Smålandsfarvandet Offshore Wind Farm - Supplementary Report to inform Appropriate Assessment and Environmental Impact - Common Scoter

Birds

Natura 2000

Rambøll A/S

Draft

November 2015

The expert in WATER ENVIRONMENTS

This report has been prepared under the DHI Business Management System certified by Bureau Veritas to comply with ISO 9001 (Quality Management)

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Prepared for Rambøll A/S

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Project number	11814614-3
Approval date	05-11-2015
Revision	Draft: 0.3
Classification	Restricted

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1 Introduction

The present note covers supplementary assessments related to the Appropriate Assessment for Smålandsfarvandet Offshore Wind Farm in relation to Common Scoter *Melanitta nigra* and the EC Special Protection Area (SPA) SPA 96 Farvandet mellem Skælskør Fjord og Glænø (DK005X096) (Skov & Heinänen 2015).

More specifically, the assessment aims at adjusting estimates of habitat displacement impacts on Common Scoter following the recent (July 2015) update of the size of the European fly-way population. The estimated size of the European fly-way population of Common Scoter has been changed from 550,000 birds (the population size on which the original appropriate assessment was based) to a range between 600,000 and 1.2 million birds (wpe.Wetlands.org). As the Wetlands International database has been the reference for waterbird population estimates used in this project the revised estimate for Common Scoter has been taken at face value for this adjustment. Using 600,000 birds as the lower bound of the population range for Common Scoter results in an adjustment of the PBR threshold from 17,012 to 28,245.

In addition to the scenario reflecting the full 200 MW project within 44 km^2, scenarios for developing 150 MW within a footprint area of 33 km^2 and 200 MW within a footprint area of 22 km^2 were quantified. In all cases, the footprint area is developed as the contiguous area giving the maximum displacement impact. It should be noted that larger displacement impacts should be expected if the project was developed within non-contiguous footprint areas.

2 Displacement scenarios and assessments

The assessment of the three scenarios focuses on displacement effects of Common Scoters. These are dealt with by estimation of density-dependent mortality in neighbouring areas including SPAs, using analysis of redistribution caused by displacement from the wind farm. Coupled to that population level effects (i.e. long-term survival) of the total displacement of seaducks are assessed, using thresholds for sustainable removal from the relevant bio-geographical populations.

The estimation of density-dependent mortality is based on an analytical framework, which combines the following analyses (see Skov & Heinänen 2015 for details):

- Estimation of the distribution of target species of waterbirds, in this case only Common Scoter, using species distribution models applied on aerial waterbird survey data from the period 2004-2014 (see details in Zydelis & Heinänen 2014);
- Estimation of displacement effects on Common Scoter by analysing the results of the distribution models in GIS, applying specific displacement ranges and proportions reported from monitoring activities;
- Redistribution analysis in GIS by which densities of displaced Common Scoter are moved into areas of similar habitat quality outside the displacement zone associated with the wind farm;
- Estimation of density-dependent mortality caused by increases in densities of displaced Common Scoter in the areas outside the displacement zone associated with the wind farm.

The computation of the redistribution analyses and estimation of density-dependent mortality for the three scenarios required the following modifications to the techniques described in Skov & Heinänen (2015). The footprints were defined based on habitat suitability scores for Common Scoter only (instead of a combination of scores for three seaduck species). Displacement was estimated based on 75% of the birds being displaced from the footprint *sensu* the proportion reported for Horns Rev 2 offshore wind farm (Petersen et al. 2014), even if the density of turbines in the 150 MW 33 km^2 and in the 200 MW 44 km^2 is 46% lower than in Horns Rev (1.5 versus 2.8 .turbine/km^2) and the density in the 200 MW 22 km^2 scenario is slightly higher than in Horns Rev (3.0 versus 2.8 turbine/km^2). Due to the highly uncertain trend of the population of Common Scoter a precautionary *f* value has been applied. For comparison, results are also presented using a less plausible *f* value of 0.5. All other parameters were identical to the parameters used in the Appropriate Assessments.

