NUMBER AND DISTRIBUTION OF BIRDS IN AND AROUND TWO POTENTIAL OFFSHORE WIND FARM AREAS IN THE DANISH NORTH SEA AND KATTEGAT

Scientific Report from DCE – Danish Centre for Environment and Energy No. 327 2019

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Data sheet

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Abstract: The Danish Energy Agency requested a total of ten surveys of birds conducted in two areas of interest in the North Sea and in Kattegat, five surveys in each area. The surveys were conducted as aerial line transect surveys from December 2018 until April 2019. This publication reports the findings of the surveys. Relevant bird species for each of the two areas are described, and thematic maps are presented. In compliance with the contract this publication does solely present the distribution of the observed birds. No estimation of total numbers has been performed under this contract.
The dominant bird species found in the two survey areas were Gannets and Razorbills/Guillemots. In both survey areas these bird species were found in high numbers, both inside and outside the area of interest for offshore wind farms. Diving ducks, as for instance Common Scoter, were found in low numbers.
Red-throated Diver/Black-throated Diver was found in concentrations in the North Sea survey area particularly, and to a less extent in the Kattegat survey area.
Densities of divers were lower in the area of interest for the offshore wind farms. Since divers are known to be displaced by offshore wind farms out to more than 15 km, the displacement effect of these birds may be reduced by careful considerations of the actual positioning of potential wind farms.

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1. Introduction

In the December of 2018 DCE, Aarhus University contracted with the Danish Energy Agency to conduct surveys of birds in two predefined Danish marine areas. One area was between north coast of Sjælland, northwards to Anholt, eastwards to the Swedish/Danish EEZ border and westwards to Sjællands Odde. The other area was west of Jutland, from the coast approximately 70 km westwards, southwards to ca. 15 km north of Blåvandshuk and north-wards to a line west of the western entrance of Limfjorden.

At each site, a total of five aerial surveys of birds was conducted between De-cember 2018 and April 2019. The aerial surveys were conducted line transect sampling counts, performed along predefined transect lines.

In this report the survey data are presented. The number of observed birds by species or species group and their distribution are given. Estimation of total numbers of the bird species is not presented here, according to the tender from the Energy Agency.

In both survey areas the bird community was dominated by marine species as for instance divers (primarily Red-throated Diver), Gannets, Herring Gull, Great Black-backed Gull, Kittiwake, Razorbill and Guillemot. In the coastal and shallow areas of both survey areas a number of diving ducks were rec-orded, mainly Common Eider and Common Scoter.

This report does not attempt to assess the potential effects or impacts from offshore wind farms on the bird communities in the two study areas.

2. Method

The two survey areas were in the North Sea and Kattegat. In the North Sea the survey area was west of Jutland, from the coast stretching approximately 70 km westwards, southwards to ca. 15 km north of Blåvandshuk and northwards to a line west of the western entrance of Limfjorden (Figure 1). The Kattegat survey area was between north coast of Sjælland, northwards to Anholt, eastwards to the Swedish/Danish EEZ border and westwards to Sjællands Odde (Figure 2). The surveys were conducted from a high winged, twin-engined Partenavia P-68, flying at an altitude of 76 m (250 feet) and with a cruising speed of approximately 185 km/t (100 knots).

The observations were carried out using the Distance Sampling line transect survey method (Buckland et al. 2001, 2015). The predefined transect lines and associated waypoints were entered in a GPS from which the pilot could navigate (Figure 1 & 2). The total length of the transect lines in the North Sea survey area was 812 km, while in Kattegat it was 735 km.

During the surveys, two experienced observers familiar with species identification covered each side of the aircraft. All observations were continuously recorded on dictaphones, giving information on species, number, behaviour, transect band and time. The behaviour of the observed birds included the activities: sitting (on the water), diving, flushing or flying.

Observations were related to transect bands, which were determined by using an inclinometer (predetermined angles of 4°, 10° and 25° below the horizontal measured abeam flight direction), and thus included four bands on each side of the aircraft. Beneath the aircraft, a band of 44 m on each side of the flight track could not be observed.

During the aerial surveys a GPS logged flight track data at six second intervals. Each record contained longitude, latitude, altitude and time. Accuracy of GPS longitude and latitude was normally considered to be within 2 m.

The majority of observations were considered to be accurate to within four seconds. With a flight speed of 185 km/h the positional accuracy on the longitudinal axis was within 206 m. In a few circumstances with high bird densities, grouping of observations in periods of up to 10 seconds may have occurred, leading to an accuracy of observation positioning of up to 515 m.

As the survey results are highly sensitive to weather conditions, surveys were not carried out when wind speed exceeded 6 m/s, because detectability of birds on the sea surface was severely reduced. Low visibility or glare also reduced detectability. In cases of severe glare, observations from one side of the aircraft were temporarily discontinued.

Figure 1. The North Sea bird survey area. The potential offshore wind farm area is indicated. Survey track lines and associated waypoints are shown.

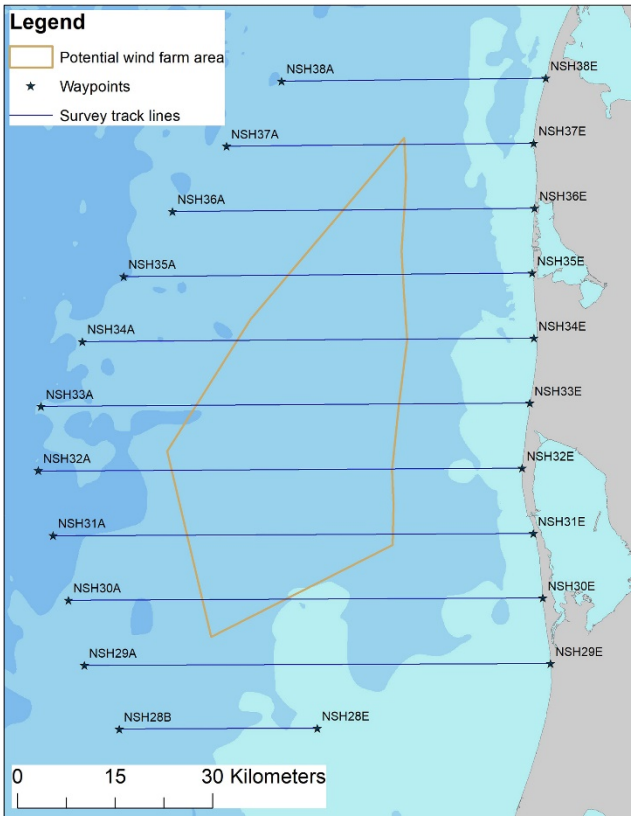
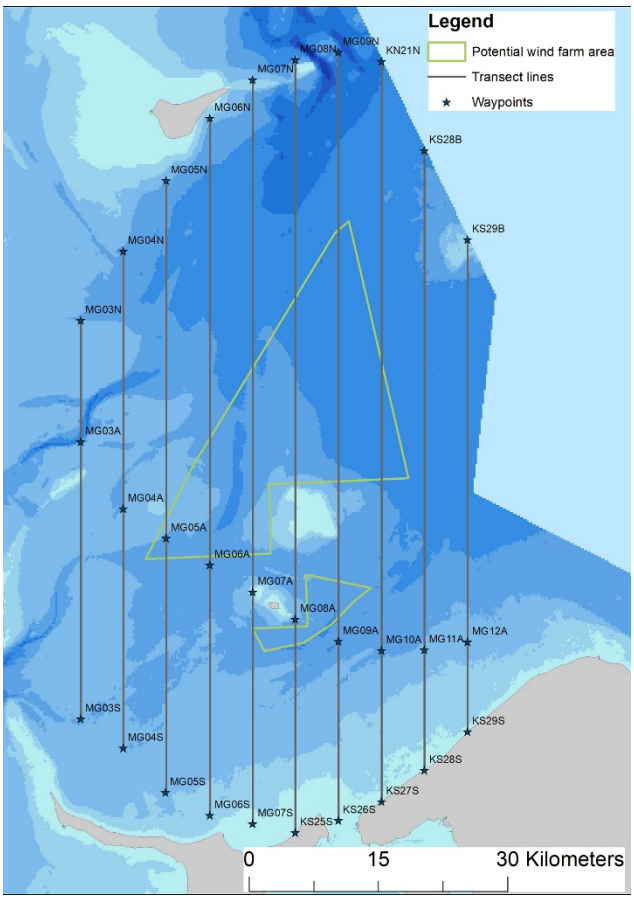


Figure 2. The Kattegat bird survey area. The potential offshore wind farm areas are indicated. Survey track lines and associated waypoints are shown.



The survey data was established on a GIS platform, and numbers and distributions of selected bird species are presented on thematic maps. In this report no attempt is done to assess the effect of potential wind farms in the two study areas.

3. Results

Five aerial surveys of birds were conducted in each of the two areas. In the North Sea the surveys were conducted on the following dates: 20th January 2019, 24th February 2019, 19th March 2019, 7th April 2019 and 19th April 2019.

The survey coverage was almost identical between surveys in the North Sea study area (Table 1). Survey coverage of each of the surveys are indicated in figures with bird distributions by survey.

The survey conducted on 19th April was part of a larger survey coverage. The data from the larger coverage was commissioned by Miljøstyrelsen, and will be presented in a separate report later this year.

Table 1. The total length of transect covered during each of the five aerial surveys of birds in the North Sea study area.

Date	Length of transect Covered (Km)
20-01-2019	679,6
24-02-2019	669,5
19-03-2019	676,7
07-04-2019	673,0
19-04-2019	649,4

A total of 24 bird species and 5 species groups were recorded in the North Sea survey area (Table 2). Identification to species groups was used in cases when identification to specific species was not possible.

The most numerously observed bird species in the North Sea study area was Gannet. Also, divers, gulls and Razorbills/Guillemots were observed in high numbers (Table 2).

In the Kattegat area the surveys were conducted on the following dates: 17th December 2018, 10th January 2019, 1st March 2019, 1st April 2019 and 17th April 2019.

The transect lines in Kattegat was ca. 735 km. The survey conducted on 1st March was slightly shorter (676 km) due to low fog, preventing coverage of the southwestern ends of transects (Table 3). Survey coverage of each of the surveys are indicated in figures with bird distributions by survey. On 7th April 2019 waypoints names were confused, which caused the fourth line from the east to dislocate from the line. Despite this the observations from that line are shown in this report.

Table 2. The number of observed birds by species or species group during five surveys in the study area in the Danish North Sea. Sum of observations are given, though this number does not indicate total numbers present in the area.

Species	Sum	20th Jan 2019	24th Feb 2019	19th Mar 2019	7th Apr 2019	19th Apr 2019
Diver sp.	248	26	34	32	110	46
Red-throated Diver	368	27	108	21	159	53
Black-throated Diver	1		1			
Fulmar	2		1		1	
Gannet	1203	2	10	21	894	276
Cormorant	3			1	2	
Mute Swan	2		2			
Teal	50					50
Wigeon	7					7
Tufted Duck	2					2
Common Eider	3	2			1	
Common Scoter	285	228	5	7	45	
Great Skua	1				1	
Arctic Skua	1					1
Common Gull	9				1	8
Herring Gull	830	196	175	140	222	97
Lesser Black-backed Gull	10				9	1
Great Black-backed Gull	145	39	8	9	65	24
Black-headed Gull	12				5	7
Little Gull	43				43	
Kittiwake	614	166	217	128	91	12
Gull sp.	178	2	145	6	8	17
Arctic/Common Tern	10				3	7
Little Tern	1					1
Sandwich Tern	3				2	1
Tern sp.	3					3
Razorbill	1				1	
Razorbill/Guillemot	967	120	99	297	295	156
Guillemot	143	12	46	8	63	14

Table 3. The total length of transect covered during each of the five aerial surveys of birds in the Kattegat study area.

Date	Length of transect Covered (Km)
17-12-2018	736,2
10-01-2019	735,7
01-03-2019	676,4
01-04-2019	739,3
17-04-2019	734,8

A total of 30 bird species and 7 species groups were recorded in the Kattegat survey area (Table 4). Identification to species groups was used in cases when identification to specific species was not possible. The most numerously observed bird group was Razorbill/Guillemot. Also, gulls, Gannets, divers and diving ducks (mainly Common Eider and Common Scoter) were observed in

high numbers. Cormorants were observed in high numbers, but these were primarily confined to roosting sites on stone reefs around Hesselø and therefore not dealt with in further detail here.

Table 4. The number of observed birds by species or species group during five surveys in the study area in the Kattegat. Sum of observations are given, though this number does not indicate total numbers present in the area.

Species	Sum	17th Dec 2018	10th Jan 2019	1st Mar 2019	1st Apr 2019	17th Apr 2019
Diver sp.	134	8	23	43	52	8
Red-throated Diver	100	56	4	37	2	1
Black-throated Diver	4	1	1		2	
Red-necked Grebe	4				4	
Grebe sp.	6			6		
Fulmar	2		1		1	
Gannet	499	6	9	2	312	170
Cormorant	1327	623	490	37	169	8
Grey Heron	2				2	
Unidentified Swan	5		5			
Mute Swan	5			3	2	
Greylag Goose	7				2	5
Barnacle Gosse	1				1	
Mallard	30				30	
Wigeon	15					15
Golden-eye	6	1		3	2	
Long-tailed Duck	5				5	
Common Eider	1381	545	261	251	248	76
Common Scoter	2320	1555	260	149	348	8
Velvet Scooter	109	8		46	48	7
Diving Duck sp.	1		1			
Red-breasted Merganser	114	32	21	26	21	14
Marsh Harrier	1					1
Great Skua	1				1	
Common Gull	4				4	
Herring Gull	1011	153	312	250	125	171
Lesser Black-backed Gull	13				5	8
Great Black-backed Gull	228	34	58	38	31	67
Black-headed Gull	6	1			4	1
Kittiwake	66	10	31	22	3	
Gull sp.	325	302	12	9	2	
Arctic/Common Tern	1					1
Sandwich Tern	1					1
Razorbill	48	30	11		7	
Razorbill/Guillemot	3214	278	1112	918	845	61
Guillemot	29		8	13	3	5
Black Guillemot	1				1	

3.1 North Sea

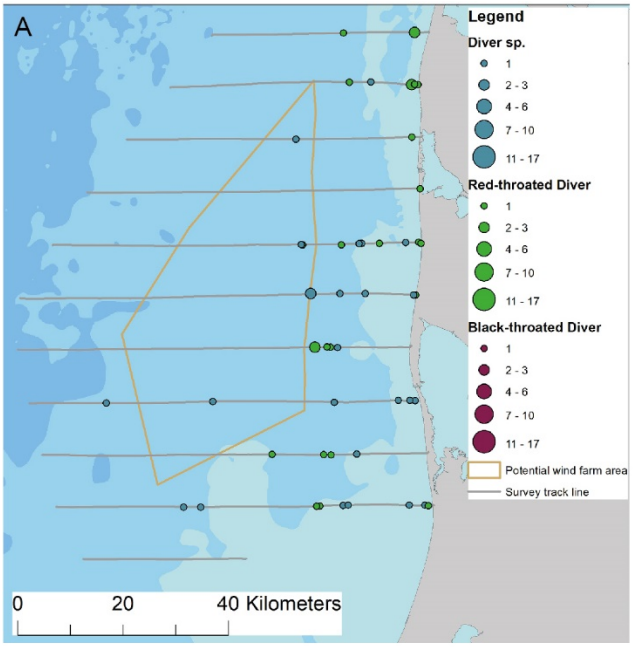
In the North Sea study area the most frequently observed birds were pelagic feeders and surface feeders.

