activities that might affecting the divers access to food.

For the Horns Rev area, the analysis of the full 24 year aerial survey data found very different displacement effects across the three wind farms there (Scott-Hayward *et al.* 2024). While for Horns Rev 1 it was not possible to conclude with certainty about displacement effects, the results were clear on a marked displacement effect of the Horns Rev 2 wind farm and no displacement from the Horns Rev 3 wind farm. For the Horns Rev 2 wind farm the displacement extended to a distance of 10 km, and there were no indications of that reducing over time. The remarkable difference in responses between Horns Rev 2 and Horns Rev 3 was speculated to be related to the newer Horns Rev 3 wind farm having much more widely spaced (larger) wind turbines making the wind farm more open and possibly less intimidating to the divers[3].

To illustrate the potential scale of the effect should a 10 km displacement distance had gone unnoticed at Horns Rev 1 an attempt has been made to quantify the number of divers potentially affected. Using the pre-construction density of divers in the Horns Rev 1 wind farm area for the displacement zone as well (0.12 individuals/km2; Scott-Hayward et al. 2024) and conservatively assuming a 50% displacement rate for the wind farm and the full assumed 10 km displacement zone (600 km2 in total), 37 divers might have been displaced. In terms of the potential population consequences, the question is how the survival of the displaced divers might be affected. Looking to guidance in the UK on assessing population consequences of displacement for seabirds during the non-breeding season, a range of mortality rates from 1%-3% is advised (NatureScot 2023). These rates are provided for guillemot, razorbill, puffin,

[3] Horns Rev 2 has 2.6 turbines/square kilometer while Horns Rev 3 has 0.6 turbines/square kilometer. The figure for Horns Rev 1 is 4.0 turbines/square kilometer.

gannet and kittiwake and it is assumed here that they will be applicable also for divers. Using the higher mortality rate, this would mean an annual mortality of 1.1 divers from displacement effects from Horns Rev 1.

Looking at the overall area covered by the aerial surveys, there has been an increase in diver abundance from the period before to the period 5 years into operation of Horns Rev 1 (Phase 0 to Phase 1), followed by a decline since then up to now (Phase 1 to Phase 3) returning to the similar level of abundance observed before the construction of Horns Rev 1 (Scott-Hayward *et al.* (2024).

It is also noted by Scott-Hayward *et al.* (2024) that the divers in the Horns Rev area, and it follows in the expanded SPA 113, is part of a much larger concentration of divers found in the southeastern North Sea in spring. The occurrence in the Horns Rev area will therefore be affected by between year variation and trends in prey availability over this much larger area, adding a backdrop of natural variation in abundance of divers in the SPA.

8.2.2. Common scoter

Much of what is known about wind farm displacement for common scoter stems from the studies conducted around the Horns Rev wind farms. As for the divers the analysis of the full 24 year aerial survey data set found very different displacement effects across the three Horns Rev wind farms (Scott-Hayward *et al.* 2024). While for Horns Rev 1 it was not possible to conclude with certainty about displacement, the results were clear on a marked even if temporary displacement effect of the Horns Rev 2 wind farm and no displacement from the Horns Rev 3 wind farm.

For the Horns Rev 2 wind farm the analysis showed a large displacement effect 2-3 years post-construction (Phase 2), extending to a distance of 5 km from the wind farm. This effect was no longer visible in Phase 3 11-12 years post-construction, where the mean density in the footprint and surrounding areas had returned to pre-construction levels.

The apparent return of scoters to the Horns Rev 2 wind farm in phase 3 points to a potential for the species to habituate to wind farms. This would seem to be corroborated by the Horns Rev 1 wind farm holding relatively large numbers of scoters during the winter 2006/2007. Compared to divers, scoters are more restricted in terms of availability of suitable feeding areas, specialised as they are feeding on bivalves at water depths typically well below 20 meters (Fox *et al.* 2025). It may therefore be speculated that they are more likely to accept the presence of wind farms if the food available within them is attractive.

The lack of displacement effect for the Horns Rev 3 wind farm four years post-construction (Phase 3) is in stark contrast to the findings for Horns Rev 2. Scott-Hayward *et al.* (2024) speculated this might be related to the newer Horns Rev 3 wind farm having much more widely spaced (larger) wind turbines making the wind farm more open and possibly less intimidating to the divers.

