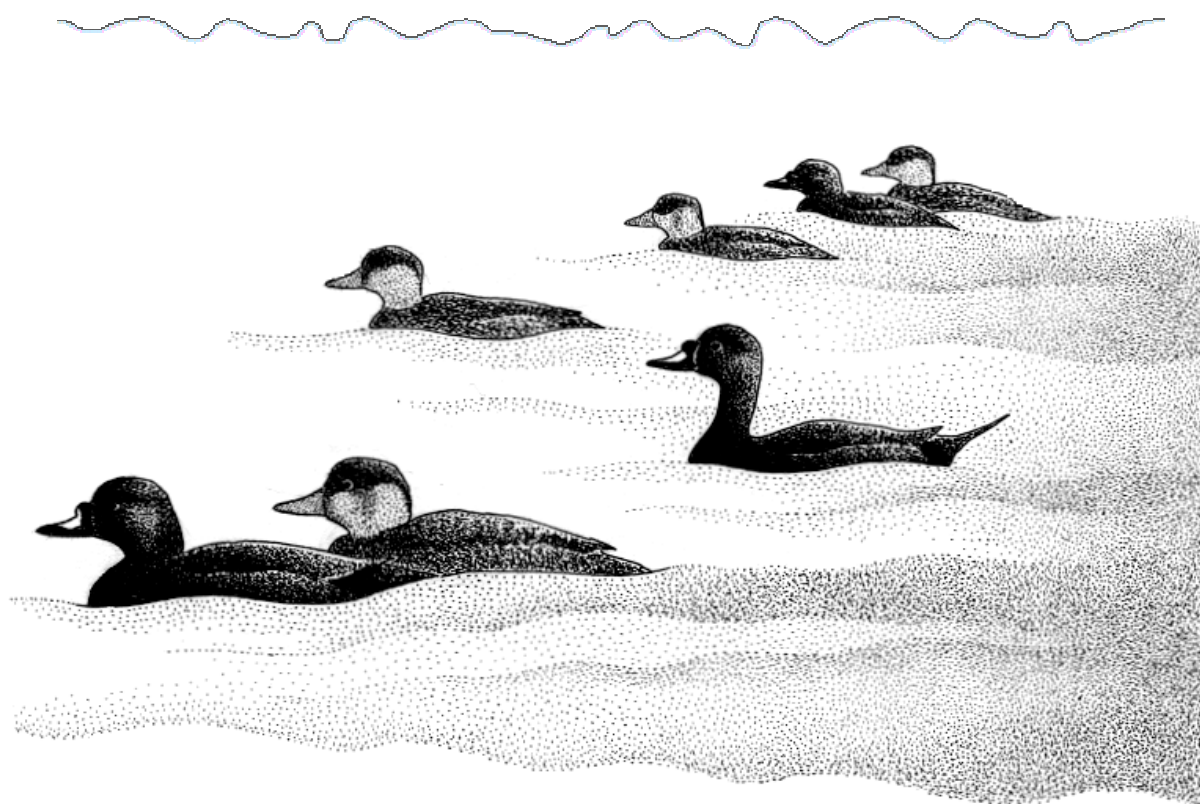


CHAPTER THREE

FOCAL SPECIES AND THE DESIGNATION AND MANAGEMENT OF MARINE PROTECTED AREAS: SEA- AND COASTAL BIRDS IN BELGIAN MARINE WATERS



based on the manuscript submitted to:

Aquatic Conservation: Marine and Freshwater Ecosystems

Jan Seys^{1}, Patrick Meire² & Eckhart Kuijken¹*

¹ *Institute of Nature Conservation, Kliniekstraat 25, B-1070 Brussel, Belgium*

² *University Antwerpen, Department Biology, Universiteitsplein 1, B-2610 Wilrijk, Belgium*

^{*} *present adress: Flanders Marine Institute (VLIZ), Victoriaalaan 3, B-8400 Oostende, Belgium*

Focal species and the designation and management of marine protected areas: sea- and coastal birds in Belgian marine waters

J. Seys, J. Van Waeyenberge, P. Meire, M. Vincx & E. Kuijken

ABSTRACT

The various groups of linear sand ridges off the continental coast of the southernmost part of the North Sea (the 'Flemish Banks') have an important seabird conservation value. During an intensive seabird surveying programme from 1992 till 1998 in the Belgian part of it, eleven species were counted in numbers amounting to 1-5% of the flyway population in an area of merely 3500 km². Six of them (Red-throated Diver, Common Scoter, Little Gull, Sandwich Tern, Common Tern, Little Tern) are considered as of international conservation value and were selected as focal species. Hotspots are situated on the shallow Westkustbanken, in the neighbourhood of the Zeebrugge outer harbour and on the Vlaamse Banken. In addition, during the 1990s the Zeebrugge harbour accommodated a medium-sized colony of Sandwich Tern (1650 pairs) and some of the largest colonies of Common (2260 pairs) and Little Tern (430 pairs) of NW-Europe. The present conservation status of these areas is insufficient and marine protected areas (in the widest sense) are needed to safeguard the strongholds for Belgian seabirds. Oil-sensitivity maps indicate that the most vulnerable sites are too close to some of the busiest shipping routes of the world to consider any rerouting measure. Weighing the disturbance-sensitivity of different subareas shows that only on the hotspots for divers and scoters there is a need to restrict boating activity during winter. In addition this southernmost part of the North Sea is a very important corridor for seabird migration. An estimated 1-1.3 million seabirds, with one-third being focal species for conservation, may fly through this bottleneck each year. New developments such as wind parks that might have a detrimental impact on resident as well as migrating seabirds must be carefully investigated.

INTRODUCTION

A worldwide call for environmental protection and installation of marine protected areas has emerged (BERGMAN *et al.* 1991, AGARDY 1994, EICHBAUM & AGARDY 1996, CONOVER *et al.* 2000, SALM *et al.* 2000). Fully protected reserves can protect critical habitat for fishery and benthic resources that have been depleted through overharvesting or habitat destruction, or help to conserve marine diversity. Provided the protected area is large enough, they can also enhance the harvest of stocks outside the reserve. Marine protected areas (MPA's) cover the entire range from fully protected marine reserves to areas where management of activities is geared towards conservation needs. In the process of designating marine protected areas, sea- and coastal birds cannot be overlooked and often play an important role. Several seabird species are threatened and need protection measures to save them from a further population decline (TUCKER & EVANS 1997). Moreover, seabirds as top-predators may act as indicators for pollution or food availability (BECKER 1989, MONTEVECCHI 1993, FURNESS & CAMPHUYSEN 1997) and hence reflect the state of the habitat they live in. Compared with fish, marine mammals and other animals that live primarily or exclusively underwater, seabirds are easy to survey. Standard surveying methods for seabirds have been developed (TASKER *et al.* 1984, KOMDEUR *et al.* 1992), enabling the collection of large amounts of data that can easily be compared and put into an international perspective. Finally, seabirds may enhance the public support for marine protected areas as a conspicuous and attractive part of the ecosystem.

Belgium recently adopted the 'Law on the protection of the marine environment in sea areas under Belgian jurisdiction' (20.01.1999: OFFICIAL JOURNAL – BELGISCH STAATSBLAD 12.03.1999) that provides a tool for the protection of species and the conservation and management of habitats through the designation of marine protected areas (CLIQUET 2000). In order to establish MPA's in Belgian waters and help guiding the management of these areas, a detailed picture of where and when important seabird concentrations occur is essential as well as background information on how various activities may affect their distribution and behaviour. The demarcation of MPA's should aim at maximizing either the number of rare species that will be protected within the MPA or the number of species whose viabilities might suffer from human activities outside the MPA. Although several atlases of seabird distribution in north-west European waters have been produced since the start of regular ship-based surveys in Europe in the 1970s (BAPTIST & WOLF 1993, CARTER *et al.* 1993, CAMPHUYSEN & LEOPOLD 1994, CAMPHUYSEN *et al.* 1995, SKOV *et al.* 1995, STONE *et al.* 1995, OFFRINGA *et al.* 1996), none but one has a scale that can guide regional conservation and management sufficiently. The work of OFFRINGA *et al.* (1996) did focus on the southernmost part of the North Sea, but included data up to February 1995 and therefore urgently needed an update.

In this paper we give a summary of all seabird data collected in Belgian marine waters during 1992-1998 and evaluate the ornithological conservation value of this part of the North Sea. Species that deserve protection priority (further referred to as focal species,

i.e. target species: ZACHARIAS & ROFF 2001) are selected by using criteria of abundance and vulnerability. Maps of the cumulative abundance of these focal species show the hotspots of internationally threatened seabird species in Belgium. In addition vulnerability maps are produced for two direct threats to seabirds at sea, namely oil pollution and shipping disturbance. Oil pollution is widely recognized as one of the major threats to seabirds in North and West European seas (DUNNET *et al.* 1990, FURNESS 1993, TUCKER & EVANS 1997, CAMPHUYSEN & HEUBECK 2001) and beached bird surveying in Europe have demonstrated that the southern North Sea must be regarded as the area most heavily affected by chronic oil pollution (CAMPHUYSEN & VAN FRANEKER 1992). The vulnerability for oil shows important differences between species (KING & SANGER 1979, CAMPHUYSEN *et al.* 1999). Disturbance by shipping activities is generally considered of much less overall influence (TUCKER & EVANS 1997, CAMPHUYSEN & LEOPOLD 1998), but may seriously affect a few disturbance-sensitive species. In order to evaluate the potential impact of new developments on migrating seabirds in this part of the North Sea (e.g. wind parks), we

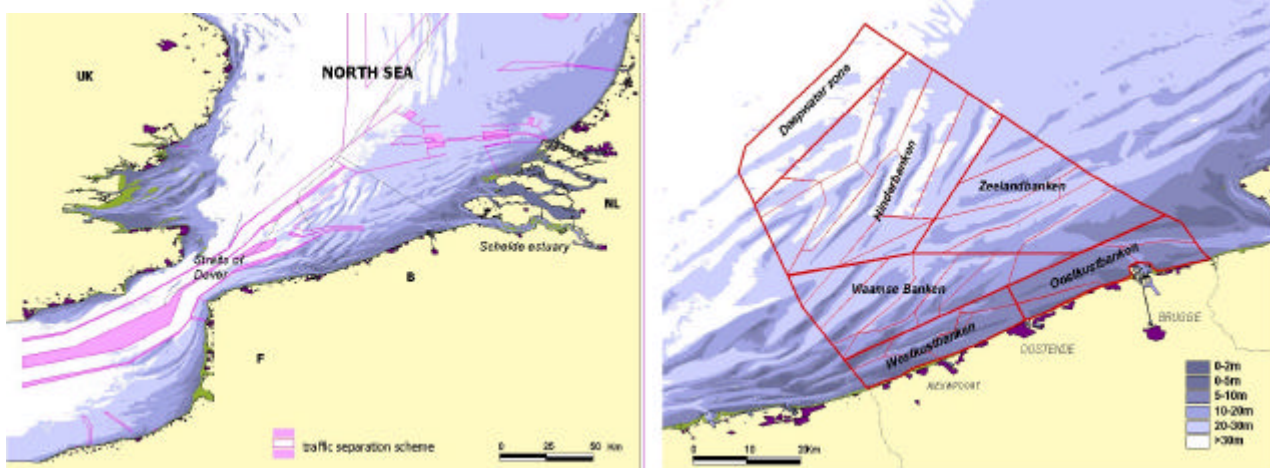
estimated the proportion of the biogeographic population of the most important species that pass through this southernmost part of the North Sea. Shellfishery is not allowed in Belgian marine waters (Royal Decree 1998) and hence the kind of issues arising in The Netherlands and other neighbouring countries (VAN DE KUIP 1991, LEOPOLD 1993, BORCHARDT 1995, SMIT 1995, LEOPOLD & VAN DER LAND 1996, HUNT *et al.* 1999, PIERSMA & CAMPHUYSEN 2001) are not known here. Other impact factors on seabirds are not treated due to lack of specific data or because the impact-effect relationship has not yet been quantified sufficiently. Maps of disturbance sensitivity and oil-vulnerability were produced, using a combination of relative abundance of species and specific vulnerability ratings. We used a methodology similar to the oil vulnerability maps produced by TASKER & PIENKOWSKI (1987), CARTER *et al.* (1993) and maps of important bird areas by SKOV *et al.* (1995). Finally, results are discussed in a context of present conservation tools and implications for future management.

MATERIAL & METHODS

STUDY AREA

Belgian marine waters are situated in the funnel-shaped southernmost part of the North Sea, at the entrance to the Channel. They cover an area of approximately 3500 km² and waters are comparatively shallow (less than 30-40 m). Sediments consist of medium to fine sands, with the smallest median grain-sizes found near the mouth of the Schelde estuary (VANNIEUWENBORGH 1982, HOUTHUYS 1990). The study-area is characterised by the occurrence of four sandbank systems or groups of linear sand ridges, each with their own steepness, strike and distance to the coast (BASTIN 1974, EISMA *et al.* 1979, DE MOOR 1985)(Fig. 1). The *Kustbanken* run parallel and at less than 10 km to the coastline, the mean depth is only 2-3 m and fine sediments are deposited here (particularly at the east-coast near the Westerschelde mouth). The *Vlaamse Banken* and *Hinderbanken* result from sand

accumulation and are oriented in an angle of c. 40° to the coastline, with the *Hinderbanken* situated much further offshore (Fig. 1). The *Zeelandbanken* have a resistant core of older deposits, are partly erosional remnants (HOUBOLT 1968, EISMA *et al.* 1979) and are largely situated in Dutch waters. Based on these sandbank systems, we subdivided Belgian marine waters in six subregions, further split up into a various number of sandbank-units (Fig. 1). Each sandbank-unit consists of at most three topographic strata: swales, slopes and crests, defined as < 10 m deep (crest), 10-20 m (slope) and > 20 m (swale)(except for the inshore Oostkust- and Westkustbanken, where < 5 m, 5-10 m and > 10 m respectively). With 1-3 depth strata in each sandbank-unit, we finally retain 96 bank strata as units for purposes of mapping and analysis.



