Breeding birds in the Danish Wadden Sea Region 1983-2006, assessment of SPAs

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(Med et dansk resumé: Udviklingstendenser for ynglefugle i EF-fuglebeskyttelsesområderne i Vadehavet, 1983-2006)

Abstract We assess the breeding birds inside the nine SPAs in the Danish Wadden Sea that are appointed according to the EU Wild Birds Directive to protect species (here termed the designated species) mentioned on the Annex 1 of the directive. The aim is at a local level to i) assess the population size of 14 breeding bird species on the Annex 1 of the EU Wild Birds Directive, and ii) compare the populations of these species with the size of 11 populations of ecologically similar species that are not included in the Annex 1 (here termed the non-Annex 1 species). For this purpose we assess the size of 111 local populations during the long (1983-1991 compared with 2006) and the short term (1996 and 2001 compared with 2006), using the definition in the EU Habitat Directive, saying that populations shall either be stable or increasing and that their distributions must not be reduced. The SPAs were established in 1994 and thus covered by the short-term data set.

For the designated species during the long term, 21 % of the populations increased, 19 % were stable, and 42 % decreased; the remaining 19 % occurred accidentally (only recorded as breeding in one of the five years). During the short term nearly the same results were found. For the non-Annex 1 species similar results were obtained for both the long and the short term. Grouping all populations of the Annex 1 species from inside the nine SPAs, 25 % of them increased or were stable, while more than 70 % decreased or occurred accidentally. Six populations of designated Annex 1 species were not found breeding in any of the five years, while for the years 1996, 2001 and 2006 the same was the case for 10 populations. Including all considered species (designated and other Annex 1 species together with non-Annex 1 species), corresponding figures were 12 and 21. These results indicate that a reduction in the breeding range has occurred. In addition, the results show no differences between designated and the non-Annex 1 species. From these results it is concluded that most of the breeding populations inside the Danish Wadden Sea SPAs have an unfavourable local conservation status according to intentions and definitions in the EU Wild Birds and Habitat directives, that the populations of the designated species have undergone the same development as the populations of the non-Annex 1 species, and that the conservation status of the designated species has not improved since the EU Wild Birds Directive was put into force in 1994.

Introduction

The member states of the European Union are obliged to appoint Special Protection Areas (SPAs) to safeguard the wild bird species and secure their populations according to the EU Wild Birds Directive adopted by the European Council in 1979 (Directive No. 79/402/EEC of 2. April 1979). Denmark implemented the directive in 1983 and made a provisional designation of 111 SPAs for bird species listed in Annex 1 of the EU Wild Birds Directive, which includes breeding as well as staging migratory species. In 1994 a final designation of the SPAs was undertaken, and during the following years three additional sites (outside the Wadden Sea area) were included. The Danish SPAs cover about 6% of the land area and 11% of the sea area (http://www.blst.dk/Natura2000/Natura2000omraader/).

In 1998, a departmental order was adapted (no. 782 of 1 November 1998) giving conservation objectives for bird species and Special Areas of Conservation (SACs) designated in accordance with the EU Habitat Directive and the EU Wild Birds Directive (hereafter called the Habitat Directive and the Bird Directive, respectively) as the national contribution to the NATURA 2000 network (here termed the 'international conservation areas'). In the departmental order it is stated that the conservation objective for the international conservation areas is to secure and maintain favourable conservation status on a national level both for the species and the natural habitat types. The definition of a 'favourable conservation status' for a species and its natural habitats is given in the Habitat Directive; such a status is achieved if i) the population dynamics of the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, ii) the natural range of the species is neither shrinking or likely to shrink during a foreseeable future, and iii) there is, and will probably continue to be, sufficiently extensive areas with the species' natural habitats to maintain its population on a long-term basis.

A preliminary assessment of the national conservation status of each of the bird species on the Annex 1 of the Bird Directive was made by Pihl et al. (2006).

In the following, the breeding bird species from the Annex 1 of the Bird Directive for which the SPAs in the Wadden Sea were designated are termed 'the designated species'. The aim of the present paper is to i) assess the population trends of the designated species at a local level in nine SPAs covering the entire Danish Wadden Sea, and ii) compare these population trends with the corresponding population trends of a group of ecologically 'similar' species not included in the Annex 1 (termed the 'non-Annex 1 species', see Appendix). For the assessment we use the criteria given in the Habitat Directive, but in a reformulated form in order to make them operational: a favourable conservation status is achieved if a) the species' population size is stable or increasing inside the SPA considered, and b) the species is actually breeding in the SPA each year. Species with an unfavourable conservation status are those with decreasing populations, those occuring irregularly, and those that are no longer present as annual breeders in the SPA considered.

The reason for selecting the Wadden Sea area for this study is the international importance of the area for many bird species (Koffijberg et al. 2006) and the fact that the breeding birds have been monitored regularly every fifth year since 1991 (covering only islands and salt marshes) and

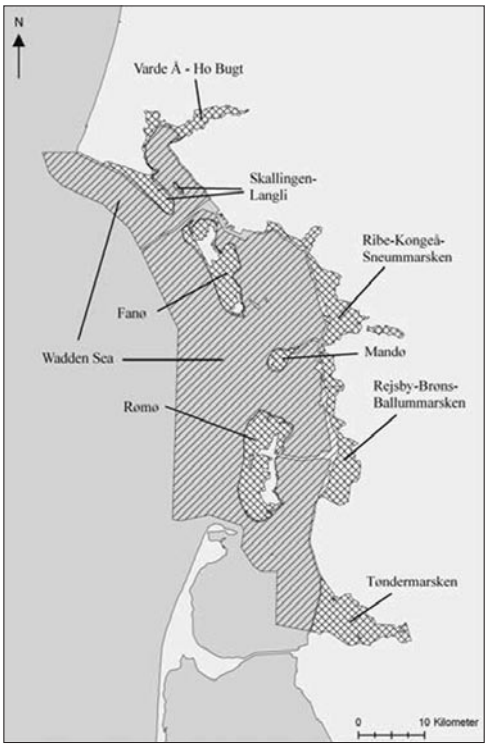

Fig. 1. The nine SPAs appointed in the Danish Wadden Sea area according to the EU Wild Birds Directive.
De ni EF-fuglebeskyttelsesområder i det danske Vadehavsområde der er udpeget i henhold til EF-fuglebeskyttelsdirektivet.

1996 (also covering polder areas) (Rasmussen & Thorup 1998, Koffijberg et al. op.cit.). A provisional assessment of migratory and breeding bird species in the Danish Wadden Sea SPAs was conducted by Laursen (2005, 2006). However, these reports only treated six SPAs, all dominated by freshwater marshland. In contrast, the present report deals with breeding birds in all nine SPAs in the Danish Wadden Sea area, covering salt marshes, beaches and uninhabited and inhabited islands as well as polder areas with grassland and cultivated fields.

Study sites

The nine SPAs cover a total of 1505 km^2 (Skov- og Naturstyrelsen 1995) and include the following sites (see Fig. 1): SPA no. 49: Varde-Ho Bugt, 27.0 km^2 salt- and freshwater marshes, meadows and bogs. SPA no. 51: Ribe-Kongeå-Sneummarsken, 66.6 km^2 polders covered by extensive grassland, cultivated fields, and freshwater areas. SPA no. 52: Mandø, 8.5 km^2, an embanked, inhabited and partly cultivated island covered by grassland, and surrounded by salt marshes outside the seawalls. SPA no. 53: Fanø, 43.7 km^2, an inhabited island covered by dune heaths, conifer plantations, cultivated fields and salt marshes. SPA no. 55: Skallingen-Langli, 22.4 km^2, a peninsula and an uninhabited island covered by salt marshes, dunes, beaches and intertidal flats. SPA no. 57: The Wadden Sea, 1158.5 km^2 tidal flats, high sands and saltmarshes. SPA no. 60: Tøndermarsken, 65.2 km^2, embanked polder area containing a freshwater and a saltwater lagoon, reed beds, grassland and cultivated fields. SPA no. 65: Rømø, 70.1 km^2, an inhabited island covered by beaches, dunes, salt marshes, embanked freshwater marshes, cultivated areas and coniferous plantations. SPA no. 67: Rejsby-Brøns-Ballummarsken, 42.8 km^2 embanked polder area with grassland and cultivated fields.