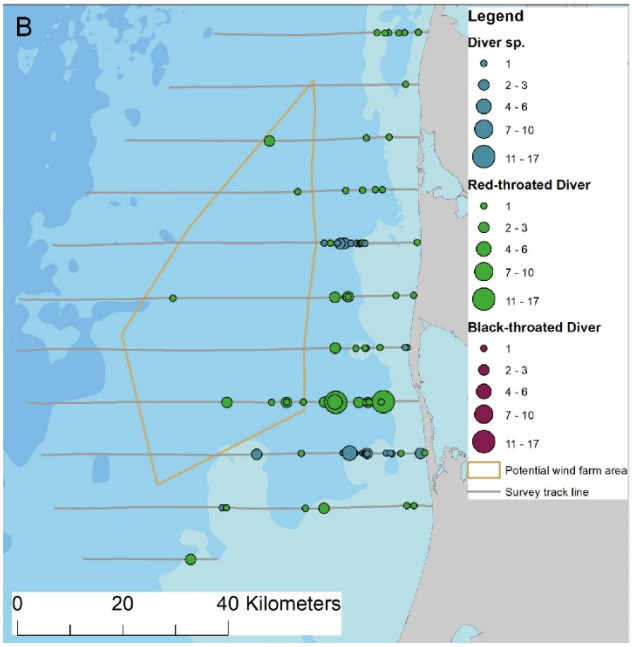
3.1.1 Divers

A total of 617 divers was observed during the five surveys of birds in the North Sea study area (Table 2). Of these 60 % were unidentified divers (Red-throated Diver/Black-throated Diver), while other 40 % were identified to Red-throated Diver. Only 1 Black-throated Diver was identified to species.

The majority of the observed divers were observed in the eastern part of the study area, relatively close to land (Figure 3 ABC). During the survey conducted on 7th April a concentration was also observed along the northern part of Horns Rev in the southern part of the study area (Figure 3 D). On 19th April some divers were also observed in the western part of the study area (Figure 3 E).

The distribution of divers in the southern part of the study area may be influenced by the proximity to the Horns Rev offshore wind farms.


A
Legend
Diver sp.
1
2 - 3
4 - 6
7 - 10
11 - 17
Red-throated Diver
1
2 - 3
4 - 6
7 - 10
11 - 17
Black-throated Diver
1
2 - 3
4 - 6
7 - 10
11 - 17
Potential wind farm area
Survey track line
0
20
40 Kilometers


B
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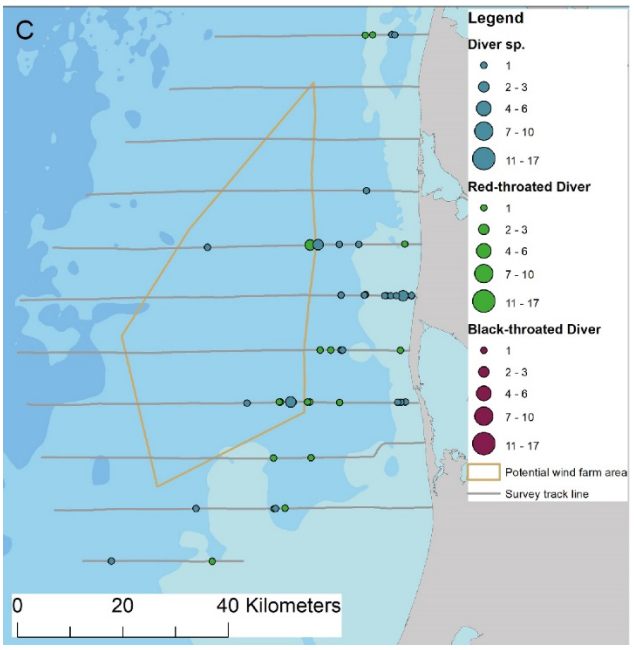
Diver sp.
1
2 - 3
4 - 6
7 - 10
11 - 17
Red-throated Diver
1
2 - 3
4 - 6
7 - 10
11 - 17
Black-throated Diver
1
2 - 3
4 - 6
7 - 10
11 - 17
Potential wind farm area
Survey track line
0
20
40 Kilometers


C
Legend
Diver sp.
1
2 - 3
4 - 6
7 - 10
11 - 17
Red-throated Diver
1
2 - 3
4 - 6
7 - 10
11 - 17
Black-throated Diver
1
2 - 3
4 - 6
7 - 10
11 - 17
Potential wind farm area
Survey track line
0
20
40 Kilometers

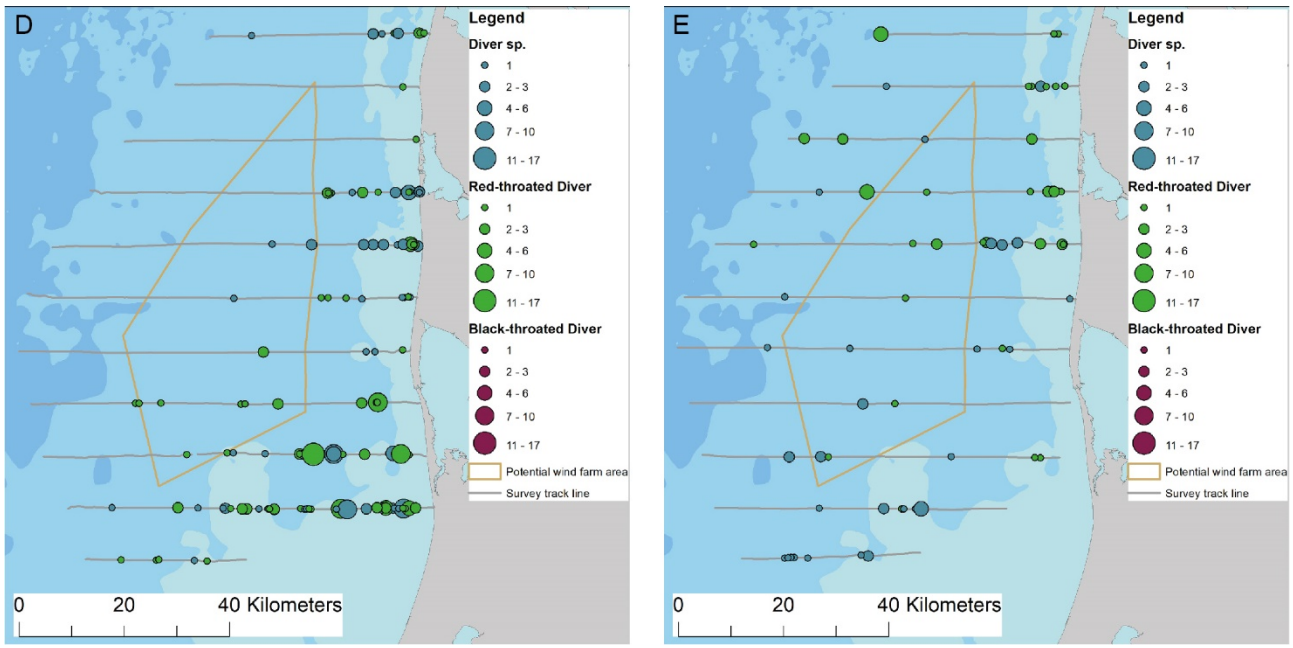


Figure 3. The spatial distribution of observed Divers in the North Sea survey area during five surveys January to April 2019.

3.1.2 Gannet

Gannet was the most numerously observed bird species in the North Sea study area. Numbers fluctuated markedly between surveys, reaching from 2 birds on 20th January 2019 to 894 on 7th April 2019 (Table 2). Only few and scattered Gannets was observed during the first three surveys (Figure 4 ABC). The highest numbers of Gannets was observed on 7th April. These birds had a clumped distribution, with concentrations observed in the south, the centre and in northwestern and northeastern parts of the study area (Figure 4 D). On 19th April concentrations of Gannets were also observed in the study area, this time primarily in the western parts (Figure 4 E).

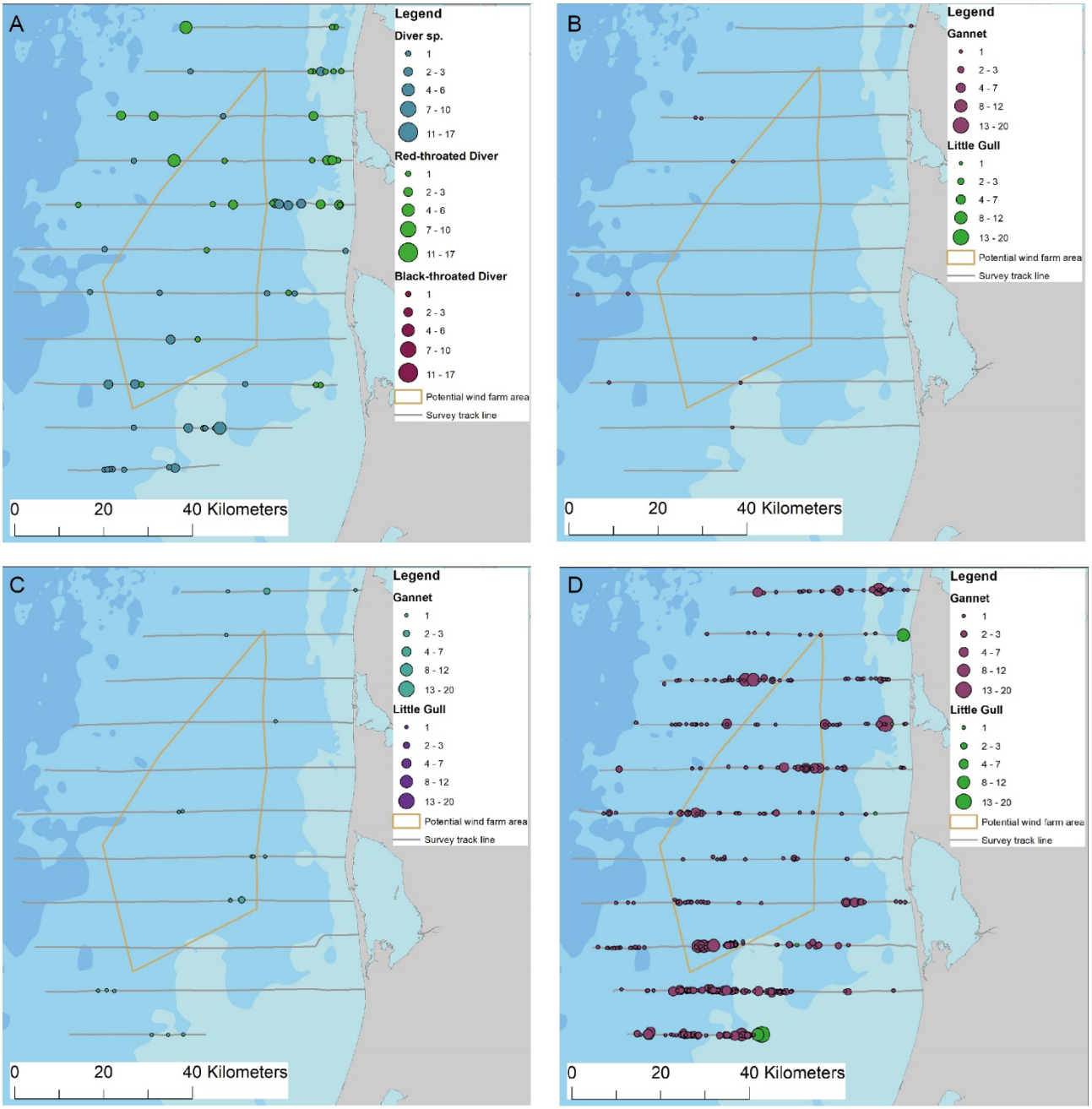
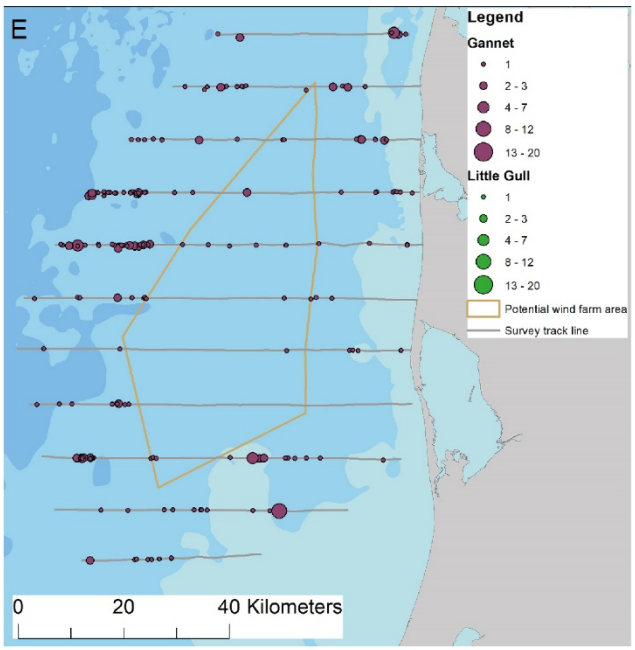


Figure 4. The spatial distribution of observed Gannets and Little Gulls in the North Sea survey area during five surveys January to April 2019.



3.1.3 Common Scoter

Rather few Common Scoters were sighted in the study area. A total of 285 birds were recorded, the majority (228) on 20th January 2019 (Table 2). Most of the sightings were in shallow waters along the west coast of Jutland or on the northern parts of Horns Rev (Figure 5 ABCD). On 19th April no Common Scoters were observed (Table 2, Figure 5).

The distribution of Common Scoter in the southern part of the study area may be influenced by the proximity to the Horns Rev 3 offshore wind farm.