The quantification of displacement related effects on Common Scoter rests on several assumptions, which were detailed in the Appropriate Assessment (Skov & Heinänen 2015). Although these uncertainties have been dealt with on the basis of expert judgements, the assessment of the population level consequences of displacements were quantified using PBR thresholds for sustainable removal from the relevant bio-geographic bird populations concerned. Obviously, the mortality related to the development of offshore wind farms only constitutes one of a range of mortality factors related to recent anthropogenic activities. As these factors have not been accounted for in the applied survival rates of the PBR calculations the impact from these factors has to be added to the impact from the development of the Sejerø Bugt offshore wind farm in order to assess the total anthropogenic pressure in relation to the PBR threshold.

Seaduck populations in northern Eurasia and North America have generally suffered serious declines over the last two decades. Eight out of eleven seaduck species wintering in European waters are in decline, two species are increasing and one species – Common Scoter - has an uncertain overall population status but has declined in the Baltic Sea and Kattegat by 47% (Skov et al. 2011). Of the 17 species of seaducks in the North Pacific Rim, at least 13 are reported to be declining (www.seaduckinfo.org) including the North American Black Scoter *Melanitta americana* (formerly considered a sub-species of Common Scoter) which has declined by 40 %. Below, the most important recent anthropogenic mortality factors on Common Scoters in their breeding, staging and wintering areas are listed, - factors for which little evidence of the magnitude of their influence on mortality in Common Scoter is available. However, the likely most significant pressure drivers behind the widespread drastic population changes in seaducks are increased predation in breeding areas (Flint 2013) and reduction in carrying capacity of feeding habitat in breeding (Flint 2013) and wintering areas (Skov et al. 2011, Riemann et al. 2015).
Climate changes in the breeding habitats in the tundra regions

- Increased frequency of flooding and sedimentation in the tundra regions
- Increased frequency of fires in the tundra regions
- Hunting in Denmark, Sweden and Finland during non-breeding season
- Reduction in carrying capacity of feeding habitat during breeding
- Reduction in carrying capacity of feeding habitat during non-breeding
- Disturbance during breeding from increased anthropogenic activities
- Increased disturbance during non-breeding from shipping, boats and other anthropogenic activities
- Drowning in fishing nets
- Increased frequency of diseases in adults and ducklings due to poorer body condition
- Increased predation by foxes and other predators on account of declining prey stocks for carnivorous mammals in the tundra regions

In light of this, an expert judgement was made to assess whether the total anthropogenic pressure on the Common Scoter population would be at or above 100%, i.e. at a level following construction of Smålandsfarvandet Offshore Wind Farm above which population level effects cannot be dismissed (Zydelis et al. 2009, Busch & Garthe 2016).

3 Results

3.1 Smålandsfarvandet

The highest suitability for Common Scoters in Smålandsfarvandet was predicted to be located in the shallower areas of the western part of Smålandsfarvandet (Figure 3-1). The 44, 33 and 22 km^2 footprints were identified as areas located in the southwestern part of the project area, which was classified as of very high habitat suitability to Common Scoter (Figure 3-1).