Looking at the overall area covered by the aerial surveys, there has been a steady increase in common scoter abundance through phases 0 to 2, followed by an apparent stabilisation of numbers in Phase 3 at a level markedly higher than before wind farm construction began in the area (Scott-Hayward *et al.* 2024).

8.2.3. Little gull

A combined analysis of data across all aerial surveys conducted at Horns Rev over the years, like the one carried out for divers and common scoter by Scott-Hayward *et al.* (2024), has not been attempted for little gull. This means the analysis conducted on the monitoring around the Horns Rev 1 wind farm is the only dedicated analysis of wind farm effects available from the area (Fox *et al.* 2006, Petersen *et al.* 2006).

An inspection of the data from the aerial surveys over the years would suggest numbers have been variable between years but overall relative stable with spring peaks at the scale of 50-100 birds in the overall study area, springs 2022 and 2023 (construction and one year post-construction Horns Rev 1, respectively) standing out with 127 and 372 individuals recorded, respectively.

8.3. Conclusion project alone

In the extensive analysis of the full aerial survey data set collected over 24 years in the Horns Rev area Scott-Hayward *et al.* (2024) found no evidence of the Horns Rev 1 wind farm having led to displacement of divers and common scoters.

This doesn't exclude that displacement have happened, which was indeed indicated by the monitoring programme for Horns Rev 1 (Fox *et al*. 2006; Petersen *et al*. 2006). but it does suggest that this displacement would have been sufficiently small to be drowned out in the bigger pattern of changes observed in the abundance and distribution of these species in the Horns Rev area over the 24 year period studied.

A contributing factor to this, as already noted by Noer *et al.* (2000), is that the wind farm area and its surroundings was not particularly important for divers and common scoters before the wind farm was constructed. That and its relatively small size making it very difficult to tease out effects of the wind farm on these species.

For divers, the fact that numbers increased in the wind farm area as well as in the general area after construction of Horns Rev 1, with the 5-year period after construction of the wind farm (phase 1) seeing the highest abundance of divers in the Horns Rev area during the last 24 years (Scott-Hayward *et al.* 2024), strongly suggests that the wind farm is no hindrance to achieving/maintaining a favourable conservation status for divers in the expanded SPA 113.

Therefore, it can be concluded with a high degree of certainty that any continued minor displacement of divers (indiscernible in the analysis by Scott-Hayward *et al.* 2024) resulting from a 15 years lifetime extension of Horns Rev 1 is **unlikely to cause harm** to the designation of SPA 113. As a consequence, it can also be concluded that the lifetime extension is **unlikely to cause harm** to the integrity of the Natura 2000-area.

For common scoter, the area of the wind farm saw an increase in numbers post-construction, which stayed relatively stable after that. At the same time numbers in the general area steadily increased from Phase 0 into Phase 2, after which it levelled off at a level markedly higher than before the construction of Horns Rev 1. It has also clearly been shown that common scoters are willing to enter the wind farm to feed in relatively large numbers, as was also found to be the case for Horns Rev 2 about 10 years into operation. All in all, this strongly suggests that the wind farm is no hindrance to achieving/maintaining a favourable conservation status for common scoter in the expanded SPA 113.

Therefore, it can be concluded with a high degree of certainty that any continued minor displacement of common scoters (indiscernible in the analysis by Scott-Hayward *et al.*2024) resulting from a 15 year lifetime extension of Horns Rev 1 is **unlikely to cause harm** to the designation of SPA 113. As a consequence, it can also be concluded that the lifetime extension is **unlikely to cause harm** to the integrity of the Natura 2000-area.

For little gull it is even harder than for divers and scoters to conclude about displacement effects of Horns Rev 1. Similar to those species, if anything there seems to have been an increase after the construction of Horns Rev 1, and little gulls have been observed in the wind farm on more occasions. Furthermore most little gulls have been observed in the western and central part of the area, meaning Horns Rev 1 is not within a main concentration area in the SPA.

It is concluded with a high degree of certainty that any continued displacement of little gulls resulting from a 15 year lifetime extension of Horns Rev 1 is **unlikely to cause harm** to the designation of SPA 113. As a consequence, it can also be concluded that the lifetime extension effects on little gulls are **unlikely to cause harm** to the integrity of the Natura 2000-area.

9. Cumulative effects

The Natura 2000-screening for the Horns Rev 1 lifetime extension concluded that significant cumulative effects could not be excluded from the existing and planned expansion of offshore wind farms in the Danish and German parts of the North sea with respect to displacement effects on the internationally important concentration of divers found in the southeastern North Sea in spring.