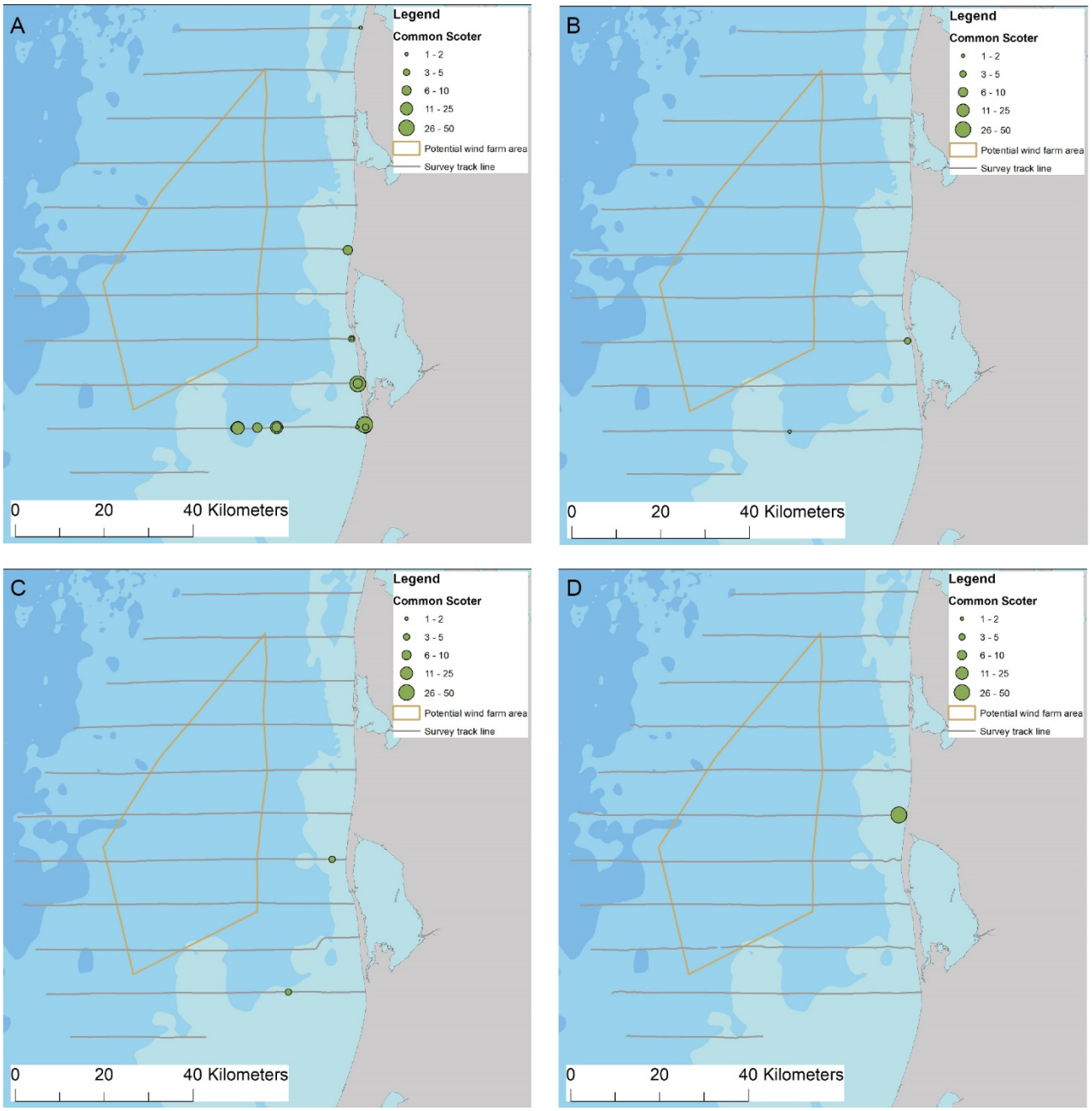
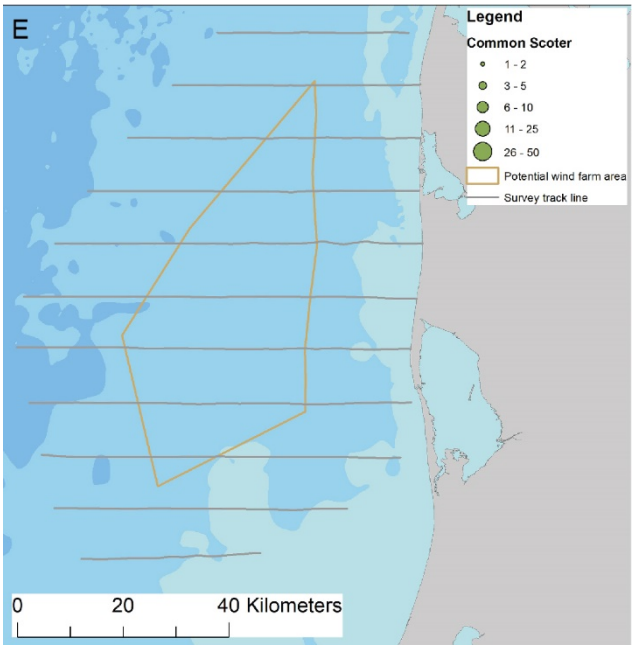


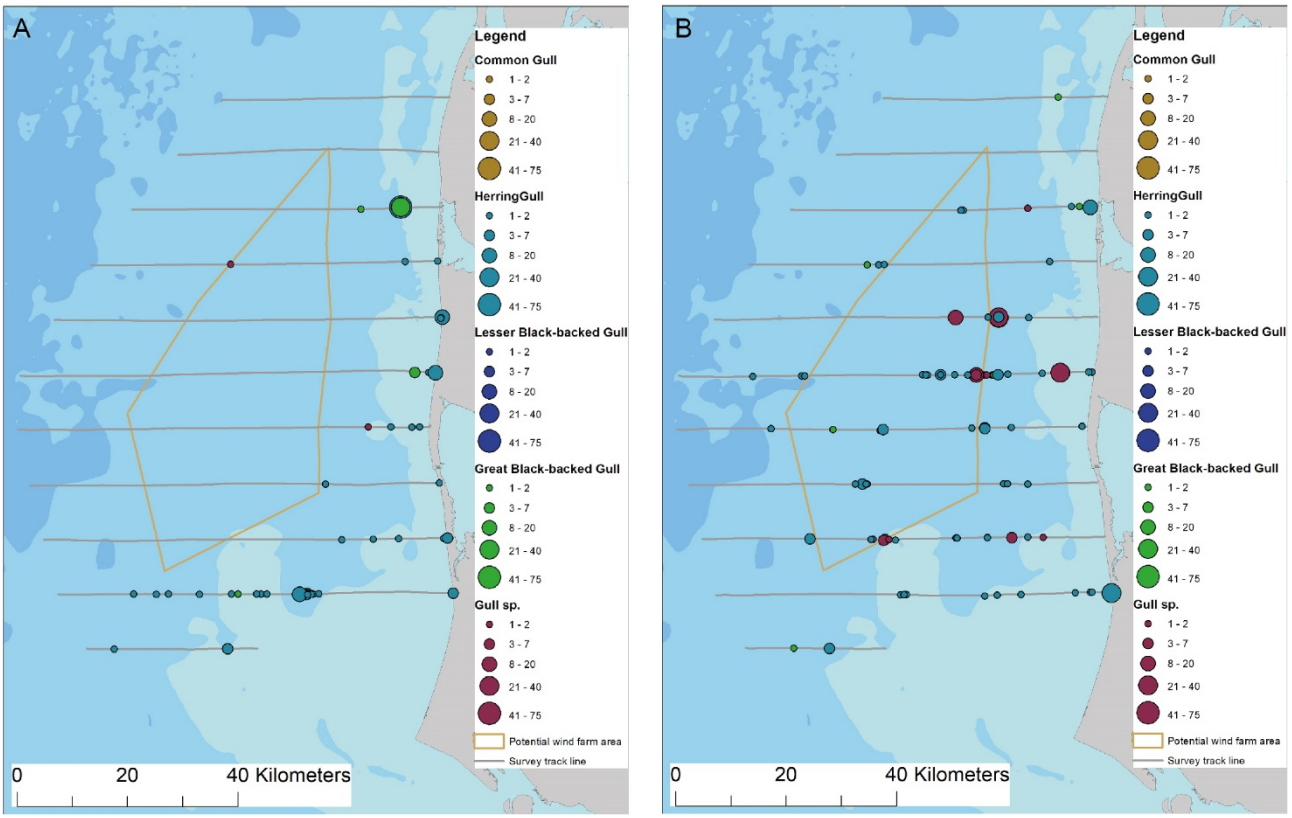
Figure 5. The spatial distribution of observed Common Scoters in the North Sea survey area during five surveys January to April 2019.



3.1.4 Gulls

During the five surveys Common Gulls, Herring Gulls, Lesser Black-backed Gulls, Great Black-backed Gulls, Black-headed Gulls and unidentified gulls were observed. The most numerous gull species was Herring Gull, of which 830 birds was recorded, evenly spread over the surveys (Table 2). Great Black-backed Gull was also recorded during all surveys, while Lesser Black-backed Gull was only recorded during the two survey in April 2019 (Table 2). The two gull species Little Gull and Kittiwake are dealt with below.

The gulls were mainly observed in the eastern part of the study area and along the northern part of Horns Rev, with less frequent observations in the western parts (Figure 6 ABCDE).



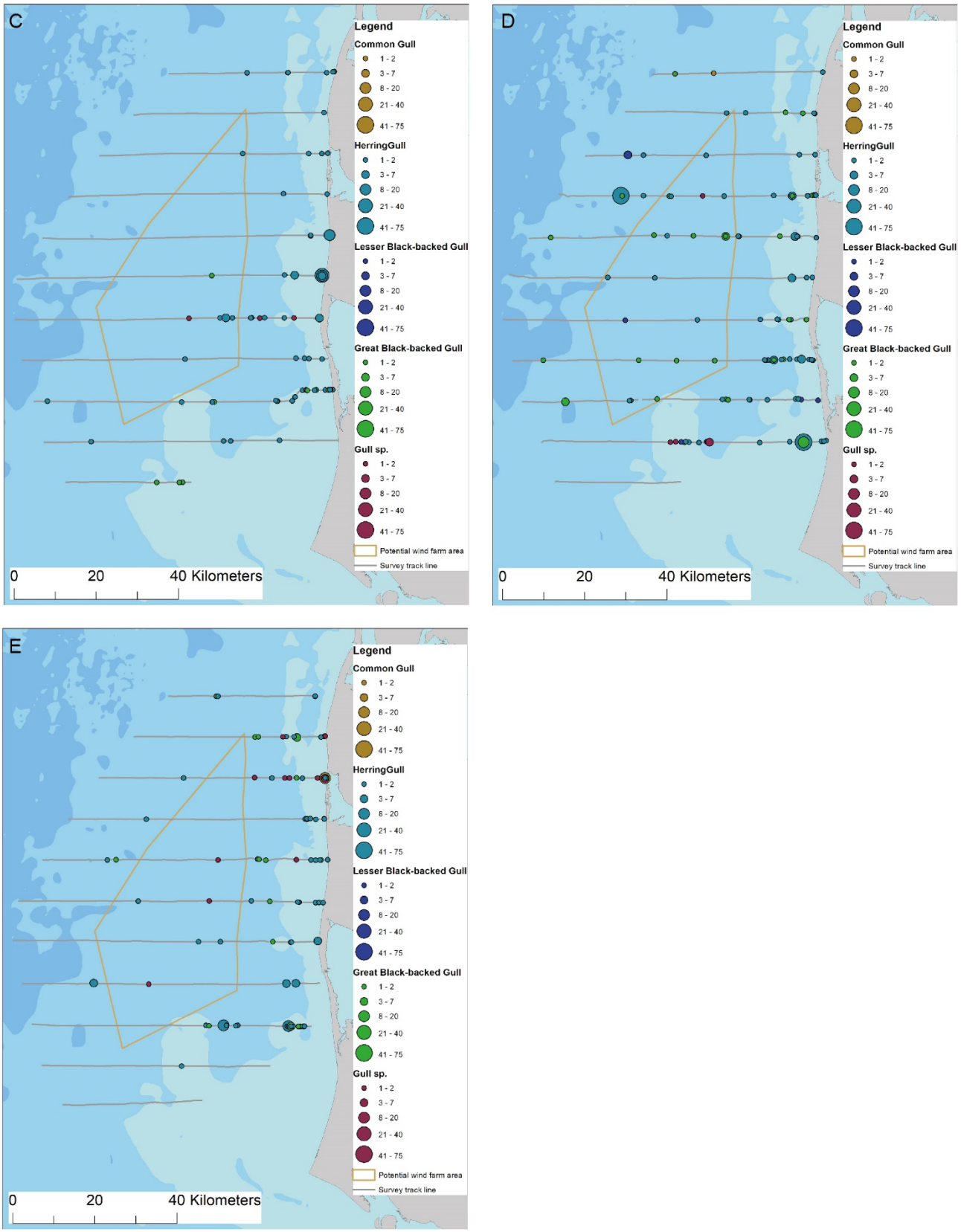


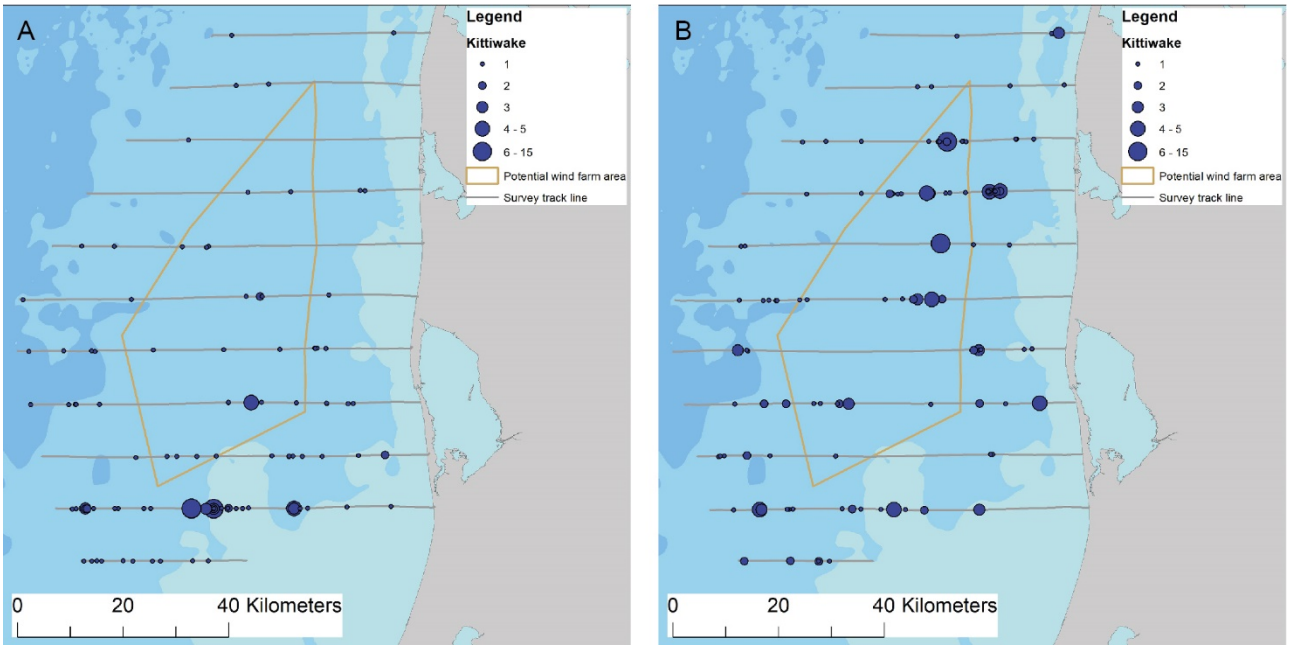
Figure 6. The spatial distribution of observed gulls (Common Gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull and gull sp.) in the North Sea survey area during five surveys January to April 2019.

3.1.5 Little Gull

Little Gull was only observed in the North Sea study area during the survey conducted on 7th April 2019, when a total of 43 birds was recorded (Table 2). The birds were found on the northern parts of Horns Rev and close to the Jutland coast in the northern parts of the study area (Figure 4 D).

3.1.6 Kittiwake

A total of 614 Kittiwakes was observed during the five surveys in the North Sea study area. Most birds (217) was recorded on 24th February (Table 2). Kittiwakes were concentrated in the southern parts of the study area on 20th January 2019 (Figure 7 A), in the southern and central parts during the surveys performed on 24th February, 19th March and 7th April 2019 (Figure 7 BCD). Only 9 Kittiwakes was observed scattered across the study area on 19th April 2019 (Figure 7 E).