Material and methods

A provisional list of the breeding bird species from the Annex 1 of the Bird Directive for which the SPAs are designated (the designated species of the present paper) was published by the Ministry of the Environment (Fredningsstyrelsen 1983 and, with some additions, Skov- og Naturstyrelsen 1995). The list was revised and updated in 2005, now only including species on the Bird Directive's Annex 1 (By- og Landskabsstyrelsen 2008). The designated species in the present study are from this updated list, while the non-Annex 1 species were selected from the provisional lists. These non-Annex 1 species is considered a random selection of species living in the same habitat types as the designated species, and the purpose of including them was to find out how the conservation status of the designated species had changed compared to a group of ecologically similar species.

In connection with the present analyses the term 'population' is used as meaning the members of a given species within a given SPA, irrespective of their breeding status. Using this definition, we analysed a total of 111 populations distributed in the nine SPAs, representing a total of 25 bird species (14 designated species and 11 non-Annex 1 species; see Table 1 and Appendix).

Excluded in the selection process were species not covered by monitoring programmes or otherwise counted systematically: Bittern *Botaurus stellaris*, Greylag Goose *Anser anser*, Shelduck *Tadorna tadorna*, Gadwall *Anas strepera*, Common Teal *Anas crecca*, Garganey *Anas querquedula*, Shoveler *Anas clypeata*, Marsh Harrier *Circus aeruginosus*, Spotted Crake *Porzana porzana*, Corncrake *Crex crex* (outside SPA no. 49), Stock Dove *Columba oenas*, Turtle Dove *Streptopelia turtur*, Barn Owl *Tyto alba*, Yellow Wagtail *Motacilla f. flava*, Bluethroat *Luscinia svecica cyanecula*, Grasshopper Warbler *Locustella naevia* and Bearded Tit *Panurus biarmicus*.

Information on breeding numbers from the period 1977-1992 was extracted from local bird reports, relevant papers and single-species reports (see Appendix). In 1996, 2001 and 2006 all breeding shorebirds, gulls and terns and a few additional species were surveyed by the Trilateral Monitoring and Assessment Program for the Wadden Sea (TMAP; Koffijberg et al. 2006), using standardised census methods (Hälterlein et al. 1995), and these complete surveys covered the majority of the sites within the SPAs in the Danish Wadden Sea. Data from these surveys are available as a database, and some results have been published previously (e.g. Rasmussen & Thorup 1998, Rasmussen 2003, Thorup 2003, Thorup & Laursen 2008).

The survey coverage and time spent in 1977-1992 is poorly known; this is true even for the trilateral breeding bird survey in 1991 which only covered sites west of the mainland seawalls (Fleet et al. 1994). Most likely, however, the coverage was low compared with the surveys in 1996, 2001 and 2006 (Fig. 2). To overcome the most obvious

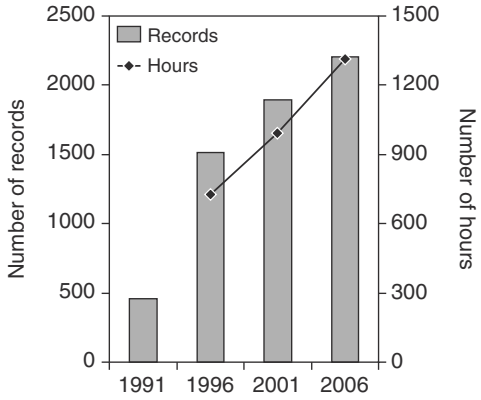

Fig. 2. Number of records in the breeding bird database and number of hours spend in monitoring breeding birds in the Danish Wadden Sea during 1991-2006 (DMU data). There is no information on the amount of hours used in the 1991 survey, or on the number of records or hours used in the earlier surveys.
Antal observationer i ynglefugledatabasen for Vadehavet og antal timer brugt på monitering af Vadehavsområdet i 1991-2006. Der er ingen oplysninger om hvor mange timer, der er brugt på moniteringen i 1991, og heller ikke om datamængden eller timeforbruget i de tidligere moniteringer.

deficiencies, we only accepted count data prior to 1996 if they included an almost complete coverage of one or more species in the SPA considered. We only used data from one survey for each SPA within each of the periods 1977-1985 and 1986-1992, and in cases with more than one apparent high-quality count within one of these periods only the one from nearest to 1983 or 1991, respectively, was used. However, it was not possible to find high-quality data for all SPAs and species.

For the complete surveys in 1996, 2001 and 2006 we do have information on survey coverage and intensity, including the area covered at each counting site, the count schedules, and the amount of time spent at each count. In polder areas we exclude count data based on less than one hour per 200 ha, and we also exclude data not collected within the standardized counting periods defined for each species (see Hälterlein et al. 1995).

The pre-1996 data were arranged into two groups: data from 1977-1985, which in the estimations were treated as if they were collected in 1983 (as 61 % of the data from this period were), and data from 1986-1992, treated as if they were collected in 1991 (as 89 % of them were).

Since we only have data from five years we could not use advanced statistical methods such as Trendspotter (Soldatt et al. 2007). Therefore we have chosen simple pragmatic test procedures, in the following called procedure A, B and C. All three were applied on both a longer and a shorter term, comparing the population figures from 2006 with, respectively, the figures from 1983/1991 and the figures from 1996/2001.

Test procedure A: That of the two pre-2006 counts differing most from the 2006 count was used in the statistical test. However, if the numbers from the pre-2006 counts suggested opposite trends, one an increase and the other a decrease compared with the 2006 numbers, the number from the earliest of the two counts was chosen.

Test procedure B: As procedure A, except that even when one of the older counts were lower and the other higher than the 2006-count, the one being most different from the 2006-count was chosen.

Test procedure C: The average value of the two pre-2006 counts was compared to the 2006 figure.

The pre-2006 number obtained in this way was compared to the 2006 figures using the χ^2 test except when the 'expected' value was less than 5, in which case the binomial test was used instead. If the figures compared were so small that their sum was less than 6, the difference was not tested and these populations were not included in the results (this was the case for 22 populations during the short term and for 30 populations during the long term). The terms 'increasing' and 'decreasing' are used only if there is a statistically significant difference ($P < 0.05$) between the compared figures, otherwise the population level is characterized as 'stable'.

If a population was recorded in only one of the possible five years, and this year was either the first or the last (in most cases 1983 or 2006), the population is characterized as having an 'accidental' occurrence. If a population was not recorded as breeding in any of the five survey years it is characterized as 'not breeding during the long term' and, likewise, if it was not recorded as breeding in any of the years 1996, 2001 and 2006 it is characterized as 'not breeding during the short term'. The term 'unstable' is used for accidentally occurring populations and populations recorded as not breeding.

