Oil rates in Common Guillemots

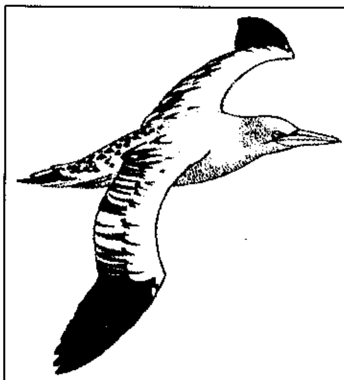
[Proportion of oiled Common Guillemots among those found dead or dying on beaches]

Guillemot – oil – EcoQO

Project INTERNAT*NZM-DNZ

C.J. Camphuysen

Netherlands' beached bird survey programme of the Dutch Seabird Group (NZG/NSO)
CSR *Consultancy*



Ankerstraat 20,
1794 BJ Oosterend,
Texel,
The Netherlands
kees.camphuysen@wxs.nl
+ 31 222 318744

Contents

ABSTRACT

Camphuysen C.J. 2002. Oil rates in Common Guillemots: Proportion of oiled Common Guillemots among those found dead or dying on beaches, Guillemot – oil – EcoQO. CSR Report 2002-@@@. CSR *Consultancy*, Oosterend, Texel

An earlier pilot study on oil pollution and beached bird surveys indicated that oil rates can be used as a suitable indicator for levels of chronic marine oil pollution in the North Sea. This report reviews the existing data and the possibilities for a monitoring programme for the entire North Sea area, using oil rates on an indicator species, the Common Guillemot *Uria aalge.* Information is supplied on the background and planning for a European study, that includes investigations into the sources of pollution (mineral oil and other substances).

Project:	INTERNAT*NZM-DNZ
commissioned by	Ministry of Transport, Public Works and Water Management National Institute for Coastal and Marine Management (RIKZ)
contract nr.	RIKZ 71021577
conducted by:	CSR *Consultancy* C.J. Camphuysen Ankerstraat 20, 1794 BJ Oosterend, Texel, The Netherlands + 31 222 318744 kees.camphuysen@wxs.nl

Keywords: Beached bird surveys BBS, chronic oil pollution, Ecological Quality Objectives (EcoQO), *Uria aalge*, North Sea, OSPAR

Summary

One of the most obvious adverse effects of (chronic) pollution of the world's oceans and seas with mineral oil is the mortality of seabirds. 'Beached bird surveys', systematic censuses of beachcast corpses of birds, have been widely used to document this. A system has been proposed in which species specific oil rates provide a consistent parameter, indicative of the differing risk of birds (or corpses of birds) to become oiled. This parameter is to be used for the evaluation of trends in marine oil pollution in European seas under the Ecological Quality Objectives (EcoQOs).

Abundant swimming seabirds with a high vulnerability index are ideal to monitor chronic oil pollution. The Common Guillemot *Uria aalge* was selected be used: the **Guillemot-oil-EcoQO**. Observed regional differences in oil rates of Common Guillemots suggest a higher pressure of oil on bird populations in the Channel area and the south-eastern North Sea than in the western and northern areas. Oil rates among stranded birds in The Netherlands have substantially declined during the past 25 years. In the early 1980s, a drastic increase in *numbers* of oiled seabirds was mistakenly interpreted as an increase in chronic oil pollution, while the *oil rate* had in fact not changed very much. Oil rates, but *not* bird numbers, are stable indicators of chronic oil pollution. The ecological quality objective with respect to the proportion of oiled Common Guillemots (the Guillemot – oil – EcoQO) is that the proportion of such birds should be 10% or less of the total found dead or dying, in all areas of the North Sea". Beached bird surveys have been standardised internationally. Specific adjustments for the EcoQO include the ageing of Common Guillemots, the restriction to work in winter, to exclusively use complete corpses and to sample sufficient individuals for a reliable oil rate.

A sampling protocol to identify different types of oil and other substances is proposed to identify sources of pollution. Oil sampling will be systematic, sampling every first Common Guillemot over 5 km survey effort, irrespective of the visible fouling of the plumage to avoid bias. For each 600 km of coastline, up to 100 samples per annum are presently foreseen.

Beached bird surveys have been conducted in many countries around the North Sea and large sets of data are currently available, little of which has been published. Data of International Beached Bird Survey (IBBS), could be used to update our knowledge of geographical differences in oil pollution levels. Trend analyses of areas where high quality data have been collected during winters in the past 10-15 years would provide base-line data for the Guillemot – oil –EcoQO. Base-line data from oil-sampling programmes are sparse and inventory of non-published data should be made to stimulate analysis and publication.

The main expenses the Common Guillemot EcoQO will originate from professional time needed for international co-ordination, manual production, statistical analysis, chemical analysis of oil samples and the publication of results. When beached bird surveys are continued, other Ecological Quality objectives, such as the Fulmar-Litter-EcoQO will remain possible at relatively low cost.

Total costs for a monitoring programme Guillemot – oil – EcoQO would amount to approx. € 92,000 per annum. Half this sum (€ 43,750) is required for the chemical analysis of oil samples.

Introduction

One of the most obvious adverse effects of (chronic) pollution of the world's oceans and seas with mineral oil is the mortality of seabirds. 'Beached bird surveys', systematic censuses of beachcast corpses of birds have been widely used to document this (Camphuysen & Van Franeker 1992; Camphuysen & Heubeck 2001).

Beached bird surveys have been developed originally to measure the impact of oil on seabirds and seabird populations. In recent years, however, beached bird surveys have been promoted as effective tools measuring trends in chronic oil pollution. The variable risk for birds (or corpses of birds) to become contaminated by oil in different sea areas and over time is assumed indicative of chronic oil pollution levels of our seas. To monitor the levels of chronic oil pollution through beached bird surveys, there is no need to accurately assess total numbers of birds washing ashore. Instead, a system has been proposed in which a 'sufficient sample' should be taken each season to allow the calculation of a reliable *'oil rate'* (*i.e.* proportion of oiled birds among those found dead or dying on the coast; Camphuysen & Dahlmann 1995; Camphuysen & Heubeck 2001; Seys *et al.* 2002).