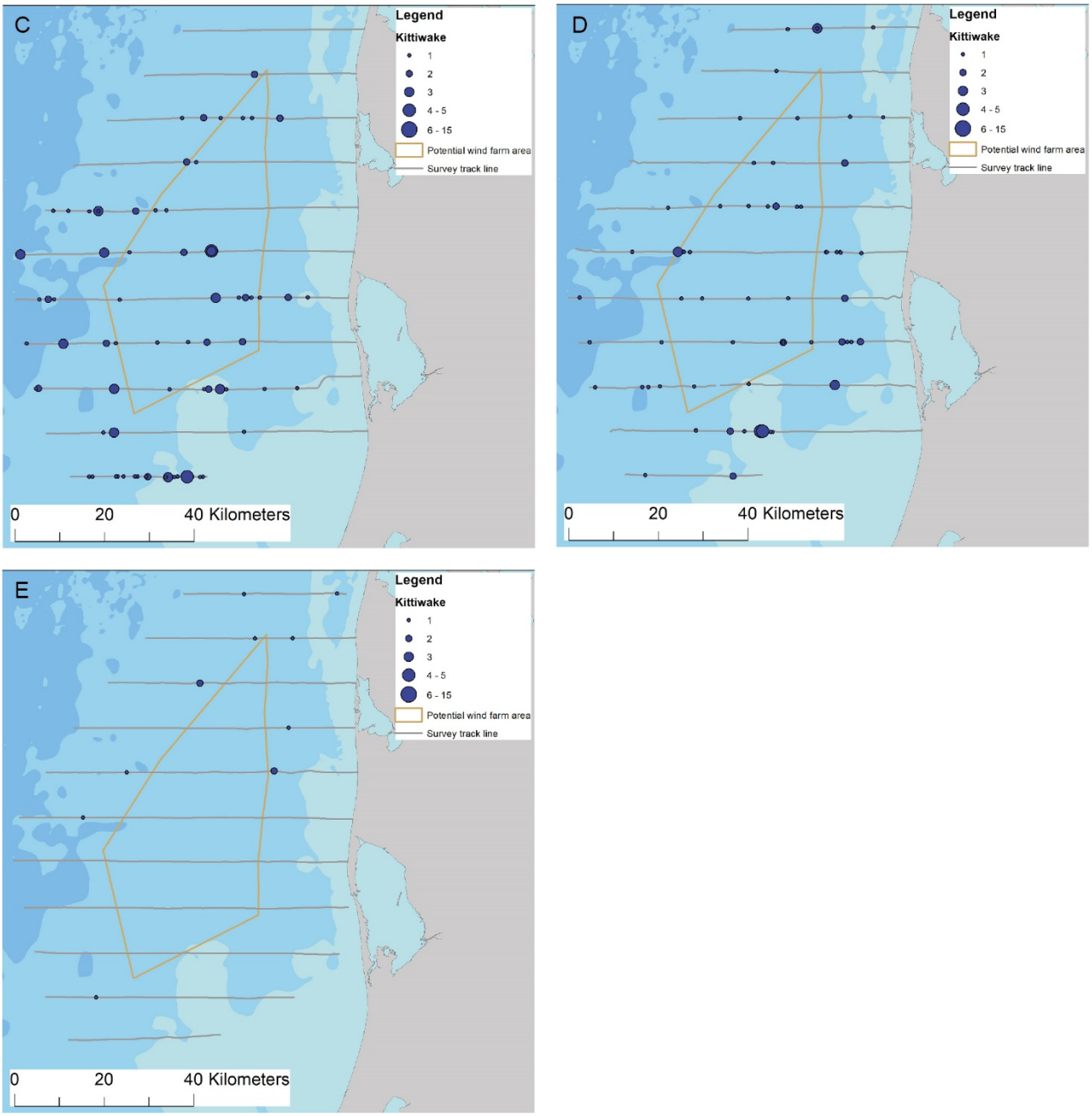


Figure 7. The spatial distribution of observed Kittiwakes in the North Sea survey area during five surveys January to April 2019.

3.1.7 Razorbill/Guillemot

A total 1.111 Razorbills/Guillemots was observed during the five surveys in the North Sea study area (Table 2). The majority of these (87 %) were not identified to species, while 143 birds (13 %) was identified as Guillemots. Only one bird was identified to Razorbill.

Razorbills/Guillemots were mainly recorded off the shallow coastal areas of the study area, scattered across the deeper parts of the area (Figure 8 ABE). During the surveys conducted on 19th March and 7th April 2019 a concentration of Razorbills/Guillemots was found in the central parts of the study area (Figure 8 CD).

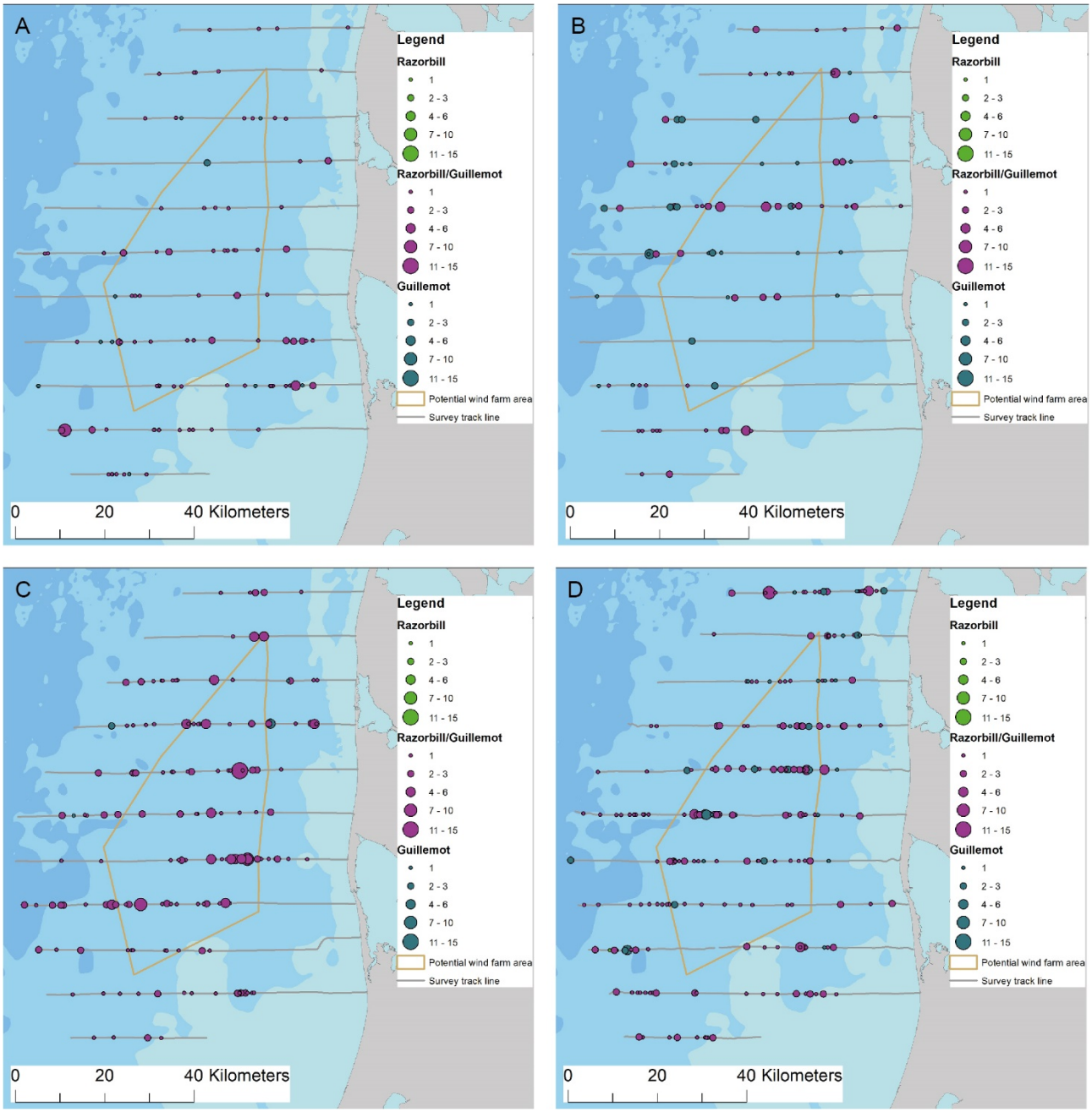
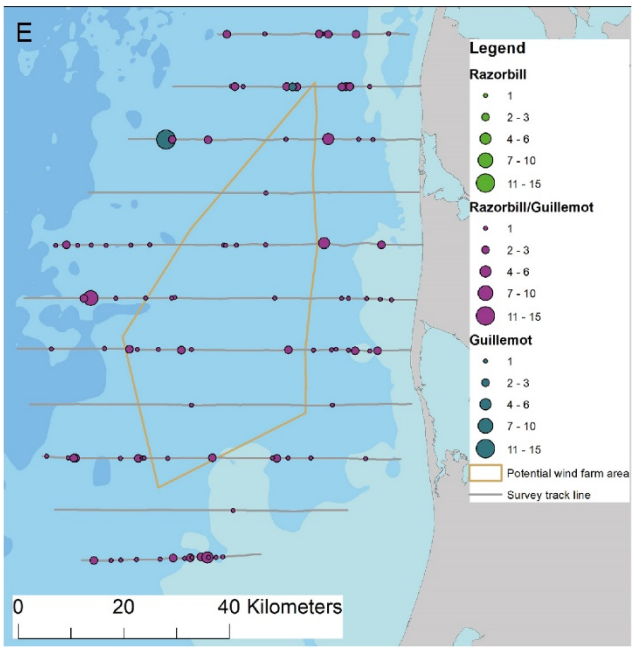


Figure 8. The spatial distribution of observed Razorbills and Guillemots or Razorbills/Guillemots in the North Sea survey area during five surveys January to April 2019.



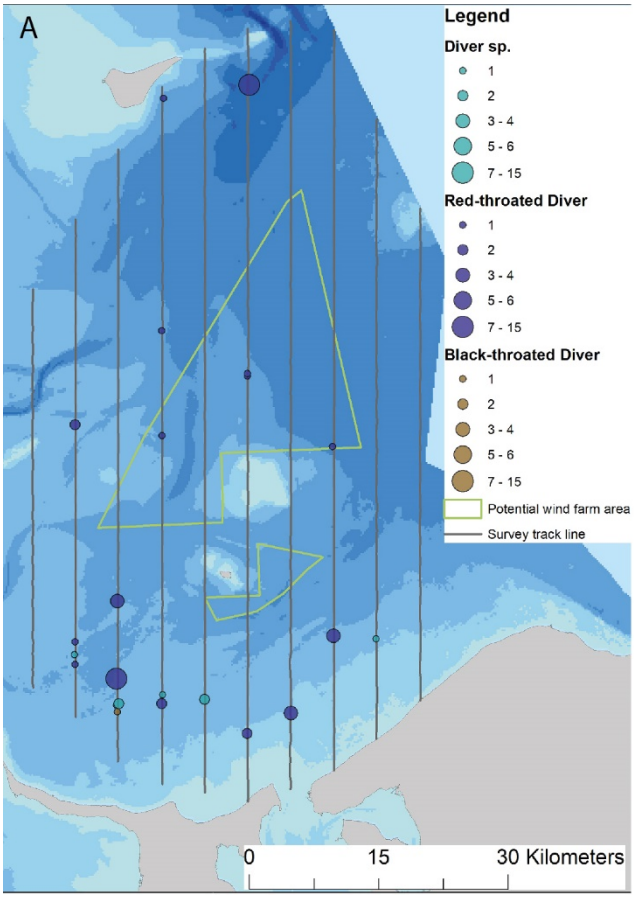
3.2 Kattegat

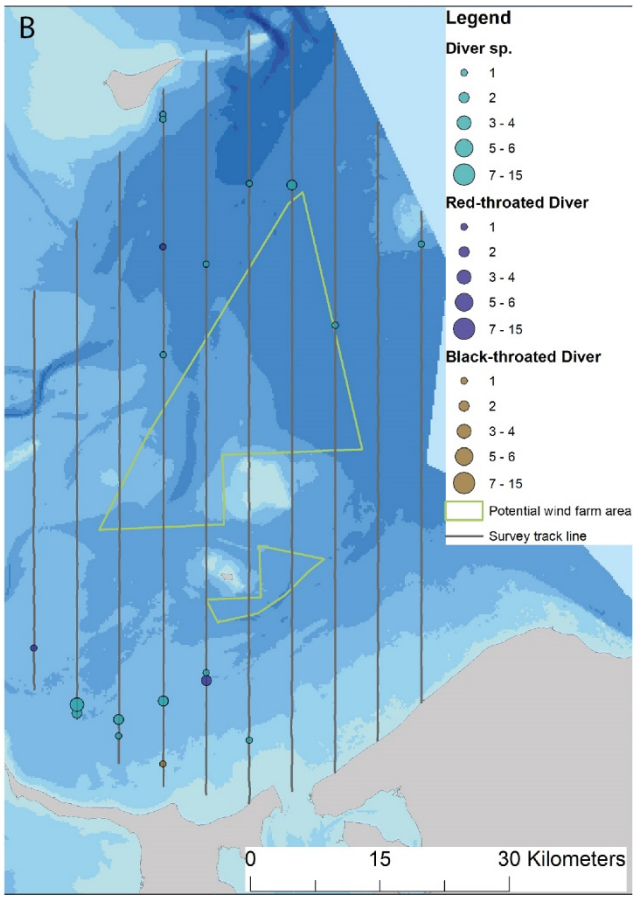
The bird community in the Kattegat study area was dominated by offshore species as for instance divers, Gannets, gulls, Razorbills and Guillemots. Also, Common Eiders and Common Scoters were recorded in high numbers (Table 4), although almost entirely observed on coastal shallow waters.

3.2.1 Divers

A total of 238 divers was observed in the Kattegat survey area during the five surveys of birds. Of these 100 (42 %) birds was identified as Red-throated Diver, 4 birds (2 %) was identified as Black-throated Diver, while 134 (56 %) was unidentified divers. Divers were observed during all surveys, though only 9 birds during the survey on 17th April (Table 4).

Divers were mainly recorded on medium water depth along the north coast of Sjælland, south of Anholt and in the western parts of the study area (Figure 9 ABCDE). Only few observations was recorded in the deeper northeastern parts of the study area.