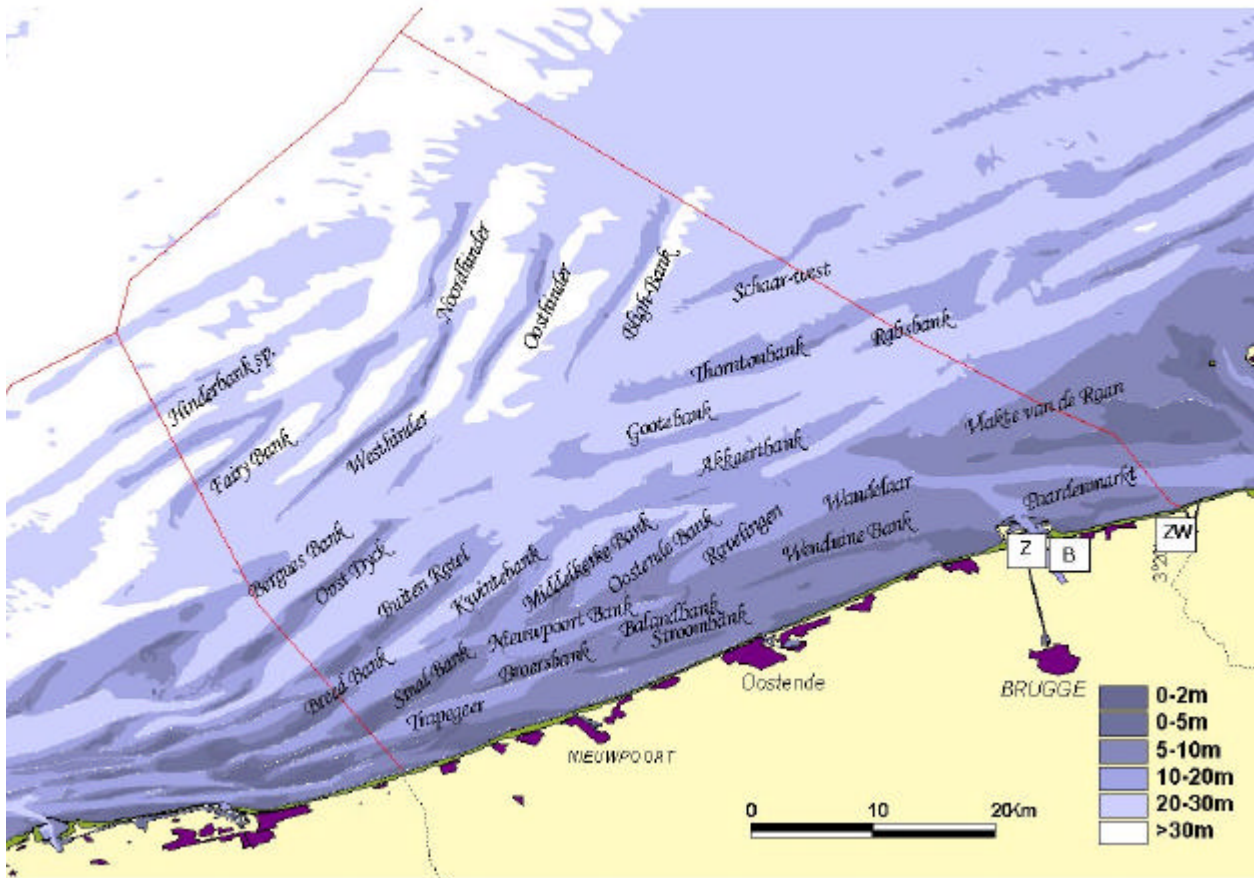


Fig. 1. Belgian study-area, with: (a) setting within the Southern Bight of the North Sea; (b) subdivision in 6 subregions and 35 sandbanks; (c) most important sandbanks and tern colonies: Z=Zeebrugge, B=Baai van Heist, ZW=Zwin

Peak flood and ebb currents are directed respectively northeast and southwest. The mean tidal range near the Belgian coast is about 3-5 m. The mean tidal movement corresponds to an elongated current ellipse. The velocity of the surface peak currents attains values of 1 m s^{-1} (VAN CAUWENBERGHE 1992). The Belgian coastline measures 65 km and counts three small (Nieuwpoort, Blankenberge, Oostende) and one

medium-sized harbour (Zeebrugge). The harbour of Zeebrugge extended seaward in the early 1980s, creating some 150 ha of temporary nesting areas for terns and gulls (SEYS *et al.* 1998). For more details on the study area see OFFRINGA *et al.* (1996) and SEYS *et al.* (submitted).

SURVEY METHODS

Various methods have been applied to collect seabird data within the study-area:

(1) Ship-based surveys were carried out in the period September 1992 - December 1998, using a standard strip transect method for counting seabirds at sea (TASKER *et al.* 1984). The study-area has been covered as good as possible during regular trips on board of the *Belgica* and the *Ter Streep* and on fixed ferry-routes from Oostende to Ramsgate or Dover. The total effort in Belgian marine waters amounted to 16,000 km or a total transect area of 4817 km². Every square km has on average been surveyed 1.4 times, with more than twice as much effort during winter and autumn compared to spring-summer. Only the most offshore deepwater zone has been poorly covered (32 km²).

Ferry counts on fixed routes accounted for 20% of the total travelled distance. The ferry results will further be used to document seasonal patterns in occurrence of seabirds in the southernmost part of the North Sea.

(2) Land-based winter counts of inshore species (scoters and other seaducks, grebes, divers) in the shallow western coastal bank area (DEVOS 1990, unpublished data IN), held on an irregular base.

(3) Aerial winter counts of scoters. The entire coastal stretch to a distance of approximately 15 km has been counted on a monthly base during winter since 1986, flying at a speed of 100-140 km h⁻¹ and at a height of 150 m (MAERTENS *et al.* 1988, 1990, DEVOS *et al.* 1991, OFFRINGA 1997, VAN WAEYENBERGE 1998). The plane flew

along fixed survey lines, which enabled a full count of all birds present in the survey area.

(4) Counts of gulls on beaches, groins and seafronts and in harbours on the entire Belgian coastal stretch of 65 km were performed in December 1989 (DEVOS & DEBRUYNE 1990), July and September 1990 (DEVOS & DEBRUYNE 1991) and on a monthly base during the winter 1998-99 (SPANOGHE 1999).

(5) Census programme of breeding gulls and terns carried out yearly in the main colonies (DE PUTTER & ORBIE 1990, ORBIE 1991, DE PUTTER & WILLEMYNS 1992, DE SCHEEMAER 1992, VAN DEN BOSSCHE *et al.* 1995, DEVOS & ANSELIN 1997, SEYS *et al.* 1998).

In addition we assessed the importance of the area as a corridor for migrating seabirds from literature findings. An estimate of peak numbers of seabirds in the study-area on the basis of cumulative densities over a longer period does not tell how many individual specimens of each species may actually migrate through the southernmost part of the North Sea. Particularly those species that tend to migrate in large numbers during a rather short period and restricted to

a well-defined corridor may be missed. We roughly estimated, on the basis of literature findings, what proportion of the flyway population of the most abundant seabird species fly through the southernmost part of the North Sea (in between 51° and 52° N), either on migration from or to their wintering grounds, or as residents of this part of the North Sea. We can imagine that some (theoretical) species arrive in the area, stay here and do not move any further. In such a species, the total number will probably approach the estimate based on density data very well. At the other extreme, some seabird species try to migrate through the study-area as quickly as possible. They will probably be missed completely during regular ship-based surveys, and here the actual number will have to be based entirely upon knowledge of the general migration patterns. In reality, most seabirds demonstrate a mixed pattern, with total numbers to be derived from weighing both resident populations and migration against each other.

DATA ANALYSIS AND PRESENTATION

Estimates of total numbers

Birds counted during ship-based surveys within a 300 m transect were transformed into densities (N km⁻²), applying a correction factor for small and dark swimming birds (STONE *et al.* 1995). Total counts from aerial-, land-based and breeding colony surveys were added to the database, after converting total numbers for the counted area to densities per sandbank stratum. This method is in line with the way data were processed at a North Sea scale by Skov *et al.* (1995). Hence density data of terns are largely based on total number of breeding birds spread out over the known feeding range around the major colony of Zeebrugge. The overall maximal densities per 1x1 minute square (each square was counted on average 3.8 times) were then averaged by sandbank stratum and season (with seasons defined as: winter= December-February, spring= March-May, summer= June-August, autumn= September-November). Estimates of maximal total numbers per species in Belgian marine waters were obtained directly from aerial-, land-based- and breeding colony surveys or from ship-based actions after extrapolating the densities to the full extent of the study-area. Total numbers were assessed for the Belgian marine waters as a whole (3500 km²). To compensate for the size of a marine area in determining its international importance, Skov *et al.* (1995) standardized the values to an area of 3000 km², a value comparable to the size of our study-area.

Selection of focal species

From the 121 bird species observed above Belgian marine waters, 99 were strictly terrestrial (passerines, swallows, owls, birds of prey, pigeons), aquatic but not marine (waders, rails, grebes other than Great-crested Grebe *Podiceps cristatus*, herons, geese and ducks) or marine but too rare (< 80 specimens observed during entire study-period) to be considered any further. Out

of the remaining 23 species, a small set of focal species was selected. In general terms focal species are for ecological or social reasons believed to be valuable for the understanding, management and conservation of natural environments. Collectively, they are species on which our attention is preferentially focussed for one reason or another (ZACHARIAS & ROFF 2001). We took as focal species seabirds that need attention due to an unfavourable international conservation status and are found in internationally important numbers in the Belgian marine waters. They should:

(1) attain 1% of the flyway population in Belgian marine waters (at least in one season), conform the 1% criterion of the 'Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat'

(2) be included in:

* the EC-Birds Directive (79/409) on the Conservation of Wild Birds', Annex I ('Species that are the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution'),

* the Bern Convention on the Conservation of European Wildlife and Natural Habitats, Appendices I/II ('Species which habitats should be protected from deliberate damage or destruction') or

* the Bonn Convention on the Conservation of Migratory Species of Wild Animals, Appendices I/II ('Species in danger of extinction throughout all or major parts of their range', 'Species which would benefit from international cooperation in their conservation and management' respectively)(see TUCKER & EVANS 1997).

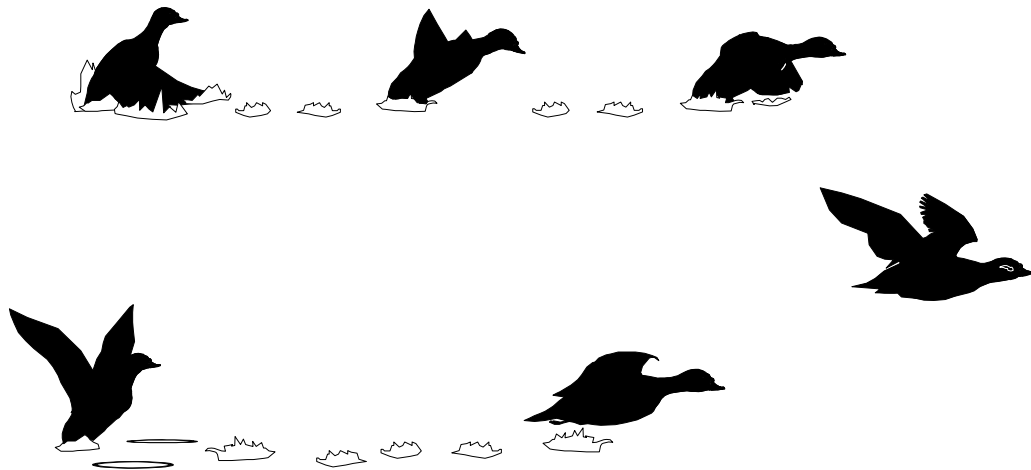
Species that surpass the 1% criterion in Belgian marine waters but are not included in the highest priority lists of the legislative instruments mentioned above, are further referred to as 'locally important species'.

Hotspots for focal species and areas with high concentrations of oil- and disturbance vulnerable species

For each of the focal species the distribution in time and space is described and illustrated. A cumulative picture of the hotspots for the focal species is presented, showing where major concentrations of the most threatened birds occur. The 'value' that has been calculated for each bank stratum corresponds to the relative density, times a weight-factor. The weight equals to the $\log(x+1)$ of the highest observed percentage of the flyway population of that species in Belgian marine waters. The relative density is 0, 1, 2, 3 or 4 depending on whether the species is observed within a bank stratum in density classes of 0%, 1-25%, 25-50%, 50-75% or 75-100% of the maximal value observed for that species in all bank strata in that season.

In a second approach not the rarity of bird species is emphasised, but the vulnerability towards oil pollution. We calculated a value for each bank stratum by multiplying the relative densities of the 23 common seabird species with a weight factor. This weight factor is the oil vulnerability index (OVI), as developed for North Sea waters by CAMPHUYSEN (1998), divided by hundred. This OVI integrates values for various aspects of distribution and behaviour and ranges from <30 (slightly vulnerable) to 50-70 (highly vulnerable).

Disturbance sensitivity maps include a weight-value based on the traffic disturbance index (TDI), as developed for the southern North Sea by CAMPHUYSEN *et al.* 1999. The TDI combines different aspects of occurrence and behaviour on a six-points scale. We simplified the TDI values to four classes: 0 (slightly sensitive: TDI < 35), 1 (moderately sensitive: TDI 35-40), 2 (sensitive: TDI 40-50) or 3 (highly sensitive: TDI:50-65).



RESULTS

SELECTION OF FOCAL SPECIES

Out of the 23 more common seabird species observed in Belgian marine waters, 6 species were retained as 'focal species' after applying the criteria described above: Red-throated Diver, Common Scoter, Little Gull, Sandwich Tern, Common Tern and Little Tern (Table 1). Another 5 species exceeded the 1%-criterion but are not mentioned in the highest priority lists of the Bern Convention, the Bonn Convention or

the EC-Birds Directive. These species (Great-crested Grebe, Great Skua, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull) are referred to as 'locally important species'. Another 12 sea- and coastal bird species regularly occur in the area (with total number of specimens observed > 80 during the study-period)(Table1).

Table 1: Selection of focal seabird species in Belgian marine waters, based on: 1) maximal numbers observed by season during ship-based surveys or additional aerial-and land-based counts (LW= Land-based/winter; AW= Aerial/winter; BS= Breeding numbers/summer-spring); 2) the size of the flyway population; 3) their global status as indicated by international conservation instruments/agreements (EC-BD= Birds Directive; Bern=Bern Convention; Bonn= Bonn Convention). Bold figures outnumber the 1% norm, outlined by ROSE & SCOTT (1997) or 1% of the estimated population as published by: (2) LLOYD et al. (1991); (3) HILDEN & TASKER (1997); (4) HARRIS (1997). Other sources: * DEVOS & DEBRUYNE (1991). Only the 23 sea- and coastal bird species of which more than 80 specimens have been observed in the study-area during 1992-98 are included in the table.

Species	Maximal numbers observed in Belgian marine waters (ship-based surveys)				Additional data (land-based, aerial & colony counts)	1% Flyway population (ref.)	EC-BD Ann.	Bern App.	Bonn App.
	Spr.	Sum.	Aut.	Win.					
FOCAL SPECIES									
<i>Gavia stellata</i>	246	0	183	1453		750 NW-Europe (1)	I	II	II
<i>Melanitta nigra</i>	992	372	771	5846	15528 AW	16000 NW-Afr., W-Siberia, W/N-Europe (1)		III	II
<i>Larus minutus</i>	3670	207	2396	1861		750 C/E-Europe (1)		II	
<i>Sterna sandvicensis</i>	274	659	108	0	3300 BS	1500 W-Europe, W-Africa (1)	I	II	II
<i>Sterna hirundo</i>	60	437	180	0	3900 BS	1800 S/W-Europe (1)	I	II	
<i>Sterna albifrons</i>	0	13	0	0	860 BS	340 E-Atlantic (1)	I	II	II
LOCALLY IMPORTANT SPECIES									
<i>Podiceps cristatus</i>	397	0	297	3736	3150 LW	1500 NW-Europe (1)			III
<i>Stercorarius skua</i>	14	88	439	40		272 Europe, W-Africa (1)			III
<i>Larus fuscus</i>	5951	5310	15608	737		4500 W-Europe, Medit., W-Africa (1)	II	X	
<i>Larus argentatus</i>	5159	1669	6094	5158	19272 LW (*)	14000 NW-Europe (1)			III
<i>Larus marinus</i>	628	524	3517	5727		4800 NE-Atlantic (1)	II	X	
OTHER SEA- & COASTAL BIRD SPECIES (> 80 specimens)									
<i>Alca torda</i>	728	0	824	3791		4820 NW-Europe (3)			III
<i>Fulmarus glacialis</i>	933	1312	1441	325		100000 NE-Atlantic (2)			III
<i>Morus bassanus</i>	1676	641	3714	619		8920 NE-Atlantic (2)			III
<i>Phalacrocorax carbo</i>	381	13	34	5		3200 NW-Europe (1)			III
<i>Anas penelope</i>	854	0	4	83	7956 LW	12500 NW/NE-Europe, W-Siberia (1)			III II
<i>Aythya marila</i>	0	0	0	0	1940 LW	3100 NW-Europe (1)	II/III	III	II
<i>Somateria mollissima</i>	0	0	41	1421	4953 AW	15000 Baltic, Denmark, The Netherlands (1)			III II
<i>Melanitta fusca</i>	0	0	124	11	540 LW	10000 N-Europe, W-Siberia (1)	II	III	II
<i>Larus ridibundus</i>	2122	243	1245	2150	4220 LW (*)	50000 NW-Europe (1)			III
<i>Larus canus</i>	5932	71	2853	6927		16000 NW/C-Europe, Atlantic, Medit. (1)	II	III	
<i>Rissa tridactyla</i>	2340	569	4237	5648		84000 E-Atlantic (1)			III
<i>Uria aalge</i>	6056	255	1217	13101		19900 NW-Europe (4)			III

Eleven species have been observed with more than 1% of the flyway population during the 1992-98 study-period. Only two species (Little Gull, Lesser Black-backed Gull) did so in more than one season (Table 1).