There is considerable regional and temporal variation in oil rates. Oil rates are also clearly species specific and oil vulnerability indices have been designed to evaluate the risk for seabird populations, based on parameters as exposure, (behavioural) specialisation, population size, and different levels of dispersion over sea areas through the year (King & Sanger 1979; Camphuysen 1989a; Camphuysen 1998, Seys *et al.* 2001a; Williams *et al.* 1995; Begg *et al.* 1997). However, species specific oil rates provide a consistent and repeatable parameter, indicative of the differing risk of birds (or corpses of birds) to become oiled in certain sea areas (Camphuysen and Van Franeker 1992; Furness & Camphuysen 1997; Camphuysen 1998). It is this parameter that is intended to be used for the evaluation of trends in marine oil pollution in European seas under the Ecological Quality Objectives (EcoQOs); Issue 4 (Seabirds).

Short history of beached bird surveys in Europe

In Europe, beached oiled seabirds were first reported in the late 19th and early 20th centuries (see review Camphuysen & Heubeck 2001 and references therein). However, it was not until the First World War that oiled seabirds became a common phenomenon. Local incidents and certain mass strandings prompted people to search a few beaches and some of the counts of dead seabirds were published as short notes in various natural history journals, or as reports to local authorities or government bodies. It was not until the 1950s and 1960s that serious attempts were made to establish and maintain programmes for monitoring beached (oiled) seabirds. The first countries in which regular beached bird surveys became established were Belgium, Britain, and The Netherlands (Table 1).

During the 1970s and early 1980s the number of participating European countries gradually increased and the Royal Society for the Protection of Birds in Britain co-ordinated beached bird survey results internationally from 1972 onwards (Stowe 1982). The International Beached Bird Survey (IBBS), was an attempt to link national mid-winter counts (usually in the last weekend of February), in order to get a more international overview. The co-ordination was shifted to the Danish Ornithological Society in later years (Skov *et al.* 1989). Although the IBBS has been continued in recent years, the data have not been analysed and there are no recent publications on the geographical aspect of oil rates for most of Europe.

In the 1990s, beached bird survey schemes operated on a more or less regular basis in 13 European countries (Table 1), varying considerably in temporal and geographic coverage. Many surveys were organised independent of the IBBS, but most countries would provide data for the IBBS on request. The high level of chronic oiling in the southern North Sea, and the frequency with which oiled seabirds occur on beaches probably helped maintain the interest and commitment of participating volunteers in long-running schemes, as has concern over the development of North Sea oil fields since the 1970s (Dunnet 1987).

Table 1. Beached bird surveys in Europe. Incidental reports (X) and the occurrence of systematic beached bird surveys (BB) are indicated per decade (from Camphuysen & Heubeck 2002; see references therein).

	1910s	20s	30s	40s	50s	60s	70s	80s	90s
Belgium					BB	BB	BB	BB	BB
Britain	X	X	X	X	X	BB	BB	BB	BB
Denmark			X	X	X	BB	BB	BB	BB
Estonia	X					X			BB
Finland				X	X	X	X	X	
France						BB	BB	BB	BB
Germany					BB	BB	BB	BB	BB
Ireland						X	X	X	
Latvia								BB	BB
Lithuania									BB
Netherlands	X	X	X	BB	BB	BB	BB	BB	BB
Norway						X	X	BB	BB
Poland					X	X	BB	BB	BB
Portugal								BB	BB
Spain							X	BB	BB
Sweden					X		X	X	
Russia				X	X			?	?

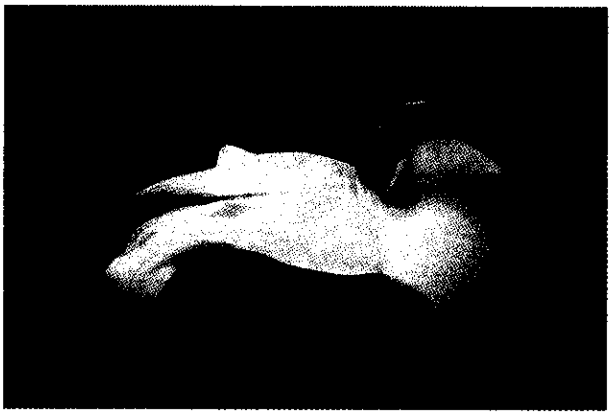
The usage of an oil rate, after being proposed in Camphuysen & Van Franeker (1992) has been widely accepted as a policy instrument and is used by many beached bird survey programmes around the North Sea and elsewhere. The North Sea Ministers, in their Bergen Declaration March 2002, decided to implement some selected EcoQO's as pilot projects. Among these is the EcoQO on marine oil pollution in the North Sea, using the oil rates of corpses of seabirds (Issue 4). Policy usage of oil-pollution data collected on beaches has cross-fertilised the system of beached bird surveys and has been a stimulus for their continuation. The implementation of an Ecological Quality Objective for seabirds and oil in the North Sea will further boost beached bird survey programmes.

Oil rates in Common Guillemots as a parameter

Seabirds can be divided into pelagic species and taxa with a more coastal orientation (Figure 1). Some species spend their entire life at sea; others enter the marine environment only during specific periods (*i.e.* winter) or during migration. More aerial species (e.g. albatrosses) have a relatively lower risk to contact floating oil and have a tendency to escape over larger areas after becoming (lightly) oiled than generally swimming species with a high wing-loading (e.g. divers, seaduck and auks). Hence, abundant swimming seabirds with a high vulnerability index and with a marine orientation (more or less permanent exposure) are ideal species to monitor chronic oil pollution. In a set-up where it is intended to study geographical differences and temporal trends of marine oil pollution, a common and widespread species should be selected.

A Black-browed Albatross *Thalasarche melanophrys* as an example of a wide-ranging, aerial, pelagic seabird.