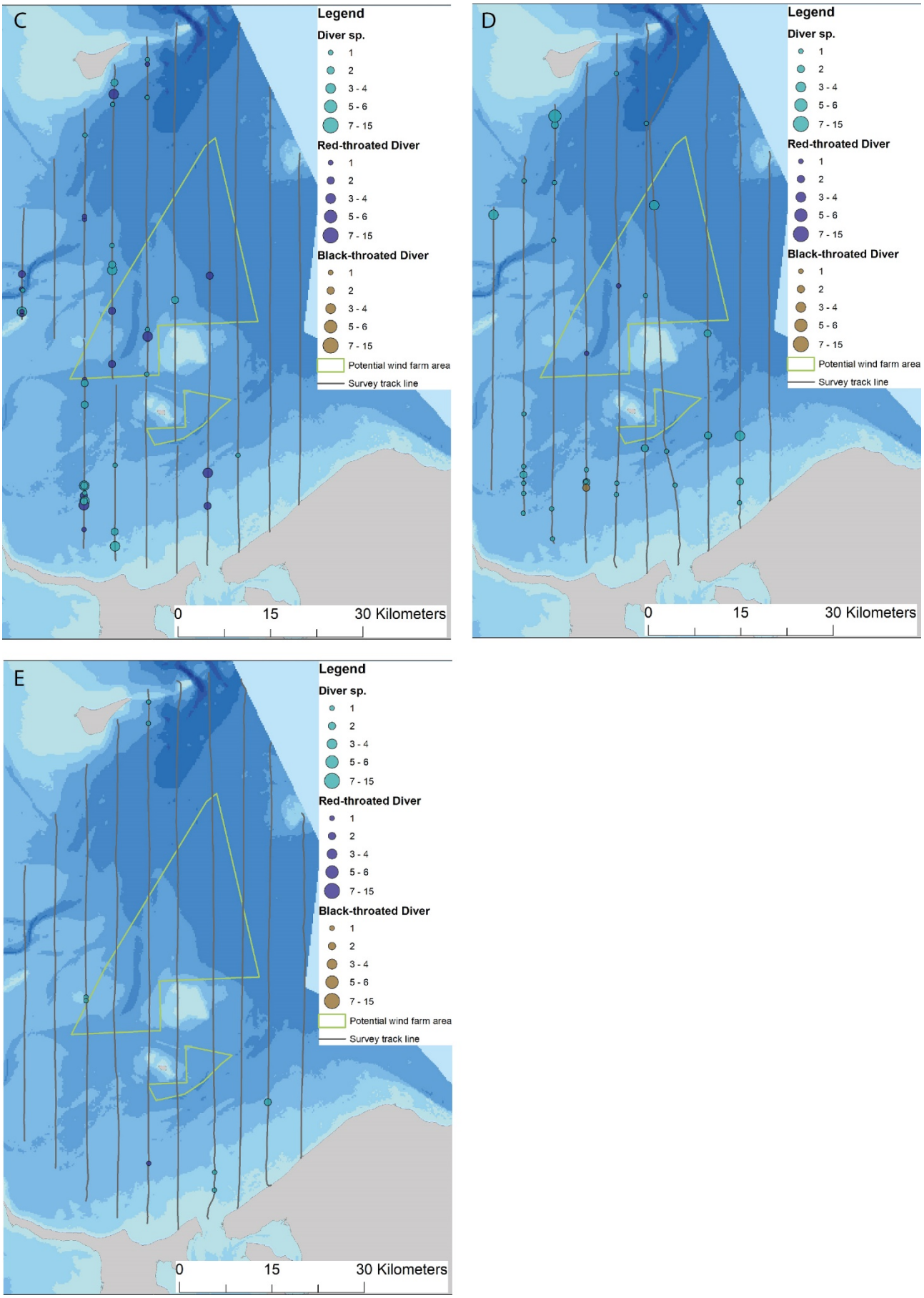
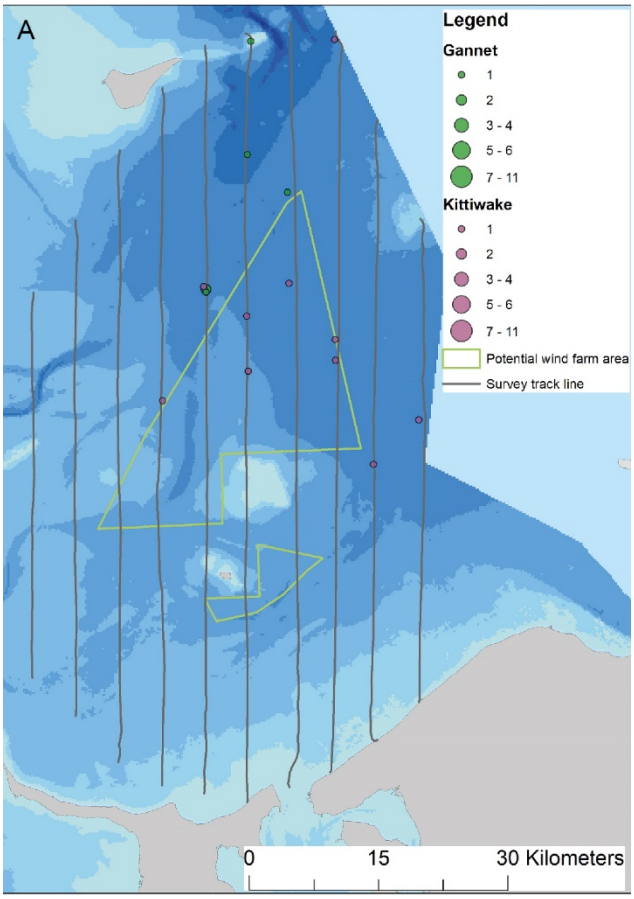


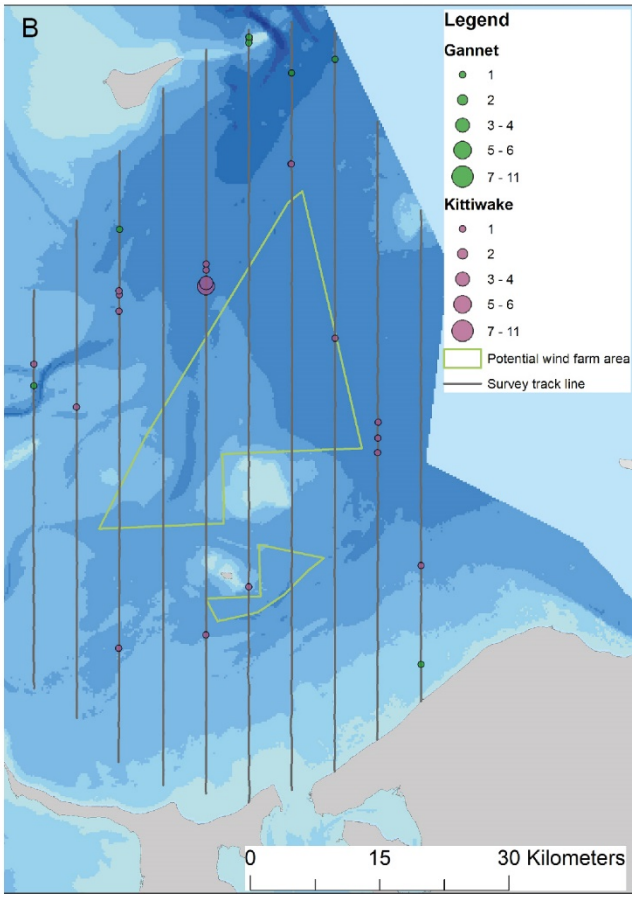
Figure 9. The spatial distribution of observed Divers in the Kattegat survey area during five surveys January to April 2019.

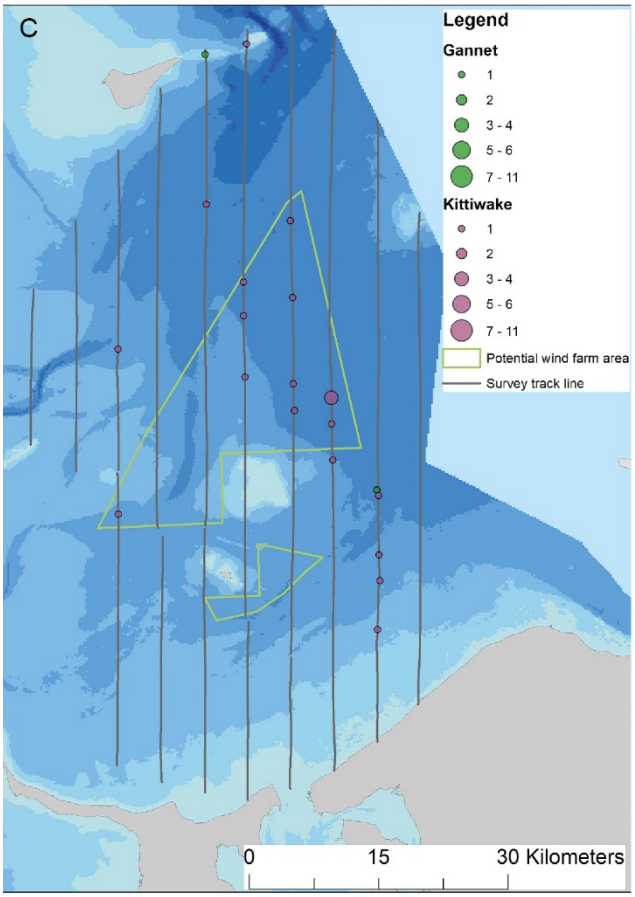
3.2.2 Gannet

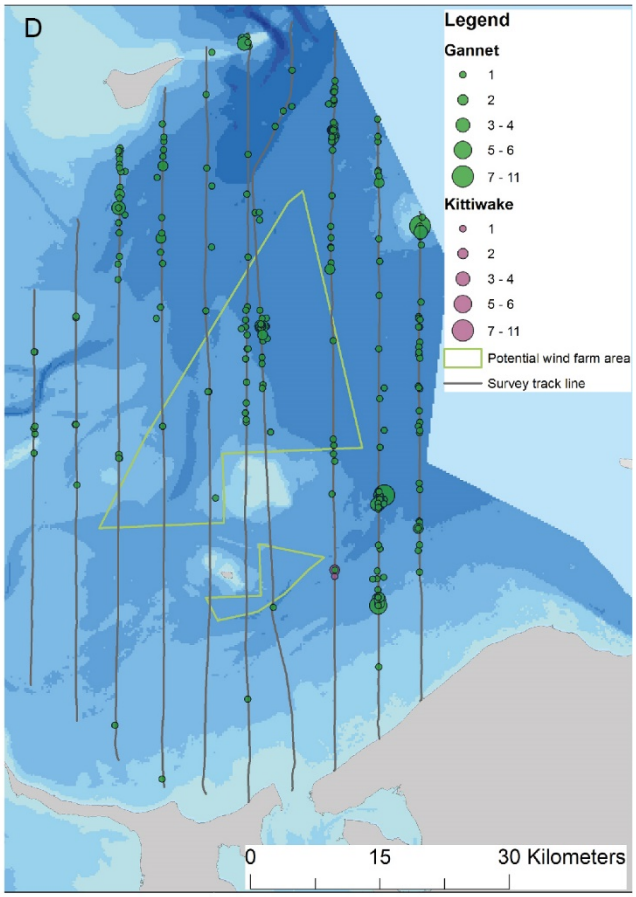
A total of 499 Gannets was observed during the five surveys in the Kattegat study area. Only few Gannets were recorded during the three first surveys on 17th December 2019, 10th January and 1st March 2019, while most birds were seen on 1st April 2019 (312). On 17th April 2019 170 Gannets were recorded (Table 4).

The few Gannet observed during the three first surveys were primarily seen in deep parts of the study area (Figure 10 ABC). During the surveys performed on 1st April and 17th April 2019 the majority of Gannets were found in the deep central, northern and eastern parts of the study area (Figure 10 DE).









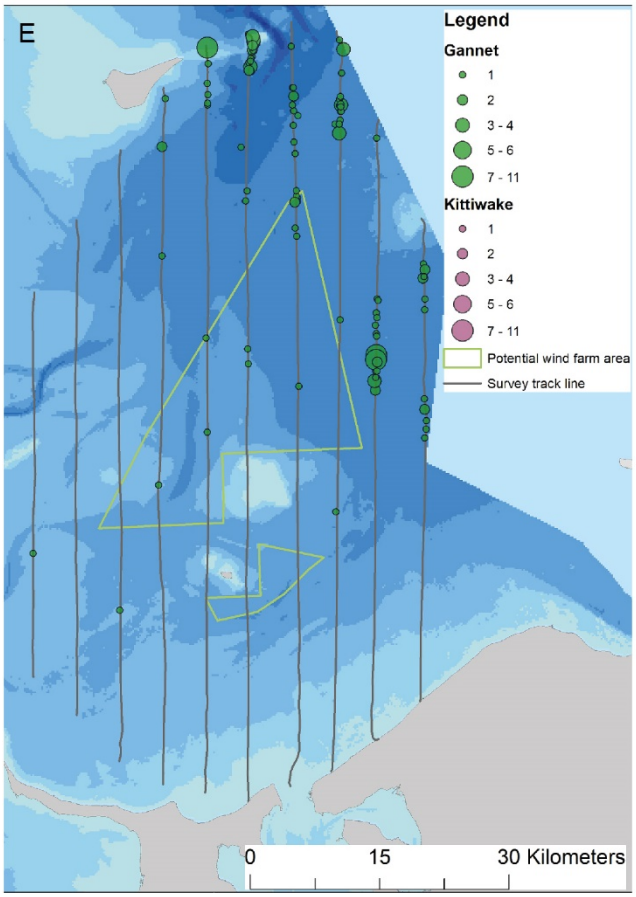
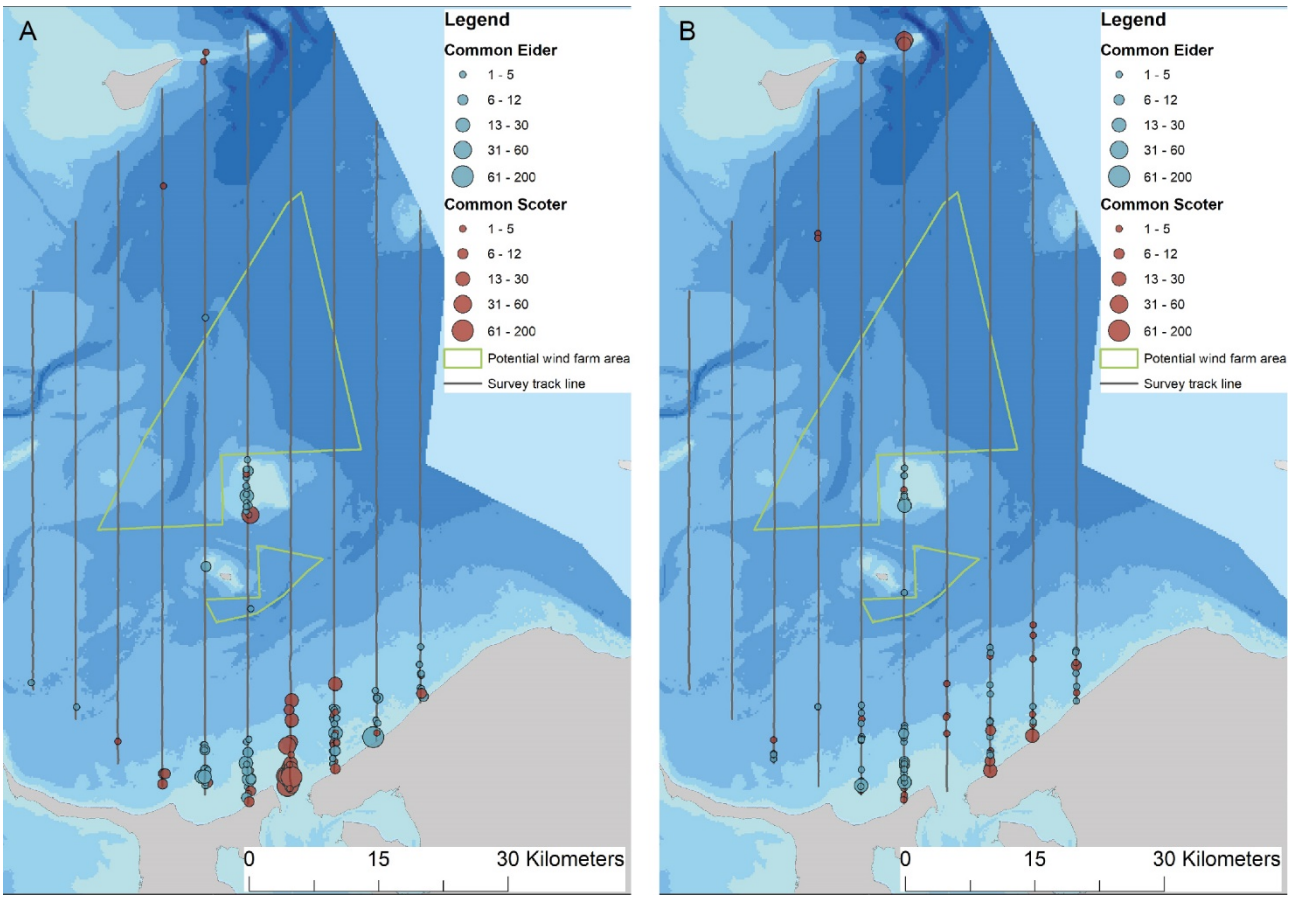