In order to compare the population trends of the species relative to each other, a trend index was calculated for each species, based on the number of increasing or stable populations (I) versus the number of decreasing or unstable populations (D): index = (I+1)/(D+1). So defined, an index value ≥1

Table 1. Total number of pairs in the nine SPAs in the Danish Wadden Sea for species mentioned in the Bird Directive's Annex 1.
Det totale antal par i alle ni EF-fuglebeskyttelsesområder i det danske Vadehavsområde for arter anført i EF-fuglebeskyttelsesdirektivets Bilag 1.

	1983 (1977-85)	1991 (1986-92)	1996	2001	2006
Hen Harrier *Circus cyaneus*	0	0	5	0	0
Montagu's Harrier *Circus pygargus*	31+	27+	32	24	16
Corncrake *Crex crex**	0	-	0	3	0
Avocet *Recurvirostra avosetta*	-	1131	776	541	573
Kentish Plover *Charadrius alexandrinus*	-	-	57	89	47
Dunlin *Calidris alpina*	-	42	28	20	12
Ruff *Philomachus pugnax*	168	70	8	3	10
Gull-billed Tern *Gelochelidon nilotica*	3	2	12	0	0
Sandwich Tern *Sterna sandvicensis*	2	0	1039	715	3229
Common Tern *Sterna hirundo*	69	154	215	65	18
Arctic Tern *Sterna paradisaea*	679	571	1057	902	719
Little Tern *Sterna albifrons*	-	-	219	219	77
Black Tern *Chlidonias niger*	76	26	49	12	19
Short-eared Owl *Asio flammeus*	-	-	12	4	3

* The Corncrake is only counted in SPA no. 49.

shows that the species in question exhibits a favourable conservation status (in our reformulated sense) in half or more of the SPAs in which it occurs. A similar index is calculated in order to compare the SPAs relative to each other.

Hypothetically, a species could disappear from all SPAs except one where, on the other hand, it increased so much that the total population size was unchanged or even higher than initially. In such a case most people would agree that the species did not have a favourable conservation status, although the population total suggested that it had, which is the main reason for chosing the procedure here described. However, we also present the trends obtained when combining numbers for all SPAs, but only for the designated (Annex 1) species (data for the long term is only available for ten of them, however). Similar analyses for some non-Annex 1 species were published by Thorup & Laursen (2008).

Results

The 14 Annex 1 species considered are listed in Table 1, with total number of pairs in the nine SPAs.

The test procedures A, B and C yielded similar results (Table 2), with non-significant differences between the results from the three procedures when looking at the designated species (number of decreasing populations and those occurring accidentally pooled) on the long (χ_4^2 = 3.76, P = 0.44) and the short term (χ_4^2 = 1.70, P = 0.79). Similar result were obtained for the non-Annex 1 species (χ_4^2 = 1.36, P = 0.85 on the long term, χ_4^2 = 7.70, P = 0.10 on the short term). In the further analyses we selected procedure A which tends to give intermediary results when compared with procedures B and C. Doing so, we find for the designated species during the long term that 21 % of the populations increased, 19 % remained stable, 42 % decreased, and 19 % occurred accidentally (Fig. 3, Table 2). During the short term, 16 % of the populations increased, 24 % were stable, 41 % decreased, and 19 % occurred accidentally, proportions that do not deviate statistically from those found for the long term (χ_2^2 = 0.55, P = 0.76; number of decreasing populations and those occurring accidentally pooled). For the non-Annex 1 species on the long term, 25 % of the populations increased, 20 % were stable, 45 % decreased, and 10 % occurred accidentally; on the short term 20 % increased, 28 % were stable, 44 % decreased, and 8 % occurred accidentally (Fig. 3); even here the differences between the long term and the short term proportions are statistically insignificant (χ_2^2 = 0.44, P = 0.80; the 'decreasing' and 'accidental' groups again pooled). Comparing the designated species and the non-Annex 1 species in the same way did not suggest any differences

Table 2. Proportion (%) of breeding bird populations in the Danish Wadden Sea SPAs showing increasing, stable and decreasing trends, or occurring accidentally only, when estimating procedure A, B and C, respectively, were applyed in the analysis. The results are shown both for the long term (1983 and 1991 compared with 2006) and the short term (1996 and 2001 compared with 2006). The results for the Annex-1 species (designated or not) in all SPAs in the Danish Wadden Sea combined are shown at the bottom.
Andelen (pct.) af fuglebestandene i Vadehavets EF-fuglebeskyttelsesområder, der er gået frem (increasing), ligger på et uændret niveau (stable), eller er gået tilbage (decreasing), dels på langt (long term) og dels på kort sigt (short term). Arterne er opdelt på Annex 1 arter, hvis forekomst indgår i grundlaget for områdets udpegning (designated), andre Annex 1 arter (other), og øvrige arter (non-Annex 1). Nederst er desuden vist tendenserne for alle Annex 1 arter i alle områderne under ét.

	Long term					Short term				
	Increasing	Stable	Decreasing	Accidental	N	Increasing	Stable	Decreasing	Accidental	N
Procedure A										
Designated species	20.9	18.6	41.9	18.6	43	16.2	24.3	40.5	18.9	37
Other Annex 1 species	0.0	14.3	57.1	28.6	7	33.3	16.7	16.7	33.3	6
Non-Annex 1 species	25.0	20.0	45.0	10.0	20	20.0	28.0	44.0	8.0	25
Procedure B										
Designated species	23.3	9.3	48.8	18.6	43	16.2	21.6	43.2	18.9	37
Other Annex 1 species	0.0	14.3	57.1	28.6	7	28.6	14.3	28.6	28.6	7
Non-Annex 1 species	25.0	20.0	45.0	10.0	20	20.0	28.0	44.0	8.0	25
Procedure C										
Designated species	14.0	23.3	44.2	18.6	43	13.2	34.2	31.6	21.1	38
Other Annex 1 species	0.0	25.0	25.0	50.0	4	20.0	20.0	20.0	40.0	5
Non-Annex 1 species	16.7	33.3	38.9	11.1	18	3.8	57.7	30.8	7.7	26
All SPAs combined										
Annex 1 species	25.0	0.0	62.5	12.5	8	7.7	15.4	69.2	7.7	13

between them, neither on the long term ($\chi_2^2 = 0.19$, P = 0.91) or the short term ($\chi_2^2 = 0.35$, P = 0.84). Figures for the Annex 1 species not designated were low and are not included in the analyses, but they appear in Table 2.

Six populations of designated species were recorded as not breeding in any of the five years; if all the species are considered (including Annex 1 species not designated and non-Annex 1 species), 12 populations were not breeding in any year (Fig. 4). Looking at the last three survey years (1996, 2001, 2006), 10 populations of designated species were not breeding in any year, and if all the species are considered, 21 populations (19 % of those examined) were not breeding in any year.

The trend index for the Annex 1 species (Table 3) indicates a favourable status (population increasing or stable in at least half of SPAs in which the species occur) at the long term for Montagu's Harrier *Circus pygargus*, Avocet *Recurvirostra avosetta*, Sandwich Tern *Sterna sandvicensis*, Arctic Tern *Sterna paradisaea* and Little Tern *Sterna albifrons*, but at the short term this holds true only for Montagu's Harrier and Sandwich Tern. For the remaining nine species the index indicates an unfavourable status at both the long and the short term.