The highest share (nearly 5%) of an entire sea- or coastal bird population in Belgian marine waters, was observed in the Little Gull (Table 2).

Table 2: Status and vulnerability of the dominant sea- and coastal bird species of Belgian marine waters. Indicated are: the priority category (see Table 1, with F: focal species, L: locally important species, O: other), the maximal proportion of the flyway population observed within Belgian marine waters and the season when those peak densities occurred, the European SPEC-category and Threat Status (TUCKER & EVANS 1997), the 'oil vulnerability index' (OVI) according to CAMPHUYSEN (1998) and the 'traffic disturbance index' (TDI) following CAMPHUYSEN et al., 1999. The OVI for *S.albifrons* and *S.sandvicensis* is assumed to be similar to *S.hirundo* (*), for the TDI of *S.albifrons*(**) the mean value of *S.sandvicensis* & *S.hirundo* has been applied. For *Anas penelope* we adopted the same TDI as for *Aythya marila* (***). Various shadings are used for classes of oil and disturbance vulnerability, with: slightly sensitive (white), moderately sensitive (light grey), sensitive (grey), highly sensitive (dark grey).

Category	Species	Max.% of population (season) = x	SPEC category (1)	European Threat Status (2)	Conservation Value Index (=log(x+1))	Oil Vulnerability Index (OVI)	Traffic Disturbance Index (TDI)
F	<i>Larus minutus</i>	4.9% (spring)	3	D	0.77	46	40
F	<i>Sterna albifrons</i>	2.5% (spring/summer)	3	D	0.54	35*	36**
F	<i>Sterna sandvicensis</i>	2.2% (spring/summer)	2	D	0.51	35*	37
F	<i>Sterna hirundo</i>	2.2% (spring/summer)	-	S	0.51	35	35
F	<i>Gavia stellata</i>	1.9% (winter)	3	V	0.46	50	52
F	<i>Melanitta nigra</i>	1.0% (winter)	-	S	0.30	52	60
L	<i>Podiceps cristatus</i>	2.5% (winter)	-	S	0.54	45	43
L	<i>Stercorarius skua</i>	1.6% (autumn)	4	S	0.41	48	26
L	<i>Larus fuscus</i>	3.5% (autumn)	4	S	0.65	46	35
L	<i>Larus argentatus</i>	1.4% (winter)	-	S	0.38	42	35
L	<i>Larus marinus</i>	1.2% (winter)	4	S	0.34	52	37
O	<i>Alca torda</i>	0.8% (winter)	4	S	0.38	64	47
O	<i>Uria aalge</i>	0.7% (winter)	-	S	0.26	62	46
O	<i>Anas penelope</i>	0.6% (winter)	-	S	0.20	19	39***
O	<i>Aythya marila</i>	0.6% (winter)	3 ^w	L ^w	0.20	45	39
O	<i>Larus canus</i>	0.4% (winter)	2	D	0.15	36	27
O	<i>Morus bassanus</i>	0.4% (autumn)	2	L	0.15	54	39
O	<i>Phalacrocorax carbo</i>	0.1% (spring)	-	S	0.11	42	34
O	<i>Somateria mollissima</i>	0.2% (winter)	-	S	0.11	56	51
O	<i>Rissa tridactyla</i>	0.1% (winter)	-	S	0.11	54	40
O	<i>Larus ridibundus</i>	0.1% (winter)	-	S	0.08	36	19
O	<i>Melanitta fusca</i>	0.1% (winter)	3 ^w	L ^w	0.04	52	52
O	<i>Fulmarus glacialis</i>	0.0% (autumn)	-	S	0.00	50	39

- (1) The following 'Species of European Conservation Concern' (SPEC) categories are mentioned: category 2= concentrated in Europe but with an unfavourable conservation status; 3= not concentrated in Europe but with an unfavourable conservation status; 4=concentrated in Europe and with a favourable conservation status; ^w: relates to winter
- (2) European Threat Status: D(eclining), S(ecure), V(ulnerable), L(ocalized), ^w: relates to winter populations

DISTRIBUTION OF FOCAL SPECIES

Red-throated Diver *Gavia stellata* and Common Scoter *Melanitta nigra* are basically wintering species. Little Gull *Larus minutus* shows important numbers in all seasons except summer. Three tern species breed in the outer harbour of Zeebrugge since the late 1980s in numbers amounting to more than 2% of the flyway population (Table 2).

LITTLE GULL (LARUS MINUTUS)

Some 75,000 pairs of Little Gull breed in lowland freshwater wetlands of Siberia, Finland, Sweden, Poland and the Baltic states (CRAMP & SIMMONS 1983, ROSE & SCOTT 1997). Outside the breeding season, Little Gulls are mainly coastal and marine in their distribution and concentrate on current lines or fronts, where they

feed on small invertebrates by surface-dipping. Each year during spring between 8000 and 20,000 Little Gulls are observed at the Dutch coast (DEN OUDEN & STOUIGIE 1990). However, the very high numbers seen in spring 1988-91 by Dutch seabird watchers demonstrate that in some years probably 50-100% of the entire flyway population migrate through the area (CAMPHUYSEN & LEOPOLD 1998). About 90% of the birds in our study-area were identified as adults. The Little Gull has an unfavourable conservation status in Europe (Table 2) and populations are declining (TUCKER & EVANS 1997).

The seasonal pattern shows a peak of sightings in March-April, and to a lesser extent in autumn (September-November). Little Gulls are present in small numbers throughout the winter (Fig. 2).

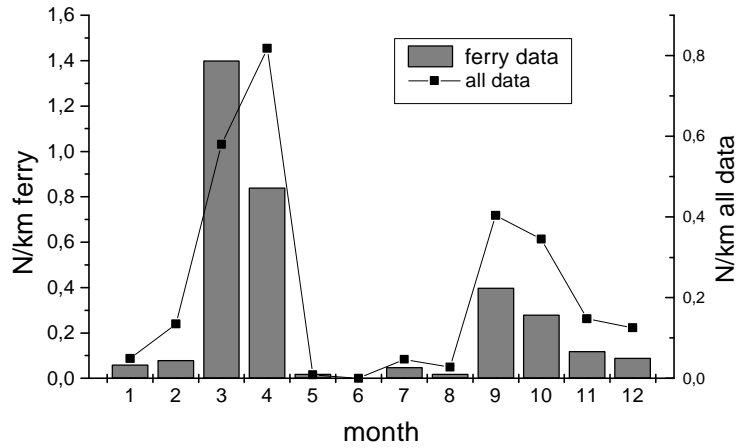


Fig. 2. Seasonal pattern of occurrence ($N\ km^{-1}$) of Little Gull *Larus minutus* in the southernmost part of the North Sea during 1992-98. The pattern based on ferry data - collected on fixed routes - is indicated separately.

Little Gulls at sea are usually seen in small flocks (< 10 birds), although they may form larger groups (CAMPHUYSEN & LEOPOLD 1994, KEIJL & LEOPOLD 1997). The southernmost part of the North Sea appears very attractive for larger flocks (see also VAN IMPE 1966, BULTEEL & VAN DER VLOET 1969). At several occasions flocks of 200-500 birds were encountered on the French

side of the Vlaamse Banken. Groups of 50-250 individuals are not rare near the harbour of Oostende. The core-areas for Little Gull in Belgian waters are situated on the Vlaamse Banken in winter and spring, and in the Stroombank-area and the Vlakte van de Raan in autumn (Fig.3).

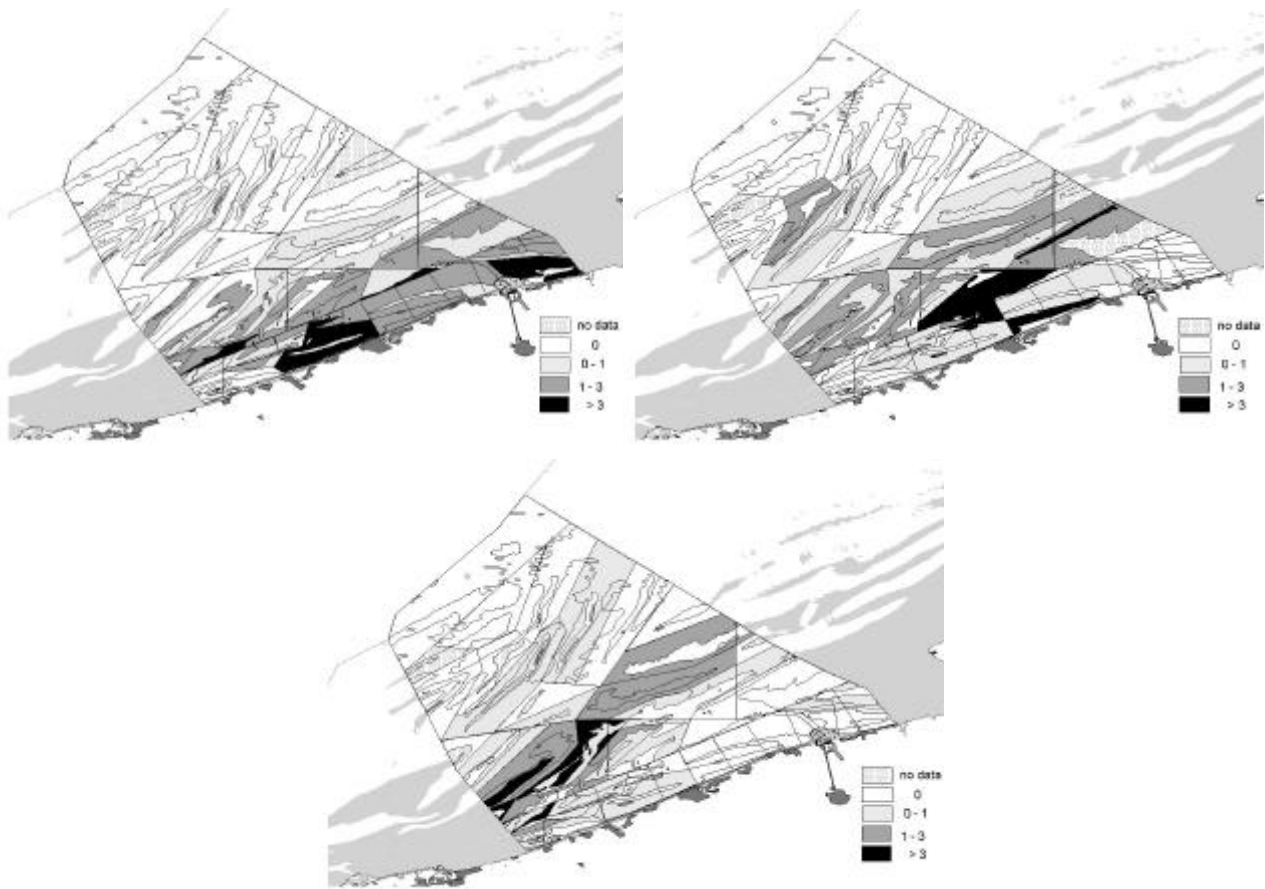


Fig. 3. Distribution ($N\ km^{-2}$) of Little Gull *Larus minutus* in Belgian marine waters during 1992-98 in: a) autumn b) spring and c) winter

RED-THROATED DIVER (GAVIA STELLATA)

Over 80% of the European breeding population of Red-throated *Gavia stellata* and Black-throated Diver *G. arctica* breed in Russia and Scandinavia (TUCKER & HEATH 1994, HAGEMEIJER & BLAIR 1997). Closest breeding grounds are in Scotland, Iceland and Fennoscandia. In winter these birds, but also birds from Greenland (OKILL 1994), enter the southern North Sea, forming small flocks in shallow coastal areas. Major concentrations during the non-breeding season occur in the south-eastern North Sea (SKOV *et al.* 1995). They feed on a large variety of small fish, the main prey items being Cod *Gadus morhua*, Herring *Clupea harengus*, Sprat *Sprattus sprattus*, gobies and sticklebacks (MADSEN 1957, CRAMP & SIMMONS 1977, GLUTZ VON BLOTZHEIM & BAUER 1980, LEOPOLD unpubl. data).

Of 2632 divers observed during 1992-98 in the study-area, 54% were identified to species-level. Red-throated Diver is dominant with 92% versus 8% Black-throated Diver (and 3 Great Northern Divers). Two out of three of the Red-throated Divers in our study-area were identified as adults. Divers have an unfavourable conservation status in Europe, with populations considered to be 'vulnerable' according to the European Threat Status (TUCKER & EVANS 1997). They are listed on Annex I of the EC Birds Directive 1979, are very vulnerable to oil-pollution and highly sensitive to disturbance by shipping activities.

Red-throated Divers are winter visitors, with highest numbers in November-March (see also CAMPHUYSEN & LEOPOLD 1994). No birds have been observed at sea from May to September (Fig.4).

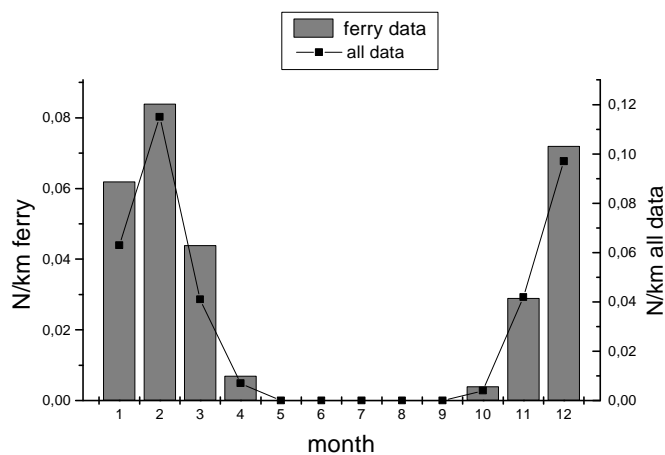


Fig. 4. Seasonal pattern of occurrence ($N\ km^{-1}$) of Red-throated Diver *Gavia stellata* in the southernmost part of the North Sea during 1992-98. The pattern based on ferry data - collected on fixed routes - is indicated separately.

Divers occur solitary or in small flocks in the study-area. The largest group that was observed counted 56 birds, disturbed by a ferry on the Nieuwpoort Bank in March 1996. Groups of 5-20 individuals are not rare at the western Kustbanken (Trapegeer, Smal Bank), on the Vlakte van de Raan and in the Vlaamse Banken area.

Larger flocks (100-500 ind.) are described in literature only occasionally from rich feeding areas (GLUTZ VON BLOTZHEIM & BAUER 1980). At the Belgian coast highest densities in winter were recorded on the Middelkerke Bank and the Smal Bank (Fig.5).