A Herring Gull *Larus argentatus* as an example of aerial species with a more coastal orientation.



The Common Eider *Somateria mollissima*, an example of seaduck with a strictly coastal distribution where large, highly vulnerable concentrations are formed.

A Common Guillemot *Uria aalge* (front) and a Razorbill *Alca torda* (background), two common examples of the auk family: pelagic seabirds that spend much time on the water.

Figure 1. The risk to become contaminated with oil at sea is different between species. Largely aerial, dispersive or wide-ranging pelagic species such as albatrosses have generally lower vulnerability indices than species that spend most of their time swimming and also occur in dense concentrations such as seaduck. A monitoring programme should always take species-specific differences in the vulnerability for oil into account (Slides © C.J. Camphuysen).

In Europe, one of the best candidates is the Common Guillemot *Uria aalge*, a member of the auk family (Alcidae), with an estimated European population of around 2 million individuals (Harris 1997). Common Guillemots are common winter visitors in all countries around the North Sea, in the Norwegian Sea, in the Bay of Biscay, in the Skagerrak and Kattegat area and even in the Baltic (Durinck *et al.* 1994; Stone *et al.* 1995; Snow & Perrins 1998).
It is indeed the Common Guillemot that is intended to be used as an Ecological Quality Objective (EcoQO; Issue 4. Seabirds) for the evaluation of trends in marine oil pollution in European Seas: the **Guillemot-oil-EcoQO.**

Oil rates in Common Guillemots: existing knowledge

Oil rates in Common Guillemots are high in comparison with many other species, reflecting their high vulnerability to oil (Figures 1-2). In the Netherlands between 1978 and 1991, oil rates in Common Guillemots amounted to 88% (Camphuysen & Van Franeker 1992). Over a similar period (1980s) in Germany, Denmark, Norway and the Shetland Islands, levels of

70% (Averbeck *et al.* 1992), 82% (Danielsen *et al.* 1990), 34% (K. Skipnes *in litt.*) and 11% (M. Heubeck *in litt.*) were produced respectively. Such an overview of geographical differences in oil rates for a specific species (see for details Camphuysen & Van Franeker 1992) was in fact a repetition of a previous analysis based on the International Beached Bird Survey produced by the Royal Society for the Protection of Birds in the early 1980s for auks (Fig. 2; Stowe 1982).

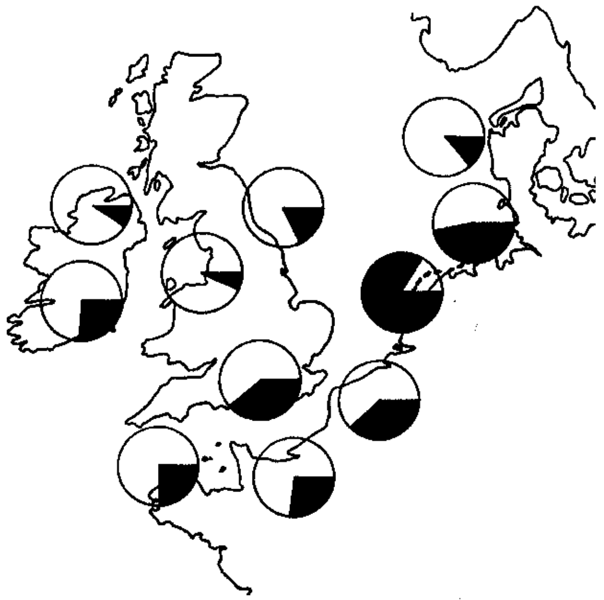


Figure 2. Mean proportions of gull corpses found oiled during International beached Bird Surveys 1971-81 (from Stowe 1982).

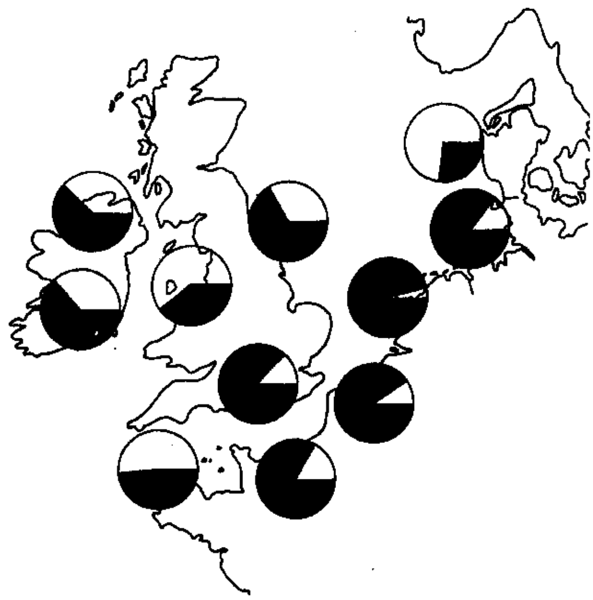


Figure 3. Mean proportions of auk corpses found oiled during International beached Bird Surveys 1971-81 (from Stowe 1982).

Furness & Camphuysen (1997) repeated the comparison with updated material in the mid-1990s (Fig. 4), and confirmed the regional differences in oil rates suggesting a higher pressure of oil on bird populations in the Channel area and the south-eastern North Sea than in the western and northern areas.

Oil rates among stranded birds in a well-studied country as The Netherlands have substantially declined during the past 25 years (Fig. 5, Table 2). Although Common Guillemots rank still among the species with the highest values, even in this species the oil rate has almost halved since the beached bird surveys were re-established in a more systematic manner in the late 1970s (Camphuysen 1995, 1998). There are similar signals in other countries around the North Sea, indicating that the pressure of chronic oil pollution is declining. A detailed analysis of material in the Netherlands showed that, in concert with more particular attempts to prevent the coast from becoming oiled (legislation, control, and clean-up operations), oil rates in coastal species have declined more markedly than oil rates in offshore species such as Common Guillemots. An analysis of existing material is required to see if this pattern is consistent all over the North Sea.