A similarly conclusion was reached for the 2 GW Nordsøen 1 Plan Natura-2000 screening (COWI 2024a), which was subsequently corroborated in the Natura 2000-appropriate assessment for the same plan (COWI 2024b). It should be noted however that more detailed assessment of impacts was deferred to the concrete projects eventually to be taken forward under the Plan. Concerns were especially raised for developments in the part of the plan area (subarea 1) immediately north of the SPA 113 (see figure 9-1).

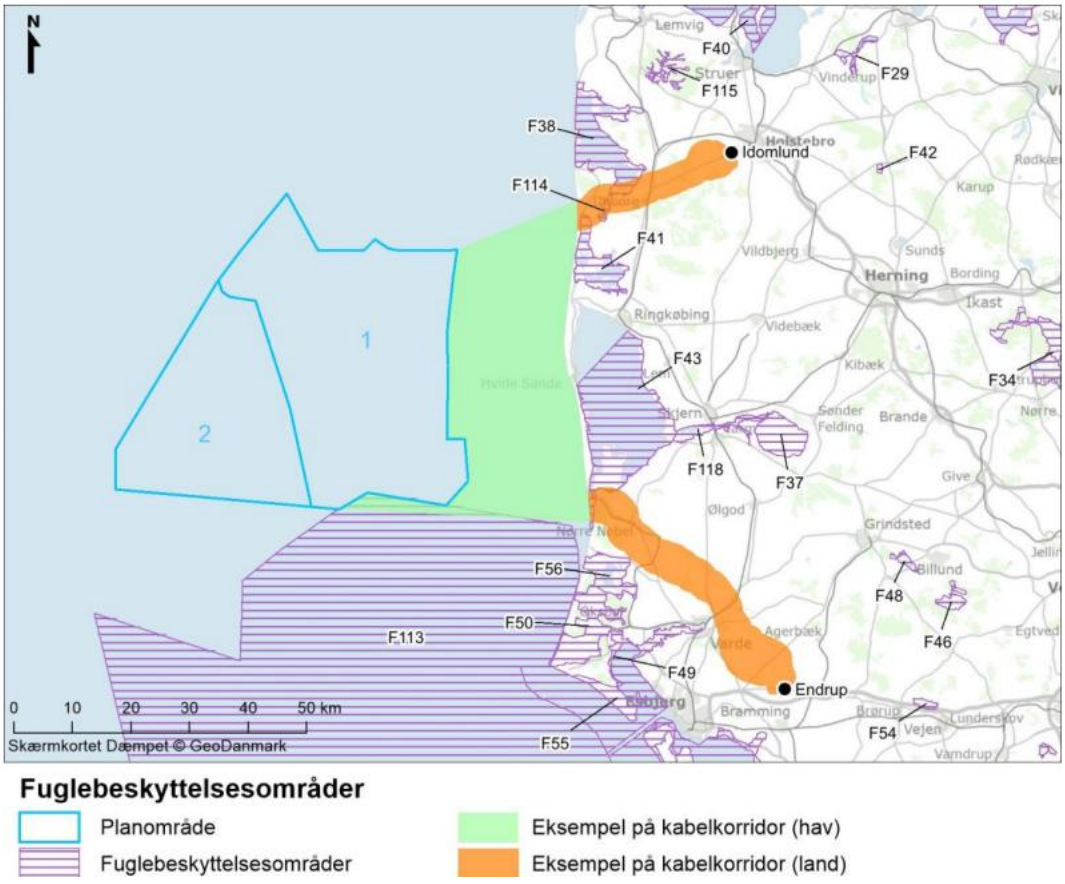

Figure 9-1. The North Sea 1 Plan area relative to Natura 2000 bird protection areas (SPA's - *Fuglebeskyttelsesområder*) The plan area is divided in an eastern (1) and a western part subarea (2). Illustration from COWI 2024a).

In the German North Sea three windfarms are in operation close to the Danish border and thereby the Natura 2000 area N246, including SPA 113:

- Butendiek, 288 MW, commissioned in 2015.
- DanTysk, 288 MW, commissioned in 2015.
- Sandbank, 288 MW, commissioned in 2017.