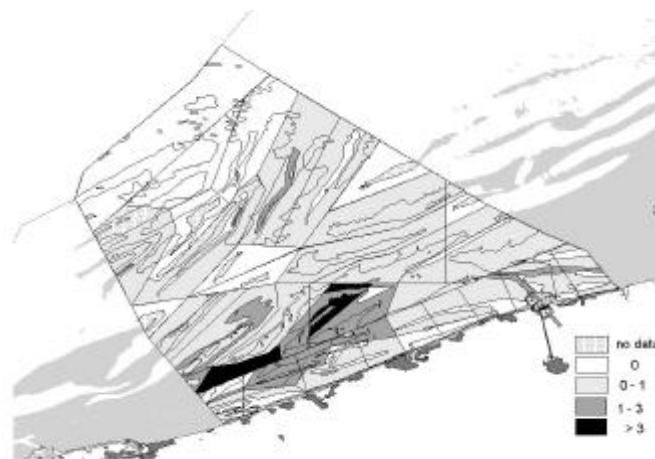


Fig. 5. Winter distribution ($N\ km^{-2}$) of Red-throated Diver *Gavia stellata* in Belgian marine waters during 1992-98.

COMMON SCOTER (MELANITTA NIGRA)

Common Scoters have a circumpolar distribution and breed in Iceland, Scotland, Ireland, Fennoscandia and Siberia. Outside the breeding season, Common Scoters are highly gregarious and predominantly feed on various bivalve species (CRAMP & SIMMONS 1977). They concentrate in shallow coastal waters where high densities of prey-items are readily available. In The Netherlands, *Spisula subtruncata* proved to be the dominant prey-item during periods of maximal abundance of the scoters (LEOPOLD *et al.* 1995b). Although Common Scoters are currently not under threat (TUCKER & EVANS 1997), their high vulnerability for oil-pollution and disturbance, and the fact that they rely on undisturbed, relatively shallow coastal waters

with dense populations of molluscs, make them a sensitive species (LEOPOLD *et al.* 1995b).

Common Scoters have been observed in the study-area throughout the year, with highest numbers in February-March (Fig. 6). So far there are no summer observations of flocks of moulting and fly-less scoters in Belgium, as has been reported for The Netherlands (LEOPOLD *et al.* 1995b). Major movements of scoters in the southernmost part of the North Sea – as indicated by seabird counts on fixed ferry routes in between Belgium and south-England, i.e. outside the major wintering grounds of scoters – occur in February-April (Fig.6).

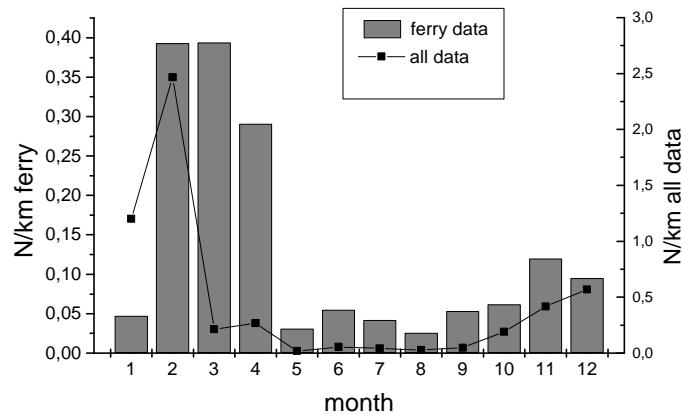


Fig. 6. Seasonal pattern of occurrence ($N km^{-1}$) of Common Scoter *Melanitta nigra* in the southernmost part of the North Sea during 1992-98. The pattern based on ferry data - collected on fixed routes - is indicated separately.

Belgian coastal waters were already attractive for scoters in a distant past. QUINET (1897) mentions that 'countless numbers covered the sea here as well as the Schelde estuary from Vlissingen to Terneuzen' and that the birds were 'scary and it took great pains to shoot them there'. Since the start of systematic aerial surveys in 1986, total numbers of Common Scoter in Belgian

coastal waters fluctuated largely (Fig. 7). These fluctuations may be induced by exchange with nearby feeding sites (the Delta region in The Netherlands, northern France and probably the Thames) or by year-to-year variations in the migration patterns of northern wintering populations (Denmark)(LEOPOLD *et al.* 1995).

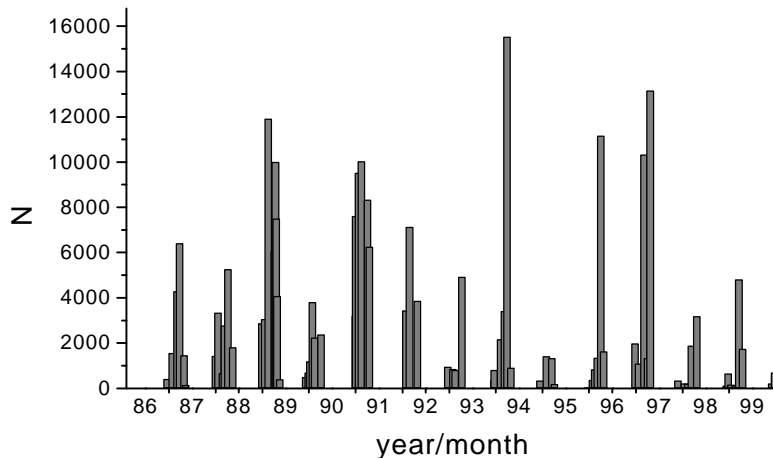


Fig. 7. Total numbers of Common Scoter counted in Belgian coastal waters during aerial and land-based surveys from 1986 till 1999.

All major concentrations of scoters in Belgium occur in the western Kustbanken area (Fig. 8). Three strongholds can be identified: 1) the Trapegeer-area (including Den Oever, Westdiep, Broersbank); 2) the Stroombank-Balandbank-Grote Rede area; 3) the Nieuwpoort Bank. The latter held one flock of 12,900 Common Scoters in March 1997, and an excess of 1000 birds on at least six further occasions (in six different winters). The Trapegeer and its immediate neighbourhood is the most inshore wintering site. The largest group of scoters observed here amounted to 8020 in March 1996. Flocks of 1000-5000 individuals

are frequent and occurred in the winters 1989-92 and 1996-97. The Stroombank-Balandbank-Grote Rede area (off Oostende) is the most eastern wintering site within Belgian marine waters and the most important one. Peak numbers here were recorded in February 1994, with 15,274 individuals. Flocks of 1000-8500 Common Scoters are counted here annually (except for the winter 1990 and 1998). There are years that Common Scoters concentrate very much inshore (Stroombank), while during other winters they remain further off the coast just south of the Oostende Bank (Grote Rede).

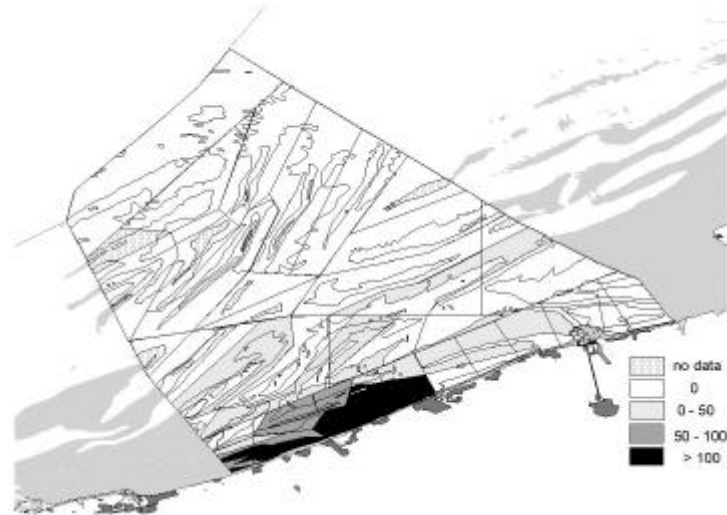


Fig. 8. Winter distribution ($N km^{-2}$) of Common Scoter *Melanitta nigra* in Belgian marine waters during 1992-98.

LITTLE TERN (*STERNA ALBIFRONS*)

With an East-Atlantic flyway population of only 34,000 birds, the Little Tern is a key-species for bird conservation in Europe (TUCKER & EVANS 1997) and hence listed on *Annex 1* of the EC Birds Directive. Outside the breeding season most European birds winter between Guinea and Cameroon (MUSELET 1997). The most obvious threat to Little Terns is disturbance at the nesting sites (DEN BOER *et al.* 1993). In Europe it nests in small groups on sand, gravel or shingle beaches or islands or on sparsely vegetated or bare, undisturbed artificial habitats. Like other terns, it feeds by plunging to take small fish and invertebrates from near the surface. Little Terns tend to feed very close inshore.

Little Terns have been annual breeders at the Belgian coast before mass-tourism evolved (VAN DEN BOSSCHE *et al.* 1995). At least six locations are known where Little Terns used to nest on beaches, in dunes or near sea-inlets. Reconstruction of the data (Fig. 9) indicates that some 50-75 pairs used these areas as nesting sites in the 1950s, with numbers declining strongly in the early 1960s. The last 3 pairs were recorded in 1973. As for the other tern species, the

development of vast, undisturbed areas in the outer harbour of Zeebrugge during the 1980s, created new nesting opportunities (DE SCHUYTER & DE SCHUTTER 1989, DE PUTTER & ORBIE 1990, DE PUTTER & WILLEMYS 1992, DE SCHEEMAEKER & DEFOORT 1992, DE SCHEEMAEKER & D'HOORE 1994, DE SCHEEMAEKER & LUST 1995, 1996, VAN DEN BOSSCHE *et al.* 1995). The first pair nested in 1985 and the population grew to 425 pairs in 1997, spread over various small subcolonies. Due to constant changes in the availability of suitable nesting area, numbers fluctuated largely (130-425 pairs) during 1994-2001. In 1998 Little Terns nested for the first time (21 pair) in the newly created beach reserve of the 'Baai van Heist' (52 ha), situated next to the eastern pier of the harbour. Numbers increased to 80 pair in 1999, but in 2000 and 2001 no breeding was reported here. It is possible that the in 2000 newly developed 'tern peninsula' of 5 ha inside the eastern part of the outer harbour (as a compensation for loss of breeding ground more to the west) attracted some of the nesting birds from the beach reserve. In 2001 some 120 pair were found nesting at the peninsula, making this area the most important colony of the Zeebrugge harbour at present.

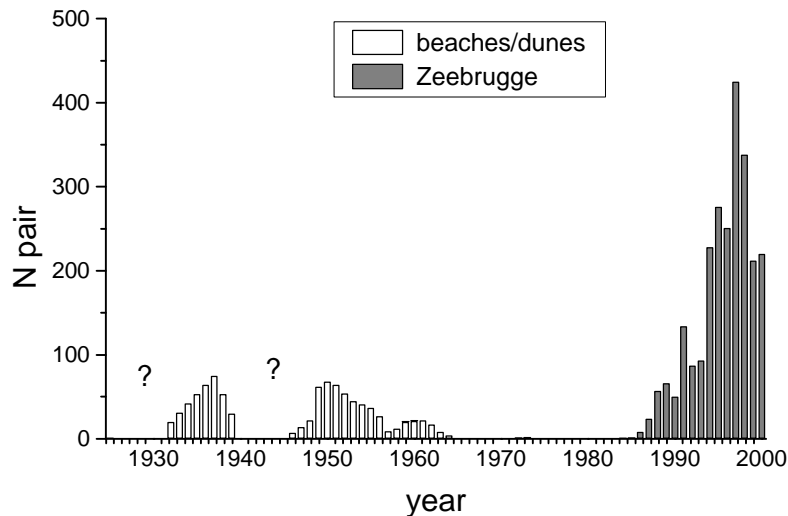


Fig. 9. Reconstruction of trend in breeding population of Little Tern *Sterna albifrons* in Belgian colonies during 1925-2000 (after VAN DEN BOSSCHE *et al.* 1995, supplemented with data from the Institute of Nature Conservation and Filip De Ruwe). Breeding pairs in natural conditions (beaches/dunes) are distinguished from pairs in the Zeebrugge harbour and neighbourhood.

With 130-425 pairs (1994-2001) the Zeebrugge population ranks among the biggest colonies of Little Tern in the North Sea. In the United Kingdom and The Netherlands, most colonies are small (< 20 pairs) and very few colonies are larger than 100 pairs (DEN BOER *et al.* 1993, SEARS & AVERY 1993). The largest colony described for the U.K. in 1995 was situated at Great Yarmouth and amounted to 197 pairs (THOMPSON *et al.* 1997), and 360 pairs were counted at Foulness in 1983 (LLOYD *et al.* 1991). A historical maximum in The Netherlands is derived from the former area 'De Beer', holding some 500 pairs in the 1930s (MEININGER *et al.* 2000). Nowadays the entire Dutch population counts merely 300-400 pairs, with the largest Little Tern colony (180 pairs) situated at the Hoge Platen in the Schelde estuary (DEN BOER *et al.* 1993). The same applies to France, where less than 100 pair nest along the

Channel and Atlantic coasts (CADIOU & LE GISOM 1999). Moreover Little Terns at Zeebrugge have a high hatching success (> 1.5 young per pair) (DE RUWE & DE PUTTER 1999).

The Little Tern arrives at the Zeebrugge colonies at the end of April and leaves the area in July (DE PUTTER & ORBIE 1992). Very few birds are seen at sea, since most Little Terns tend to feed very close inshore or within the harbour of Zeebrugge. Observations near the breeding colonies demonstrated that the majority remains within about 3 km of the nesting location. Therefore the core-areas for Little Tern in Belgium are the immediate vicinity of the harbour of Zeebrugge, in particular the coastal stretch to the east (Paardenmarkt area).

SANDWICH TERN (*STERNA SANDVICENSIS*)

In Europe, Sandwich Terns breed in two distinct regions: in the northwest and the southeast (CRAMP 1985). The NW-European population has its stronghold in the North Sea, with the bulk found in large breeding colonies in undisturbed coastal and island habitats. Sandwich Terns feed exclusively in relatively shallow marine areas, where they feed predominantly by plunge diving on small surface shoaling fish (Herring *Clupea harengus*, Sandeel *Ammodytes* sp., ...). It winters off West-Africa. The species has an unfavourable conservation status, is declining in numbers and hence listed on *Annex I* of the EC Birds Directive.

The creation of suitable breeding habitat in the outer harbour of Zeebrugge in the mid-1980s attracted

many Sandwich Terns from Dutch colonies (DERKS & DE KRAKER 1993). After the first (unsuccessful) nesting record for Belgium in 1988 (ORBIE 1991) numbers increased quickly to a maximum of 1650 pairs in 1993, followed by a decrease to 73 pairs in 1998. An active management immediately prior to the breeding seasons of 1999 and 2000 (creating open spots within colonies of Black-headed Gulls) resulted in numbers increasing again gradually to 1550 pairs in 2000 (Fig. 10) (DE SCHEEMAER & D'HOORE 1994, DE SCHEEMAER & DEFOORT 1992, DE SCHEEMAER & LUST 1995, 1996, VAN DEN BOSSCHE *et al.* 1995, data IN, F. De Ruwe, G. De Putter).

