

4.4 Oil Pollution and Seabirds

4.4.1 Introduction

Oiled seabirds washing ashore, dead or alive, have had a signalling function since the very early days of oil pollution at sea. The number of dead oiled seabirds on the coastline is not in itself a reliable parameter for monitoring changes in oil pollution at sea. The percentage of birds that is oil contaminated among the birds found washed ashore (called the 'oil rate'), however, has proven to be a useful monitoring tool (Camphuysen and Franeker, 1992; Stowe, 1982; Vauk *et al.*, 1989). Differences in oil rates between sea areas have clearly indicated that chronic oil pollution was more intense around shipping lanes than elsewhere. In recent years, beached bird survey techniques have been further refined and species-specific oil-rates were introduced as the main instrument to measure trends in chronic oil pollution at sea (Camphuysen and Franeker, 1992; Camphuysen and Heubeck, 2001).

4.4.1.1 Ecological importance

Chronic oil pollution is a constant threat to seabirds and other marine life. Oiled seabirds are the most visible and obvious casualties resulting from oil spills, but the sensitivity to oil of other marine organisms and coastal habitats is enormous (Baker, 1983; Bergman, 1985; Kingston, 1992). This is particularly true for soft-sediment environments, such as the Wadden Sea, and attempts to minimize oil pollution in this area were initiated long ago. However, the most important sources of chronic oil pollution in terms of casualties among seabirds are typically situated offshore, such as shipping and offshore oil and gas exploration (Dahlman *et al.*, 1994). Tens of thousands of seabirds are known to wash ashore oiled each winter in the southern North Sea alone (Camphuysen, 1989), but as yet it has been difficult to demonstrate effects in terms of major population declines. There are various explanations for this, one of which is the lack of adequate data (age composition of casualties and information on breeding origin; Heubeck *et al.*, 2003), but of greater significance is probably the overall success of seabirds due to, for example, shifts in prey availability due to the overfishing of predatory fish (Camphuysen and Garthe, 2000).

4.4.1.2 Conclusions of the 1999 QSR

Oil pollution of the seas was recognized as a problem in the first half of the 20th century and both national and international regulations to control discharges of oil were introduced. The introduction of MARPOL 73/78 (International Convention for the Prevention of Marine Pollution from Ships)

was eagerly awaited, but as reported in the 1999 QSR, investigations had not provided evidence for a sudden improvement since Annex I (Regulation for the Prevention of Pollution by Oil) of this Convention came into effect in 1983. At the same time, however, and partly contrary to observations during aerial surveys where no significant trends could be found, declining oil rates among beached birds were seen as a clear sign that the situation was improving (Camphuysen, 1998; summarized in the 1999 QSR). Yet, it was concluded that despite these apparent declines, oil rates were still very high, particularly for pelagic seabirds of the North Sea. Within the Wadden Sea, the decline was most prominent, and this was seen as a positive effect of joint efforts to clear this area from chronic pollution by extensive surveillance of near-shore waters and consistent clean-up operations when the Wadden Sea became under threat by localized spills.

4.4.2 Policy

4.4.2.1 Trilateral policies

Shipping activities are a continuous source of contamination of the marine environment with oil, garbage and hazardous substances (de Jong *et al.*, 1999). Information on temporal changes and spatial differences in the oil pollution of the marine environment is being provided by Beached Bird Surveys carried out according to standardized methods and on a long-term basis. Trilateral policies for the reduction of pollution from ships were agreed at the Ministerial Conferences in Stade 1997 (Trilateral policy and management, §2.1.3-5) and in Esbjerg 2001 (Esbjerg Declaration: shore reception facilities §54-56, impacts of shipping §57-62, PSSA Wadden Sea §63-66). The aim of all these measures was the elimination of operational oil pollution, combating illegal discharges and minimizing accidental pollution by oil from shipping.

4.4.2.2 'Special Area' concept

A new and important feature of the MARPOL Convention was the concept of Special Areas (regarding oil MARPOL Annex I). These areas are considered so vulnerable to pollution by oil that oil discharges within them have been completely prohibited, with only minor and well-defined exceptions. The 1973 Convention identified the Mediterranean, the Black Sea, the Baltic Sea, the Red Sea and the Gulf area as Special Areas. The North Sea was excluded, despite its fisheries, rich wildlife and its status as one of the most polluted sea areas in the world (Couper, 1983). This was altered in September 1997 with the adoption of the

Kees (C.J.) Camphuysen
David M. Fleet
Bettina Reineking
Henrik Skov

1997 amendment that came into force on 1 February 1999: North West European waters were designated a Special Area under MARPOL Annex I. This region covers the North Sea and its approaches (including the Wadden Sea), the Irish Sea and its approaches, the Celtic Sea, the English Channel and its approaches and part of the North East Atlantic immediately to the West of Ireland. In Special Areas, discharge into the sea of oil or oily mixtures from any oil tanker and ship over 400 t is prohibited. The expectations from this step are considerable, because the amounts of oil that are allowed to be spilled at sea in Special Areas are so small that oiled seabirds should not occur, except in occasional oil incidents. Obviously, the declaration of a Special Area status is just one step. Intensified or at least continuous control through aerial surveillance and harbor inspections is required to prosecute offenders and to bring illegal discharges down to acceptable levels.