The index estimated for each SPA (Table 4), based on the trends of the Annex 1 species living in them, shows that half or more of the species exhibit a favour-

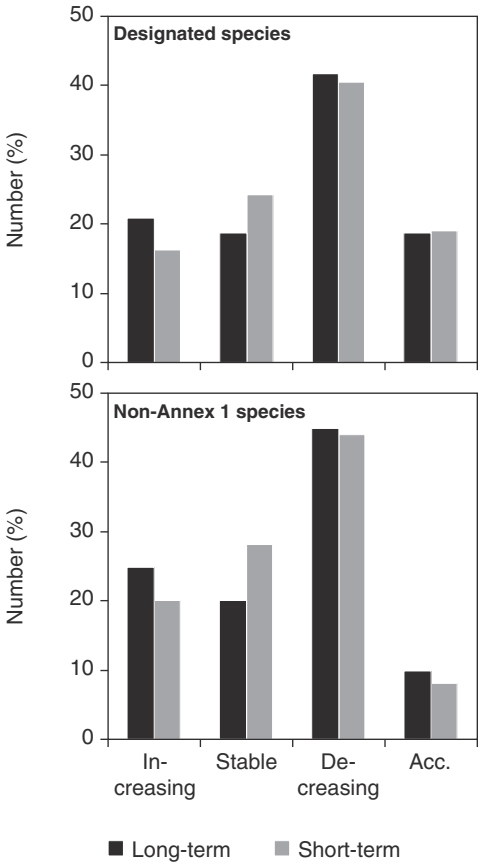

Fig. 3 Relative numbers (%) of bird populations of designated species and the non-Annex 1 species which were found to be increasing, stable, decreasing or occurring accidentally (Acc.) in the nine SPAs in the Danish Wadden Sea during 1983 and 1991, compared to 2006 (long term), and during 1996 and 2001, compared to 2006 (short term). For N-values see Table 2. Further explanation in the text.
Relative antal (%) af fuglebestande for henholdsvis de udpegede og de ikke udpegede arter, der blev fundet at være stigende, stabile, faldende eller tilfældigt forekommende (Acc.) i de ni EF-fuglebeskyttelsesområder i det danske Vadehavsområde i 1983 og 1991, sammenlignet med 2006 (langtidsperioden); og i 1991 og 2001, sammenlignet med 2006 (korttidsperioden). N-værdier fremgår af Tabel 2. Yderligere forklaring i teksten.

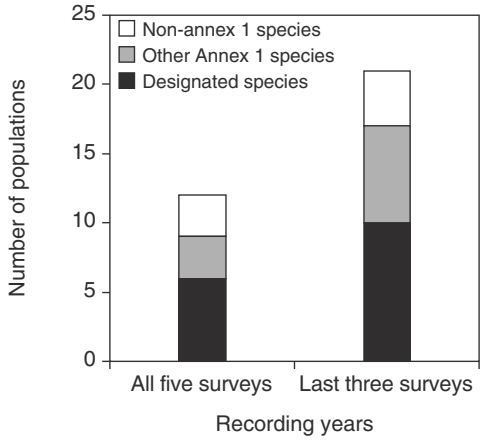

Fig. 4. Number of bird populations recorded as not breeding in its SPA in the Danish Wadden Sea during any of the five surveys (1983, 1991, 1996, 2001, 2006; N = 12), and during the last three surveys (1996, 2001, 2006; N = 21).
Antal fuglebestande registreret som ikke ynglende i et af de ni EF-fuglebeskyttelsesområder i det danske Vadehavsområde i alle fem undersøgelsesår (1983, 1991, 1996, 2001, 2006), og i de sidste tre undersøgelsesår (1996, 2001, 2006).

able conservation status on both the long and the short term at Mandø (no. 52) and Skallingen-Langli (no. 55); on the long term only at Rømø (no. 65); and on the short term only at Rejsby-Brøns-Ballummarsk (no. 67).

If the population estimates from all the nine SPAs are combined for each of the Annex 1 species (designated as well as un-designated) (Table 2), only 25 % of the species had increased on the long term, while the remaining 75 % had declined or occurred accidentally. On the short term, only 8 % had increased, 15 % had remained stable, and 77 % had decreased or occurred accidentally.

Discussion

Historical data can give valuable information, and Boyd (2003) argued that considering management aspects, "pragmatism must take precedence over perfectionism". In the present case, the main problem is the uneven survey coverage of the SPAs over the years. Increasing number of birds could simply reflect an increasing survey effort over time or the employment of more effective methods. In the present study, the figures from the first years (1983 and 1991) could not be corrected for low survey intensity, or for any skewness in the coverage. We suspect that during the early surveys most observation time was spent in the parts of the SPAs having most species and highest bird densities, meaning that a larger proportion of the birds were counted than suggested alone by the duration of the visit. Any such bias would be particularly pronounced in case of uncommon bird species such as Dunlin and Kentish Plover, and also for colony breeders such as Avocets, gulls

Table 3. Trend index values for the 14 designated Annex 1 species, calculated from the number of increasing or stable populations in relation to the number of decreasing or unstable populations in the Danish Wadden Sea SPAs.
Index for udviklingstendensen (trend index) for de 14 Annex 1 arter i Vadehavet. I og D angiver i hvor mange af de ni EF-fuglebeskyttelsesområder den pågældende art gik frem eller var stabil (I) henholdsvis gik tilbage eller var ustabil (D).

	Long term			Short term		
	Increasing-stable (I)	Decreasing-unstable (D)	Trend index (I+1)/(D+1)	Increasing-stable (I)	Decreasing-unstable (D)	Trend index (I+1)/(D+1)
Hen Harrier *Circus cyaneus*	0	3	0.3	0	3	0.3
Montagu's Harrier *C. pygargus*	2	2	1.0	4	0	5.0
Corncrake *Crex crex*	0	1	0.5	0	1	0.5
Avocet *Recurvirostra avosetta*	5	3	1.5	4	5	0.8
Kentish Plover *Charadrius alexandrinus*	2	3	0.8	1	3	0.5
Dunlin *Calidris alpina*	1	3	0.5	1	3	0.5
Ruff *Philomachus pugnax*	1	6	0.3	1	4	0.4
Gull-billed Tern *Gelochelidon nilotica*	0	4	0.2	0	6	0.1
Sandwich Tern *Sterna sandwicensis*	1	1	1.0	1	1	1.0
Common Tern *S. hirundo*	0	4	0.2	1	5	0.3
Arctic Tern *S. paradisaea*	3	3	1.0	2	4	0.6
Little Tern *S. albifrons*	3	3	1.0	2	3	0.8
Black Tern *Chlidonias niger*	0	1	0.5	0	1	0.5
Short-eared Owl *Asio flammeus*	0	5	0.2	0	5	0.2

and terns. On the other hand, some rare pecies – such as the Short-eared Owl *Asio flammeus* – and cryptically living species like the Ruff were probably overlooked to some extent in the early counts. That widely distributed species such as Lapwing *Vanellus vanellus* and Redshank *Tringa totanus* were underestimated during the early counts is fairly obvious (Thorup & Laursen 2008).

Regarding the first assessment criterion for a favourable conservation status, i.e. that the species population size should be increasing or stable over time, rather few populations among the designated species showed increasing (16-21 %; Fig. 3) or stable numbers (19-24 %) on the long and short term. In contrast, more than 40 % of the populations decreased and about 18 % had an accidental occurrence. The majority of the populations thus had a locally unfavourable conservation status, indicating that the habitat quality in many SPAs is not sufficient to allow the former population densities to be maintained.

We also assessed the trends of the non-Annex 1 populations and showed that most of these populations were likewise decreasing or having an accidental character (Fig. 3). The trends of the non-Annex 1 populations are actually very similar to those of the designated species populations. This indicates that the designated species, for which the SPAs were established, have not fared any better than birds species not on the Annex 1 of the Bird Directive, and thus have not been offered special protection inside the SPA.