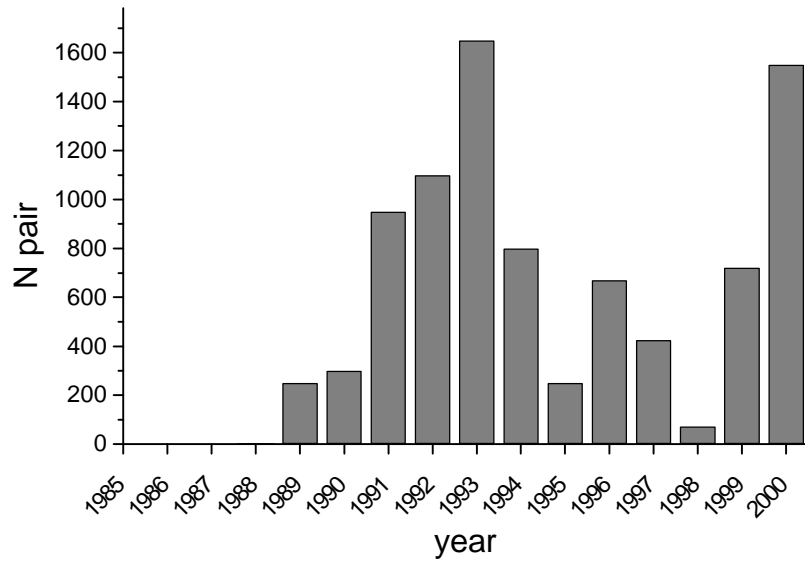


Fig. 10. Trend in the breeding population of Sandwich Tern *Sterna sandvicensis* in Belgium during 1985-2000 (after ORBIE 1991, VAN DEN BOSSCHE et al. 1995, supplemented with data from the Institute of Nature Conservation and F.De Ruwe). All breeding pairs were found in the outer harbour of Zeebrugge.

With a maximum breeding population of 1650 pair, Zeebrugge ranks amongst the medium-sized colonies in the North Sea. Largest colonies in The Netherlands in the 1990s amounted to c. 8000 pairs (Griend), c. 4000 pairs (Hompelvoet) and c. 3000 pairs (Hoge Platen) (BAPTIST & MEININGER 1996) and historical data (1929-1963) from the former area 'De Beer' mention 11,000 pairs as a maximum (MEININGER *et al.* 2000). By contrast the entire population of France counts merely

6755-6907 pairs, with only 350-435 pairs in the northern part of the country (CADIU & LE GISOM 1999).

The first birds arrive in March, with migration peaks in April-May and again in July (Fig. 11). The Sandwich Terns that breed at Zeebrugge fly as far as 30-40 km to their feeding grounds situated to the west of the colony, i.e. on the Vlaamse Banken and western Kustbanken.

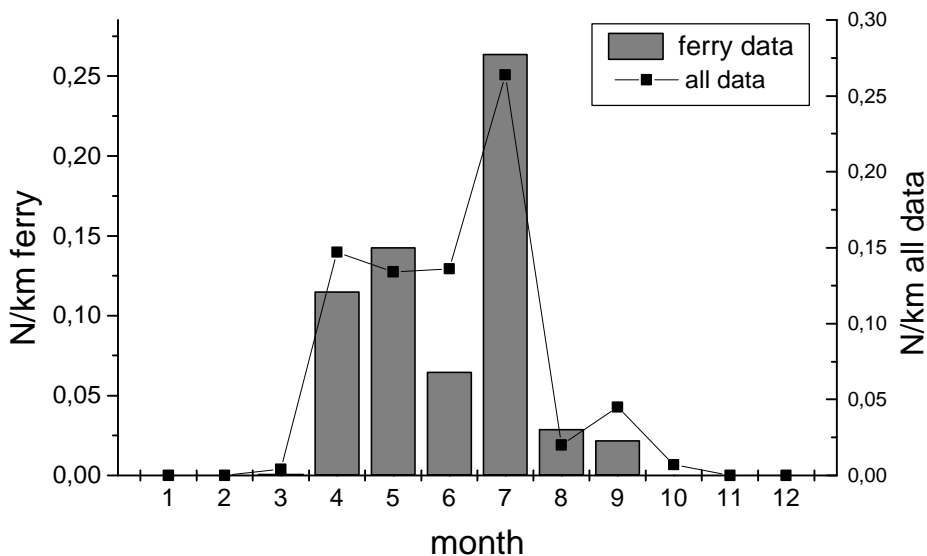


Fig. 11. Seasonal pattern of occurrence ($N\ km^{-2}$) of Sandwich Tern *Sterna sandvicensis* in the southernmost part of the North Sea during 1992-98. The pattern based on ferry data - collected on fixed routes - is indicated separately.

COMMON TERN (*STERNA HIRUNDO*)

Common Terns nest throughout temperate Europe and Asia. They nest both in coastal and inland sites, and feed on marine and freshwater fish and aquatic invertebrates. Like other terns, they fish by shallow plunge diving. Most Common Terns winter off the West-Africa coast, rather few venture further south across the equator. The European status of the Common Tern is secure (TUCKER & EVANS 1997).

Common Terns first nested at the Belgian coast in 1960, when suitable nesting habitat was created within

the Zwin nature reserve (Fig. 12). The Zwin population never exceeded the 375 pairs and has now virtually disappeared (c. 30 pairs in 2000: comm. G.Burggraeve). Meanwhile the vast and sparsely vegetated terrains raised with sand in the outer harbour of Zeebrugge attracted an increasing number of Common Terns (DE SCHEEMAER & DEFOORT 1992, ROSSAERT *et al.* 1993, DE SCHEEMAER & D'HOORE 1994, DE SCHEEMAER & LUST 1995, 1996, VAN DEN BOSSCHE *et al.* 1995, data IN, F. De Ruwe, G. De Putter), with a peak of 2260 pairs in 2000. Smaller numbers have been breeding in the inner harbour as well.

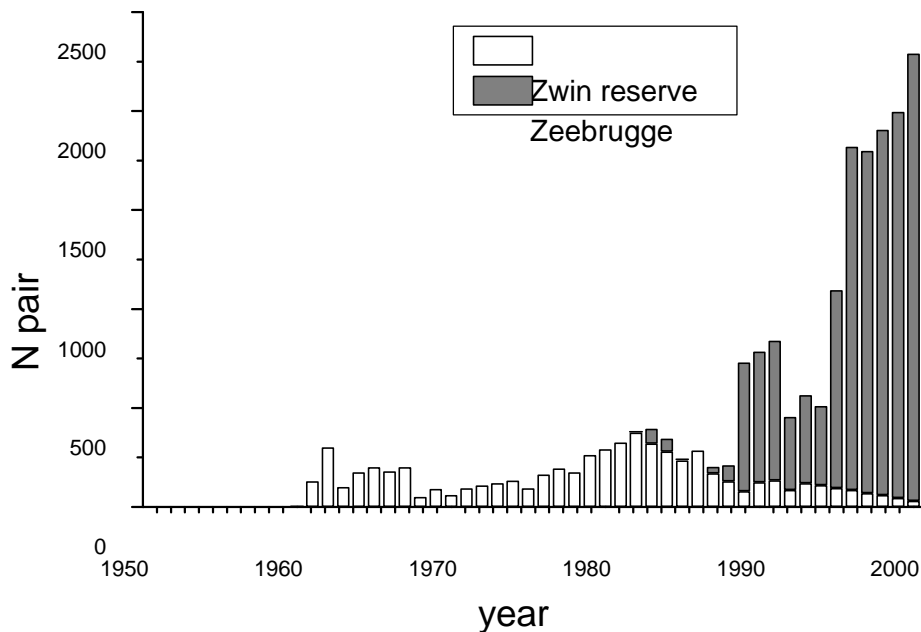


Fig. 12. Trend in the breeding population of Common Tern *Sterna hirundo* in Belgian coastal colonies during 1925-2000 (after VAN DEN BOSSCHE *et al.* 1995, with additional data from the Institute of Nature Conservation). Breeding pairs from the Zeebrugge harbour are indicated separately from those at the Zwin nature reserve.

As such, Zeebrugge is currently the largest but one colony of Common Tern in NW-Europe. In comparison, Germany had a total coastal population of 6931 pairs of Common Tern in 1996, with the largest colony at Minserer Oog Island (1800 pairs) (SÜDBECK *et al.* 1998). France counted 4782-4976 pairs in 1998, with only 1546-1644 pairs along the Atlantic and Channel coasts (CADIOU & LE GISOM 1999). The largest colony here was situated in 1958-59 at the northwest coast (c. 1500 pairs: YEATMAN-BERTHELOT & JARRY 1995). The entire population of the U.K. amounted to 14,700 pairs in 1985-87 (LLOYD *et al.* 1991) with only three colonies larger than 1000 pairs (Blakeney Point, maximum of 1800 pairs). And although The Netherlands knew vast colonies in the past (17,500-19,000 at the former 'De Beer': MEININGER *et al.* 2000), nowadays the largest Dutch colony situated at Griend counts merely 1800 pairs. However in some years many more terns may be present, so that Griend must be considered the largest

European colony. On the other hand the reproductive success at this colony (0.38-0.80: STIENEN & BRENNINKMEIJER 1998) is much lower than at Zeebrugge (1.20: VAN WAEYENBERGE *et al.* 2000).

The first Common Terns arrive at the end of March – early April (Fig. 13). Resident nesting birds at the Zeebrugge colony cause a peak in the numbers observed per km during ship-based surveys in June. A peak in July during surveys on board ferries to the UK results from important migratory movements. Regular boat-trips in the proximity of Zeebrugge indicate that local Common Terns do not feed beyond 5 km away from the nesting site. Very large flocks (500-1000 birds) are often observed in the wake of in- and outgoing ferries when they manoeuvre within the harbour and stir up large numbers of small prey-items.

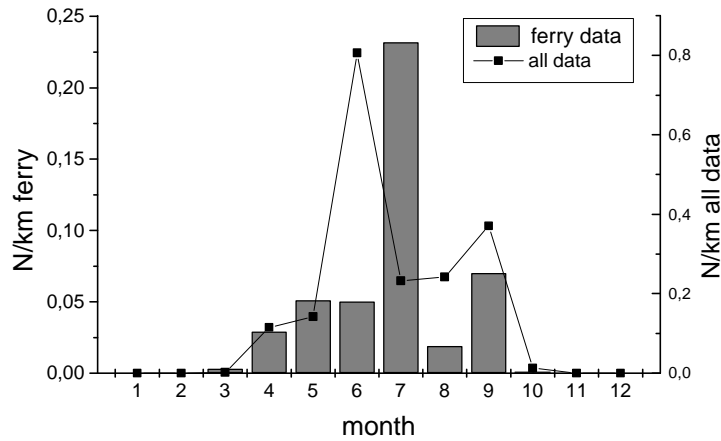
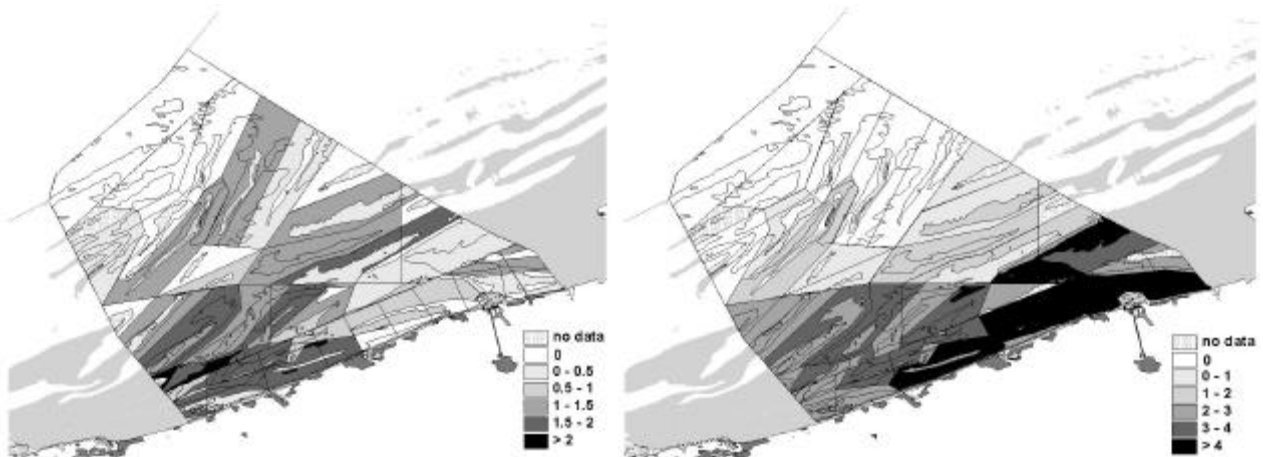


Fig. 13. Seasonal pattern of occurrence ($N\ km^{-1}$) of 'Comic Terns' (undifferentiated Common/Arctic Terns) *Sterna hirundo/paradisaea* in the southernmost part of the North Sea during 1992-98. The pattern based on ferry data - counts along fixed routes - is indicated separately.

HOTSPOTS FOR SIX FOCAL SEABIRD SPECIES

A cumulative picture of the abundance and weight of focal seabird species in Belgian marine waters (Fig. 14) indicates where major efforts for conservation should focus on. Hotspots in every season are the Westkustbanken (Trapegeer-Broersbank-Den Oever, Nieuwpoort Bank, Stroombank, Balandbank, Smal Bank), the Vlakte van de Raan and most of the Vlaamse

Banken. The Oostkustbanken (Paardenmarkt, Wenduinebank, ...) are very important from spring till autumn, mainly as feeding grounds for the three focal tern species. In winter this area has less weight in terms of abundance of focal species than the westcoast. The deep water zone and Hinderbanken area are comparatively poor (Fig.14).



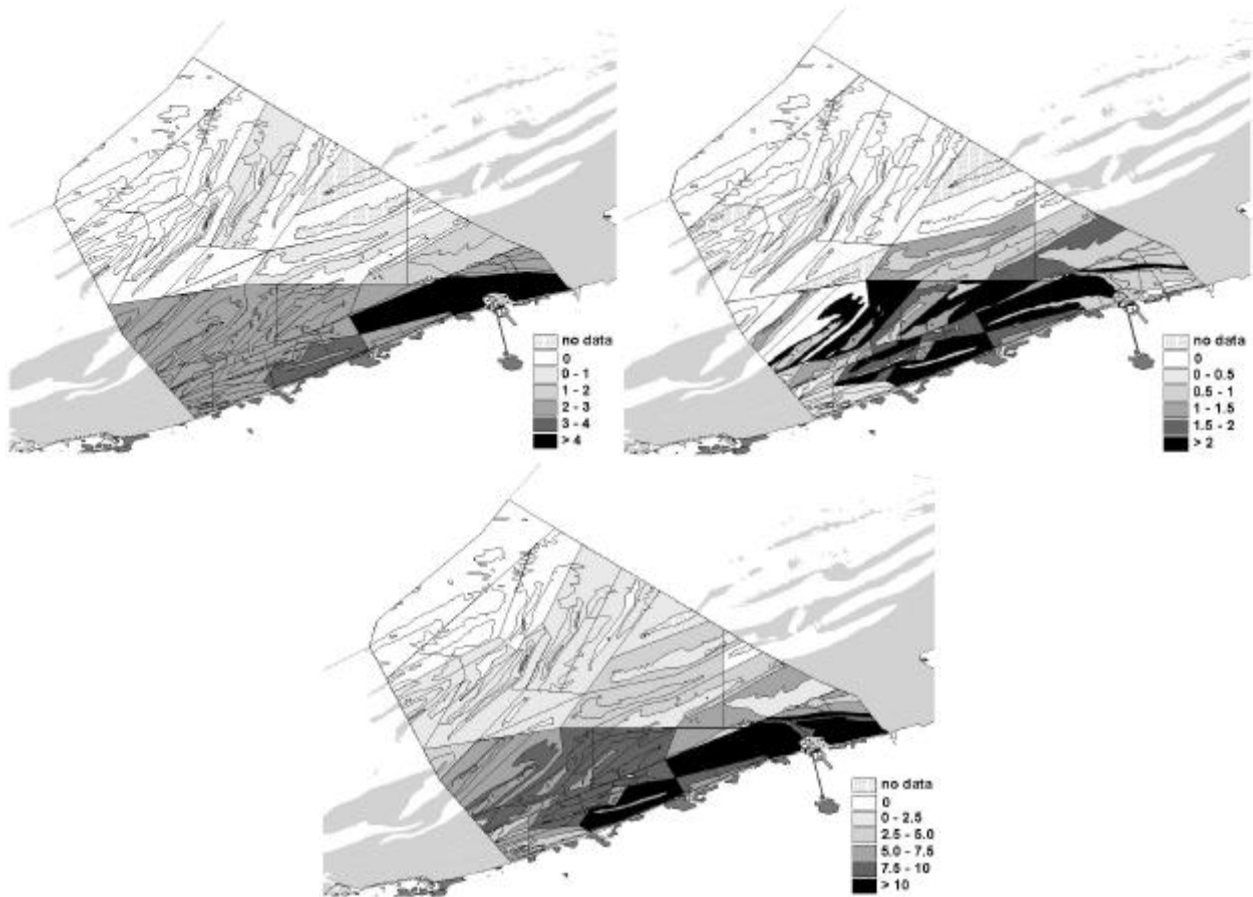


Fig. 14: Hotspots for six focal seabird species in Belgian marine waters in a) winter b) spring c) summer d) autumn e) overall. Shading is based on the relative abundance of six focal species times a weight factor.