4.4.2.3 PSSA Wadden Sea

In 2002, following a joint application of Denmark, Germany and The Netherlands, the Wadden Sea was designated as a Particularly Sensitive Sea Area (PSSA) by the International Maritime Organization (IMO) (Reineking, 2002). A PSSA is an area that needs special protection because of its significance for recognized ecological or socio-economic or scientific reasons. In addition, the area should be at risk from international shipping activities. The designated PSSA Wadden Sea is the marine area of the Wadden Sea Conservation Area, comprising the Wadden Sea national parks in Germany and the Wadden Sea nature protection areas in Denmark and The Netherlands. The major shipping routes have been excluded from the PSSA.

The PSSA Wadden Sea designation will send strong signals to the international shipping community and increase awareness of the particular sensitivity of the area to impacts from shipping, such as oil.

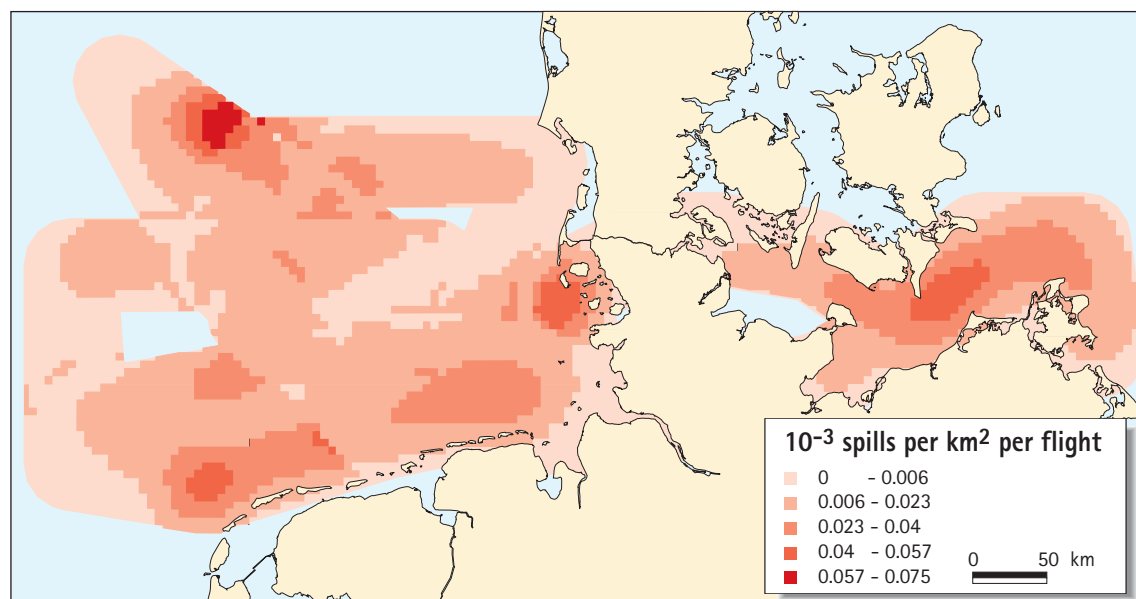
4.4.3 Sources of pollution

Chronic oil pollution is not only restricted to mineral oil, but in fact, numerous lipophilic substances are involved, including mineral oil, while few studies were capable of discriminating between types. While incidents with non-mineral oils are known to occur (Camphuysen *et al.*, 1999), and adverse effects are well known (Bommel , 1991), the scale and trends in levels of non-mineral oil pollutants in the marine environment are very uncertain (Timm and Dahlmann, 1991; Hak, 2003).

With regard to mineral oil pollution within the North Sea area, there is good evidence that ordinary ships' fuel oils, deliberately discharged with bilge waters, are the main source of oil pollution (Vauk *et al.*, 1987; Vauk *et al.*, 1989; Dahlmann *et al.*, 1994; Fleet and Reineking, 2000, 2001; Reineking and Fleet, 2002). Since the 1980s, when oil sampling and analysis in Germany began, fuel oil residues from shipping were identified as the main source of chronic oil pollution, accounting for nearly 90%.

Aerial surveys have shown a clustering of slicks around the major shipping lanes in the south and in the south-east (Directie Noordzee, 1995, 2001; Schallier *et al.*, 1996; von Viehahn, 2001). Figure 4.4.1 shows the high concentrations of oil pollution especially in the area with intensive sea traffic (traffic separation scheme) off the coast of The Netherlands, but also off the coast of the North

Figure 4.4.1: Standardized density of oil spills in the period 1989–1998 for the German Bight. Source: von Viehahn, 2001.