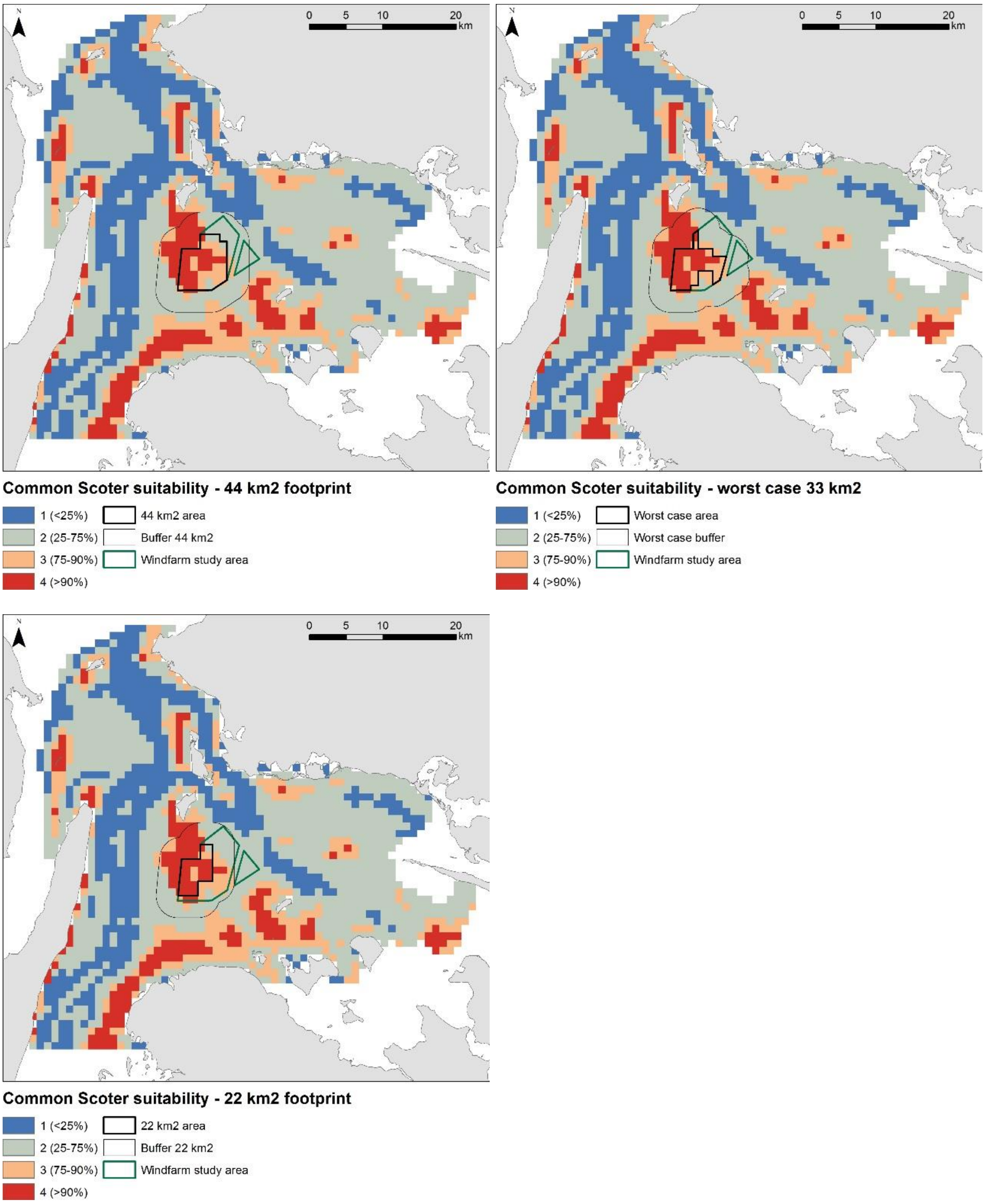

Figure 3-1 The 200 MW 44 km^2 footprint, 150 MW 33 km^2 footprint and 200 MW 22 km^2 footprint and 3 km buffer zones with the predicted densities of Common Scoter classified into four suitability classes, (percentiles) <25%, 25-75%, 75-90% and >90%.

For the 44 km^2 footprint scenario, the total number of Common Scoters displaced from both the footprint and buffer zone in Smålandsfarvandet was 18,488 (Table 3-1). For the 200 MW 22 km^2 scenario, the total number of Common Scoters displaced was 17,494 (Table 3-1), and for the 150 MW 33 km^2 scenario, the total number of Common Scoters displaced was17,972 (Table 3-1).

Table 3-1 Number of Common Scoters displaced from the buffer and wind farm footprints (200 MW 44 km^2, 200 MW 22 km^2 and 150 MW 33 km^2 footprints). The number of displace birds is indicated for each suitability class.

	Suitability	N displaced 200 MW/44 km^2	N displaced 200 MW/22 km^2	N displaced 150 MW/33 km^2
Buffer	1	0	0	0
	2	2908	2625	2807
	3	1471	2978	1887
	4	4629	4629	4773
Wind farm	1	0	0	0
	2	486	0	204
	3	2922	226	1839
	4	6031	7036	5816

The total density-dependent increase in mortality due to the 44 km^2 scenario was estimated as 5,721 birds (Table 3-2). The increase in mortality due to the displacement related to the 200 MW 22 km^2 scenario would be 4,894 in comparison to the baseline (Table 3-3). The increase in mortality due to the displacement related to the 150 MW 33 km^2 scenario would result in that 5,367 more Common Scoter would die in comparison to the baseline (Table 3-4).