Assessment at the level of single SPAs may have limited value, but in the present case all populations within the nine

SPAs in the Danish Wadden Sea Region were considered. Furthermore, there was no indication of any differences in the number of populations exhibiting decreasing trends or accidental occurrence before and after 1994, when the Bird Directive went into force; i.e., no effect of the directive could be demonstrated in the study.

In our study, we excluded 17 species that were not covered by systematic monitoring programmes in the Wadden Sea. These species are either Annex 1 species or were mentioned in the provisional PSA lists (Fredningsstyrelsen 1983, Skov- og Naturstyrelsen 1995). The exclusion of these species could have influenced our conclusions since most of these species (59 %) have shown country-wide increases in recent years (Grell 1998). To get an impression of how much the omission of these species could have influenced our results, we tried to include the country-wide values for them in the long-term results for the Annex 1 species from the Wadden Sea (combined with the results on the short term for the species not covered by on long term). This procedure suggested that 40 % of all considered species would increase, 7 % would remain stable, and 53 % would decrease if the species in question could have been formally included in our study. In other words, if information on these species had been available from the SPAs, the proportion of species showing increasing trends would probably have been somewhat higher than found in our study, but the majority of the species would still have been decreasing.

The second criterion for a favourable conservation status is that the range of the species should not be reduced over a suitable time period. We found that six populations of the designated species did not breed during the five survey years, and 10 populations failed to do so during the three latest years 1996, 2001 and 2006. If all examined populations are included, the corresponding figures are 12 and 21 populations (the latter figure corresponding to 19 % of all examined populations). That more species failed to breed within the SPAs during the later years could partly be an effect of the reduced number of years considered (3 instead of 5), but also strongly suggets that the proportion of populations not breeding increased over time, meaning that the breeding range of these species were shrinking.

Table 4. Index values for the nine SPAs in the Danish Wadden Sea, summarising the population trends of the designated bird species within their borders. The indices are calculated from the given number of species showing increasing/stable or decreasing/unstable trends. An index value ≥1 indicates that half or more of the populations of designated species within the SPA exhibits an increasing or stable population development.

Index (SPA index) der for hvert EF-fuglebeskyttelsesområde sammenfatter udviklingstendensen for de 14 udpegede Annex 1 arter. I og D angiver hvor mange af de pågældende arter der gik frem eller var stabile (I) henholdsvis gik tilbage eller var ustabile (D).

	Long term			Short term		
	Increasing-stable (I)	Decreasing-unstable (D)	SPA index (I+1)/(D+1)	Increasing-stable (I)	Decreasing-unstable (D)	SPA index (I+1)/(D+1)
No. 49. Varde Å-Ho Bugt	0	2	0.3	0	2	0.3
No. 51. Ribe-Kongeå-Sneummarsk	2	3	0.8	1	3	0.5
No. 52. Mandø	2	2	1.0	2	1	1.5
No. 53. Fanø	1	6	0.3	1	6	0.3
No. 55. Skallingen-Langli	3	3	1.0	3	3	1.0
No. 57. Vadehavet	2	5	0.5	2	5	0.5
No. 60.Tøndermarsken	1	5	0.3	1	4	0.4
No. 65. Rømø	5	4	1.2	4	5	0.8
No. 67. Rejsby-Brøns-Ballummarsk	1	2	0.7	1	1	1.0

The trend indices for the Annex 1 species (Table 3) show mostly increasing or stable trends for Avocet, Sandwich Tern, Arctic Tern and Little Tern. For comparison, the results of the trilateral program, covering the entire Wadden Sea, likewise show stable numbers for Avocet and Sandwich Tern and increasing trends for Arctic Tern and Little Tern (Koffijberg et al. 2006). Of the Annex 1 species with decreasing trends or unstable occurrence in Denmark, Kentish Plover, Dunlin and Ruff also showed decreasing numbers in the trilateral program, while Hen Harrier *Circus cyaneus*, Common Tern *Sterna hirundo* and Short-eared Owl were stable and Gull-billed Tern *Gelochelidon nilotica* increased (Koffijberg et al. op.cit.). Evidently, for some species the decrease occurs over a wider range, but for some of the species the populations primarily decrease in the Danish part of the Wadden Sea.

Of the designated and other Annex 1 breeding bird species in six marshland SPAs in the Danish Wadden Sea area analysed up to 2001, 24 % increased, 17 % were stable, 53 % decreased and 6 % occurred accidentally (Laursen 2006). These results are rather similar to the results found in our study, although both the periods and the analysis methods were different. The former study also analysed the land use of the freshwater marshland and found large differences in the proportion of grassland within the SPAs. However, even in SPAs with a high proportion of grasslands the population trends differed greatly, but in those SPAs - or parts of SPAs - that were managed for birds, such as Margrethe Kog in Tøndermarsken and areas on the island of Mandø, a larger proportion of the populations were increasing (Laursen 2005). In the present study we also found that populations with mostly increasing or stable trends occur at Mandø. Similar trends were also found in the SPA Skallingen-Langli, and more detailed analyses revealed that it was especially on the island of Langli that numbers increased (Thorup 2006). Both Mandø and Langli are islands which benefit from a low predation pressure from foxes *Vulpes vulpes* that can seriously reduce the breeding success of ground-nesting birds (Schekkerman et al. 2008, MacDonald & Bolton 2008).

Studies in the Danish Wadden Sea showed large declines of the Oystercatcher *Haematopus ostralegus*, Lapwing, Black-tailed Godwit *Limosa limosa* and Redshank, all widespread species, in mainland polder areas with no plans for management of ground water level or for land use in a form beneficial for breeding waders (Thorup & Laursen 2008). Detailed analyses in Tøndermarsken of past and present management show that relatively simple changes in farming practice can lead to increasing populations of several breeding bird species (Kahlert et al. 2007, Clausen et al. 2007). However, a comparison between the results from the Danish Wadden Sea and from SPAs in the Netherlands, showing that three species of Annex 1 species increased, four were stable and six decreased or fluctuated, suggests that it may be difficult to achieve local favourable conservation status for breeding bird species in the Wadden Sea region (SOVON & CBS 2005).

Our assessment of the breeding bird species in the Danish Wadden Sea shows that a large proportion of the populations are decreasing or no longer breed regularly, and that the majority of the breeding populations of designated species as well as non-Annex 1 species in the Danish Wadden Sea have a local, unfavourable conservation status. This situation was not improved by the establishment in 1994 of the SPAs in the Danish Wadden Sea.

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Resumé

Udviklingstendenser for ynglefugle i EF-fuglebeskyttelsesområderne i Vadehavet, 1983-2006

Medlemslandene i den Europæiske Union er forpligtiget til at udpege EF-fuglebeskyttelsesområder (SPAs)

The Ruff has disappeared from many sites and decreased considerably in most others. Photo: Erik Thomsen.
Brushanen er forsvundet fra mange lokaliteter og er gået meget tilbage på andre.

i henhold til EF-fuglebeskyttelsesdirektivet for at beskytte de fuglearter, der er anført på direktivets Bilag 1. Hvert SPA er udpeget på baggrund af en række arter (her benævnt 'de udpegede arter') fra direktivets Bilag 1, som skal nyde en særlig beskyttelse i det pågældende SPA. Denne artikel har til formål at i) vurdere ynglefuglebestandenes antalsmæssige udvikling på lokalt niveau for de udpegede arter og ii) sammenligne denne udvikling med udviklingen for andre arter, der ikke er anført på direktivets Bilag 1, og som lever i samme habitattype (her benævnt som 'de ikke udpegede arter'). Undersøgelsen omfatter alle ni EF-fuglebeskyttelsesområder, der tilsammen dækker hele det danske Vadehav, og vurderingen baseres på formuleringen i EF-habitatdirektivet om, at de udpegede arters bestandsniveauer skal være konstante eller stigende, og at deres geografiske udbredelse ikke må indskrænkes. Vi analyserede 111 bestande i 9 EF-fuglebeskyttelsesområder (se Appendix), omfattende 25 arter hvoraf 14 er anført på EF-fuglebeskyttelsesdirektivets Bilag 1; de sidste 11 arter var ikke udpegede arter. Tendenserne undersøges dels på længere sigt (årene 1983 og 1991 sammenlignet med 2006), dels på kortere sigt (1996 og 2001 sammenlignet med 2006). EF-fuglebeskyttelsesområderne er endeligt udpeget i 1994, så den korte tidsperiode dækker perioden hvor de var etableret, mens den lange tidsperiode tillader en sammenligning før og efter etableringen.