The current plans for wind farm development in the German North Sea involves two development areas bordering Danish waters (Figure 9-2, BSH 2025):

- N-5 – a development area of 396 km^2 dedicated for 4 GW. Thee area has the status "Area for subsequent use under review" for nature conservation and environmental legal reasons. There is not yet a planned timeline for a possible tender process and build-out of this area. The windfarm Sandbank is within this area.
- N-13.4 – a sub-area of 196 km^2 dedicated for 2 GW. There is not yet a planned timeline for a possible tender process and build-out of this area eihter.

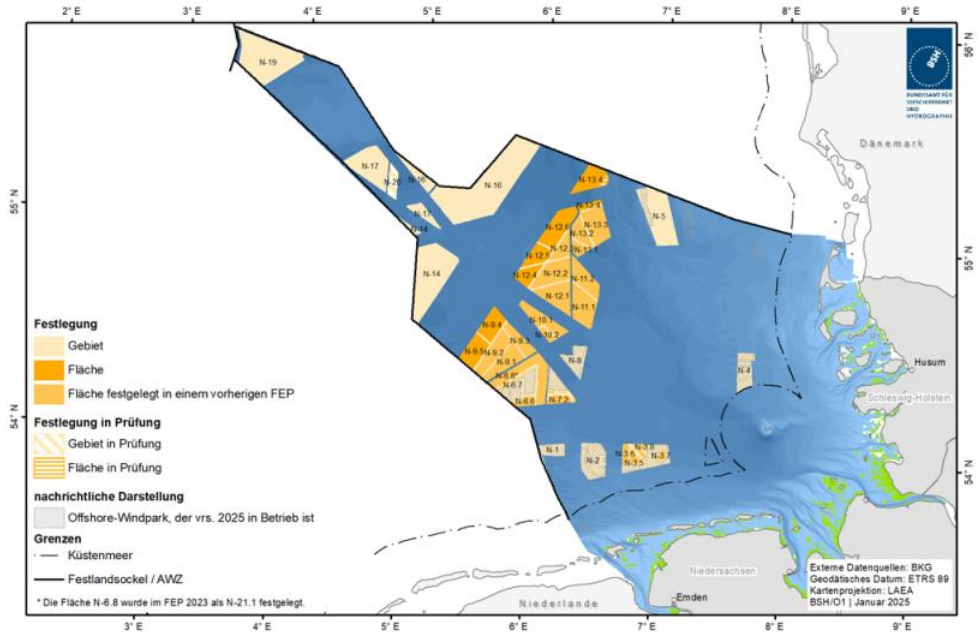

Figure 9-2. [Festlegungen zu Gebieten und Flächen in der AWZ der Nordsee]. Illustration from BSH 2025.

The N-5 development area is bordering the Natura 2000 area N246, including the SPA 113. In an analysis of important seabird concentrations and sensitivities to wind farm development Dierschke *et al*. (2024) found the N-5 area to have a low sensitivity score for seabirds, including divers (Figure 9-3).