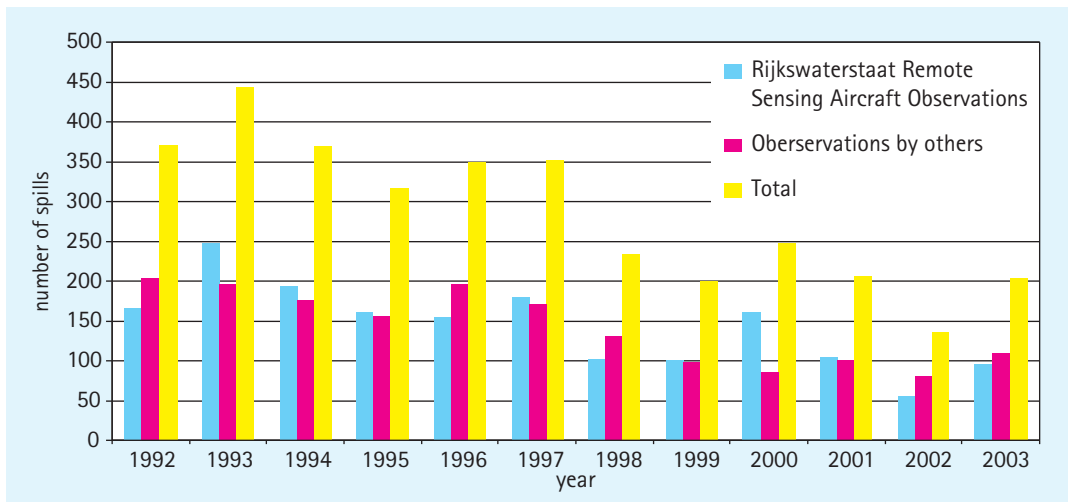


Figure 4.4.2: Reported oil spills on the Dutch Continental Shelf 1992–2003. (Data from Directoraat-Generaal Rijkswaterstaat, Directie Noordzee; data before 1992 is not reliable).

of Schleswig-Holstein. According to the reported oil spills off the Dutch and German coast (see Figures 4.4.2 and 4.4.3) there is a decline in comparison to the 1990s.

The clustering of oil slicks around the busiest shipping areas is clearly reflected in oil rates found on beach-washed bird corpses, both in the past (Stowe, 1982) and in recent years (Furness and Camphuysen, 1997; Camphuysen, 2003; Fleet and Reineking 2001). This would suggest that the main source of pollution remained the same over time. It should be stressed, however, that, with the exception of a 3.5 year study on the German coast in the period 1997–2001 (Dahlmann and Secheyne, 2000; Fleet and Reineking, 2001), there is fairly little concrete information about the sources of pollution in recent years. Regular analysis of oil residues found on beached birds and beaches would provide an insight in any changes in source of oil pollution at sea, and would therefore show where measures for pollution control should be tightened.

4.4.4 Oiled Seabirds

Systematic beached bird surveys, organized to assess the fraction of oiled seabirds washed ashore among the total number of dead birds found on beaches (oil rate), have been intense for decades, particularly in Denmark, Germany and The Netherlands (Joensen, 1972 a,b; Joensen and Hansen, 1977; Reineking and Vauk, 1982; Averbek *et al.*, 1993; Camphuysen, 1989, 1997; Reineking, 1997; Fleet and Reineking, 2000, 2001; Durinck and Skov, 2001; Fleet *et al.*, 2003). Earlier results indicated slow but consistent declines in oil rates over the past decades (Camphuysen, 1997, 1998; Durinck and Skov 2001; Fleet and Reineking, 2001). Nevertheless, oil rates in the Southern North Sea and in the Wadden Sea area throughout the 1980s and 1990s were regarded unacceptably high, particularly for pelagic seabirds. The enforcement of a Special Area status in 1999 should lead to further decreases in oil rates among seabirds; so far, results have not become evident.

Since the 1999 QSR, oil rates of the most com-

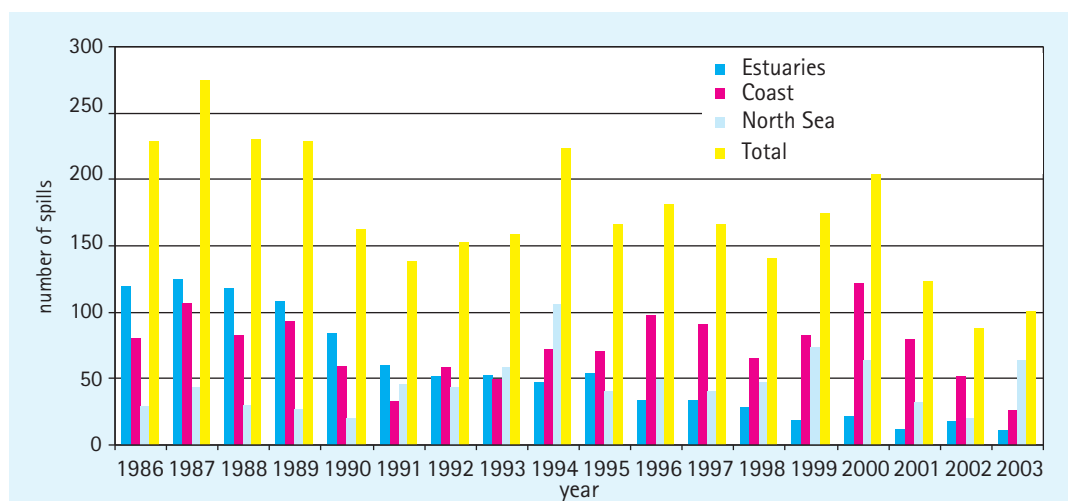


Figure 4.4.3: Reported oil spills in the German North Sea 1986–2003. (Data from the 'Maritimes Lagezentrum Havariekommando').

mon seabird found on North Sea beaches, the common guillemot *Uria aalge*, an indicator for marine oil pollution, have been proposed as one of the Ecological Quality Objectives (EcoQOs) (Camphuysen, 2004) by the Biodiversity Committee (BDC) of the OSPAR Commission. The EcoQO, as agreed by the 5th North Sea Conference, was defined as: the proportion of oiled common guillemots should be 10% or less of the total found dead or dying individuals of this species, in all areas of the North Sea. Common guillemots were chosen on the basis of their wide distribution in winter and their sheer abundance: sufficiently large samples could be obtained each winter in all North Sea countries to calculate a reliable oil rate figure. The methodology of both the surveys and the subsequent analysis of data has been described previously (Camphuysen and Dahlmann, 1995; Camphuysen and Meer, 1996; Camphuysen and Heubeck, 2001).