Performance of the metric

In the work plan for Ecological Quality Objectives it is suggested that the historic trajectory of the metrics (misses, and false alarms) should be evaluated, as well as the performance of the metric. In many of the trend analyses of oil rates in Common Guillemots, the material has shown to provide a rather consistent, gradual decline over time with relatively little scatter around the trend line (Camphuysen 1995). The experimental establishment of free oil harbour reception facilities in Germany was immediately reflected in a decline in oil rates recorded in

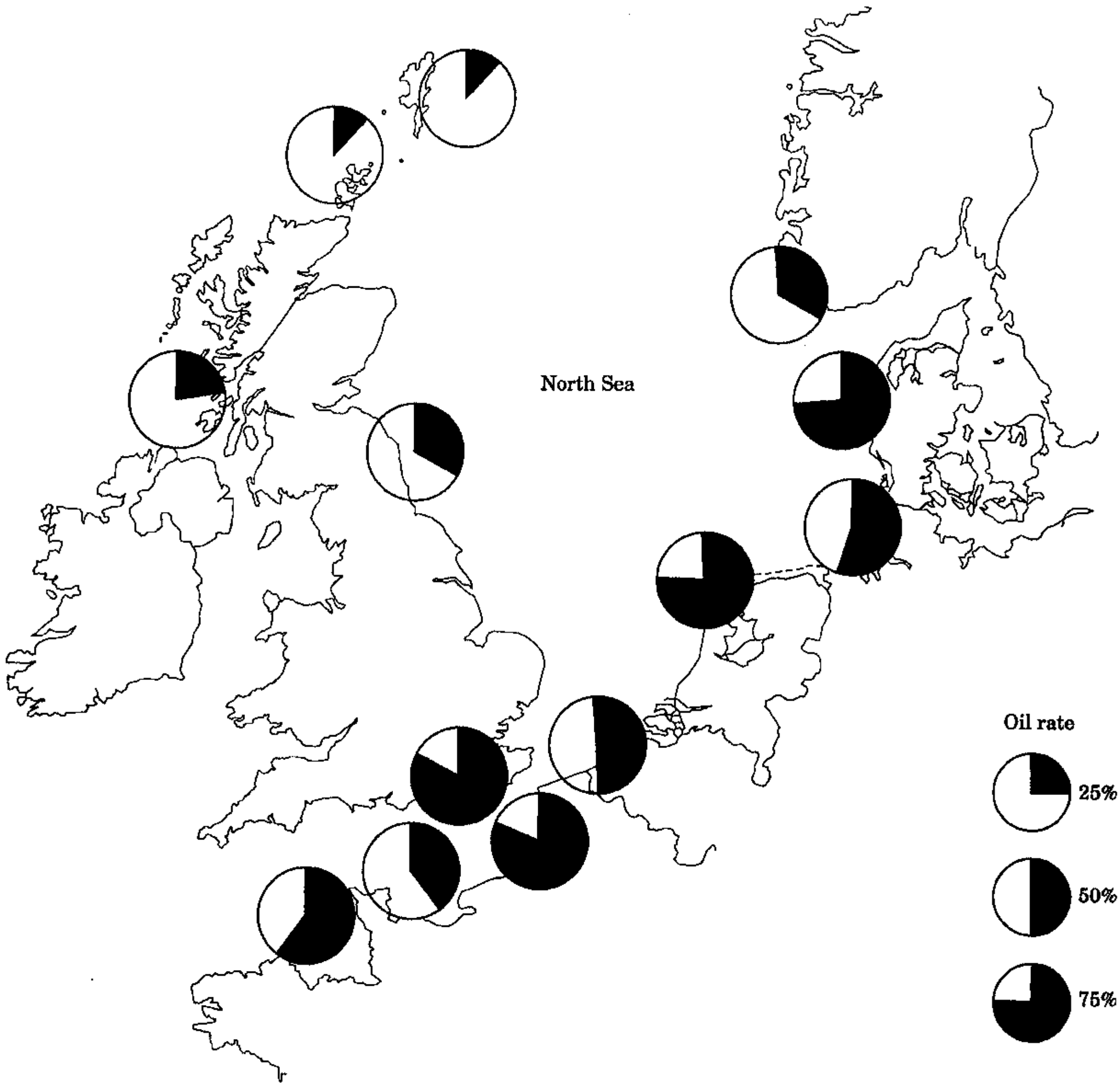


Figure 4. Differences in oil rates of Common Guillemots in Western Europe (data from Camphuysen 1995, as published by Furness & Camphuysen 1997).

local beached bird surveys for as long as the experiment lasted (Averbeck & Voigt 1992; Camphuysen & Heubeck 2001).

With respect to Common Guillemots, there has not been any clear false alarm in recent years, except when specific oil incidents are referred to. The *Erika* incident in western France was an event during which a very large number of oiled Common Guillemots was obtained during systematic surveys associated with the event (Anon. 2000; Dréan-Quénec'hdu & L'Hostis 2001). The 'unreasonably' high oil-rate would never have had the risk to be misinterpreted as an increase in chronic oil pollution levels, simply because of the media publicity surrounding the event.

A false alarm was in fact given in the early 1980s, when a drastic increase in *numbers* of oiled corpses of auks and Black-legged Kittiwakes *Rissa tridactyla* was mistaken for an increase in chronic oil pollution (Camphuysen 1981). It turned out that food-driven wrecks of starved birds were responsible for the very large numbers of seabirds washing ashore in these years (Camphuysen 1989a, 1990b, 1992). A subsequent analysis of the material showed that the *oil rate* had in fact not changed very much in the years where very large numbers of casualties washed ashore. This in fact resulted in the proposal to use the oil rate rather than bird numbers as a rather stable indicator of the risk for birds or corpses of birds to become oil fouled in certain areas (Camphuysen & Van Franeker 1992). The oil rate as a measure was further studied and evaluated in the mid-1990s, including a power analysis of observed trends (Camphuysen 1995, 1997) and was soon adopted by national and international authorities, as well as by the scientific community.