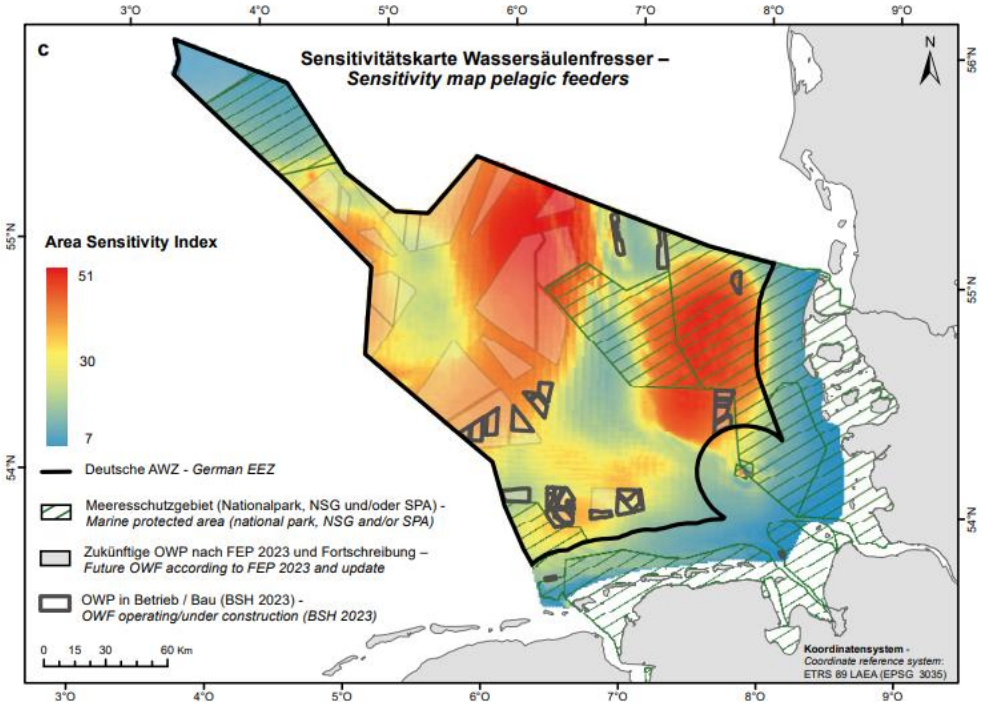

Figure 9-3. Spatial distribution of the sensitivity of seabirds to offshore windfarms (Area Sensitivity Index ASI: summed products of log-scaled bird densities and species-specific sensitivity SSI) in the German North Sea: c) pelagic feeders (6 species). All Marine Protected Areas are shown as well as offshore wind farms commissioned by 2023 and offshore wind farm areas envisaged by the site development plan of 2023 (FEP 2023) and update. Scaling in relation to the maximum ASI occurring in each case. Illustration from Dierschke *et al* . 2024.

Looking at the available information on long-term trends in diver numbers, as regards the Horns Rev area (constituting a significant part of the SPA 113) seen over the period of 24 years of aerial surveys, spanning the period before the construction of Horns Rev 1 to the construction and operation of two further wind farms, diver numbers have been highly variable but overall stable in the general area. The same seems to have been the case in the German Bight, despite the large wind farm related displacement effects seen there.

The extent to which cumulative effects of additional wind farms will significantly affect the population of divers will depend on a number of things and not least the actual realised built-out and the location and design of the individual wind farms taken forward. The results from the analysis of the data set from the Horns Rev area suggests that the continuing development with wind turbines getting bigger and with increasing distances between turbines and wind farms becoming more open as a consequence[4], might markedly reduce displacement effects for new wind farms. In the plans for future offshore wind development in Danish and German waters it is anticipated that turbines will continue to increase in size with the result that wind farms will be even more open than is the case for Horns Rev 3.

It will be important to further consolidate the findings of no displacement for Horns Rev 3 with continued monitoring of the Horns Rev area to be able to properly account for potential impacts of new offshore wind farm developments in the region. It will be for the Natura 2000 assessments for individual future projects and plans to consider their contribution to cumulative effects for the SPA 113 and the diver population as such.

For the proposed lifetime extension of the Horns Rev 1 wind farm, the assessment presented here have clearly shown that the wind farm is unlikely to make any material contribution to cumulative effects at the level of the spring staging population of divers in the southeastern North Sea. Despite the very extensive and unique long-term data set available from the Horns Rev area spanning the time before the construction of Horns Rev 1 and 20 years into its operation, it has not been possible to pick up marked displacement effects of the wind farm, suggesting that any effects will be small and well within the natural variation in diver abundance and distribution in the Horns Rev area. Even in the theoretical case that a 10 km displacement distance as observed at Horns Rev 2 should have gone unnoticed for Horns Rev 1 and applying conservative assumptions on displacement and mortality rates, the potential impact in terms of additional mortality would be at the scale of a single individual a year.

It is therefore a reasonable conclusion that the lifetime extension of the Horns Rev 1 wind farm is not going to make any difference to the cumulative effects of wind farm developments on divers in the SPA 113, hence it is **unlikely to cause harm** to the integrity of the Natura 2000-area N246 and by implication the Natura 2000 network and conservation status of divers.

The common scoter is much less likely to be affected by effects from future offshore wind development compared to divers, preferring relatively shallow areas, often close to the coast, which are not the focus of planned larger wind farm developments in neither the Danish or German North Sea, as well as seemingly having a larger capacity for habituation.

In terms of the one planned wind farm development that might affect common scoters within SPA 113, the Nordsøen 1 plan, the Natura 2000 screening concluded it was unlikely to significantly affect the designation of common scoters (COWI 2024a), It will be for the Natura 2000 assessments of the concrete future projects and plans to consider their contribution to cumulative impacts on common scoters within the SPA 113 and the population found in Southern North Sea. For the Horns Rev 1 lifetime extension the contribution to cumulative effects for common scoter will be very small and indiscernible on the background of the natural variation in abundance and spatial distribution observed within the SPA 113 and hence **unlikely to cause harm** the integrity of the Natura 2000-area N246 and by implication the Natura 2000 network and conservation status of common scoter.