4.4.5 Trends in oil rates in the Wadden Sea area

In the following analysis, the Danish-German-Dutch North Sea coast has been subdivided into ten sub-regions based on the planning of surveys in each of the participating countries (Table 4.4.1).

Within the sub-regions a distinction was made between (1) coast exposed to the Wadden Sea (mainland coast as well as island coast facing the mainland) and (2) coast exposed to the North Sea (on islands). The second column (DK) comprises data for the Danish Wadden and North Sea, the last column (NL mainland) includes data for the Dutch mainland coast of the North Sea south of the Wadden Sea.

For common guillemots, one conclusion can be drawn straight away: the EcoQO of 10% oiled has not yet been reached, although an overall decline in oil rates since the mid-1980s is obvious (Table 4.4.1; Figure 4.4.4). The results give a modest indication of a sharper decline since 1999, and in fact, with the exception of Germany's North Sea exposed coasts, oil rates seem to have stabilized over the most recent years at levels just below 50%. On the Schleswig-Holstein (SH) North Sea exposed coast in Germany, the average oil rate since 1999 is 34%. This is significantly lower than the average for the winters 1992/93 to 1997/98 (62%). On the North Sea exposed coast in Niedersachsen (Nds), this difference was less apparent. Nevertheless, the lowest three oil rates recorded in the period 1992/93-2002/03 in this region were measured in the last three years, with the lowest

Table 4.4.1:

Oil rates in common guillemots (% oiled of total number found) in the sub-regions in and around the Wadden Sea in winter 1984/85-2002/03. Blank cells indicate insufficient data (sample <25 individuals), or no sampling effort. DK = Danish west coast including Wadden Sea; FRG Hel ns = Helgoland (North Sea exposed), German Bight; FRG Nds ws = Wadden Sea exposed coasts in Niedersachsen; FRG Nds ns = North Sea side of the islands in Niedersachsen; FRG SH ws = Wadden Sea exposed coasts in Schleswig-Holstein; FRG SH ns = North Sea side of the islands Schleswig-Holstein; FRG SH + Nds ws = Wadden Sea exposed German coasts; NL ws = Dutch coasts Wadden Sea exposed; NL islands = North Sea side of the Dutch Wadden Sea islands; NL mainl = Dutch North Sea coast southwards of Den Helder. ns = North Sea exposed (coast of the islands facing the North Sea), ws = Wadden Sea exposed (mainland coast as well as island coast exposed to the mainland).

Winter	DK	FRG Hel ns	FRG Nds ws+ns	FRG Nds ns	FRG SH ws+ns	FRG SH ns	FRG Nds+SH ws	NL ws	NL islands	NL mainl.
1983/84	78.7									
1984/85	75.8	86.6			43.3				92.3	71.0
1985/86	78.0	89.3	77.8		47.7			82.4	96.5	73.4
1986/87	90.1	92.0							90.9	80.0
1987/88	77.5	81.0			39.1			85.0	95.5	99.0
1988/89	78.4	73.7			39.4			52.7	86.7	58.0
1989/90	66.2	62.4	59.3		30.9			30.0	67.8	66.7
1990/91	74.8	58.1			21.7				62.5	84.1
1991/92	85.2	67.1	73.3		40.8				96.7	96.5
1992/93	31.1			47.8		43.4	21.4	22.2	18.4	28.1
1993/94	54.2			46.0		78.4	57.5	36.1	20.0	50.3
1994/95	71.3	85.3		65.5		72.0	35.7	46.2	33.3	47.2
1995/96				48.8					20.0	35.0
1996/97		63.3		61.0		79.6			66.7	83.3
1997/98	55.6			55.4		34.5			43.8	62.5
1998/99	43.8	41.4		25.4		24.8	26.0	3.3	27.1	25.6
1999/00	59.6	78.9		53.5		33.3	16.7	72.7	22.2	65.3
2000/01		54.8		43.1			14.3		60.0	41.7
2001/02	46.6			36.5		33.3	30.8		17.4	60.0
2002/03	56.0			29.3		36.4			60.0	98.2