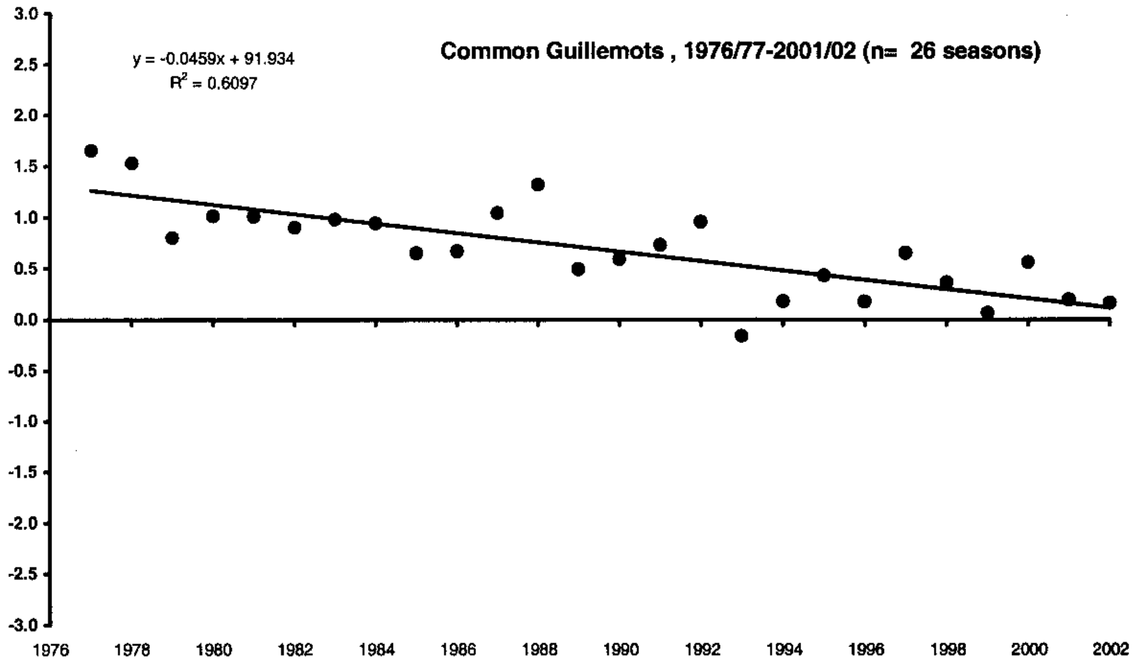


Figure 5. Significant decline in (logit-transformed) oil rates of Common Guillemots found dead along the North Sea coast in The Netherlands in winter 1976/77 (1976) to 2001/02 (2002) (NZG/NSO unpublished data, as data were received up to 30 Nov 2002).

Logit 3.0 = 99.9% oiled, logit 2.0 = 99% oiled, logit 1.0 = 91% oiled, logit 0 = 50% oiled, logit -1.0 = 9% oiled, logit -2.0 = 1% oiled, logit -3.0 = 0.1% oiled).

Ecological Quality Objective as agreed by the Fifth North Sea Conference

The ecological quality objective with respect to the proportion of oiled Common Guillemots (the Guillemot – oil – EcoQO) is seemingly simple and straightforward:

> *"The proportion of such birds should be 10% or less of the total found dead or dying, in all areas of the North Sea".*

However, given the short-term variability of oil-rates due to all sort of factors such as particular local circumstances, oil incidents and seabird wrecks, it is important to agree on what a level of 10% oiled birds actually is and how this needs to be assessed. Would this be the first time a 10% level was reached? Would this be an *average* or a *maximum* oil rate over a period of several consecutive years?

With regard to 'further information' to be obtained, the monitoring and data handling should be improved while taking note of a Belgian paper on the frequency of monitoring

(Seys *et al.* 2002). Hidden in the workplan, but with substantial implications for the (international) project is the request to:

"Take into account different types of oil, including paraffine."

Both factors, the oil rates and the types of oil, have been addressed separately in the following text, because the work planned for either factor is quite different.

Oil rates

Camphuysen (1995) examined trends in oil rates and the statistical power of appropriate trend tests. The power ($1-\beta$) is the probability that a trend, if present, will be detected as statistically significant. It depends on the size of the trend, the error variance, the number of years (n), and the size of the test. Presumably the fraction of oiled birds (the oil rate, y) has some s-shaped relation with some index of oil pollution (x) and a widely used mathematical representation of such s-shaped curve is the logit function. The analysis of oil rates focuses on this index of oil pollution. Camphuysen (1995) showed time series of the observed index x for Common Guillemots with fitted linear trends (by least squares estimation) for several countries (*i.e.* The Netherlands, Denmark, Germany, Norway, and Shetland Islands). Significant declines were found in Shetland, Germany and The Netherlands, whereas shorter time series for Norway and Denmark did not reveal significant trends.

These linear trends cannot continue in infinity and a plateau is likely to be reached when approaching very low levels of oil pollution (for example <5% oiled). Small local spills, widely spaced in time, will lead to relatively marked shifts in oil rates when the overall levels are very low, especially if the sample size is low (<100 corpses; Seys *et al.* 2002). Therefore, a statistical analysis was conducted for observed trends in Dutch material. This study examined the variability of the material (*i.e.* the standard deviation of the (yearly) logit-transformed oil rate indices around the observed linear trend) to come up with a proposal for a time span within which the desired 10% level has to be observed (Fig. 6). The results indicate

Table 2. Numbers of complete corpses of Common Guillemots found along the Dutch North Sea coast in winter 1976/77 – 2001/02 (Unpubl. material NZG/NSO; see also Fig. 4).