Table 3-2 The density dependent mortality for Common Scoter in Smålandsfarvandet related to the 200 MW 44 km2 scenario (assuming a 2.5% increase in mortality per 1% increase in abundance) in the study area (after adding the displaced birds from the footprint and buffer). The baseline mortality is the natural mortality. The difference between the baseline mortality and the mortality induced by the displacement is indicated in the last column.

	Suitability	Baseline mortality	Increase in mortality (2.5% per % increase)	New mortality (%)	N dead birds	baseline N dead birds	Difference (increased N of dead birds)
200 MW 44 km^2	1	10.85%	0.0%	10.9%	853	853	-
	2	10.85%	14.8%	12.5%	7,883	6,908	975
	3	10.85%	21.2%	13.2%	7,651	6,358	1,293
	4	10.85%	48.5%	16.1%	11,291	7,839	3,453
				Total	27,678	21,957	5,721

Table 3-3 The density dependent mortality for Common Scoter in Smålandsfarvandet related to the 200 MW 22 km^2 scenario (assuming a 2.5% increase in mortality per 1% increase in abundance) in the study area (after adding the displaced birds from the footprint and buffer). The baseline mortality is the natural mortality. The difference between the baseline mortality and the mortality induced by the displacement is indicated in the last column.

	Suitability	Baseline mortality	Increase in mortality (2.5% per % increase)	New mortality (%)	N dead birds	baseline N dead birds	Difference (increased N of dead birds)
200 MW 22 km^2	1	10.85%	0.0%	10.9%	853	853	-
	2	10.85%	9.4%	11.9%	7,532	6,908	624
	3	10.85%	15.5%	12.5%	7,297	6,358	939
	4	10.85%	47.0%	16.0%	11,170	7,839	3,331
				Total	26,851	21,957	4,894

Table 3-4 The density dependent mortality for Common Scoter in Smålandsfarvandet related to the 150 MW 33 km2 scenario (assuming a 2.5% increase in mortality per 1% increase in abundance) in the study area (after adding the displaced birds from the footprint and buffer). The baseline mortality is the natural mortality. The difference between the baseline mortality and the mortality induced by the displacement is indicated in the last column.

	Suitability	Baseline mortality	Increase in mortality (2.5% per % increase)	New mortality (%)	N dead birds	baseline N dead birds	Difference (increased N of dead birds)
150 MW 33 km^2	1	10.85%	0.0%	10.9%	853	853	-
	2	10.85%	13.0%	12.3%	7,767	6,908	8596
	3	10.85%	17.8%	12.8%	7,441	6,358	1,082
	4	10.85%	48.2%	16.1%	11,264	7,839	3,426
				Total	27,324	21,957	5,367

The site related mortality due to 44 km^2 scenario is equivalent to 20.3% of the PBR threshold. The additive mortality (Smålandsfarvandet and the baseline wind farms listed in Table 3-5) for Common Scoter is at a high level (12,874), which is equivalent to 45.6% of the PBR threshold using the precautionary *f* value of 0.4, and equivalent to 36.5% of the PBR threshold using a *f* value of 0.5 (Table 3-5).

For the 200 MW 22km^2 scenario the site-related mortality of Smålandsfarvandet OWF is equivalent to 17.3% of the PBR threshold for Common Scoter. The additive mortality (Smålandsfarvandet and the baseline wind farms listed in Table 3-5) for Common Scoter is at a very high level (12,047), which is equivalent to 42.7% of the PBR threshold using the precautionary *f* value of 0.4, and equivalent to 34.1% of the PBR threshold using a *f* value of 0.5 (Table 3-5).

For the 150 MW 33km^2 scenario the site-related mortality of Smålandsfarvandet OWF is equivalent to 19.0% of the PBR threshold for Common Scoter. The additive mortality (Smålandsfarvandet and the baseline wind farms listed in Table 3-5) for Common Scoter is at a very high level (12,520), which is equivalent to 44.3% of the PBR threshold using the precautionary *f* value of 0.4, and equivalent to 35.5% of the PBR threshold using a *f* value of 0.5 (Table 3-5).

Table 3-5 Summary table for Smålandsfarvandet of the assumed density dependent mortality from selected operational wind farms. The mortality at "other wind farms" was assumed to be the same as the rate between displaced birds and increase in density dependent mortality as in this study.