For little gull, the part of the SPA 113 covered by aerial surveys, and holding the Horns Rev 1 windfarm, has be shown to hold low numbers questioning the importance of the area for the species and its part of the designation. In any case, the numbers potentially affected by Horns Rev 1 are tiny, and unlikely to contribute anything of any significance to cumulative effects of wind farm developments in the Horns Rev area or elsewhere. It is therefore concluded that the Horns Rev 1 lifetime extension is **unlikely to cause harm** to SPA 113 and by implication Natura 2000-area N246 from cumulative effects.

[4] Where Horns Rev 1 and 2 have 3-4 turbines/square kilometer and Horns Rev 3 has 0.6 turbines/square kilometer the future wind farms under the Nordsøen 1 Plan is likely to have 0.2-0.4 turbines/square kilometer.

10. References

BSH 2025. Flächenentwicklungsplan 2025 für die deutsche Nordsee und Ostsee. Bundesamt für Seeschifffahrt und Hydrographie. https://www.bsh.de/DE/THEMEN/Offshore/Meeresfachplanung/Flaechenentwicklungsplan_2025/Anlagen/Downloads_FEP2025/FEP_2025.pdf?__blob=publicationFile&v=1

Christensen, T., Petersen, I., & Fox, A. (2006). Effects on birds of the Horns Rev 2 offshore wind farm: Environmental impact assessment. - NERI technical report commissioned by Energy E2. 79 pp.

COWI 2024a. Miljøvurdering af Plan for Nordsøen I. Delrapport 2. Miljørapport – Eksisterende forhold og miljøvurdering. Rapport udarbejdet for Energinet.

COWI 2024b. Natura 2000-væsentlighedsvurdering af Plan for Nordsøen I – Bilag 1 – Miljørapport. Udarbejdet for Energinet.

COWI 2024c. Natura 2000-konsekvensvurdering af Plan for Nordsøen I – Bilag 2 – Miljørapport. Udarbejdet for Energinet.

Danish Energy Agency (2006). Danish Offshore Wind. Key Environmental Issues. The Environmental Group: The Danish Energy Agency, The Danish Nature Agency, DONG Energy and Vattenfall.

Danish Energy Agency (2013). Danish Offshore Wind. Key Environmental Issues – a Follow-up. The Environmental Group: The Danish Energy Agency, The Danish Nature Agency, DONG Energy and Vattenfall.

Danish Energy Agency. (2024). Vejledning om ansøgnings- og tilladelsesprocessen for repowering og forlængelse af elproduktionstilladelse (levetidsforlængelse) af bestående elproduktionsanlæg på havet.

Danish Environmental Protection Agency (2020). Habitatvejledningen. Vejledning til bekendtgørelse nr. 1595 af 6. december 2018 om udpegning og administration af internationale naturbeskyttelsesområder samt beskyttelse af visse arter. Vejledning nr. 48.

Danish Environmental Protection Agency (2021). Strategisk miljøvurdering Natura 2000-plan 2022-2027. Sydlige Nordsø. Natura 2000-område nr. 246. Habitatområde H255. Fuglebeskyttelsesområde F113. https://sgavmst.dk/media/lftb1e3s/n246-smv-for-natura-2000-plan-2022-27-sydlige-nordsoe.pdf

Danish Environmental Protection Agency (2023). Natura 2000-plan 2022-2027. Sydlige Nordsø. Natura 2000-område nr. 246. Habitatområde H255. Fuglebeskyttelsesområde F113. https://sgavmst.dk/media/fp2pkafk/n246-natura-2000-plan-2022-27-s-nordsoe.pdf

Dierschke V, Furness RW, Gray CE, Petersen IK, Schmutz J, Zydelis R, Daunt F (2017). Possible Behavioural, Energetic and Demographic Effects of Displacement of Red-throated Divers. JNCC Report No. 605. JNCC, Peterborough.

Dierschke, V., K. Borkenhagen, L. Enners, S. Garthe, M. Mercker, V. Peschko, H. Schwemmer & N. Markones (2024). Sensitivity of seabirds to offshore wind farms in the German North Sea with respect to functional habitat loss due to avoidance. Vogelwelt 142: 59–74.