Winter	unoiled	oiled	sample	oilrate	logit oil
1976/77	1	45	46	0.9783	1.6532
1977/78	3	102	105	0.9714	1.5315
1978/79	19	120	139	0.8633	0.8004
1979/80	16	166	182	0.9121	1.0160
1980/81	315	3213	3528	0.9107	1.0086
1981/82	98	784	882	0.8889	0.9031
1982/83	374	3595	3969	0.9058	0.9828
1983/84	237	2072	2309	0.8974	0.9416
1984/85	244	1097	1341	0.8180	0.6528
1985/86	211	989	1200	0.8242	0.6709
1986/87	13	145	158	0.9177	1.0474
1987/88	67	1409	1476	0.9546	1.3228
1988/89	374	1165	1539	0.7570	0.4935
1989/90	297	1160	1457	0.7962	0.5917
1990/91	320	1718	2038	0.8430	0.7299
1991/92	79	714	793	0.9004	0.9561
1992/93	572	399	971	0.4109	-0.1564
1993/94	297	451	748	0.6029	0.1814
1994/95	116	314	430	0.7302	0.4325
1995/96	68	102	170	0.6000	0.1761
1996/97	40	179	219	0.8174	0.6508
1997/98	139	321	460	0.6978	0.3635
1998/99	913	1068	1981	0.5391	0.0681
1999/00	218	793	1011	0.7844	0.5608
2000/01	128	199	327	0.6086	0.1916
2001/02	272	395	667	0.5922	0.1620

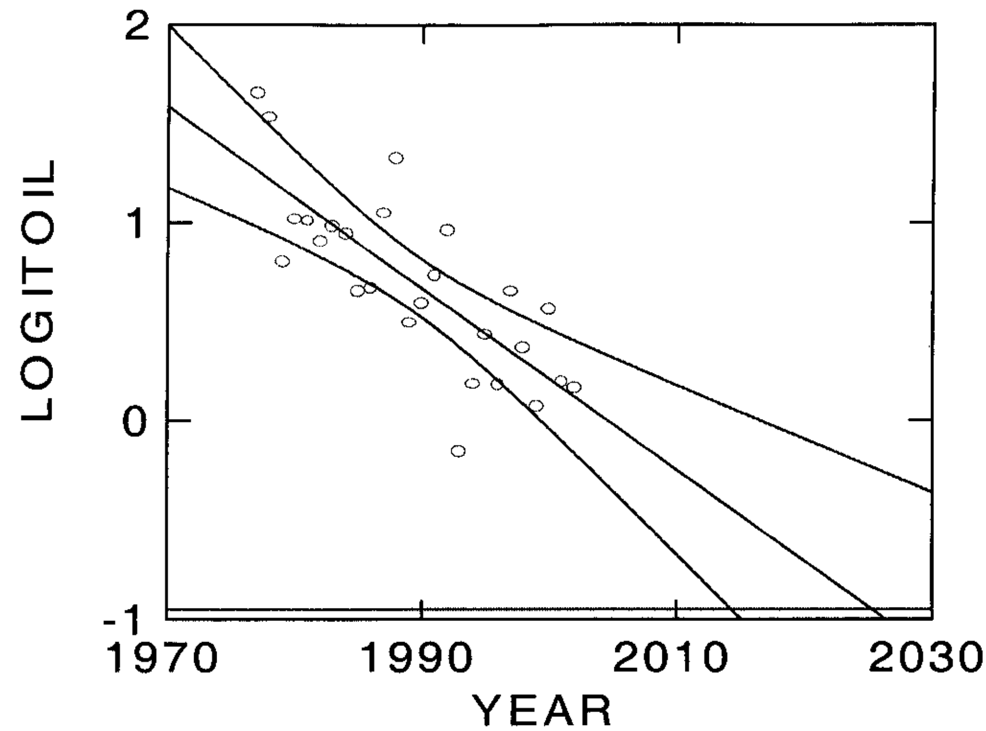


Figure 6. Significant decline in (logit-transformed) oil rates of Common Guillemots found dead along the North Sea coast in The Netherlands in winter 1976/77 (1976) to 2001/02 (2002), showing actual datapoints (as in Fig. 5), the observed and predicted trend if this is continued at the same rate, and 95% confidence intervals [n = 26, multiple R = 0.781, multiple R^2 = 0.610, adjusted multiple R^2 = 0.593, Standard error of estimate = 0.286, residual mean square = 0.082] (NZG/NSO unpublished data, as data were received up to 30 Nov 2002).

Logit 2.0 = 99% oiled, logit 1.0 = 91% oiled, logit 0 = 50% oiled, logit -1.0 = 9% oiled. Further statistical information:

Effect	Coefficient	Std Error	t	P(2 Tail)
INTERCEPT	91.934	14.901	6.170	0.000
SLOPE	-0.046	0.007	-6.123	0.000
Effect	Coefficient	Lower 95%	Upper 95%	
INTERCEPT	91.934	61.180	122.688	
SLOPE	-0.046	-0.061	-0.030	

that it would require 6 years of observation to reject the null-hypothesis with 80% chance that the objective of an oil rate of 10% has been reached when in fact 20% is still contaminated with oil. At lower levels of oil pollution the time required increases substantially (Table 3).

Table 3. Effect size, logit effect size and the years of monitoring required to reject the null-hypothesis that the 10% objective has been reached at four levels of oil pollution (11, 15, 20, and 25% oiled) among Common Guillemots, based on present trends and variability in Dutch material, 1976/77-2001/02 (NZG/NSO database, unpublished material).

Effect size (with respect 10%)	Logit effectsize (with respect –0.95)	years required so that 1-beta > 0.8
11%	-0.9080	364
15%	-0.75	17
20%	-0.60	6
25%	-0.48	3

We would therefore propose that it would require a period of at least 5 years in which an average of 10% oiled Guillemots has been recorded (specific incidents to be excluded from the analysis) before the conclusion that the objective has been reached should be justified. The risk of error at such low levels of oil pollution is still substantial within that time period, and post-monitoring at a smaller scale is therefore recommended.