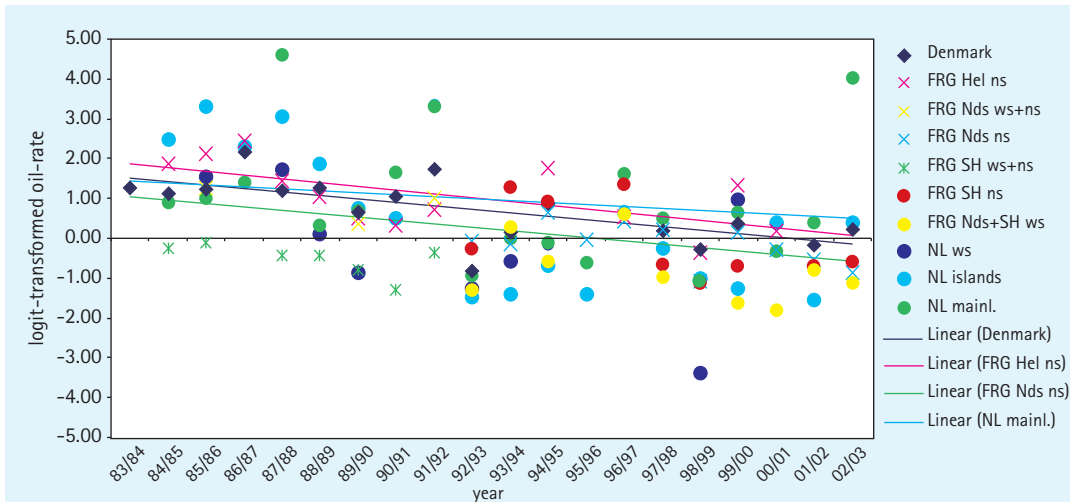


Figure 4.4.4: Logit-transformed oil rates in common guillemots in the areas around the Wadden Sea (cf. Table 4.4.1) and overall declining linear trends in the Dutch Wadden Sea + mainland, in Denmark, and in two areas at the German North Sea coast (Helgoland and North Sea exposed coast in Niedersachsen). Logit values of 0.0 refer to oil rates to 50%; 100% and 0% are infinitely large positive and negative values respectively.

value on record (29%) in 2002/03. Camphuysen (2003) observed a reverse trend in oil rates in pelagic seabirds in 2002/03 (Table 4.4.1), but concluded that this might have been caused by an unfortunate coincidence of oil incidents (including the 'Tricolor' in the Channel and the 'Assie Eurolink' that sank north of Terschelling). It should be noted, however, that high oil rates in common guillemots occurred again in winter 2003/04 (70%; NZG/NSO unpubl. data; not included in the present analysis), indicating that chronic oil pollution levels are still high.

Oil rates fluctuate from year to year, and where oil incidents or significant local spills may raise oil rates, natural mortality events have a tendency to lower the values found. These fluctuations introduce some noise in the signal received, but we chose not to arbitrarily remove values from the time series, but rather to work with the variability in the material as it was found. It is very interesting to note that several of the more drastic variations between seasons are synchronous in all or at least most sub-regions studied (Table 4.4.1; Figure 4.4.4).

Common guillemots may not be considered a typical example of the Wadden Sea avifauna; other abundant seabirds deserve attention. For most inshore species, as exemplified by shelduck and herring gull, recent oil rates are generally much lower than historic levels within the Wadden Sea. In the Danish part of the Wadden Sea, a recent increase in the oil rates of gulls and other inshore species has been recorded (Durinck and Skov, 2001). Common eider *Somateria mollissima*, shelduck *Tadorna tadorna*, and herring gull *Larus argentatus* were selected as numerous representatives of the Wadden Sea bird population. Because individual winter seasons did not always provide

sufficient samples, the data was grouped in time intervals and overall oil-rates were calculated. The most recent period (1999–2003, *i.e.* after the area became designated as a Special Area) may now be compared with results from the 1990s and 1980s (Table 4.4.2). Exceptionally high, starvation-induced natural mortality in the eider over the most recent winters, leading to artificially lowered oil rates, hindered the possibilities for a comparison of results prior to and after 1999. Two trends are apparent: (1) higher oil rates in the 1980s than in recent years, and (2) for each species, higher oil rates along North Sea shores than within the Wadden Sea itself. The first trend is in agreement with overall declines in oil pollution reported in Western Europe, the second is in line with earlier conclusions that the North Sea (and the shipping lanes in it) is much more oil-contaminated than the Wadden Sea area.

4.4.6 Conclusions

The results of beached bird surveys in the Wadden Sea area and its approaches indicate that oil rates have declined significantly over the last decades. The decline is most prominent in the Wadden Sea itself, whereas oil rates of birds found along North Sea shores (including the North Sea side of the Wadden Sea islands) are consistently higher than those in the Wadden Sea. Pelagic seabirds, notably common guillemots, still have relatively high oil rates and the recent designation of North West European waters as a Special Area under MARPOL Annex I (enforced in 1999) has not yet lead to a drastic further decline in oil contamination levels on beached birds. Data from the German North Sea coast suggests further declines after 1999, but recent observations in The Netherlands (winter 2002/03, and winter 2003/04) suggest a re-

Table 4.4.2:

Grouped oil rates in shelduck, common eider and herring gull (% oiled of total number found) in the sub-regions in and around the Wadden Sea since winter 1984/85. Blank cells indicate insufficient data (sample <25 individuals). See Table 4.4.1 for sub-regions.

ns = North Sea exposed (coast of the island facing the North Sea),

ws = Wadden Sea exposed (mainland coast as well as island coast facing the mainland).