Dorsch, M., Burger, C., Heinänen, Kleinschmidt, B., Morkūnas, J., Nehls, G., Quillfedlt, P., Schubert, A., Žydelis, R., 2020. DIVER: German tracking study of seabirds in areas of planned Offshore Wind Farms at the example of divers (Funded by the Federal Ministry of Economics and Energy (BMWi) on the basis of a decision by the German Bundestag. No. 0325747A/B.

Fox, A., Christensen, T., Desholm, M., Kahlert, J., & Petersen, I. (2006). Birds: Avoidance responses and displacement. In: Danish offshore wind - key environmental issues. DONG Energy; Vattenfall; The Danish Energy Authority; The Danish Forest and Nature Agency.

Fox, A.D., Osterberg, J., Petersen, I.K., Balsby, T.J.S., Markones, N., Schwemmer, P. and Garthe, S. (2025), Large-scale depth-related seasonal distribution patterns of a benthic-feeding sea duck in two contrasting marine systems. Ibis. https://doi.org/10.1111/ibi.13409

Fox, Anthony D., Petersen, Ib, Balsby, Thorsten, 2025 Comments and suggestions on the Natura 2000 Appropriate Assessment, Operational Lifetime Extension, Horns Rev 1 - Vattenfall/Ørsted. Aarhus University, DCE - Danish Centre for Environment and Energy, 11 s. – Scientific note no. 2025:61

Fredshavn J., Holm T.E., Bregnballe T., Sterup J., Pedersen C.L., Nielsen R.D., Clausen P., Nyegaard T. & Eskildsen D.P. 2025. Størrelse og udvikling af fuglebestande i Danmark - 2025. Artikel 12-rapportering til Fuglebeskyttelsesdirektivet. Aarhus Universitet, DCE - Nationalt Center for Miljø og Energi, 48 s. – Videnskabelig rapport nr. 672: https://dce.au.dk/fileadmin/dce.au.dk/Udgivelser/Videnskabelige_rapporter_600-699/SR672.pdf

Garthe, S., Schwemmer, H., Peschko, V. et al. 2023. Large-scale effects of offshore wind farms on seabirds of high conservation concern. Sci Rep 13, 4779. https://doi.org/10.1038/s41598-023-31601-z

Stefan Garthe, Henriette Schwemmer, Moritz Mercker, Volker Dierschke, Nele Markones, Verena Peschko, Philipp schwemmer, Jochen C. Krause 2025. Wind farms in proximity to marine protected areas put conservation targets at risk, Journal for Nature Conservation, Volume 84, 2025 - https://doi.org/10.1016/j.jnc.2024.126805

Heinänen, S., Žydelis, R., Kleinschmidt, B., Dorsch, M., Burger, C., Morkunas, J., Quillfeldt, P., Nehls, G. (2020). Satellite telemetry and digital aerial surveys show strong displacement of red-throated divers (Gavia stellata) from offshore wind farms. Marine Environmental Research. 160. https://doi.org/10.1016/j.marenvres.2020.104989

Irwin, C., Scott, M., S., Humphries, G. & Webb, A. 2019. HiDef report to Natural England - Digital video aerial surveys of red-throated diver in the Outer Thames Estuary Special Protection Area 2018. Natural England Commissioned Reports, Number 260.

Kleinschmidt, B., et al. (2019). The diet of red-throated divers (Gavia stellata) overwintering in the German Bight (North Sea) analysed using molecular diagnostics. Marine Biology, Vol. 166, Article No. 77.

Lindeboom. H.J., et al. (2011). Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. Environmental Research Letters, Vol. 6, 35101-13

MacArthur Green / Royal HaskoningDHV 2021. Displacement of red-throated divers in the Outer Thames Estuary SPA – Deadline 11 Update. East Anglia ONE North and East Anglia TWO Offshore Windfarms. Report for East Anglia ONE North Limited and East Anglia TWO Limited. ExA.AS-2.D11.V5 EA1N&EA2 Displacement of red-throated divers in the Outer Thames Estuary

Mendel, B. P. (2019). Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of Loons (Gavia spp.). – J. Environ. Manage. 231: 429-438.