The period March-May, referred to as 'spring', show the highest concentration of focal species. It combines important winter concentrations of divers and scoters, present till the end of March, with high numbers of terns arriving in the breeding colonies from April/May onwards and staying in the area till late summer. Although autumn is known amongst seabird watchers as an interesting period for rare migrating species, the cumulative densities of focal species are generally low in Belgian waters. Winter and summer show intermediate values.

OIL-SENSITIVE AREAS

By incorporating a measure for oil-vulnerability, sites can be compared in terms of sensitivity for oil-pollution. Winter turns out to be the most delicate period for oil-pollution, immediately followed by spring. The potential impact of oil-slicks on threatened bird species is considerably smaller in autumn and summer. Much higher oil-vulnerability indices for wintering birds (auks, scoters, divers,..) compared to those of terns are the main reason for this difference. Generally spoken,

Generally spoken vulnerable seabird species tend to concentrate on the sandbank slopes in winter and autumn at depths of 5-15 m. In addition the shallower parts of the sandbanks are of great importance to feeding terns in spring and summer. The swales in between the sandbanks show the lowest conservation values. Key-sites for birds situate 5-20 km from the coastline in autumn and winter, and 0-20 km in spring and summer. Beyond 20 km the conservation value gradually declines.

the closer an oil-slick approaches the coastline the worse the presumed impact on seabirds (Fig. 15). Within each season the western sandbank systems Westkustbanken and Vlaamse Banken are highly oil-sensitive (Fig. 15a). During winter, the Oostkustbanken (with the exception of the Vlakte van de Raan) are less vulnerable than the western part of Belgian inshore waters. In spring and summer the Oostkustbanken are most vulnerable (Fig.15b).

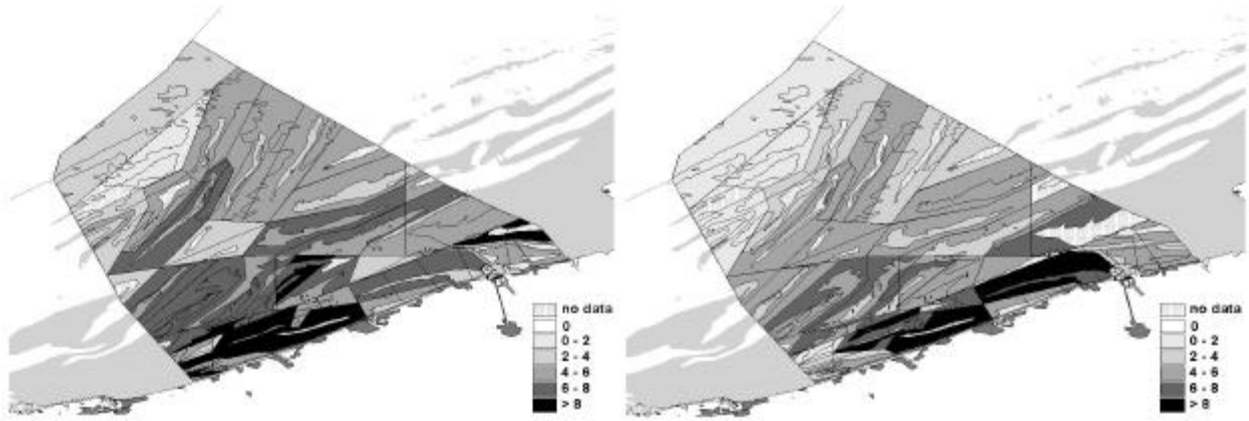


Fig. 15. The oil-vulnerability for sea- and coastal birds in Belgian marine waters in: a) winter b) spring. Shading is based on an oil vulnerability value, calculated from the relative abundance and the oil vulnerability index of the 23 most abundant species.

DISTURBANCE-SENSITIVE AREAS

Disturbance-sensitive species such as scoters, divers and (to a lesser extent) auks and grebes are most abundant in winter and early spring. Higher values in autumn compared to summer are caused by increasing numbers of sensitive species from October onwards.

Most vulnerable sites in terms of disturbance are the Westkustbanken and Vlaamse Banken, both in winter and early spring (Fig. 16). There is little reason to worry about disturbance at sea during summer.

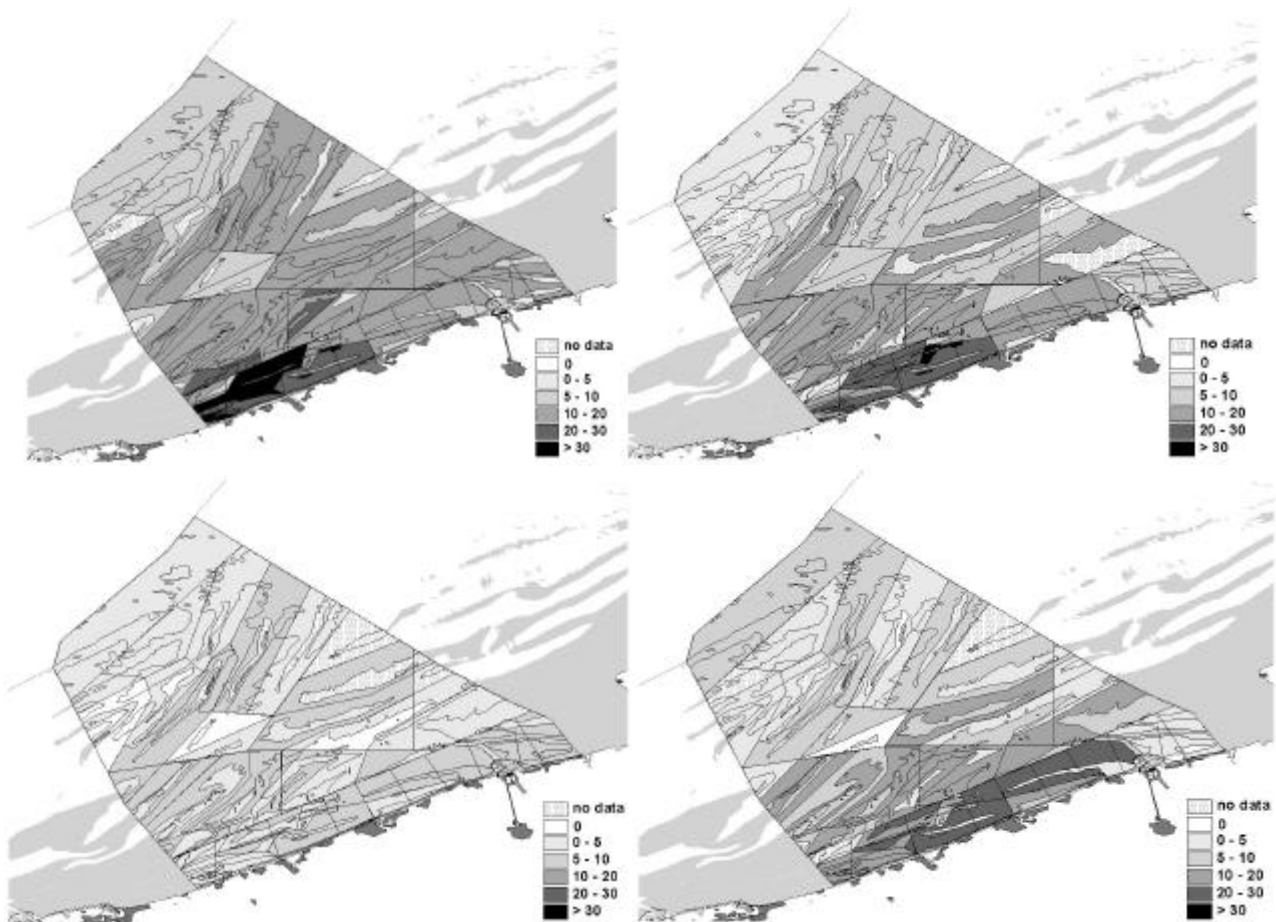


Fig. 16. The disturbance-sensitivity for seabirds in Belgian marine waters in: a) winter b) spring c) summer d) autumn. Shading is based on a disturbance sensitivity value, calculated from the relative abundance and the disturbance sensitivity of the 23 most abundant species.

Very sensitive spots (disturbance sensitivity value >30) in winter and/or spring are: Nieuwpoort Bank, Trapegeer-Den Oever-Broersbank, Stroombank and

Balandbank, closely followed (values: 20-30) by Ravelingen, Smal Bank-north and Middelkerke Bank (Fig.16a,b).

ROLE AS CORRIDOR FOR MIGRATING SEABIRDS

The southernmost part of the North Sea (between 51° and 52° N) is of great importance as a corridor for migrating seabirds. Table 3 shows rough estimates as compiled from various information sources (OLIVER & DAVENPORT 1971, CRAMP & SIMMONS 1977, GLUTZ VON BLOTZHEIM & BAUER 1980, REDMAN & MILBLED 1980, TAYLOR *et al.* 1981, CAMPHUYSEN & VAN DIJK 1983, VAN DER POEL 1984, BROWN 1985, FURNESS 1987, TASKER *et al.* 1987, CAMPHUYSEN & DERKS 1989, DEN OUDEN & STOUGIE 1990, PLATTEEUW 1990, YEATMAN-BERTHELOT 1990, LLOYD

et al. 1991, BOUDOLF *et al.* 1992, ADRIAENSEN *et al.* 1993, BAILLIE *et al.* 1994, CAMPHUYSEN & LEOPOLD 1994, MEEK *et al.* 1994, PLATTEEUW *et al.* 1994, SEARS *et al.* 1995, SKOV *et al.* 1995, STONE *et al.* 1995, BARRETT & FOLKESTAD 1996, OFFRINGA *et al.* 1996, BARRETT & BAKKEN 1997, BOURNE & WHILDE 1997, DUNNET 1997, FJELDSÅ & LAMMI 1997, LEOPOLD & SKOV 1997, MERNE 1997, PONS & YÉSOU 1997, CAMPHUYSEN 1998, CAMPHUYSEN & LEOPOLD 1998, CADIOU & LE GISOM 1999, OLIVER 1999, SEYS own observations).

Table 3: Estimated maximal proportion of the flyway population of 18 common seabird species that cross or reside in the southernmost part of the North Sea (51°-52° N) during an average year. The resident number of birds is based on OFFRINGA *et al.* (1996), adjusted for the Belgian marine waters with results from this study. Notes: *: on average 83% of all identified small divers in the area were Red-throated Divers (CAMPHUYSEN & VAN DIJK 1983); **: on average 80% of all identified 'comic' terns were Common Tern in OFFRINGA *et al.* (1996); *** Sum of 433 pairs in Essex/Kent (in 1985/87: LLOYD *et al.*, 1991) + 430 pairs in Belgium (this study) + 226 pairs in the Delta region in The Netherlands (in 1992: DEN BOER *et al.* 1993) + 43 pairs in Nord/Pas-de-Calais, France (1998: CADIOU & LE GISOM, 1999)

Species	Flyway population (see Tab.1)	Estimated maximal number of 'resident' birds (in relation to flyway population)			Estimated maximal number migrating through the Straits of Dover			Maximum % of biogeographic population residing in or flying over the southernmost part of the North Sea
		N	season	%	N	season	%	
<i>Gavia stellata</i>	75,000	*4,176	W	5.6	10-15,000	W	13-20	13-20
<i>Podiceps cristatus</i>	150,000	5,826	W	3.9	15-30,000	A/W	10-20	10-20
<i>Fulmarus glacialis</i>	10,000,000	4,051	A	0.0	-	-	-	<0.01
<i>Morus bassanus</i>	892,000	10,024	A	1.1	40-60,000	A	4-7	4-7
<i>Melanitta nigra</i>	1,600,000	40,028	W	2.5	60-80,000	W	4-5	4-5
<i>Stercorarius skua</i>	27,200	539	A	2.0	<27,200	A	<100	<100
<i>Larus minutus</i>	75,000	5,626	A	7.5	30-75,000	A/Sp	40-100	40-100
<i>Larus ridibundus</i>	>5,000,000	6,460	W	0.1	370-500,000	A/W/Sp	7-10	7-10
<i>Larus canus</i>	1,600,000	20,527	W	1.3	45-100,000	A/W/Sp	3-6	3-6
<i>Larus fuscus</i>	450,000	28,788	A	6.4	125,000	A/Sp	28	28
<i>Larus argentatus</i>	1,400,000	64,172	W	4.6	-	-	-	4.6
<i>Larus marinus</i>	480,000	25,117	A	5.2	6-9,000	A	1-2	5.2
<i>Rissa tridactyla</i>	8,400,000	30,467	A	0.4	-	-	-	0.4
<i>Sterna sandvicensis</i>	150,000	3,970	S	2.6	100,000	S	67	67
<i>Sterna hirundo</i>	180,000	**9,540	S	5.3	100,000	Sp	56	56
<i>Sterna albifrons</i>	34,000	***2,264	S	6.7	15,000	Sp	44	44
<i>Uria aalge</i>	1,990,000	29,291	W	1.5	20-50,000	W	1-3	1.5-3
<i>Alca torda</i>	482,000	6,161	W	1.3	4-10,000	A/W	1-2	1.3-2

Altogether up to 1-1.3 million seabirds migrate through the Straits of Dover each year, with one-third (315-385,000) being focal species for conservation. The great majority (40-100%) of the flyway population of Great Skua and Little Gull may use the Channel to leave the North Sea, as well as 30-70% of the summer resident terns and Lesser Black-backed Gulls. In addition we estimate that 10-20% of the Red-throated Divers and Great Crested Grebes may pass this bottleneck, and 3-10% of the *Larus*-gulls (except for Little Gull), Northern Gannets and Common Scoters.

Pelagic species (Fulmar, Kittiwake, auks) usually have large populations and estimates of dispersing movements are very difficult to make for these species. Hence conservative percentages of < 1-3% were proposed. The 1-1.3 million seabirds passing through the southernmost part of the North Sea compares to a purely theoretical winter maximum (i.e. summing up the maxima of various winters) of c. 200,000 resident seabirds in the area between 51-52° N or c. 100,000 seabirds in Belgian marine waters (Table 3).