	DK	FRG Hel ns	FRG Nds ws+ns	FRG Nds ns	FRG SH ws+ns	FRG SH ns	FRG Nds+SH ws	NL ws	NL islands	NL mainl.
Shelduck										
<1990	17.0	50.9			10.2			4.8	21.9	21.7
1990-1998				2.3	0.0	9.9	8.7	1.3	8.9	3.3
1999-2003				4.3		0.0	1.9	3.9		
Common eider										
<1990	55.1	29.1	16.7		58.2			10.8	51.4	95.5
1990-1998	44.2		15.9	7.5	14.1	23.0	26.4	6.7	3.4	15.4
1999-2003	0.0		3.4	1.4		2.7	1.6	1.2	2.1	14.2
Herring gull										
<1990	31.6	18.0	1.5		12.6			12.2	23.1	20.2
1990-1998	23.6	17.5	6.1	1.6	12.5	16.7	1.2	4.1	21.0	14.4
1999-2003	8.6	0.0		4.0		4.5	1.2	3.4	11.1	25.0

versed trend, with very high oil rates in pelagic seabirds and repeated strandings of oil slicks on beaches (NZG/NSO unpubl. material). This reversal can only partly be attributed to some unfortunate recent oil incidents, such as the sinking of the Tricolor and the Assie Eurolink in December 2002. For most inshore species, as exemplified by shelduck and herring gull, recent oil rates are generally much lower than historic levels within the Wadden Sea).

It is too early yet, to assess effects of the designation of the PSSA Wadden Sea in 2002. Longer data sets are necessary to find correlations to the measures taken on the different levels to reduce oil pollution in the area concerned.

4.4.7 Target evaluation

A specific target regarding beached oiled birds has not been formulated in the Wadden Sea Plan until now. However, the Ecological Quality Objective (EcoQO), as developed within the OSPAR framework and described above, can be applied and evaluated.

Although an overall decline in oil rates since the mid 1980s is obvious, the Ecological Quality Objective (EcoQO) of an oil rate of less than 10% in common guillemots has not yet been reached.

4.4.8 Recommendations

Continuation of beached bird surveys in each of the three countries as an important monitoring tool to evaluate trends in chronic oil pollution at sea is strongly recommended. The analysis presented here suffered from inconsistencies over time in the choice of sub-regions, shortening data series and reducing the statistical power of the

material. It is therefore strongly recommended to keep the most recent subdivision of the survey area in the future, so that trends can be followed with greater confidence.

It is of great importance to maintain the spread of observer activity over the entire winter period, and not to fall back to a level of isolated mid-winter surveys. The Beached Bird Surveys in the framework of the TMAP should be ensured over the entire winter period with harmonized survey frequency in the three Wadden Sea states.

The implementation of the analysis of oil from bird feathers and beach samples is strongly recommended (*cf.* Dahlmann *et al.*, 1994; Fleet and Reineking, 2001). Uncertainties with regard to the sources of oil pollution, issues that are difficult to deal with in aerial surveys and satellite monitoring programs, can be solved this way. Oil analysis of beach and/or feather samples can also be successfully used as legal evidence in prosecuting oil discharge by ships (Dahlmann, 1991) and for North Sea wide oil pollution control measures.

With North West European waters established as a Special Area under MARPOL Annex I, a lot has been achieved. However, just making an area a Special Area is rather pointless if this is not enforced by (national) law and if this law is not adequately implemented. It is clear that additional measures are required to make sure that mariners obey the regulations and stop discharging oil or oily waters (<15 ppm) within this area. Among others, the following actions regarding pollution prevention as well as control and enforcement measures would help to reduce chronic oiling as a threat to marine wildlife:

- Mandatory on-board transponders and oil fingerprinting of all vessels in North Sea waters would facilitate surveillance, enforcement and the prevention of pollution;
- Harmonization and implementation of the EC Directive 2000/59/EC on port reception facilities, including 100% indirect financing of waste collection;
- Implementation of a ship accreditation system for skippers who promote and adopt best environmental practices and have clean environmental records;
- Increase of co-operation between EU-countries, including information exchange and increased frequency of joint exercises regarding, for example, aerial surveys;
- Stronger legal deterrence. Imposed (minimum) fines must be increased to clearly reflect the full extent of the crimes under both shipping and environmental laws;
- Improvement / extension of aerial surveillance.

As a more specific step to try and reduce oil rates in seabirds (and to protect sensitive areas), it is recommended to identify, monitor and protect

sensitive areas at sea in the North Sea, also areas other than the PSSA Wadden Sea. Spatial patterns and seasonal trends in vulnerable concentrations of seabirds in the North Sea and west of Britain have been identified and published. Despite this knowledge, there is little evidence that this information is being used to improve planning of clean-up operations (e.g. Tricolor incident), in the decision process to either immediately combat illegal spills at sea or leave them to disperse naturally (and slower), or in the planning of aerial surveillances for oil at sea. A stronger emphasis on the most vulnerable areas could help to reduce the oil problem.

A final step is education. During training of sea cadets it should be emphasized that even a very small amount of discharged oil can cause immediate and serious damage to the environment, and that it is not so much the amount of oil spilled but the time and location where the oil is released that leads to significant mortality among seabirds and other marine wildlife. It may at least be hoped that the information provided will be remembered and that an illegal discharge will be recognized as a criminal act by the offender himself.