Nielsen, R. D., Holm, T. E., Clausen, P., Sterup, J., Pedersen, C. L., Clausen, K. K., Bregnballe, T., Thomsen, H. M., Balsby, T. J. S., Petersen, I. K., Mikkelsen, P., Dalby, L. & Mellerup, K. A., (2024). Fugle 2018-2023: NOVANA. Videnskabelig rapport fra DCE - Nationalt Center for Miljø og Energi; Nr. 633. 629 s.

Noer, H., Christensen, T., Clausager, I., & Petersen, I. (2000). Effects on birds of an offshore wind park at Horns Rev: Environmental impact assessment. NERI Report. Commissioned by Elsamprojekt A/S 2000.

Percival, S.M. (2013). Thanet Offshore Wind Farm. Ornithological Monitoring 2012-13. Report for Vattenfall.

Percival, S.M. (2014). Kentish Flats Offshore Wind Farm: Diver Surveys 2011-12 and 2012-13. Report for Vattenfall.

Petersen, I. K., Christensen, T. K., Kahlert, J., & Deshom, M. &. (2006). Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. DMU, National Environmental Research Institute.

Petersen, I., & Fox, A. (2007). Changes in bird habitat utilisation around the Horns Rev 1 offshore wind farm, with particular emphasis on Common Scoter.

Petersen, I., Nielsen, R., & Mackenzie, M. (2014). Post-construction evaluation of bird abundances and distributions in the Horns Rev 2 offshore wind farm area, 2011 and 2012. Report commissioned by DONG Energy. Aarhus University, DCE – Danish Centre for Environment and Energy. 51 pp.

Petersen, I., Nielsen, R.D., & Clausen, P. (2019a). Opdateret vurdering af IBA-udpegninger i relation til otte specifikke marine områder. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi, 80 s. - Teknisk rapport nr. 203. http://dce2.au.dk/pub/TR203.pdf.

Petersen, I., Sterup, J., & Nielsen, R. (2019b). Optællinger af vandfugle i den danske del af Nordsøen og Skagerrak, april og maj 2019. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi,26 s. - Teknisk rapport nr. 158. http://dce2.au.dk/pub/TR158.pdf.

Rexstad, E. & Buckland, S. 2012(?). Displacement analysis boat surveys Kentish Flats. CREEM, University of St. Andrews. Report for SOSS. - https://www.bto.org/sites/default/files/u28/downloads/Projects/Final_Report_SOSS01A.pdf

Scott-Hayward, L., Petersen, I.K., MacKenzie, M., Pedersen, C.L., Isojunno, S., Nielsen, R.D, Sterup, J., Thomsen, H.M. and Neergaard, R.S. (2024). Changes in the distribution and abundance of common scoter and diver species in the Horns Rev I, II and III offshore windfarm areas, Denmark. Bird distribution responses to wind farms, Horns Rev. Energinet Eltransmission A/S

TÜV SÜD 2025. Confirmation on Evaluation of Life Time Extension Registration no.: 4111900-5-e Rev.1

Vilela R, Burger C, Diederichs A, Bachl FE, Szostek L, Freund A, Braasch A, Bellebaum J, Beckers B, Piper W and Nehls G (2021) Use of an INLA Latent Gaussian Modeling Approach to Assess Bird Population Changes Due to the Development of Offshore Wind Farms. Front. Mar. Sci. 8:701332. doi: 10.3389/fmars.2021.701332

Vilela, R., Burger, C., Diederichs, A., Nehls, G., Bachl, F., Szostek, L., Freund, A., Braasch, A., Bellebaum, J., Beckers, B., Piper, W. (2022). Final Report: Divers (Gavia spp.) in the German North Sea: Changes in Abundance and Effects of Offshore Wind Farms. A study into diver abundance and distribution based on aerial survey data in the German North Sea. BioConsult Report prepared for Bundesverband der Windparkbetreiber Offshore e.V.

Webb, A., Irwin, C., Mackenzie, M., Scott-Hayward, L., Caneco, B. & Donovan, C. (2017). Lincs Wind Farm: Third Annual Post-Construction Aerial Ornithological Monitoring Report. HiDef Aerial Surveying Ltd report to Lincs Wind Farm Ltd

Wetlands International (2024). Waterbird Population Estimates. Hentet fra Wetlands International: wpe.wetlands.org.

WSP 2025. Natura 2000-screening and Annex IV species assessment. Operational lifetime extension, Horns Rev 1. Report for Vattenfall/Ørsted.