Sources of oil
As stressed above, with regard to 'further information' to be obtained within the Guillemot – oil – EcoQO, it has been specifically requested to take into account the different types of oil, including paraffin. Paraffin is only one of many substances encountered on beaches and probably one of the least harmful substances in cold seas as a result of coagulation. Seabird mortality incidents have been induced by apparently 'harmless' substances such as fish oil (Newman & Pollock 1973; Anon. 1975). Substances encountered in recent years during beach bird surveys, as dumped in bulk into the sea, or as additives to for example lubricating oils used on vessels, include palm oil and other vegetable oils, paraffin, dodecylphenol, nonylphenol, polyisobutylene, olefines (i.e. Octadecene, Nonadecene, Docosene), and dioctyldiphenylamine ((McKelvey *et al.* 1980; Engelen 1987; Van den Brink 1989; Averbeck 1990; Bommelé 1991;. Timm & Dahlmann 1991; Zoun 1991; Zoun *et al.* 1991; Zoun & Boshuizen 1992; Camphuysen *et al.* 1999; and Bundesamt für Seeschiffart, Hamburg unpubl. data). The molecular features of environmental contaminants causing disruption of the plumage of seabirds are well known and need not be repeated here (Rozemeijer *et al.* 1992).

Previous studies have demonstrated that various types of mineral oils (e.g. crudes, fuel oil, sludges) nor the various other substances could possibly be recognised by eye. Even more, a precise analysis of some of the more difficult substances required considerable effort in a specialised laboratory and sometimes still resulted in incomplete analyses (unclear compounds in the sample). The request to assess sources of oil (taking into account different types of oil, including paraffin) is an important addition to most existing beached bird survey schemes. Camphuysen & Dahlmann (1995) evaluated the possibilities after an analysis of a three year, EC funded research project during which types of pollutants on beached birds and beaches were studied (Dahlmann *et al.* 1994).

A sampling programme of oil and other substances on beaches and on beached birds will provide evidence on the occurrence of certain mineral oil types (*i.e.* the sources of pollution) and other substances which can otherwise not be obtained on a sufficiently large scale (*e.g.* Dahlmann *et al.* 1994). Since beaches are surveyed for the presence of oiled birds, it is cost-effective to add systematic sampling of oiled feathers for chemical analysis. Oil on beaches sampled at the same time may or may not be directly connected to the oiled seabirds present at the same time. Guidelines provided in 1995 for the Oslo and Paris Convention for the prevention of marine pollution for the Ad Hoc working group on Monitoring in Copenhagen (13-17 November 1995; Camphuysen & Dahlmann 1995) covered the chemical part connected with beached bird surveys, including the methods of sampling and analysis of oil and lipofilic substances in a specialised laboratory. Analyses of oil in the feathers of seabirds or on beaches within the framework of the oiled seabirds monitoring programme are carried out for the following purposes:

(a) Identification of the main sources of chronic oil pollution on the coasts and their trends.
(b) Comparative investigations about the main sources of oil pollution in different countries.
(c) Identification of "hot spots", *i.e.* areas of higher burden of oil pollution from distinct sources.
(d) Identification of unknown chemicals in the feathers of birds or on beaches. Although the term 'oil' is used in the seabird monitoring programme, an attempt should be made to identify chemicals in the feathers of seabirds or on beaches, to differentiate between oil and chemicals. Unless identified, all chemicals must be regarded as harmful to human health and dead, contaminated birds can be used as a first

warning. No additional efforts are necessary by adding chemicals to the monitoring programme. The sampling strategy includes all foreign substances encountered on bird carcasses.

(e) Identification of the actual sources of oil pollution and pollution by chemical substances in acute, more severe cases (incidents).

Methodological recommendations (1) beached bird surveys

Beached bird surveys have been standardised nationally, with small methodological differences between countries (Camphuysen & Van Franeker 1992; Seys *et al.* 2002). Camphuysen & Dahlmann (1995) and Camphuysen & Heubeck (2001) recommended that (with slight modifications for the specific case of recording Common Guillemots), to obtain comparable results over large geographical areas the following set-up is required:

- To run a cost-effective beached bird survey, the use of a network of trained volunteers is required. Volunteers are usually recruited from natural history organisations and in most countries these volunteers are skilled amateur ornithologists.
- Subregions should be chosen to cover the entire coastline. Subregion design should be in response to local conditions and will vary between countries, with different strategies in those whose coastline is mainly comprised of long sandy beaches and countries where the coast consists of numerous islands, fjords or long stretches of cliff (see for details Camphuysen & Van Franeker 1992). A representative fraction of the coast directly bordering the sea should be chosen and remain standardised over the years.
- If beached birds cannot be removed from the vicinity of the shore area (scavengers may redistribute carcasses thrown above the high tide-line), they should be marked (e.g. by clipping the primaries) to avoid double counting. Marks should be clear and easy to identify even on incomplete corpses.
- Each bird should be identified to species and aged by external characteristics according to a manual provided by the (international) co-ordinator. All birds should be checked for leg rings or other marks, e.g. patagial tags or neck collars.
- The condition and completeness of corpse and the extent (either a percentage of body cover or a rank, e.g. slight, medium, heavy) of any oil on the feathers should be recorded. Where possible, corpses obviously oiled after death should be distinguished. To calculate oil rates, only complete corpses should be used, in which all main feather groups are available for a check of the presence of oil.
- For each count, the following information should be recorded: date, place, km surveyed, km of coast with visible oil, characteristics of the oiling, name(s) of observers, mark used to avoid double counts, completeness of survey and problems encountered, other significant pollution of the beach, list of beached birds.
- A computerised database should be established to facilitate prompt analyses and reporting of results.