References

- Averbeck, C., Korsch, M., Vauk, G. and Wilke, J., 1993. Seevögel als Ölopfer.- Umweltbundesamt, Wasser Forschungsbericht 102 04 414, Norddeutsche Naturschutzakademie, pp.58.
- Baker, J.M., 1983. Impact of Oil Pollution on Living Resources. *The Environmentalist* 3, Suppl. No. 4.
- Bergman, M.J.N., 1985. Behaviour and biological impact of (un)treated oil spills in estuarine areas. *Neth. J. Agric. Sci.* 33, 78-81.
- Bommelé, M., 1991. Harmful effects on birds of floating lipophilic substances discharged from ships. In: Camphuysen, C.J., and Franeker, J.A. van, (Eds.). *Oil pollution, Beached Bird Surveys and Policy: towards a more effective approach to an old problem.* Proc. Int. NZG/NSO workshop, 19 April 1991, Rijswijk, Sula 5 (special issue), 44-45.
- Camphuysen, C.J., 1989. Beached Bird Surveys in the Netherlands 1915-1988; Seabird Mortality in the southern North Sea since the early days of Oil Pollution. *Techn. Rapport Vogelbescherming 1, Werkgroep Noordzee, Amsterdam* pp. 322.
- Camphuysen, C.J., 1997. *Olievervuiling en olieslactoffers langs de Nederlandse kust, 1969-97: signalen van een schonere zee.* Sula 11(2) special issue, 41-156.
- Camphuysen, C.J., 1998. Beached bird surveys indicate decline in chronic oil pollution in the North Sea. *Mar. Poll. Bull.* 36, 519-526.
- Camphuysen, C.J., 2003. North Sea pilot project on Ecological Quality Objectives, Issue 4. Seabirds, EcoQO element F. Proportion of oiled Common Guillemots among those found dead or dying. CSR Report 2004-011, Texel, pp. 26.
- Camphuysen C.J., 2004. North Sea pilot project on Ecological Quality Objectives, Issue 4. Seabirds, EcoQO element F. Proportion of oiled Common Guillemots among those found dead or dying - revised edition (June 2004). CSR Report 2004-012, Texel, pp. 26.
- Camphuysen, C.J., Barreveld, H., Dahlmann, G. and Franeker, J.A. van, 1999. Seabirds in the North Sea demobilised and killed by polyisobutylene (C₄H₈)_n. *Marine Pollution Bulletin* 38(12), 1171-1176.
- Camphuysen, C.J., and Dahlmann, G., 1995. Guidelines on standard methodology for the use of (oiled) beached birds as indicators of marine pollution. Ad Hoc working group on Monitoring, Oslo and Paris Convention for the Prevention of Marine Pollution. MON 95/7, Agenda item 7, 13-17 November 1995, Copenhagen.
- Camphuysen, C.J. and Franeker, J.A. van, 1992. The value of beached bird surveys in monitoring marine oil pollution. *Technisch Rapport Vogelbescherming 10, Vogelbescherming Nederland, Zeist*, pp. 191.
- Camphuysen, C.J. and Garthe, S., 2000. Seabirds and commercial fisheries: population trends of piscivorous seabirds explained? In: Kaiser M.J. and Groot S.J. de, (Eds.). *Effects of fishing on non-target species and habitats: Biological, Conservation and Socio-Economic Issues*, Blackwell Science, Oxford, 163-184.
- Camphuysen, C.J. and Heubeck, M., 2001. Marine oil pollution and beached bird surveys: the development of a sensitive monitoring instrument. *Environmental Pollution* 112, 443-461.