I denne undersøgelse er en bestand defineret som de fugle inden for et fuglebeskyttelsesområde, der tilhører en given art, uanset om denne art rent faktisk yngler i området. De arter, der betragtes, er alle anført som ynglefugl på en af de officielle udpegningslister for EF-fuglebeskyttelsesområderne, men er altså ikke nødvendigvis registreret som ynglende i undersøgelsesårene.

For de udpegede arter, som områderne skulle yde særlig beskyttelse, fandt vi for den lange tidsperiode, at 21 % af bestandene steg i antal, 19 % var stabile, 42 % faldt og 19 % forekom tilfældigt (blev kun registreret som ynglende i ét af de fem år). For den korte tidsperiode var resultatet næsten det samme (Fig. 3). For de ikke udpegede arter fandt vi tilsvarende resultater for både den lange og den korte tidsperiode. For de udpegede arter blev alle bestandene i de ni EF-fuglebeskyttelsesområder analyseret samlet, og resultatet viste, at op mod 25 % af bestandene enten steg eller var stabile, mens over 70 % af bestandene faldt i antal eller kun forekom tilfældigt. De samlede bestande er også faldet i antal, så der er ikke tale om, at nedgang i nogle fuglebeskyttelsesområder kompenseres af tilsvarende fremgang i andre.

I de fem optællingsår blev seks bestande blandt de udpegede arter ikke registreret som ynglende, idet de var forsvundet fra det pågældende fuglebeskyttelsesområde. For tællingerne i de tre seneste år (1996, 2001, 2006) var antallet af ikke-ynglende bestande af udpegede arter 10 (Fig. 4). Inkluderes alle de undersøgte bestande, stiger antallet af ikke-ynglende bestande til henholdsvis 12 (alle 5 år) og 21 (seneste tre år) ikke-ynglende be-

stande, hvilket viser, at en del af de undersøgte arter har indskrænket deres yngleudbredelse. Resultaterne viser også at, de udpegede arters bevaringsstatus ikke adskiller sig fra de arter, som ikke er anført på direktivets Bilag 1. Det konkluderes, at de fleste ynglefuglebestande i Vadehavets EF-fuglebeskyttelsesområder har en lokalt ugunstig bevaringsstatus i henhold til EF-fuglebeskyttelsesdirektivet og EF-habitatdirektivet, og at de udpegede arters bevaringsstatus ikke er forbedret efter 1994, hvor EF-fuglebeskyttelsesområderne blev etableret.

References

Boyd, H. 2003: The need for greater use of historical population data. – Wader Study Group Bull. 100: 175-177.

By- og Landskabsstyrelsen 2008: www.blst.dk/Natura2000/Natura2000omraader/Fuglebeskyttelse/List e+over+fuglebeskyttelsesområder/

Christensen, M. & B. Jakobsen 1991: Ynglefugleoptælling på Langli og Skallingen 1990. – Rapport, Skov- og Naturstyrelsen.

Christensen, R. & L.M. Rasmussen 1996: Hedehøg i Sydvestjylland ynglesæsonen 1996. – Upubliceret rapport til DOF og Foreningen til Dyrenes Beskyttelse.

Clausen, P., J. Kahlert, J.P. Hounisen, K. Olsen, E. Bøgebjerg & J.P. Kjeldsen 2007: Tøndermarskens ynglefugle 2005-2006. – Arbejdsrapport fra DMU nr 238, Danmarks Miljøundersøgelser.

Falk, K., H. Nøhr, K. Bendix & H. Hagge 1991: Arealanvendelsen og fuglelivet i Ballum Enge. – Teknisk rapport, Ornis Consult, København.

Fischer, K. 1984: Lokalrapport Ribe Amt 1983. – Meddelelse nr 3 fra Dansk Ornitologisk Forening i Ribe Amt.

Fleet, D.M., J. Frikke, P. Südbeck & R.L. Vogel 1994: Breeding birds in the Wadden Sea 1991. – Wadden Sea Ecosystem No. 1, CWSS & TMAG, Wilhelmshaven.

Fredningsstyrelsen 1983: EF-fuglebeskyttelsesområder. Kortlægning og foreløbig udpegning i henhold til EF-fuglebeskyttelsesdirektivet. – Fredningsstyrelsen, Miljøministeriet.

Gram, I., H. Meltofte & L.M. Rasmussen 1990: Fuglene i Tøndermarsken 1978-1988. – Skov- og Naturstyrelsen.

Grell, M.B. 1998. Fuglenes Danmark.. – Gads Forlag/ Dansk Ornitologisk Forening. København.

Hälterlein, B., D.M. Fleet, R. Henneberg, T. Mennebäck, L.M. Rasmussen, P. Südbeck, O. Thorup & R. Vogel 1995: Vejledning i optælling af ynglefugle i Vadehavet. – Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Joint Monitoring Group for Breeding Birds in the Wadden Sea.

Hansen, T.B. 2001: Hedehøg i Sydvestjylland ynglesæsonen 2001. – Foreningen til Dyrenes Beskyttelse & Dansk Ornitologisk Forening, København.

Jakobsen, B. 1985: Vadehavet 1983, årsrapport over observationer: Langli/Skallingen. – Fredningsstyrelsen.

Jørgensen, H.E. 1989: Danmarks rovfugle. – Frederikshus.

Kahlert, J., P. Clausen. J.P. Hounisen & I.K. Petersen 2007: Response of breeding waders to agri-environmental schemes may be obscured by effects of existing hydrology and farming history. – J. Orn. 184, Suppl. 2: 287-293.

Koffijberg, K., L. Dijksen, B. Hälterlein, K. Laursen, P. Potel & P. Südbeck 2006: Breeding birds in the Wadden Sea in 2001. – Wadden Sea Ecosystem No. 22, Common Wadden Sea Secretariat, Wilhelmshaven.

Laursen, K. 2005: Forekomsten af yngle- og trækfugle i seks EF-fuglebeskyttelsesområder i Vadehavets marsk. – Arbejdsrapport fra DMU nr 219.

Laursen, K. 2006: Assessment of breeding birds in SPAs in Danish Wadden Sea marshland. Pp. 133-141 in K. Laursen (ed.): Proceedings from the 11th Scientific Wadden Sea Symposium, Esbjerg, Denmark, 2005. – NERI Technical Report No. 573.

MacDonald, M.A. & M. Bolton 2008: Predation of Lapwing *Vanellus vanellus* nests on lowland wet grassland in England and Wales: effects of nest density, habitat and predation abundance. - J. Orn. 149: 555-563.

Møller, H.U.S., J. Madsen & M. Iversen 1978: Lokalitetsregistrering i Sønderjylland 1977. – Dansk Ornitologisk Forening og Fredningsstyrelsen.

Pedersen, M.B. 1992: Beskyttelse af kystfugle. – Nyhedsbrev nr 2/1992, Ribe Amt.