DISCUSSION

SEABIRD CONSERVATION IN BELGIUM: STATE OF THE ART

The development of a better legal framework, including the installation and management of marine protected areas is an important tool in a proper management and planning of the coastal zone. The 'Law on the protection of the marine environment in sea areas under Belgian jurisdiction' is a new instrument that creates opportunities to install marine protected areas (20.01.1999: OFFICIAL JOURNAL – BELGISCH STAATSBLED 12.03.1999). Areas can be selected and designated by Royal Decree as 'integral marine reserves', 'special marine reserves', 'special conservation areas', 'closed areas' or 'buffer zones' (Art.7). So far no such marine protected areas have been installed in Belgian marine waters. A Ramsar site of 7,400 ha, called the 'Vlaamse Banken', was proposed in 1971 (KUIJKEN 1971) and installed in 1984 to encompass the favourite habitat of the Common Scoter in the shallow waters extending 3 nautical miles seawards between Oostende and the French-Belgian

border. Only the subarea shallower than -6m MLLWS has been included, according to Article 1 of the Ramsar Convention (Fig. 17; MAES *et al.* 2000). No direct and specific management measures have been taken to ensure protection of focal species within this Ramsar area. A larger rectangular area of 17,000 ha (Fig. 17), encompassing the entire Ramsar site and called the 'Trapegeer-Stroombank' site, has been proposed in 1996 as a Special Area of Conservation (SAC) under the EC-Habitats Directive. The proposal of this area fits well into the development of the international Natura-2000 network of SACs and resorts under the habitat of 'sandbanks, which are slightly covered by sea water all the time,' (*Annex I* of the EC-Habitats Directive). The installation of this SAC will hopefully provide for a better habitat protection. However, since birds are not included in the list of species to be protected it does not guarantee that specific measures will be taken for a better protection of these birds.

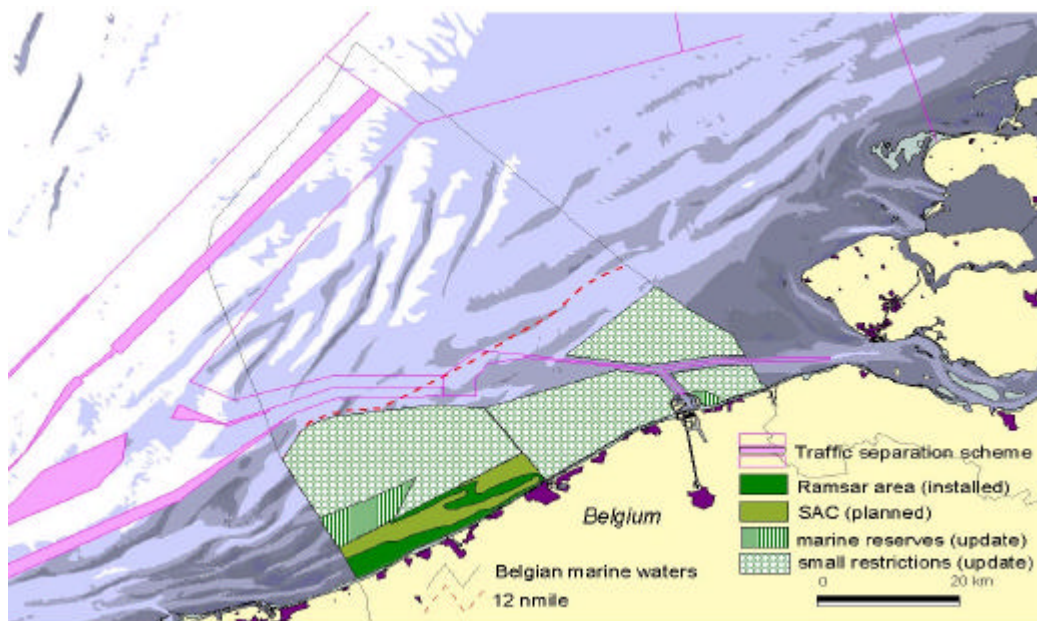


Fig. 17. Current marine conservation area (Ramsar area 'Vlaamse Banken'), planned Special Area of Conservation ('Trapegeer-Stroombank') and desirable additional MPA's in Belgian marine waters in order to safeguard the focal seabird species. A large area where only minor restrictions will be necessary is differentiated from two strict marine reserves. Also indicated are the the -10 and -20 m depth contours, the boundaries of the Belgian Continental Shelf, the territorial sea (12 nautical mile boundary) and the major shipping routes.

There is urgent need for an update of the present situation. First of all, the setting and demarcation of the Ramsar area at the westcoast, in charge since 1984, is based merely on the occurrence of the Common Scoter (KUIJKEN 1972). Due to the non-existence of standardized ship-based surveys in Belgium at that time, neither scientists nor policy-makers were aware of the ornithological value of Belgian coastal waters for other seabirds than scoters (divers, auks, ...) and there was no information at all

about the abundance of seabirds further offshore. The new data available since 1992 - when seabird surveys on board various vessels were initiated here - and detailed in this paper, show clearly that conservation measures guided by Common Scoters only are not sufficient anymore. Moreover, due to several new population estimates (ROSE & SCOTT 1994, 1997) it becomes more and more difficult for the Common Scoter to attain the 1% threshold (16,000 birds). Ranking the focal and locally important species in

Belgium in terms of the relative proportion of their flyway population, the Common Scoter (1%) is being overtaken by ten other species (Table 2). Furthermore the hotspots for the most threatened species (the four Annex I species of the Birds Directive: Red-throated Diver, Sandwich Tern, Little Tern and Common Tern) largely fall outside the proposed Special Area of Conservation (and the Ramsar area). This is in contrast with the requirement for all EC-member states to take

protective measures in the most representative areas for those species. The inclusion of the Zeebrugge outer harbour, holding some of the largest European breeding colonies of terns, in the list of Important Bird Areas in Europe (HEATH & EVANS 1999) necessitates further steps to ensure the conservation and protection of these birds.

CONSERVATION HOTSPOTS: AN UPDATE

Focal species in a broader context

According to the atlas of important bird areas for seabirds in the North Sea (Skov *et al.* 1995), the entire shallow coast of The Netherlands, Belgium and northern France is the sixth most important bird area for seabirds in the North Sea, the Channel and the Kattegat. Species occurring in this area of 16,000 km² in internationally important numbers during 1980-1993 were Red- and Black-throated Diver (average number: 3100), Great-crested Grebe (10,500), Common Scoter (75,000), Little Gull (6700), Herring Gull (53,000), Lesser Black-backed Gull (17,000) and Sandwich Tern (5100). All these bird species have been observed in numbers surpassing the 1%-threshold in Belgian marine waters as well (Table 1). In addition, Common Tern and Little Tern are focal species for the Belgian coast, resulting from very important colonies in the outer harbour of Zeebrugge. Three other species (Great Skua, Razorbill, Great Black-backed Gull), considered locally important, only occasionally occur with more than 1% of the flyway population in Belgian coastal waters.

With a surface of 3500 km², Belgian marine waters represent merely 0.6% of the total North Sea area. The comparatively high number of species exceeding the 1% criterion indicates the ornithological conservation value. It forms an important part of the shallow southern North Sea that appears particularly attractive to divers, grebes, seaducks, terns and gulls. CAMPHUYSEN & LEOPOLD (1994) concluded that this area between 51-56° N and 2-7° E is of international importance for wintering Red-throated Divers, Great Crested Grebes, Eider, Common Scoters, Common Gull, Herring Gull, Great Black-backed Gull and Common Guillemot. In summer, the area is of international importance for Lesser Black-backed Gull and Sandwich Tern. In autumn the area is of importance to migrating Northern Gannet, Great Skua, Little Gull and Common Tern and substantial numbers of Fulmar, Arctic Skua, Kittiwake and Razorbill are found here. Our results fit well in this evaluation and show that Belgian marine waters do not have a unique seabird fauna, but are an important stronghold for most shallow water species (Table 4).

Table 4. Conservation value of Belgian marine waters (this study), compared to The Netherlands and part of the southern North Sea (CAMPHUYSEN & LEOPOLD 1994). Indicated are the peak numbers in terms of % of the flyway populations and the season of maximal abundance of the most abundant species. The size of the flyway populations and the proportions of these flyway populations as used in CAMPHUYSEN & LEOPOLD (1994) have been slightly modified in accordance with: (1) ROSE & SCOTT (1997); (2) HARRIS (1997); (3) HILDEN & TASKER (1997). The percentage for *S. albifrons* in The Netherlands and the southern North Sea is based on Dutch breeding numbers (DEN BOER *et al.* 1993) supplemented with Belgian data (this study).

Species	Belgium 3,500 km ²		The Netherlands 57,000 km ²		Southern North Sea 130,000 km ²		Flyway population	
	%	season	%	season	%	season	N	source
<i>Larus minutus</i>	4.9	sp	14.3	au	18.9	au	75,000	1
<i>Sterna albifrons</i>	2.5	sp/su	1.8	sp/su	4.2	sp/su	34,000	1
<i>Sterna sandvicensis</i>	2.2	sp/su	3.9	sp	4.7	sp	150,000	1
<i>Sterna hirundo</i>	2.2	sp/su	5.1	su/au	5.9	su/au	180,000	1
<i>Gavia stellata</i>	1.9	wi	9.5	wi	13.1	wi	75,000	1
<i>Melanitta nigra</i>	1.0	wi	8.4	wi	8.4	wi	1,600,000	1
<i>Podiceps cristatus</i>	2.5	wi	9.1	wi/sp	14.1	wi/sp	150,000	1
<i>Stercorarius skua</i>	1.6	au	7.4	su/au	10.7	su/au	27,200	1
<i>Larus fuscus</i>	3.5	au	12.9	sp	18.4	sp	450,000	1
<i>Larus argentatus</i>	1.4	wi	8.4	wi	12.2	wi	1,400,000	1
<i>Larus marinus</i>	1.2	wi	7.4	au/wi	13.2	au/wi	480,000	1
<i>Uria aalge</i>	0.7	wi	6.7	wi	12.2	au	1,990,000	2
<i>Alca torda</i>	0.8	wi	4.5	wi	9.1	wi	482,000	3
<i>Larus canus</i>	0.4	wi	3.8	wi	5.0	wi	1,600,000	1
<i>Morus bassanus</i>	0.4	au	2.2	au	3.0	au	892,000	1
<i>Somateria mollissima</i>	0.2	wi	3.5	wi	3.7	wi	2,850,000	1
<i>Rissa tridactyla</i>	0.1	wi	0.9	wi/sp	1.8	au	8,400,000	1
<i>Larus ridibundus</i>	0.1	wi	0.4	au	0.5	au	5,000,000	1
<i>Melanitta fusca</i>	0.1	wi	1.3	wi	1.3	wi	1,000,000	1
<i>Fulmarus glacialis</i>	0.0	au	1.1	au	2.3	au	10,000,000	1

Focal areas

The total area of hotspots for threatened seabird species in Belgian marine waters equals 24,700 ha of highest priority (calculated ornithological conservation value of >10) and 37,700 ha of high priority (values 7.5-10), all situated within 25 km from the shoreline (Fig. 14). For a bankstratum to be assigned this highest score, at least five of the focal species must occur at 75-100% of the maximal densities observed in Belgian marine waters. The high priority class includes areas where at least three focal species are found in high densities. In order to provide sufficient protection to the most vulnerable seabird species in Belgian marine waters, a substantial part of both types of areas should be designated as MPA. Depending on the specific conservation needs, fully protected MPA's can be installed ('special marine reserves') or only small restrictions ('closed areas', 'buffer zones') need to be endorsed. These protected areas can then function as part of an international network of protected areas all along the shallow continental coasts of the southern North Sea. At least part of the following three areas should be included (Fig. 17):

(1) The western Kustbanken (Nieuwpoort Bank, Trapegeer, Broersbank, Den Oever and Stroombank) have a high priority in winter and early spring. It is the major wintering site of scoters in Belgian marine waters, and large numbers of Great-crested Grebe and divers can be found here. In spring and summer the area is regularly visited by Sandwich Terns. Though this area is well-covered by the proposed Special Area of Conservation, it will depend largely on the management measures that will be taken, whether the installation of the protected area will be an empty box or a truly effective conservation tool. Because of the high diversity and abundance of focal species and the oil- and disturbance sensitivity of scoters, divers and grebes having their strongholds here, the conservation legislation towards birds should be enhanced. The Ramsar area should be extended to the full range of the SAC (Fig. 17), including the area deeper than -6 m MLLWS (in line with Article 2 of the Ramsar Convention), the SAC should be designated as a Special Protection Area under the EC-Birds Directive and specific measures should be taken to reduce disturbing and destructive activities.

(2) Conservation needs in the vicinity of the harbour of Zeebrugge clearly have two components: the need for save breeding grounds on land (this falls under Flemish jurisdiction), and the necessity to mitigate negative influences on the best feeding grounds at sea near the colonies (under federal Belgian jurisdiction). The immediate vicinity of the Zeebrugge outer harbour has a great value in spring and summer as feeding ground for three tern species. Very little of the nesting sites and of the present feeding areas of the terns are protected these days. All Sandwich Terns nesting in Belgium, more than 95% of all Common Terns and 60-100% of all Little Terns nest in the outer harbour of Zeebrugge, without any legal protection. As a result of the conditions stipulated in the

environmental impact assessment study for the northwest part of the outer harbour, a new peninsula was created during the winter of 1999-2000 to compensate for the loss of nesting grounds there (VEEN *et al.* 1997). This 'tern-peninsula' measures 5 ha and is situated within the eastern part of the outer harbour. During the first nesting season (2000), 50 pairs of Little Tern used this area, in 2001 numbers increased to 120 pairs (pers. comm. Filip De Ruwe). Even when populations might grow in the future and other species will possibly join the Little Terns here, it does not guarantee the sustainability of the tern colonies along the Belgian coast, since the peninsula has but the legal status of 'waterway'. This is not the case for the 'Baai van Heist' Flemish beach nature reserve, situated next to the eastern pier of the outer harbour. This beach habitat of approximately 52 ha was first closed off for the public in May 1998, leading to the settlement of 21 pairs of Little Tern. In 1999 the reserve accommodated 80 pairs, and no terns managed to nest here in 2000 (due to a storm) and 2001. The major feeding grounds of Little Tern situate at maximal distances of 3 km, those of Common Tern include the harbour and the nearest 5 km (observations Jan Seys, Jeroen Van Waeyenberge, Henk Offringa). A relatively small marine protected area bordering the 'Baai van Heist' nature reserve (situated within the 'Paardenmarkt' bank stratum) would benefit the foraging opportunities of the terns in Zeebrugge and protect the seaward site of the 'Baai van Heist' beach reserve (Fig. 17). The Wenduinebank and Vlakte van de Raan are suitable feeding grounds for terns in spring and summer and meanwhile hold important numbers of grebes and Little Gull in winter and spring/autumn respectively. Here only the most destructing activities on these birds during periods of maximal abundance are needed.

(3) An area of great importance throughout the year that is not legally protected so far is the Vlaamse Banken area (Smal Bank, Kwintebank, Middelkerke Bank, Buiten Ratel, Oost Dyck, Oostende Bank, Ravelingen and Breed Bank). The Smal Bank should be considered an invaluable conservation area, forming a bridge between the shallow western Kustbanken and the more offshore Vlaamse Banken, and having highest densities of Red-throated Diver. It is a sandbank with an interesting and diverse avifauna: Sandwich Terns use the area as feeding ground in spring and summer, Little Gulls are often observed in larger concentrations in autumn and spring (and smaller numbers in winter) and Common Guillemot, Razorbill and Great-crested Grebe are common here. In order to protect the specific seabird fauna of the Vlaamse Banken, at least the Smal Bank should be designated as a Special Protection Area under the EC-Birds Directive, and specific measures should be taken to reduce disturbing activities here. This sandbank area has priority since it is one of the richest seabird sites within the Vlaamse Banken complex, it borders the 'Trapegeer-Stroombank' Special Area of Conservation and it combines high densities of inshore (grebes), midshore (divers) as well as more offshore (auks) species (Fig. 17).