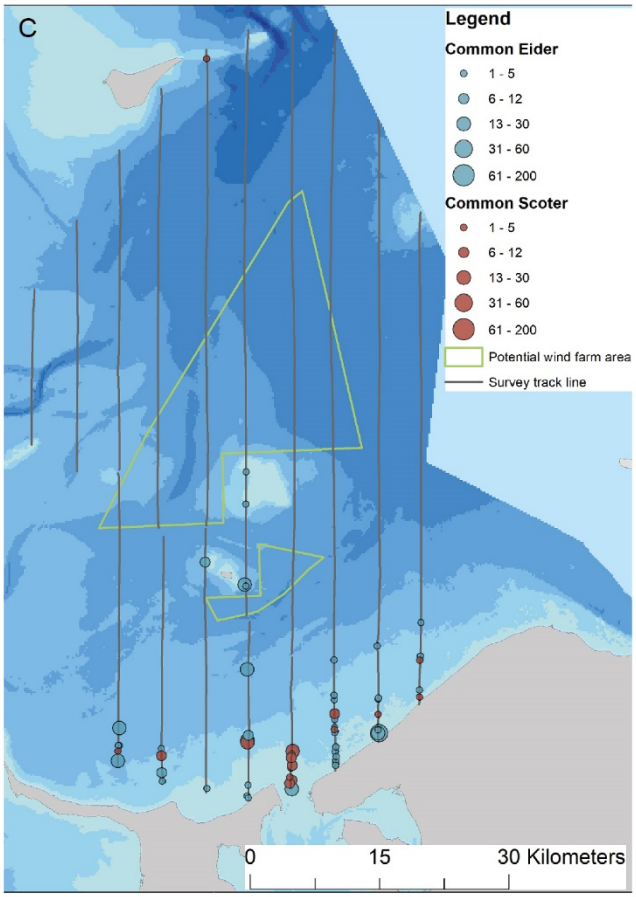
Figure 10. The spatial distribution of observed Gannets and Kittiwakes in the Kattegat survey area during five surveys January to April 2019.

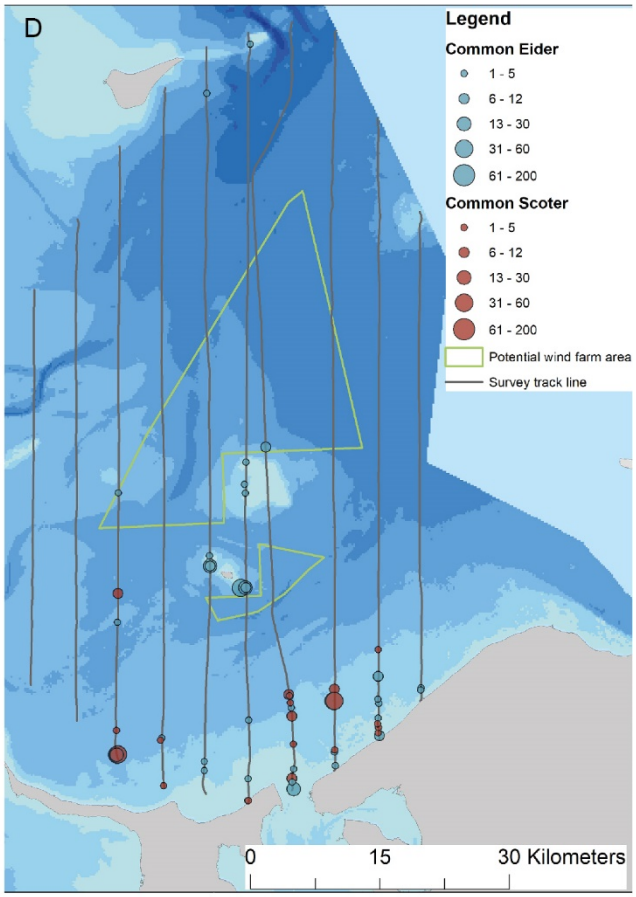
3.2.3 Common Eider

Common Eiders was recorded during all five surveys in the Kattegat study area. A total of 1381 birds was counted, most (545) on 17th December 2018 and fewest (76) on 17th April 2019 (Table 4).

Common Eiders were primarily found on shallow waters along the north coast of Sjælland and Anholt as well as on Store Middelgrund north of Hesselø (Figure 11 ABCDE).







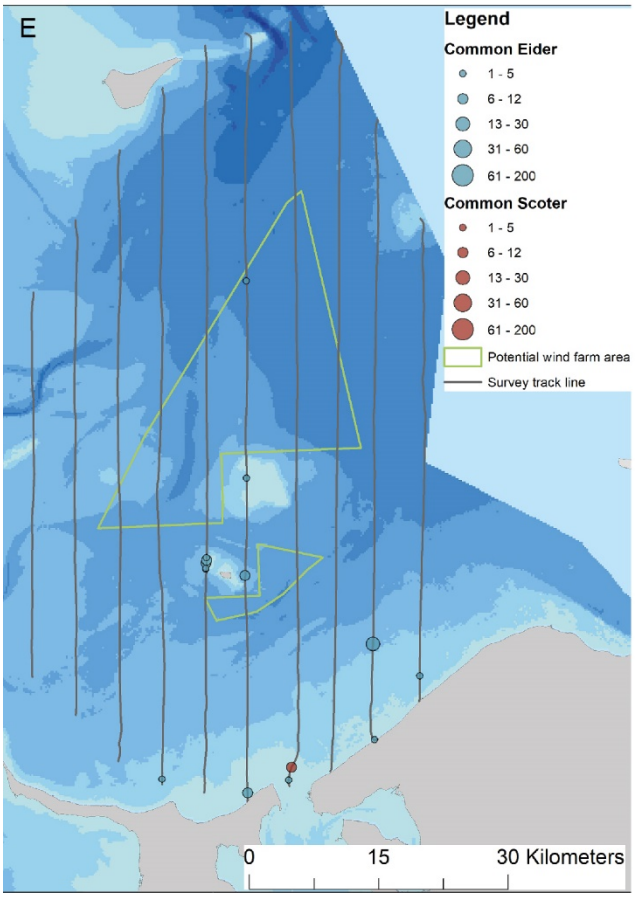


Figure 11. The spatial distribution of observed Common Eiders and Common Scoters in the Kattegat survey area during five surveys January to April 2019.

3.2.4 Common Scoter

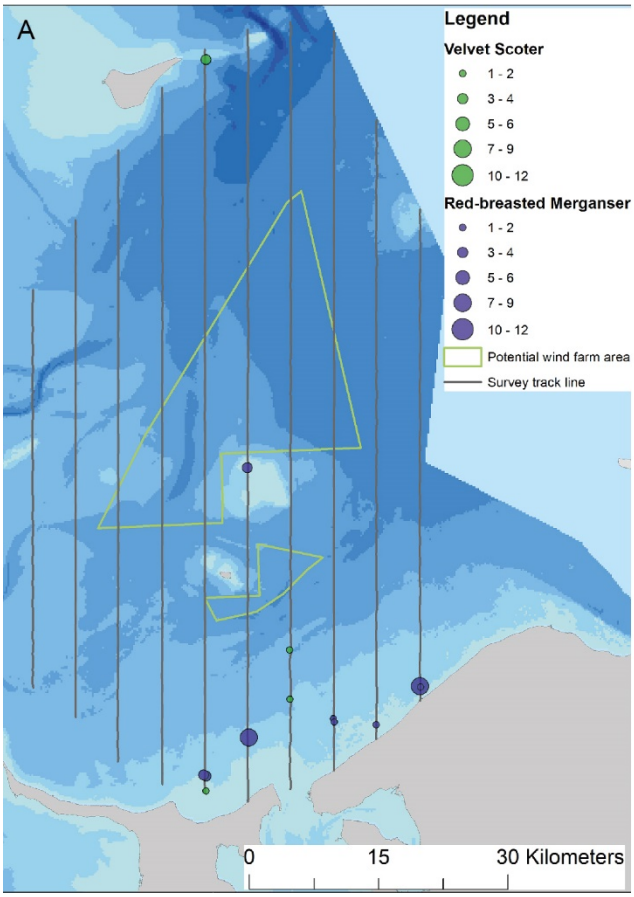
Common Scoter was recorded during all five surveys in the Kattegat study area. A total of 2320 birds was counted, most (1555) on 17th December 2018 and fewest (8) on 17th April 2019 (Table 4).

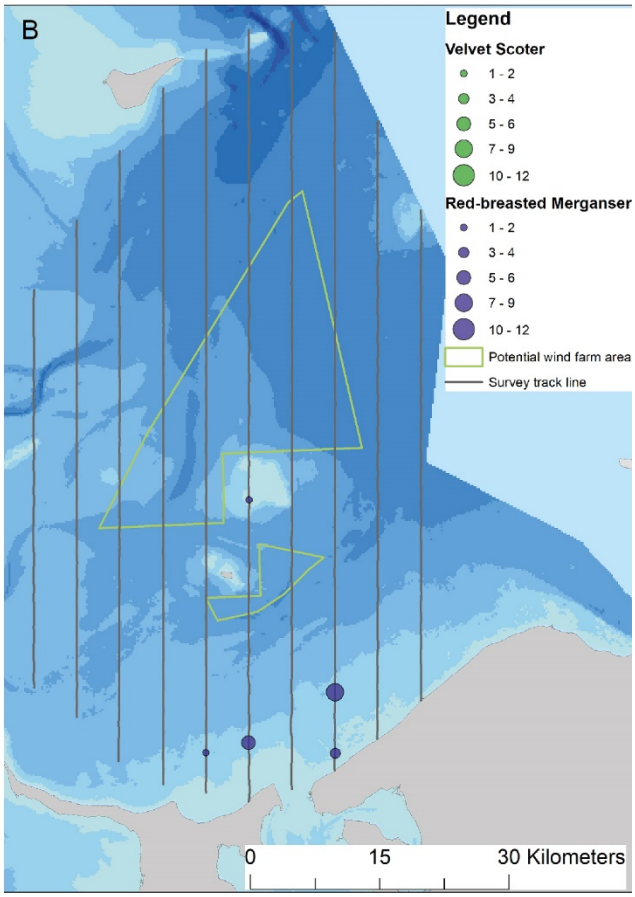
Common Scoter were primarily found on shallow waters along the north coast of Sjælland, Hesselø and Anholt as well as on Store Middelgrund north of Hesselø (Figure 11 ABCDE).

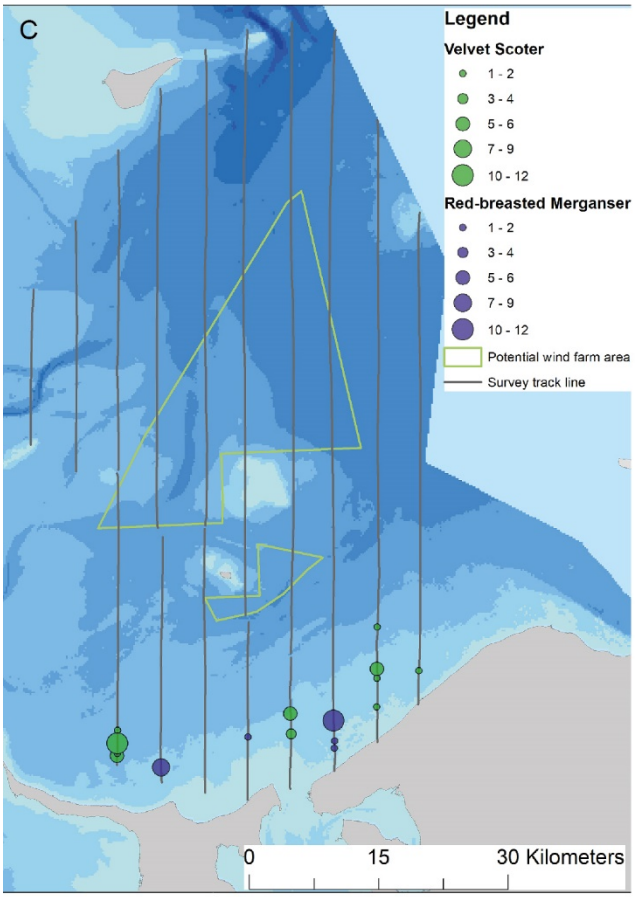
3.2.5 Velvet Scoter

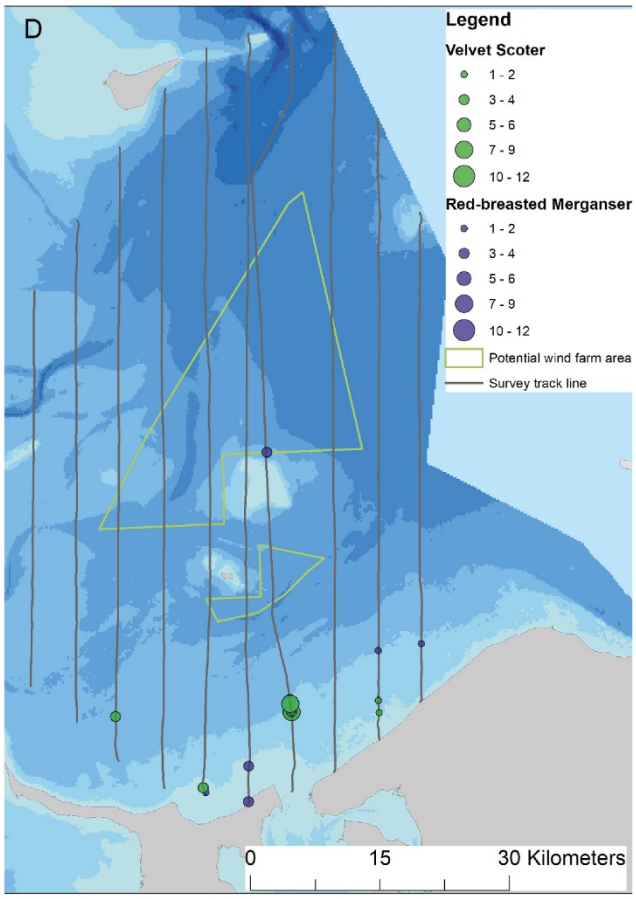
A total of 109 Velvet Scoters was recorded during the five surveys in the Kattegat study area. Biggest numbers were 48 on 1st April and 46 on 1st March 2019. No Velvet Scoters was recorded during the survey on 10th January 2019 (Table 4).