Pihl, S., P. Clausen, K. Laursen, J. Madsen & T. Bregnballe 2006: Conservation status of bird species in Denmark covered by the EU Wild Birds Directive. – NERI Tehnical Report No. 570.

Rasmussen, L.M. 1994: Overvågning af fuglene i Tøndermarsken 1992. – Miljøministeriet/Skov- og Naturstyrelsen.

Rasmussen. L.M. 2003: Ynglefugle i Vadehavet 2001. – Danmarks Miljøundersøgelser, Arbejdsrapport fra DMU nr 178 (http://arbejdsrapporter.dmu.dk).

Rasmussen, L.M. 2006. Hedehøg i Sydvestjylland. Ynglesæson 2006. – Dansk Ornitologisk Forening (http://www.dof.dk/sider/images/stories/proj/hedehoeg/dokumenter/hedehoeg2006rap.pdf).

Rasmussen, L.M., J. Frikke & S. Rønnest 1987: Fuglelokaliteter i Ribe Amt 1970-80. – Ribe Amt og Dansk Ornitologisk Forening.

Rasmussen, L.M. & I. Gram 1992: Overvågning af Saltvandssøen og Margrethe Kog 1991. – Miljøministeriet, Skov- og Naturstyrelsen.

Rasmussen, L.M. & K. Fischer 1997: The breeding population of Gull-billed Terns *Gelochelidon nilotica* in Denmark 1976-1996. – Dansk Orn. Foren. Tidsskr. 91: 101-108.

Rasmussen, L.M. & O. Thorup 1998: Ynglefugle i Vadehavet, 1996. – Faglig rapport fra DMU nr 229.

Rattenborg, N. 1987: Ynglende vadefugle på Mandø 1985-1986. – Rapport, Skov- og Naturstyrelsen.

Schekkerman**,** H., W. Teunissen & E. Oosterveld 2008: Mortality of Black-tailed Godwit *Limosa limosa* and Northern Lapwing *Vanellus vanellus* chicks in wet grasslands: influence of predation and agriculture. – J. Orn. 150: 133-145.

Skov, S. 2002: Engsnarre. P. 54 i M.B. Grell: Truede og sjældne ynglefugle 2001. – Dansk Orn. Foren. Tidsskr. 93: 43-66.

Skov- og Naturstyrelsen 1995: EF-fuglebeskyttelsesområder og Ramsarområder. – Miljø- og Energiministeriet.

Soldatt, L., H. Visser, M. van Roomen & A. van Strien 2007: Smoothing and trend detection in waterbird monitoring data using structural time-series analysis and the Kalman filter. – J. Orn. 148, Suppl. 2: 351-357.

The Short-eared Owl belongs to the group of fluctuating species with no clear trend in the Wadden Sea. Photo: Helge Sørensen.
Mosehornuglen fluktuerer uden nogen klar tendens i Vadehavet.

SOVON & CBS 2005: Trends van vogels in het Nederlandse Natura 2000 netwerk. – SOVON-informatierapport 2005/09.

Thalund, J. 1995: Vadehavet 1991, årsrapport over observationer: Langli/Skallingen. – Skov- og Naturstyrelsen.

Thorup, O. 1995: Hedehøg i Sydvestjylland ynglesæsonen 1995. – Upubl. rapport til Dansk Ornitologisk Forening, København.

Thorup, O. 1996: Naturgenopretning i Varde Ådal og strandengene langs Ho Bugt. – Teknisk rapport, Ornis Consult, København.

Thorup, O. 2003: Truede engfugle. Status for bestande og forvaltning i Danmark. – Dansk Ornitologisk Forening, København.

Thorup, O. 2006: Ynglefugle i Vadehavet 2006. – Nyhedsbrev fra DMU, Afd. f. Vildtbiologi og Biodiversitet, Aarhus Universitet.

Thorup, O. & K. Laursen 2008: Status of breeding Oystercatcher *Haematopus ostralegus*, Lapwing *Vanellus vanellus*, Black-tailed Godwit *Limosa limosa*, and Redshank *Tringa totanus* in the Danish Wadden Sea in 2006. – Dansk Orn. Foren. Tidsskr. 102: 255-267.

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Appendix

Population of designated (above line) and other (below line) species in the nine SPAs in the Danish Wadden Sea area during the five census years.

Bestand (par) af udpegede (over linje) og ikke udpegede arter (under linje) i de ni EF-fuglebeskyttelsesområder i det danske Vadehavsområde i de fem optællingsår.

	1983 (1977-85)	1991 (1986-92)	1996	2001	2006
SPA no. 49 Varde Å-Ho Bugt					
Hen Harrier *Circus cyaneus*	0	0	2	0	0
Montagu's Harrier *Circus pygargus*	-	-	4	3	0
Corncrake *Crex crex*	0 (1979)	-	0	3	0
Avocet *Recurvirostra avosetta*	-	0	0	0	0
Ruff *Philomachus pugnax*	0	0	0	0	0
Oystercatcher *Haematopus ostralegus*	-	-	15	6	17
Lapwing *Vanellus vanellus*	-	-	86	101	120
Black-tailed Godwit *Limosa limosa*	1 (1984)	-	1	0	0
Redshank *Tringa totanus*	-	-	80	106	102
References: Fleet et al. 1994, J. Frikke in litt., Hansen 2001, Rasmussen 2003 & 2006, Skov 2002, Thorup 1996, Thorup & Laursen 2008, TMAG Breeding bird database					
SPA no. 51 Ribe-Kongeå-Sneummarsken					
Montagu's Harrier *Circus pygargus*	3	4 (1987)	1	4	5
Hen Harrier *Circus cyaneus*	0	0	0	0	0
Avocet *Recurvirostra avosetta*	55	291	190	163	96
Dunlin *Calidris alpina*	-	-	0	0	1
Ruff *Philomachus pugnax*	13 (1973-80)	17	3	0	2
Common Tern *Sterna hirundo*	-	0	1	9	2
Short-eared Owl *Asio flammeus*	-	-	1	0	0
Black-tailed Godwit *Limosa limosa*	23 (1973-80)	-	26	10	3
References: Christensen & Rasmussen 1996, Fischer 1984, Hansen 2001, Jørgensen 1989, Rasmussen 2006, Rasmussen et al. 1987, Thorup 2003, Thorup & Laursen 2008, TMAG Breeding bird database					
SPA no. 52 Mandø					
Avocet *Recurvirostra avosetta*	0 (1980)	14	21	81	120
Kentish Plover *Charadrius alexandrinus*	0 (1980)	0	0	0	0
Dunlin *Calidris alpina*	2 (1980)	1	0	1	0
Ruff *Philomachus pugnax*	14 (1980)	12	0	0	3
Gull-billed Tern *Gelochelidon nilotica*	1	1	0	0	0
Common Tern *Sterna hirundo*	20	37	143	44	6
Arctic Tern *Sterna paradisaea*	190	235	87	144	191
Little Tern *Sterna albifrons*	0	0	0	0	0
Short-eared Owl *Asio flammeus*	-	0	3	3	2
Pintail *Anas acuta*	1 (1985)	1	0	0	0
Eider *Somateria mollissima*	280 (1985)	286	-	637	183
Oystercatcher *Haematopus ostralegus*	503 (1980)	454	1086	807	928
Lapwing *Vanellus vanellus*	202 (1980)	172	166	255	213
Black-tailed Godwit *Limosa limosa*	25 (1980)	30	22	90	72
Redshank *Tringa totanus*	123 (1980)	136	85	81	86
Turnstone *Arenaria interpres*	0 (1980)	0	0	0	0
References: Fischer 1984, Fleet et al. 1994, Rasmussen & Fischer 1997, Rasmussen & Thorup 1998, Rattenborg 1987, Thorup 2003, Thorup & Laursen 2008, TMAG Breeding bird database					