	Common Scoter mortality			**Reference**
	200 MW 44 km^2	200 MW 22 km^2	150 MW 33 km^2	
Smålandsfarvandet	5,721	4,894	5,367	
Baseline wind farms				
Anholt	Few	Few	Few	Skov et al. 2009
Nysted	Few	Few	Few	Petersen et al. (2006)
Rødsand	Few	Few	Few	Kahlert et al. (2007)
Horns Rev 1	1,000	1,000	1,000	Assumption, Petersen et al. (2006)
Horns Rev 2	5,310	5,310	5,310	Petersen et al. (2014)
Horns Rev 3	843	843	843	Dorsch et al. (2014)
Total	**12,874**	**12,047**	**12,520**	
PBR – f 0.4	28,245	28,245	28,245	
% of PBR – 0.4	45.6 %	42.7 %	44.3 %	
PBR – f 0.5	35,307	35,307	35,307	
% of PBR – f 0.5	36.5 %	34.1 %	35.5 %	

4 Cumulative impacts

4.1 Smålandsfarvandet and Sejerø Bugt OWFs in combination

The cumulative annual mortality related to the 200 MW 44 km^2 scenario for both Smålandsfarvandet and Sejerø Bugt Offshore Wind Farms in combination with existing wind farms is estimated at 17,693 Common Scoter (Table 4-1). This is equivalent to 62.6% of the PBR threshold using the precautionary *f* value of 0.4, and equivalent to 50.1% of the PBR threshold using a *f* value of 0.5.

The cumulative annual mortality related to the 200 MW 22km^2 scenario for both Smålandsfarvandet and Sejerø Bugt Offshore Wind Farms in combination with existing wind farms is estimated at 15,137 Common Scoter (Table 4-1). This is equivalent to 53.6% of the PBR threshold using the precautionary *f* value of 0.4, and equivalent to 42.9% of the PBR threshold using a *f* value of 0.5.

The cumulative annual mortality related to a combination of the 200 MW 44 km^2 scenario for Smålandsfarvandet and the 150 MW 33 km^2 scenario for Sejerø Offshore Wind Farm in combination with existing wind farms is estimated at 16,392 Common Scoter (Table 4-1). This is equivalent to 58% of the PBR threshold using the precautionary *f* value of 0.4, and equivalent to 47.4% of the PBR threshold using a *f* value of 0.5.

Table 4-1 Cumulative assumed density dependent mortality related to different combinations of the scenarios for Sejerø Bugt and Smålandsfarvandet OWFs with planned and operational/approved wind farms (baseline wind farms).

	Common Scoter mortality		
	200 MW 44 km^2	200 MW 22 km^2	Smålandsfarvandet 200 MW 44 km^2 and Sejerø Bugt 150 MW 33 km^2
Sejerø Bugt OWF	4,819	3,090	3,872
Smålandsfarvandet OWF	5,721	4,894	5,721
Baseline OWFs	7,153	7,153	7,153
Total	17,693	15,137	16,746
PBR	28,245	28,245	28,245
% of PBR	62.6 %	53.6 %	59.3 %
PBR – *f* 0.5	35.307	35.307	35.307
% of PBR – *f* 0.5	50.1 %	42.9 %	47.4 %

5 Effect of habitat displacement on integrity of affected SPAs

5.1 Smålandsfarvandet Offshore Wind Farm

5.1.1 Farvandet mellem Skælskør Fjord og Glænø (DK005X096)

The revised assessment of the habitat displacement of Common Scoter related to the Smålandsfarvandet OWF clearly indicated that the full development of 200 MW within a 44 km^2 will be feasible and result in density-dependent mortality, which together with the mortality related to baseline OWFs and other existing anthropogenic pressures will be below 100% PBR. It can therefore be ruled out that developing Smålandsfarvandet OWF would have adverse effects on the integrity of the SPA 96 Farvandet mellem Skælskør Fjord og Glænø (DK005X096).