Velvet Scoters was observed almost entirely on shallow coastal areas north of Sjælland (Figure 12 ABCDE).









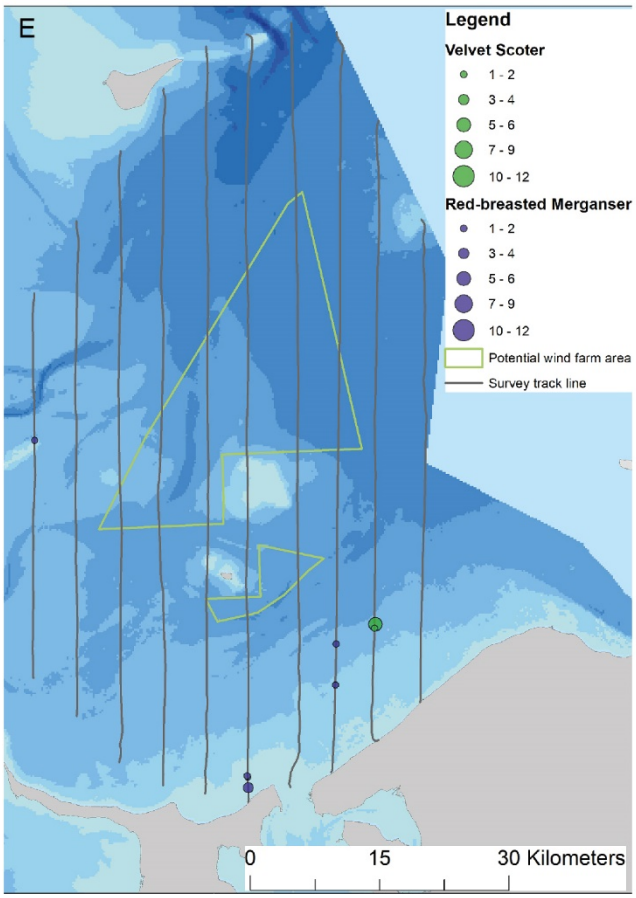


Figure 12. The spatial distribution of observed Velvet Scoters and Red-breasted Mergansers in the Kattegat survey area during five surveys January to April 2019.

3.2.6 Red-breasted Merganser

A total of 114 Red-breasted Mergansers was recorded during the five surveys in the Kattegat survey area. They were observed during all surveys with numbers reaching from 14 on 17th April 2019 to 32 on 17th December 2018 (Table 4).

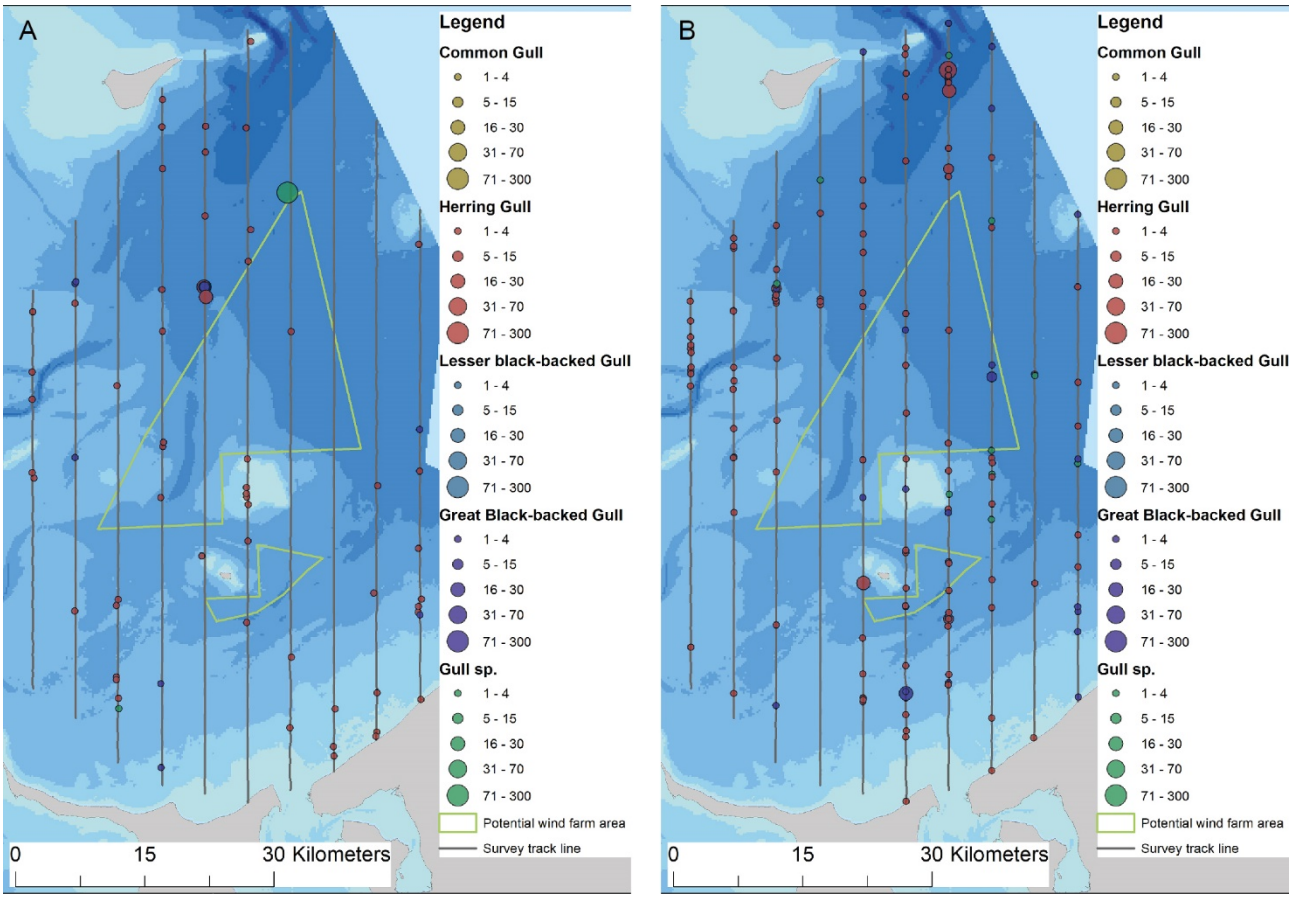
Red-breasted Merganser was observed mainly on shallow coastal areas north of Sjælland. Single or few birds was found on Store Middelgrund and in the westernmost parts of the study area (Figure 12 ABCDE).

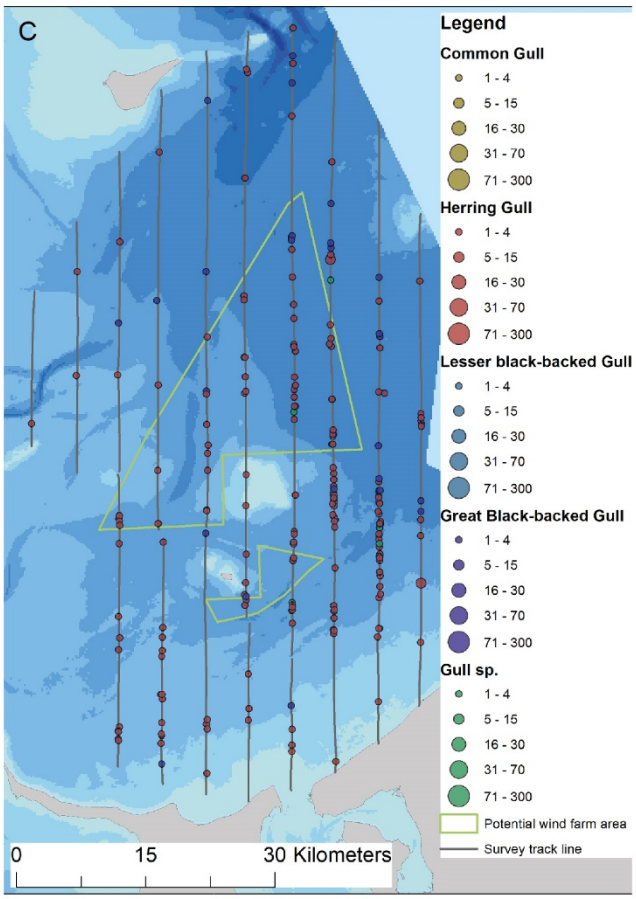
3.2.7 Gulls

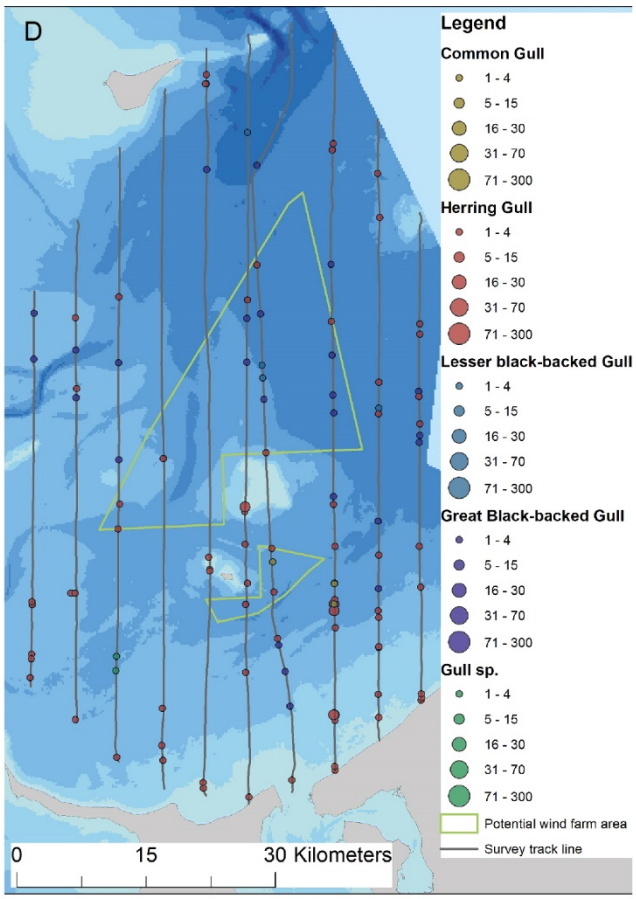
Common Gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Black-headed Gull and Kittiwake was recorded in the study area. A number of gulls could not be identified to species, and are thus presented as unidentified Gull sp. Observations of Black-backed Gull is not shown on maps. The distribution of Kittiwakes are shown separately.

The most numerously observed species of gull was Herring Gull, with 1011 birds recorded. Numbers didn't fluctuate massively. Highest numbers was 312 birds during the survey on 10th January 2019. Great Black-backed Gull was also observed in high numbers. A total of 228 birds were recorded, most (67) on 17th April 2019 (Table 4).

Gulls were recorded scattered across the study area (Figure 13 ABD), though during some surveys with concentrations in the deeper areas east and north-east of Hesselø (Figure 13CE).







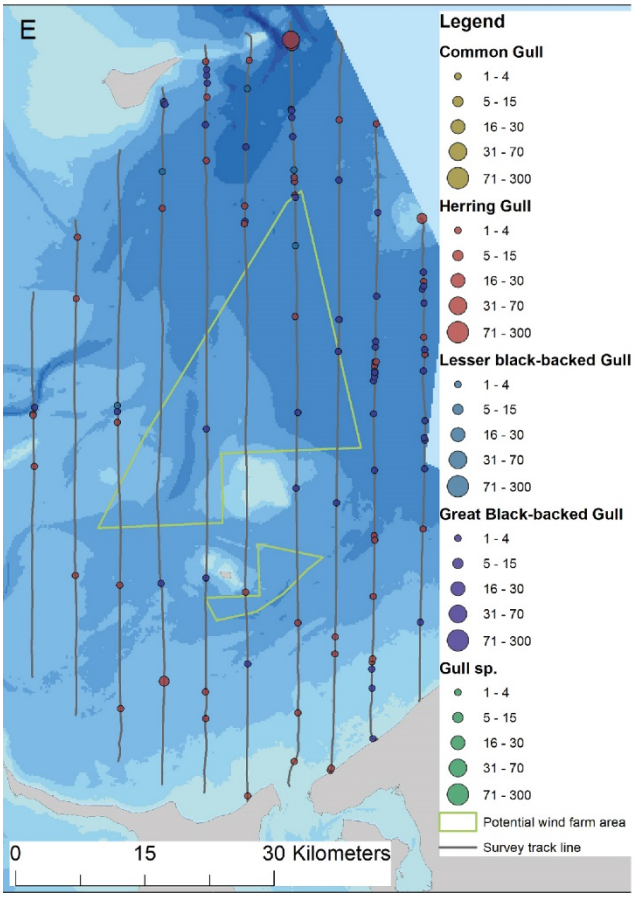


Figure 13. The spatial distribution of observed gulls (Common Gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull and gull sp.) in the Kattegat survey area during five surveys January to April 2019.

3.2.8 Kittiwake

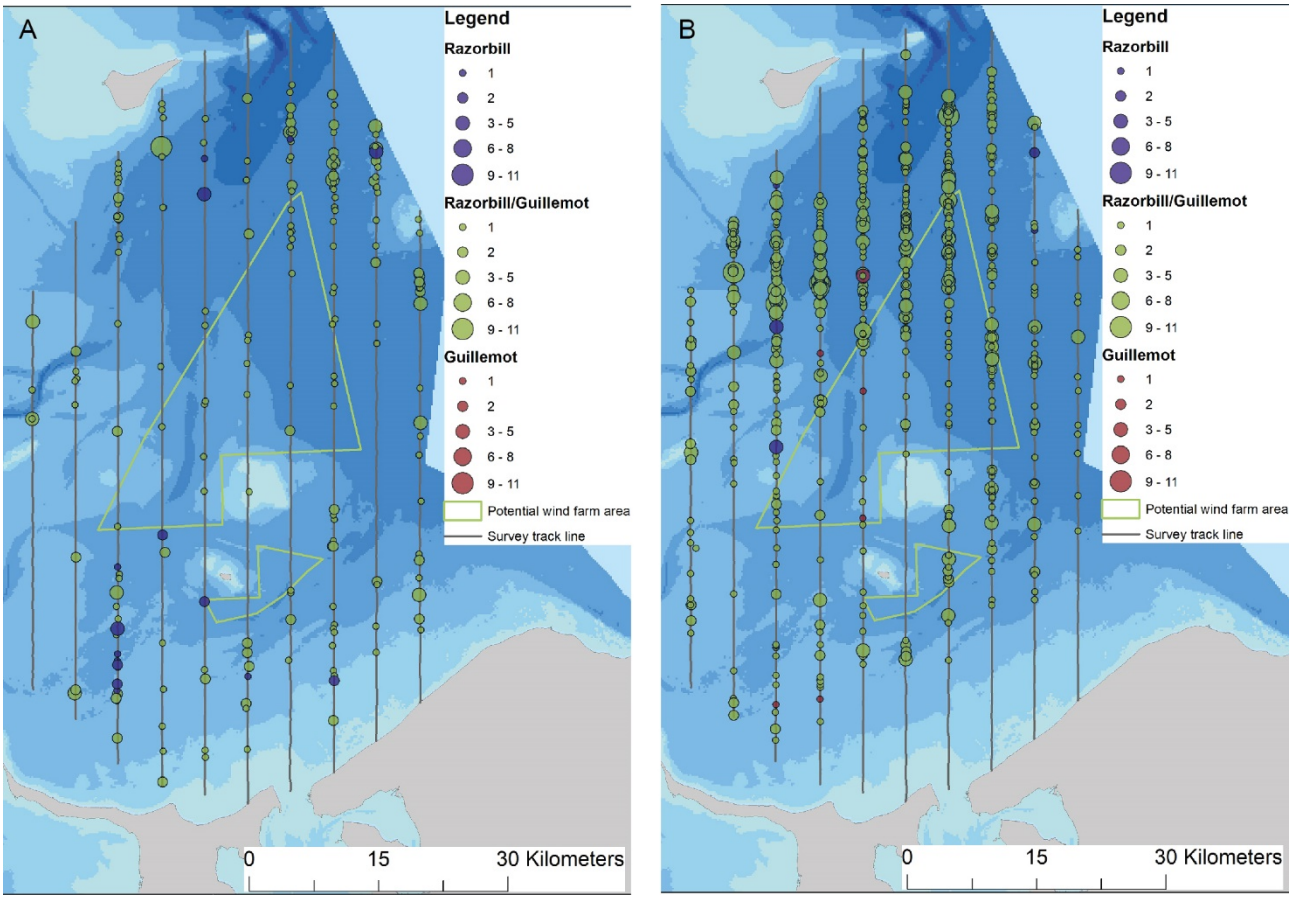
A total of 66 Kittiwakes was observed during the five surveys in the Kattegat study area (Table 4). Most of these (31) was recorded on 10th January 2019. No Kittiwakes was observed on 17th April 2019.