	1983 (1977-85)	1991 (1986-92)	1996	2001	2006
SPA no. 53 Fanø					
Hen Harrier *Circus cyaneus*	0	0	1	0	0
Avocet *Recurvirostra avosetta*	40	25	18	9	15
Kentish Plover *Charadrius alexandrinus*	5	10	16	17	3
Dunlin *Calidris alpina*	5	10	7	6	0
Ruff *Philomachus pugnax*	2	0	0	0	0
Gull-billed Tern *Gelochelidon nilotica*	0	0	0	0	0
Arctic Tern *Sterna paradisaea*	115	16	47	9	5
Little Tern *Sterna albifrons*	25	25	53	7	6
Short-eared Owl *Asio flammeus*	-	0	0	0	0
Curlew *Numenius arquata*	-	28	21	22	17

References: Fischer 1984, Fleet et al. 1994, Pedersen 1992, Thorup 2003, Thorup & Laursen 2008, TMAG Breeding bird database

SPA no. 55 Skallingen-Langli					
Dunlin *Calidris alpina*	6	3 (1990)	0	0	0
Avocet *Recurvirostra avosetta*	0	13	24	21	32
Ruff *Philomachus pugnax*	4	0	0	0	2
Gull-billed Tern *Gelochelidon nilotica*	0	0	2	0	0
Sandwich Tern *Sterna sandvicensis*	0	0	1039	714	3229
Arctic Tern *Sterna paradisaea*	141	77	224	118	69
Common Tern *Sterna hirundo*	0	0	0	0	0
Little Tern *Sterna albifrons*	2	0	0	0	21
Wigeon *Anas penelope*	0	0	0	0	0
Pintail *Anas acuta*	2	1	1	0	0
Oystercatcher *Haematopus ostralegus*	183	175	160	270	266
Lapwing *Vanellus vanellus*	107	37 (1990)	41	75	56

References: Christensen & Jakobsen 1991, Fleet et al. 1994, Jakobsen 1985, Thalund 1995, Thorup & Laursen 2008, TMAG Breeding bird database

SPA no. 57 Wadden Sea					
Montagu's Harrier *Circus pygargus*	-	-	1	0	1
Avocet *Recurvirostra avosetta*	-	413	174	42	82
Kentish Plover *Charadrius alexandrinus*	-	0	0	2	0
Dunlin *Calidris alpina*	-	5	3	1	0
Ruff *Philomachus pugnax*	-	4	0	0	0
Gull-billed Tern *Gelochelidon nilotica*	0	0	0	0	0
Sandwich Tern *Sterna sandvicensis*	0	0	0	0	0
Common Tern *Sterna hirundo*	0	3	0	0	0
Arctic Tern *Sterna paradisaea*	25	126	8	350	281
Little Tern *Sterna albifrons*	40	13	6	50	34
Short-eared Owl *Asio flammeus*	-	0	3	1	1
Pintail *Anas acuta*	-	0	6	0	0
Eider *Somateria mollissima*	-	106	195	86	30
Oystercatcher *Haematopus ostralegus*	-	372	533	588	386
Lapwing *Vanellus vanellus*	-	184	123	99	78
Black-tailed Godwit *Limosa limosa*	-	13	2	3	0
Redshank *Tringa totanus*	-	440	457	566	433
Lesser Black-Backed Gull *Larus fuscus*	0	2	0	0	0

References: Christensen & Rasmussen 1996, Fischer 1984, Fleet et al. 1994, Hansen 2001, Rasmussen 2006, Rasmussen & Fischer 1997, Thorup 2003, Thorup & Laursen 2008, TMAG Breeding bird database

	1983 (1977-85)	1991 (1986-92)	1996	2001	2006
SPA no. 60 Tøndermarsken					
Montagu's Harrier *Circus pygargus*	17	10	10	4	3
Avocet *Recurvirostra avosetta*	108	302	268	143	177
Kentish Plover *Charadrius alexandrinus*	34	2	1	2	1
Dunlin *Calidris alpina*	1	1	0	0	0
Ruff *Philomachus pugnax*	45	25	5	0	0
Gull-billed Tern *Gelochelidon nilotica*	0	1	0	0	0
Common Tern *Sterna hirundo*	4	64	71	10	0
Arctic Tern *Sterna paradisaea*	38	8	54	0	13
Little Tern *Sterna albifrons*	9	0	0	0	1
Black Tern *Chlidonias niger*	76	26	49	12	19
Short-eared Owl *Asio flammeus*	0	0	0	0	0
Wigeon *Anas penelope*	0	1	2	3	6
Pintail *Anas acuta*	0	0	3	1	4
Black-tailed Godwit *Limosa limosa*	242	128	98	125	126
Little Gull *Larus minutus*	0	0	0	0	0

References: Christensen & Rasmussen 1996, Fleet et al. 1994, Gram et al. 1990, Hansen 2001, Rasmussen 1994 & 2006, Rasmussen & Gram 1992, Thorup & Laursen 2008, TMAG Breeding bird database

SPA no. 65 Rømø					
Hen Harrier *Circus cyaneus*	0	0	2	0	0
Montagu's Harrier *Circus pygargus*	8	9 (1987)	5	1	2
Avocet *Recurvirostra avosetta*	25 (1977)	13	66	47	30
Kentish Plover *Charadrius alexandrinus*	20 (1977)	10	40	68	43
Dunlin *Calidris alpina*	16 (1977)	22	18	12	11
Ruff *Philomachus pugnax*	55 (1977)	12	-	3	3
Gull-billed Tern *Gelochelidon nilotica*	2 (1985)	0	10	0	0
Sandwich Tern *Sterna sandvicensis*	2 (1977)	0	0	1	0
Common Tern *Sterna hirundo*	45 (1977)	50	0	2	2
Arctic Tern *Sterna paradisaea*	170 (1977)	109	637	281	160
Little Tern *Sterna albifrons*	16 (1977)	3	160	162	15
Short-eared Owl *Asio flammeus*	0 (1977)	0	5	0	0
Pintail *Anas acuta*	-	0	2	0	2
Black-tailed Godwit *Limosa limosa*	55 (1977)	83	62	73	51
Curlew *Numenius arquata*	31 (1977)	36	26	-	22

References: Christensen & Rasmussen 1996, Fleet et al. 1994, Hansen 2001, Jørgensen 1989, Møller et al. 1978, Rasmussen 2006, Rasmussen & Fischer 1997, Thorup 1995 & 2003, TMAG Breeding bird database

SPA no. 67 Rejsby-Brøns-Ballummarsken					
Montagu's Harrier *Circus pygargus*	3	4 (1987)	11	12	5
Avocet *Recurvirostra avosetta*	-	60	15	35	21
Ruff *Philomachus pugnax*	35 (1977)	0 (1990)	0	0	0
Common Tern *Sterna hirundo*	-	0	0	0	8
Short-eared Owl *Asio flammeus*	-	-	0	0	0
Lapwing *Vanellus vanellus*	-	-	839	633	577
Black-tailed Godwit *Limosa limosa*	-	-	45	13	11
Redshank *Tringa totanus*	-	-	67	45	38

References: Christensen & Rasmussen 1996, Falk et al. 1991, Hansen 2001, Jørgensen 1989, Møller et al. 1978, Rasmussen 2006, Thorup 1995 & 2003, TMAG Breeding bird database