Cumulatively with Sejerø OWF the wind farm related mortality of Common Scoter will be high or 62.6% of PBR. Thus, the level of density-dependent mortality induced by a combination of the full development of both Sejerø Bugt and Smålandsfarvandet OWFs and mortality related to existing wind farms and other existing anthropogenic pressures may be above 100% PBR, and may not currently be sustained by the biogeographic population. Accordingly, precautionary assessment of the density dependent mortality of Common Scoter related to construction of both Smålandsfarvandet and Sejerø Bugt OWFs would be that adverse effects on the integrity of the SPA Farvandet mellem Skælskør Fjord og Glænø (DK005X096) may be pertinent with negative effects on the conservation objectives of the SPA. The combination of development of both Smålandsfarvandet and Sejerø Bugt OWFs with full capacity (200 MW) but within a footprint area of 22 km^2 is estimated to result in a slightly lower cumulative wind farm related mortality of Common Scoter compared to the 44 km^2 footprint or 53.6 % of PBR. As the density of turbines (3 MW) in the 22 km^2 footprint will be approximately 10% higher than in the reference site in Horns Rev 2 displacement effects and hence cumulative mortality with existing wind farms and other existing anthropogenic pressures may be close to or above 100% PBR, and may not currently be sustained by the biogeographic population. Thus, precautionary assessment of the density dependent mortality of Common Scoter related to this scenario would be that adverse effects on the integrity of the SPA Farvandet mellem Skælskør Fjord og Glænø (DK005X096) may be pertinent with negative effects on the conservation objectives of the SPA. The development of full capacity within 22 km^2 using larger turbines may however cause the turbine density of Smålandsfarvandet OWF to be comparable to or smaller than in the reference study on Horns Rev 2 in which case adverse effects on the integrity of the SPA 96 Farvandet mellem Skælskør Fjord og Glænø (DK005X096) can be discounted.

The combination of development of full lay-out and capacity for Smålandsfarvandet and ¾ lay-out/capacity of Sejerø Bugt OWFs is estimated to also result in a high level of wind farm related mortality of Common Scoter or 59.3 % of PBR. Thus, the cumulative mortality with existing wind farms and other existing anthropogenic pressures may be close to or above 100% PBR, and may not currently be sustained by the biogeographic population. Precautionary assessment of the density dependent mortality of Common Scoter related to this scenario would be that adverse effects on the integrity of the SPA Farvandet mellem Skælskør Fjord og Glænø (DK005X096) may also be pertinent for this scenario with negative effects on the conservation objectives of the SPA.

The possible project of Omø Syd Windfarm may result in displacement of Common Scoters at the same magnitude as estimated for Smålandsfarvandet with a full layout or 200 MW for 44 km^2. Thus, the cumulative impact of any of the combined developments for Smålandsfarvandet and Sejerø Bugt OWFs and Omø Syd Windfarm will be at a level where adverse effects on the integrity of the SPA Sejerø Bugt og Nekselø (DK005X094) cannot be discounted.

The PBR-based assessment of project-related and cumulative impacts above has been based on best available knowledge of the status of the Common Scoter population in Europe. It is evident that a high degree of uncertainty exists both with respect to the current population size and trends. The recent change in the status of the species *sensu* Wetlands International has taken place in the absence of a change in known trends in the size of breeding and wintering populations. While the wintering population in the Baltic Sea and Kattegat has been documented on the basis of internationally coordinated surveys to decline by approximately 50 % between 1993 and 2008, no estimates from this region are available during the more recent period when large numbers of Common Scoter have been recorded in the North Sea (wpe.wetlands.org), Due to the absence of reliable historic counts in the North Sea and the fact that no coordinated surveys have yet been carried out in the North Sea no trend information can be documented for the North Sea. Hence, the only valid information on changes in the population size of Common Scoter stem from the coordinated surveys of the entire Baltic Sea during 1992-93 and 2007-2008. Thus, the overall trend in the population (Baltic Sea and North Sea combined) is very uncertain, and given the drastic decline in the Baltic Sea and Kattegat the use of a precautionary *f* value of 0.4 seems suitable. If a less plausible *f* value of 0.5 (indicating a stable population) is applied the cumulative impacts of the combined scenarios for Sejerø and Smålandsfarvandet OWFs would be at a level at or just below 50%; 50.1% for the 200 MW 44 km^2 scenario, 42.9% for the 200 MW 22 km^2 scenario and 47.4 % for the 200/150 MW 44/33 km^2 scenario. In this case, adverse effects on the integrity of the SPA 96 Farvandet mellem Skælskør Fjord og Glænø (DK005X096) can be discounted.

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