Although the more offshore sandbanks (Hinderbanken, Zeelandbanken) do have interesting seabird populations, their cumulative ornithological conservation value is lower than what is observed at the Westkustbanken, the Vlaamse Banken or in the neighbourhood of Zeebrugge. The need to take measures to reduce seabird disturbance in part of the Zeebrugge marine area (outside the harbour piers), the Westkustbanken and the Vlaamse Banken is largely in line with what has been suggested by OFFRINGA & MEIRE (1997). Due to increasing numbers of Common Tern and Little Tern the Zeebrugge area has become even more important. On the other hand, it must be mentioned that the value of the east coast as demonstrated by the maps with hotspots for threatened bird species, depends largely on the availability of nesting sites on land. Large suitable breeding grounds for the three focal tern species are only found at Zeebrugge. With feeding ranges restricted to a mere 3 km for Little Tern, 5 km for Common Tern and 20-30

km (and more) for Sandwich Tern, the overall 'value' of the sea areas around Zeebrugge is obviously biased. A study of the breeding biology of the terns at Zeebrugge indicates that there is ample of fish in the direct neighbourhood and that reproductive success is high (VAN WAEYENBERGE *et al.* 2000). However even better feeding grounds might be present more to the west, which can not be used by the nesting terns because of the long distance to the colonies. It can be concluded that the value of the inshore areas at the westcoast depends solely on the intrinsic characteristics of the marine habitat. By contrast the neighbourhood of the Zeebrugge harbour obtains its ornithological value largely by the presence of suitable breeding grounds. Therefore from an ornithological point of view, measures in the western marine waters should be taken both to protect habitats and species, whereas near the Zeebrugge harbour conservation of seabirds can better focus on more flexible measures meant primarily to protect the vulnerable seabird species.

MAPPING AND MANAGEMENT

The collection of large amounts of standardized data on seabird distribution, the availability of estimates of population sizes and the increasing knowledge on their reaction to various impact factors make seabirds a rewarding object for weighing areas or periods to one another. The maps produced to indicate hotspots for focal species, as well as oil-vulnerable and disturbance-vulnerable sites give a comprehensive view of where attention should be focussed upon for various reasons. In a similar way Skov *et al.* 1995 mapped the important seabird areas in the North Sea on the basis of 30 species which have a population of at least 1% of the species' biogeographic population during parts of the year. They calculated the total value of each geographical area for all those species as the sum of proportions of the total populations of the species occurring in internationally important concentrations within the area. Seabirds generally use much more extensive areas than coastal or terrestrial bird species. Hence, to preclude that almost any larger unit of area in the North Sea would meet the 1%-criterion at any one season, they included a reference area of 3000 km² (on the basis of average feeding radii of key species from colonies in the North Sea). We used this 'Marine Classification Criterion' to underpin the calculation of international importance on the entire Belgian marine waters, measuring 3500 km².

To further differentiate within this area, we chose smaller sub-units and weighed them against the maximal overall observed densities.

The same technique can be applied to compare areas or periods in terms of vulnerability to various impact factors. CAMPHUYSEN & LEOPOLD (1998) and CAMPHUYSEN *et al.* (1999) identified the most vulnerable periods for boating disturbance, surface pollution with lipophilic substances and impact of flares on migrating species at potential gas-exploitation areas (900 and 405 km², respectively) off the north coast of The Netherlands. TASKER & PIENKOWSKI (1987) and CARTER *et al.* (1993) identified the most vulnerable seabird concentrations of the North Sea towards surface pollutants. DANIELSEN *et al.* (1986) mapped the conditions in the Danish sector of the North Sea and the Wadden Sea with reference to oil spill impact. In all these exercises the comparisons were based on values obtained by combining (relative) densities and specific impact factors. Depending on the aims of the study, one can choose to use actual densities or densities relative to the total population size or to the numbers in a smaller subarea. Usually either these figures or the vulnerability scores have to be transformed to similar ranges.

MAJOR THREATS TO BELGIAN SEABIRDS AND MANAGEMENT IMPLICATIONS

Oil pollution

The negative impact of oil-pollution on sea- and coastal birds is widely recognized (DUNNET *et al.* 1990, FURNESS 1993, TUCKER & EVANS 1997, CAMPHUYSEN & HEUBECK 2001). For the Belgian coast the lethal effects during winter, as demonstrated by beached bird surveying, have been elaborated by SEYS *et al.* (in

prep.). Most beached bird survey programmes are confined to winter and it is generally assumed that the impact of oil on seabirds during summer is of less importance. However sublethal effects may have thorough effects on breeding birds, as demonstrated by a pair of breeding Common Terns at the Zeebrugge harbour in 1998 (observation J. Van Waeyenberge).

One parent bird stopped bringing food to its young during three days, while preening himself trying to get rid of the oil that smothered his plumage. The weight of the three young birds declined during this period and started to increase only after the adult bird resumed foraging three days later. The smallest young did not survive this short period of diminished food supply.

It is doubtful that local management measures – other than a strict control to discourage illegal oil discharges – are able to reduce the potential oil risks for seabirds in Belgium. Routing measures are considered to be effective tools to mitigate disturbance effects on wildlife or oil pollution risks. However imposing routing measures in order to reduce the risk of oil-pollution in the southernmost part of the North Sea can hardly be effective. Major shipping routes, that produce most of the oil-slicks and that cannot be rerouted, are very nearby. Oil-slicks travel downwind at 3-4% of the wind speed (CLARK 1992), often affecting areas much further away (CAMPHUYSEN *et al.* 1999). With an average daily wind speed of 20 km h⁻¹ during winter (October-March, 1992-1999, Belgian coast: KMI data) it takes at most 2.5 days for an onshore wind to blow the oil discharged in the main shipping routes to major scoter concentrations at the Westkustbanken. With stronger winds and for the Vlaamse Banken that are much closer to the shipping routes, the oil can easily be there in a matter of hours. Moreover the vast majority of illegal discharges of oil cannot be treated efficiently in any way. Provided an oil-slick is detected instantly it is virtually impossible to stop most oil from entering the important bird areas. Therefore all effort should go to aerial surveillance of the shipping routes near the most oil-sensitive seabird areas. By tuning a continuous seabird monitoring to the aerial surveillance programme (at least during winter and early spring), energy can be focussed on the most vulnerable seabird concentrations. When an important oil-slick is detected and wind conditions are not too unfavourable, the oil-combating scheme can use this information to prevent the substance to drift in the direction of major bird concentrations.

Disturbance

Disturbance is a major threat to nesting terns (ARTS 2000, ERWIN 1989, LLOYD *et al.* 1991). At sea however, terns, *Larus*-gulls, skuas and Northern Gannet are considered poorly sensitive to disturbance by traffic (ship, airplanes, helicopters)(TUCKER & EVANS 1997, CAMPHUYSEN *et al.* 1999). Some might even be attracted by ship activities. On the other hand, seaducks (KELLER 1991, MIKOLA *et al.* 1994) and divers are highly disturbance-sensitive. These species flush for approaching vessels at distances of 200->1000 m, with an average of 500-600 m (own data). Most scoters and divers stop all activity even earlier (>1 km distance), alert for any further approach of the vessel. During this period of alertness birds cannot forage and loose potential energy-uptake time. When taking off they have to spend additional energy in moving to more quiet places, where food-availability might be much less profitable. Although so far there are no scientific data on differences in disturbance by different types of

traffic, it is assumed that fast-moving and noisy crafts (jet-ski, speedboats, large catamarans, formula-1 boats, helicopters) are more harmful than for example sailing boats. In The Netherlands, several examples of temporary or continuous disturbance of large flocks of scoters are documented (LEOPOLD *et al.* 1995a). Divers are winter residents from November to March in shallow coastal waters, with important concentrations in the proposed 'Trapegeer-Stroombank' Natura-2000 site and nearby waters (Smal- and Breed Bank, Middelkerke Bank, Buiten Ratel, Oost Dyck). Smaller concentrations occur on the Vlake van de Raan and Wenduinebank at the east-coast, and more offshore (Bligh-Bank, Oosthinder,...). Common Scoters have traditional wintering grounds in the inshore shallows of the Trapegeer-area and in the Stroombank-Nieuwpoort Bank-Balandbank-Grote Rede area. Numbers build up slowly in the course of the winter and reach maxima in January-end March. Provided the policy in this area would be the best possible protection of these very vulnerable species, traffic of vessels, low-flying airplanes and helicopters should be restricted by routing measures to a minimum from November to end March in the protected shallow sandbank areas of the westcoast (Westkustbanken and Vlaamse Banken).

Other activities

Many other activities may have an impact on the distribution, behaviour or general welfare of seabirds in the Belgian marine waters. Most of these activities affect seabirds in an indirect way, through interactions with their major prey items (all activities destroying or declining shellfish stocks or affecting stocks of small pelagic fish), by changing hydrodynamic characteristics or turbidity of the ecosystem (dredging, sand- and gravel extraction, coastal defence, land reclamation), etc... Some may have a more direct impact on sea- and coastal birds, such as the obvious disturbance created by military activities at Lombardsijde (immediately west of Nieuwpoort). Although the noise made during the exercises has only a local impact, this issue will have to be dealt with when installing a marine protected area in front of the military camp. Own observations demonstrate that all birds (including gulls) in the area fly off when shooting starts and that apparently no habituation takes place. Major problems arise in the period November-end March when large flocks of scoters occur in the area.

Marine birds and mammals may entangle in fishing gear, ropes and plastics. During 1979-89 0.2% of all birds found dead on Dutch beaches got entangled. Northern Gannet (5.4%), Cormorants (2.6%) and Great Black-backed Gull (1.3%) were most affected as victims of entanglement (CAMPHUYSEN 1990). At the Belgian coast entanglement is widespread in Northern Gannet (11.6%) and less frequently observed in divers, grebes, gulls and auks (0.1-2.0%)(SEYS *et al.* in press). Drowning of diving species in monofilament nylon gill nets (drift nets or fixed short nets) may have a dramatic impact on seabirds (and marine mammals) in the North Sea (OLDEN *et al.* 1986, BOURNE 1989, STRANN *et al.* 1991). Auks are most common as bycatch in fisheries around Iceland (PETERSEN 1994), with

records of up to 10,000 auks drowned in cod nets. Auk mortality in fishing gear is of great and perhaps increasing significance, not only in the arctic but also in more temperate waters (MEAD 1993). In northern France gill-nets are widely used and auks are found dead in those nets in substantial numbers during winter (pers. comm.). The extent of the impact of gill nets on

seabirds and marine mammals in Belgian waters is poorly documented and should be investigated in more detail in the near future. A further increase in the use of fixed nets in Belgian marine waters is considered incompatible with the protection of vulnerable, diving seabird species such as scoters, grebes, divers, auks and Northern Gannet and coastal marine mammals.

THE SOUTHERNMOST PART OF THE NORTH SEA AS A CORRIDOR FOR SEABIRD MIGRATION

We calculated that during winter more than 100,000 seabirds might reside in Belgian marine waters (this study) out of 180,000 in the southernmost part of the North Sea (between 51-52°N) (OFFRINGA *et al.* 1996). This figure is undoubtedly an overestimate since the calculation is based on maximum numbers observed at different months and over more than six years of intensive surveying. Probably maxima in Belgian waters during winter rarely exceed the 50,000. Actual numbers staying at one particular moment cannot be given due to the lack of systematic counts covering the entire study-area in a very short period. The residence time of seabirds is unknown and may vary from several months or years (Herring Gull) to just one hour, i.e. approximately the time to hurry across the area. Moreover many seabirds may pass by during nighttime and stay undetected. A rough estimate of 1-1.3 million seabirds involved in major migratory movements through the bottleneck of the Channel indicates the importance of the area as a corridor for seabird migration. In this context there is a major concern towards plans to develop offshore wind farms in this peculiar area. Wind turbines can have a direct impact when seabirds collide with them, in a more indirect way seabirds might avoid areas where clusters of windmills are located, creating vast areas unsuitable for seabirds (ORLOFF *et al.* 1992, MUSTERS *et al.* 1996, SGS ENVIRONMENT 1996, TUCKER 1996, KETZENBERG & EXO 1997, TULP *et al.* 1999, KRUCKENBERG & JAENE 1999). The most alarming point today is the lack of information on the impact of wind turbines at sea. Very little is known about the nocturnal and concentrated migration of birds in the coastal zone and on how seabirds will react on the installation of new and moving structures in the open sea habitat. Although it is widely accepted that the issue of potential bird collisions and avoidance behaviour should be taken seriously, administrations and project developers often resort to the (most positive) results of terrestrial impact studies to underpin their offshore plans.

There is a need to develop an international network of designated areas important for marine wildlife. In order to safeguard seabird populations this

can be achieved by protecting the most important breeding sites on land and by introducing an international network of in- and offshore marine Special Areas of Conservation and Special Protection Areas as required by the EC-Habitats and Birds Directives. At present all the countries in the Northeast Atlantic Marine Region have established some form of marine protected areas. The North Sea and Atlantic coasts of Denmark, Germany, The Netherlands, Belgium, France, Spain, Portugal and Great Britain have about 15 MPA's with an important sublittoral component and half of these areas were designated as MPA's because of important seabird breeding colonies. However the criteria used to select suitable sites, and the degree of protection that is given to the marine wildlife and habitats within these MPA's varies from country to country (GUBBAY 2001). There are examples of Biogenetic Reserves (as part of the Council of Europe's programme for a network of such sites) and Ramsar sites with a marine component in various countries. All countries with the exception of Belgium and Portugal have Special Protection Areas (under the EC-Birds Directive) including a marine component. And the designation of several new MPA's under the Natura 2000 network of the EC-Habitats Directive is still in preparation.

In addition corridors for major migratory movements should be safeguarded from developments threatening the transit of birds (and other organisms such as fish, marine mammals, etc...). At a national level various legal instruments may be developed or applied to achieve this goal. Despite the importance of the seas for birds and other wildlife, conservation of the marine environment lags far behind conservation on land. Though various seabird species are highly dispersive during the non-breeding season and hence probably cannot be protected by setting up such a network, for other species and for particular hotspots it will definitely improve their protection. In such a network, the linear sand ridge complexes off the Belgian (and the Dutch and northern French) coasts deserve special attention (GUBBAY 2001).

ACKNOWLEDGEMENTS

Most of the data presented here were collected through the financial support of the World Wide Fund for Nature (WWF-Belgium), the Management Unit of the Mathematical Model of the North Sea (MUMM-BMM) and the federal Services for Scientific, Technical and Cultural affairs (SSTC-DWTC). We would like to thank the authorities and the crews of the vessels *Belgica*, *Ter Streep*, *Prins Filip*, *Prins Albert*, *Princes Marie-Christine* and *Tuimelaar* and the 'Noordzee Vliegclub' for the hospitality on board and for the very exciting collaboration. We are also greatly indebted to all birdwatchers (and in particular to Henk Offringa and Wim van den Bossche) who assisted during ship-based, aerial or land-based surveys or in the breeding colonies at Zeebrugge and made their data available for this paper. Finally we would like to thank Henk Offringa, Kees Camphuysen, Thierry Jacques, An Cliquet, Jan Haelters and Ronny Schallier for comments on earlier drafts of this paper.

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