- Camphuysen, C.J., and Meer, J. van der, 1996. Recent trends in oiled seabirds. Ad Hoc working group on Monitoring, Oslo and Paris Convention for the Prevention of Marine Pollution, Environmental Assessment and Monitoring Committee (ASMO), MON 1995 summary record, Copenhagen, 20-48.
- Couper, A. (Ed.), 1983. The Times Atlas of the Oceans. Times Books, London.
- Dahlmann, G., 1991. Oil identification for court evidence. In: Camphuysen, C.J. and Franeker, J.A. van, (Eds.). Oil pollution, Beached Bird Surveys and Policy: towards a more effective approach to an old problem. Proc. Int. NZG/NSO workshop, 19 April 1991, Rijswijk, Sula 5 (special issue), 29-32.
- Dahlmann, G., Timm, D., Averbeck, C., Camphuysen, C.J. and Skov, H., 1994. Oiled seabirds - Comparative investigations on oiled seabirds and oiled beaches in the Netherlands, Denmark and Germany (1990-1993). Mar. Poll. Bull. 28, 305-310.
- Dahlmann, G. and A. Secheyne, 2000. Verölte Seevögel an der deutschen Nordseeküste 1998/99 - Ergebnisse der Ölanalysen. Seevögel 21/1, 11 - 12.
- Directie Noordzee, 1995. Verontreinigingen Nederlands Continentaal Plat 1992-1994. Directie Noordzee, Dir.-Gen. Rijkswaterstaat, Rijswijk.
- Directie Noordzee, 2001. Verontreinigingen op het NCP, 1995-2000. Directie Noordzee, Ministerie van Verkeer en Waterstaat, Rijswijk, pp. 36.
- Durinck, J. and Skov, H., 2001. Trends in marine oil pollution in Denmark 1984-2001. Report to the Danish Environmental Protection Agency, Danish Ministry of Environment. Ornis Consult Report.
- Fleet, D. M. and Reineking, B., 2000. Have efforts to clean up the marine environment been successful? - German beached bird surveys provide an index for oil pollution levels in the southern North Sea. In: Rodrigues, G.R. and C.A. Trebbia, (Eds.). Oil & Hydrocarbon Spills II, Modelling, Analysis and Control. WITPress, 117-126.
- Fleet, D. M. and Reineking, B., 2001. Bestimmung, Quantifizierung und Bewertung der Öleinträge in der Nordsee zur Beurteilung der Schiffsentsorgung in deutschen Nordseehäfen. UBA-Berlin, FKZ 297 25 310, Hochschule Bremen, pp. 279.
- Fleet, D. M., Gaus, S. and Schulze Dieckhoff, M., 2003. Zeigt die Ausweisung der Nordsee als MARPOL-Sondergebiet für Öl die ersten Erfolge? Ölopfer in der Deutschen Bucht in den Wintern 2000/2001 und 2001/2002. Seevögel Band 24/1, 16-23.
- Furness, R.W., and Camphuysen, C.J., 1997. Seabirds as monitors of the marine environment. ICES J. Mar. Sc. 54, 726-737.
- Hak, J., 2003. Toename lozingen paraffine en chemicaliën. Nieuwsbrief Beheersvisie Noordzee 2010 (6), 4-5.
- Heubeck, M., Camphuysen, C.J., Bao, R., Humple, D., Sandoval, A., Cadiou, B., Bräger, S. and Thomas, T., 2003. Assessing the impact of major oil spills on seabird populations. Mar. Poll. Bull. 46, 900-902.
- Joensen, A.H., 1972a. Oil pollution and seabirds in Denmark 1935-1968. Dan. Rev. Game Biol. 6(8), 1-24.
- Joensen, A.H., 1972b. Studies on Oil pollution and seabirds in Denmark 1968-1971. Dan. Rev. Game Biol. 6(9), 1-32.
- Joensen, A.H., and Hansen, E.B., 1977. Oil pollution and seabirds in Denmark 1971-1976. Dan. Rev. Game Biol. 10(5), 1-31.
- Jong, F. de, Bakker, J.F., van Berkel, C.J.M., Dankers, N.M.J.A., Dahl, K., Gätje, C., Marencic, H. and Potel, P., 1999. Wadden Sea Quality Status Report. Wadden Sea Ecosystem No. 9. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Quality Status Report Group. Wilhelmshaven, Germany, pp.259.
- Kingston, P.F., 1992. Impact of offshore oil production installations on the benthos of the North Sea. ICES J. mar. Sci. 49, 45-53.
- Reineking, B., 1997. Verölte Seevögel im Spülsaum - Hinweise auf Ölverschmutzung durch den Seeverkehr. Deutsche Hydrogr. Zeitschr., Aktuelle Probleme der Meeresumwelt, Supplement 7, 113-123.
- Reineking, B., 2002. The Wadden Sea designated as a PSSA. Wadden Sea Newsletter 2002 - No.2, 10-12.
- Reineking, B., and Fleet, D.M., 2002. Einfluss von Öl auf Seevögel und Meeressäuger. In: Lozán, J.L., E. Rachor, K. Reise, J. Sündermann, H. von Westernhagen (Eds.). Warnsignale aus Nordsee & Wattenmeer. Eine aktuelle Umweltbilanz. Wissenschaftliche Auswertungen, Hamburg, 235-237.
- Reineking, B., and Vauk, G., 1982. Seevögel - Opfer der Ölpest. Jordsandbuch Nr 2., Ed. Verein Jordsand zum Schutz der Seevögel e.V. Otterndorf, pp. 143.
- Schallier, R., Lahousse, L., and Jacques, T.G., 1996. Toezicht vanuit de lucht: Zeeverontreiniging door schepen in de Belgische Belangenzone van de Noordzee - Activiteiten rapport 1991-1995. Beheersvisie Mathematisch Model Noordzee en Schelde Estuarium (BMM, Brussel, pp. 51.
- Stowe, T.J., 1982. Beached bird surveys and surveillance of cliff-breeding seabirds. Royal Society for the Protection of Birds report to the Nature Conservancy Council, Sandy, pp. 207.
- Timm, D. and Dahlmann, G., 1991. Investigations into the source of non-mineral oils in the feathers of seabirds. In: Camphuysen, C.J. and van Franeker, J.A., (Eds.). Oil pollution, Beached Bird Surveys and Policy: towards a more effective approach to an old problem. Proc. Int. NZG/NSO workshop, 19 April 1991, Rijswijk, Sula 5 (special issue), 15-17.
- Vauk, G., Dahlmann, G., Hartwig, E., Ranger, J.C., Reineking, B., Schrey, E., and Vauk-Hentzelt, E., 1987. Ölopferfassung an der deutschen Nordseeküste und Ergebnisse der Ölanalysen sowie Untersuchungen zur Belastung der Deutschen Bucht durch Schiffsmüll. Report Vogelwarte Helgoland, Umweltbundesamt Berlin, pp.164.
- Vauk, G., E. Hartwig, E. Schrey, E. Vauk-Hentzelt, and M. Korsch, 1989. Seevögelverluste durch Öl und Müll an der deutschen Nordseeküste von August 1983 bis April 1988. Umweltbundesamt, Wasser Forschungsbericht 102 04 370, pp. 164.
- Viebahn, C. von, 2001. Oil spill statistics and oil spill monitoring. DGMK research report 564. Hamburg, DGMK, pp. 95.