Kittiwakes were found I the deeper parts of the study area, specially north and northeast of Hesselø (Figure 10 ABCD).

3.2.9 Razorbill/Guillemot

A total of 3291 Razorbills/Guillemots was recorded during the five surveys in the Kattegat survey area. Of these 3214 (98 %) were unidentified, while 1 % was identified to Razorbill and 1 % was identified to Guillemot (Table 4).

Razorbills and Guillemots primarily occurred in the northern and northeastern parts of the study area (Figure 14 ABCD). They avoid the shallow areas. Concentrations was also found in the deeper parts of the study area south and southwest of Hesselø. On 17th April few Razorbills/Guillemots were found in the study area (Table 4) and they were mainly distributed in the western parts of the study area (Figure 14 E).



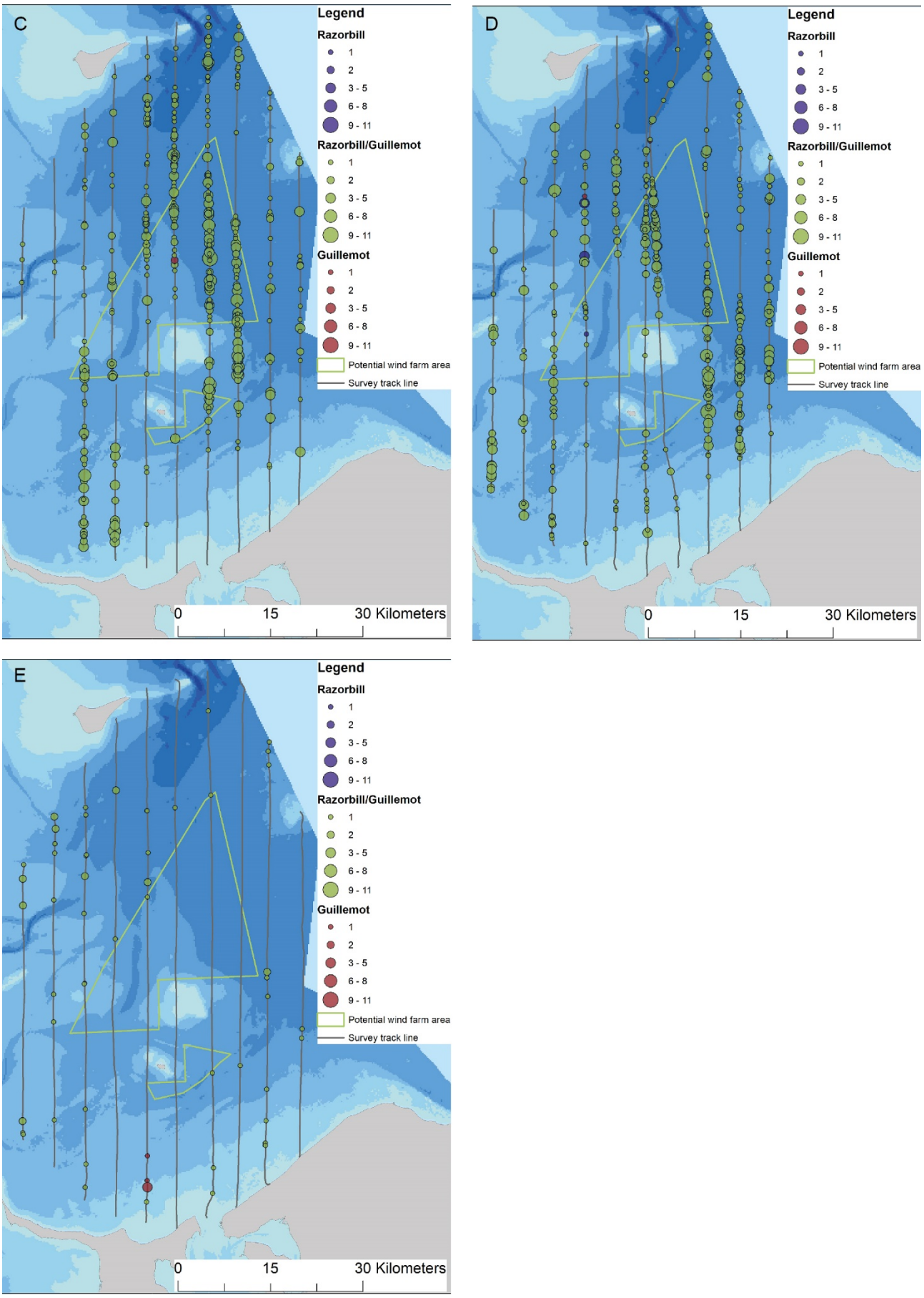


Figure 14. The spatial distribution of observed Razorbills, Guillemots or Razorbills/Guillemots in the Kattegat survey area during five surveys January to April 2019.

4. Discussion and Conclusion

The five surveys of birds in each of the two proposed offshore wind farm sites in Kattegat and in the North Sea showed, that most numerously recorded bird species were pelagic and surface feeders. In both areas high numbers of Gannets and Razorbills/Guillemots was recorded. Red-throated Diver and Black-throated Diver were also recorded, although the majority of these were observed in waters shallower than the actual areas of interest for the offshore wind farm areas.

Of surface-feeding species were gulls and terns. Since the majority of the surveys were made while terns were wintering far south of Danish waters these were poorly represented in the data.

The presence of pelagic and surface-feeding species can fluctuate greatly in space and time, reflecting hydrographic and oceanographic features that influences the distribution of food items in the sea. Thus, while the impact on divers can potentially be avoided by choosing deeper construction sites it will be more difficult to avoid areas where Gannets, gulls and Razorbills/Guillemots frequently are found in high numbers.

Both the proposed wind farm areas in Kattegat and in the North Sea seem to be distant from concentrations of Common Scoters or other diving duck species. In the North Sea the proposed wind farm area is between 20 and 35 m of water depth, shallowest in the very southern part and close to the Horns Rev 3 offshore wind farm. In this area the distribution of divers are likely influenced by the presence of the wind Horns Rev 2 and Horns Rev 3 wind farms. Results from post-construction investigations of birds around offshore wind farms in German North Sea and at Horns Rev 2 showed displacement effects of Red-throated Diver out to distances of more than 10 km from the periphery of the wind farms (Mendel et al. 2019, Petersen et al. 2014). Thus, positioning the actual North Sea wind farm site in the northwestern parts of the potential wind farm area will reduce displacement effects on divers.

The concentrations of Razorbills, Guillemots and Gannets in both the Kattegat and the North Sea study areas are distributed according to geographically varying prey availability. Reducing potential effects of these species by wind farm site selection therefore is more challenging. For these species, wind farm design may be considered as a mean to reduce potential effects (Masden et al. 2012).

Information on bird distributions from the two study areas are available from winter and spring surveys, while data from late summer and autumn are at present unavailable. In order to assess the potential impact on birds from the wind farms in the two study areas it is recommended that such data is acquired.

5. Litterature

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Appendix

Appendix 1. Waypoint names and positions for 22 waypoints used during the surveys of birds in the North Sea survey area. Waypoint positions are given as decimal degrees and as degrees and decimal minutes. Waypoint names (WPT) refer to waypoint names in Figure 1.

		LAT	LON		
Route	**WPT**	**Decimal Deg**	**Decimal Deg**	**LAT (DDMM,MMMM)**	**LON (DDMM,MMMM)**
1	NSH28E	55,70197487440	7,60489362761	55°42,1184"N	7°36,2936"E
2	NSH28B	55,69435645780	7,12044817597	55°41,6614"N	7°07,2269"E
3	NSH29A	55,78121606430	7,03071097141	55°46,8729"N	7°01,8427"E
4	NSH29E	55,79650441150	8,17427575642	55°47,7902"N	8°10,4565"E
5	NSH30E	55,88695306140	8,15325026953	55°53,2171"N	8°09,1950"E
6	NSH30A	55,87048236190	6,98739289273	55°52,2289"N	6°59,2436"E
7	NSH31A	55,95911182780	6,94469535148	55°57,5467"N	6°56,6817"E
8	NSH31E	55,97591655000	8,12767460536	55°58,5550"N	8°07,6605"E
9	NSH32E	56,06601988370	8,09778617252	56°03,9612"N	8°05,8672"E
10	NSH32A	56,04821671450	6,90352839098	56°02,8930"N	6°54,2117"E
11	NSH33A	56,13697819920	6,90523723508	56°08,2187"N	6°54,3142"E
12	NSH33E	56,15599545250	8,11493348764	56°09,3597"N	8°06,8960"E
13	NSH34E	56,24590377750	8,12310629474	56°14,7542"N	8°07,3864"E
14	NSH34A	56,22831639610	7,00321066462	56°13,699"N	7°00,1926"E
15	NSH35A	56,31971708200	7,10074045909	56°19,1830"N	7°06,0444"E
16	NSH35E	56,33570789290	8,11681579450	56°20,1424"N	8°07,0089"E
17	NSH36E	56,42558299400	8,12069264645	56°25,5350"N	8°07,2415"E
18	NSH36A	56,41139026930	7,21842188879	56°24,6834"N	7°13,1053"E
19	NSH37A	56,50330794860	7,34892996337	56°30,1985"N	7°20,9358"E
20	NSH37E	56,51539788620	8,11627222918	56°30,9239"N	8°06,9763"E
21	NSH38E	56,60544021530	8,14450207162	56°36,3264"N	8°08,6701"E
22	NSH38A	56,59508919860	7,48308285192	56°35,7053"N	7°28,9850"E

Appendix 2. Waypoint names and positions for 30 waypoints used during the surveys of birds in the Kattegat survey area. Waypoint positions are given as decimal degrees and as degrees and decimal minutes. Waypoint names (WPT) refer to waypoint names in Figure 2.

Route	WPT	LAT Decimal Deg	LON Decimal Deg	LAT (DDMM,MMMM)	LON (DDMM,MMMM)
1	MG03S	56,08592721230	11,33805061220	56°05,1556"N	11°20,2830"E
2	MG03A	56,37453950760	11,35569404840	56°22,4723"N	11°21,3416"E
3	MG03N	56,50102362580	11,36352974770	56°30,0614"N	11°21,8117"E
4	MG04N	56,57166118580	11,44830800790	56°34,2996"N	11°26,8984"E
5	MG04A	56,30327468920	11,43110766410	56°18,1964"N	11°25,8664"E
6	MG04S	56,05409941650	11,41540125110	56°03,2459"N	11°24,9240"E
7	MG05S	56,00606341150	11,49109160390	56°00,3638"N	11°29,4654"E
8	MG05A	56,27111312770	11,50983071400	56°16,2667"N	11°30,5898"E
9	MG05N	56,64346783180	11,53452046280	56°38,6080"N	11°32,0712"E
10	MG06N	56,70671893740	11,62150046570	56°42,4031"N	11°37,2900"E
11	MG06A	56,24136311230	11,58961720040	56°14,4817"N	11°35,3770"E
12	MG06S	55,98062647790	11,57216453740	55°58,8375"N	11°34,3298"E
13	MG07S	55,97014769190	11,65160803280	55°58,2088"N	11°39,0964"E
14	MG07A	56,21157331560	11,66825124160	56°12,6943"N	11°40,0950"E
15	MG07N	56,74483463560	11,70593849500	56°44,6900"N	11°42,3563"E
16	MG08N	56,76401858160	11,78811865340	56°45,8411"N	11°47,2871"E
17	MG08A	56,18162827410	11,74572399340	56°10,8976"N	11°44,7434"E
18	KS25S	55,95912979800	11,72994064290	55°57,5477"N	11°43,7964"E
19	KS26S	55,97020211670	11,81086335060	55°58,2121"N	11°48,6518"E
20	MG09A	56,15659608950	11,82446813120	56°09,3957"N	11°49,4680"E
21	MG09N	56,77016702020	11,87041803270	56°46,2100"N	11°52,2250"E
22	KN21N	56,75870768150	11,95136368730	56°45,5224"N	11°57,0818"E
23	MG10A	56,14514159360	11,90413656010	56°08,7084"N	11°54,2481"E
24	KS27S	55,98796370880	11,89233424190	55°59,2778"N	11°53,5400"E
25	KS28S	56,01852614870	11,97486693130	56°01,1115"N	11°58,4920"E
26	MG11A	56,14408717380	11,98456611730	56°08,6452"N	11°59,0739"E
27	KS28B	56,66396575390	12,02556584630	56°39,8379"N	12°01,5339"E
28	KS29B	56,56918245520	12,09940293750	56°34,1509"N	12°05,9641"E
29	MG12A	56,15030372290	12,06557274840	56°09,0182"N	12°03,9343"E
30	KS29S	56,05682358870	12,05814602310	56°03,4094"N	12°03,4887"E

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NUMBER AND DISTRIBUTION OF BIRDS IN AND AROUND TWO POTENTIAL OFFSHORE WIND FARM AREAS IN THE DANISH NORTH SEA AND KATTEGAT

The Danish Energy Agency requested a total of ten surveys of birds conducted in two areas of interest in the North Sea and in Kattegat, five surveys in each area. The surveys were conducted as aerial line transect surveys from December 2018 until April 2019.

This publication reports the findings of the surveys. Relevant bird species for each of the two areas are described, and thematic maps are presented. In compliance with the contract this publication does solely present the distribution of the observed birds. No estimation of total numbers has been performed under this contract. The dominant bird species found in the two survey areas were Gannets and Razorbills/Guillemots. In both survey areas these bird species were found in high numbers, both inside and outside the area of interest for offshore wind farms. Diving ducks, as for instance Common Scoter, were found in low numbers. Red-throated Diver/Black-throated Diver was found in concentrations in the North Sea survey area particularly, and to a less extent in the Kattegat survey area. Densities of divers were lower in the area of interest for the offshore wind farms. Since divers are known to be displaced by offshore wind farms out to more than 15 km, the displacement effect of these birds may be reduced by careful considerations of the actual positioning of potential wind farms.

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