Minimum sample size

As a minimum sample size for a reliable (annual) oilrate in Common Guillemots, at least 25 juvenile and 25 adult (complete) carcasses of Common Guillemots are required (see Seys *et al.* 2002 for an analysis and explanation of sample size). In areas where this is feasible, at least 100 specimens of either category should be examined to further exclude or at least further minimise the risk of failure. In The Netherlands, with a total coastline of *ca.* 670 km, the average number of (properly aged) casualties was 146 adults and 83 juveniles annum^{-1}. Between 1980 and 2002, an average number of 1326 Common Guillemot carcasses was obtained each year, 23% of which (242 annum^{-1}) were properly aged. Although the number of dead birds declined over time, the proportion that was properly aged increased markedly, so that also the aged sample increased over time:

Table 4. Number of complete corpses of Common Guillemots found dead (total found), numbers properly aged and the percentage aged per year in the 1980s and early 1990s and in recent years, demonstrating a decline in overall numbers but an increase in the proportion aged and therefore an increase in the sample available for assessing oil rates (NZG/NSO unpubl. data).

	total found annum^{-1}	number aged annum^{-1}	% aged annum^{-1}
1980-1994	1679	187	12%
1995-2002	736	378	46%

Since 1990, annual samples of on average 164 adults and 100 juveniles have been obtained, while searching between 850 and 2000 (average 1350) km of coastline annum^{-1}. In areas with a rather large and accessible coastline such as The Netherlands, the desired minimum number of carcasses will easily be reached every year (*'need to know'*). In most years even the higher sample of 100 carcasses of either age will be obtained given the present effort input (*'nice to know'*). For some countries, such as Belgium, with a rather short coastline, monthly surveys are likely to produce the lower sample in most years, whereas the higher sample will seldom ever be achieved (Seys *et al.* 2002). Sufficient effort input in Germany, Denmark, Orkney, Shetland, mainland Britain will provide the minimum sample size probably every year (Camphuysen & Van Franeker 1992). For southern Norway (small, isolated beaches), Sweden (largely inaccessible west coast), and north-western France this is at present uncertain.

Specific information requirements

Considering the historic trajectory of the metric, the quality assessment of the material, an evaluation of the performance of the metric and the variability of the material as deduced from (published sources), and while taking into account the recommendations formulated by Camphuysen & Dahlmann 1995, Camphuysen & Heubeck 2001, and Seys *et al.* 2002), the specific information requirements for "Guillemot – oil – EcoQO" should be as follows.

The information on oiled Common Guillemots should be collected **in winter** (November-April). The rationale behind this restriction is:

(a) Common Guillemots are most widespread in winter and are common visitors in all north-west European shelf seas.

(b) Oil rates differ between summer and winter (as a result of differences in exposure of the birds, temperatures and the breakdown of mineral oils at sea).

Few countries could participate if the surveys were held in summer, simply as a result of the general absence of Common Guillemots in their waters. Common Guillemots are common or abundant breeding birds in Britain, Faeroe Islands, Iceland, Norway and the Russian Kola Peninsula, with rather small breeding populations in Denmark (Græsholmen, Christiansø), Sweden (most at Stora Karlsö and Lilla Karlsö, Gotland), Finland (Apskär), Germany (Helgoland), and France (Bretagne), and at least until recently in Portugal (Ilhas Berlengas) and Spain (Galicia) (Nettleship & Evans 1985). In summer, Common Guillemots are localised in their distribution and occur mainly in the vicinity of their colonies (Stone *et al.* 1995).

Only **complete corpses** should be examined for the presence of oil. Scavengers tear corpses apart and incomplete corpses (often just pairs of wings with a sternum, or breastbone) cannot be used. A manual will be provided to clearly indicate and illustrate what may be considered a complete corpse and what material needs to be excluded from the analysis.

Dead Common Guillemots **should be aged** using external characteristics, because oil rates are not only species-specific, but also age-specific. Juvenile seabirds with relatively low survival probabilities have a much lower oil rate than adults (e.g. Camphuysen 2001). In Dutch material for example, where many Common Guillemots have been routinely aged since the early 1980s, oil rates among adults (75.5% overall, n = 3387) and among juveniles (47.4%, n = 1940) are structurally lower in most years (Table 5, Figure 7). Areas with relatively high proportions of adult birds in the beached material are therefore likely to produce higher oil rates than areas with mainly juveniles.

So although within areas a year-to-year comparison may be possible without knowledge of the age composition of the sample, one then has to assume that age composition is constant between years. Similarly, a geographical comparison may produce sound results, but will be misleading when age composition is different between areas. Neither a constant age-composition within areas between years, nor a constant between areas within years is likely to occur and therefore, an indicator of the age composition in stranded Common Guillemots is important. A manual will be provided to clearly indicate and illustrate how a juvenile and an adult Common Guillemot may be identified (external identification criteria that are not commonly known in published identification literature) and what material needs to be excluded from the analysis.

Table 5. Age-specific oil rates in Common Guillemots found and aged in The Netherlands, 1980/81-2001/02 (NZG/NSO database, unpublished material).

	Adult birds				Juvenile birds			
winter	unoiled	oiled	sample	oil rate	unoiled	oiled	sample	oil rate
1980/81	22	290	312	92.9	16	121	137	88.3
1981/82	1	44	45	97.8	2	20	22	90.9
1982/83	27	137	164	83.5	16	84	100	84.0
1983/84	13	62	75	82.7	5	10	15	66.7
1984/85	14	108	122	88.5	14	48	62	77.4
1985/86	18	106	124	85.5	26	34	60	56.7
1986/87	2	16	18	88.9		2	2	
1987/88	4	18	22	81.8	4	24	28	85.7
1988/89	23	162	185	87.6	63	66	129	51.2
1989/90	12	177	189	93.7	29	46	75	61.3
1990/91	68	208	276	75.4	34	55	89	61.8
1991/92	16	46	62	74.2	11	9	20	45.0
1992/93	23	23	46	50.0	65	14	79	17.7
1993/94	34	53	87	60.9	54	17	71	23.9
1994/95	9	35	44	79.5	8	16	24	66.7
1995/96	3	28	31	90.3	11	9	20	45.0
1996/97	5	29	34	85.3	7	2	9	
1997/98	24	63	87	72.4	29	24	53	45.3
1998/99	304	284	588	48.3	304	103	407	25.3
1999/00	77	354	431	82.1	114	111	225	49.3
2000/01	40	78	118	66.1	62	44	106	41.5
2001/02	91	236	327	72.2	147	60	207	29.0
	830	2557	3387	75.5	1021	919	1940	47.4

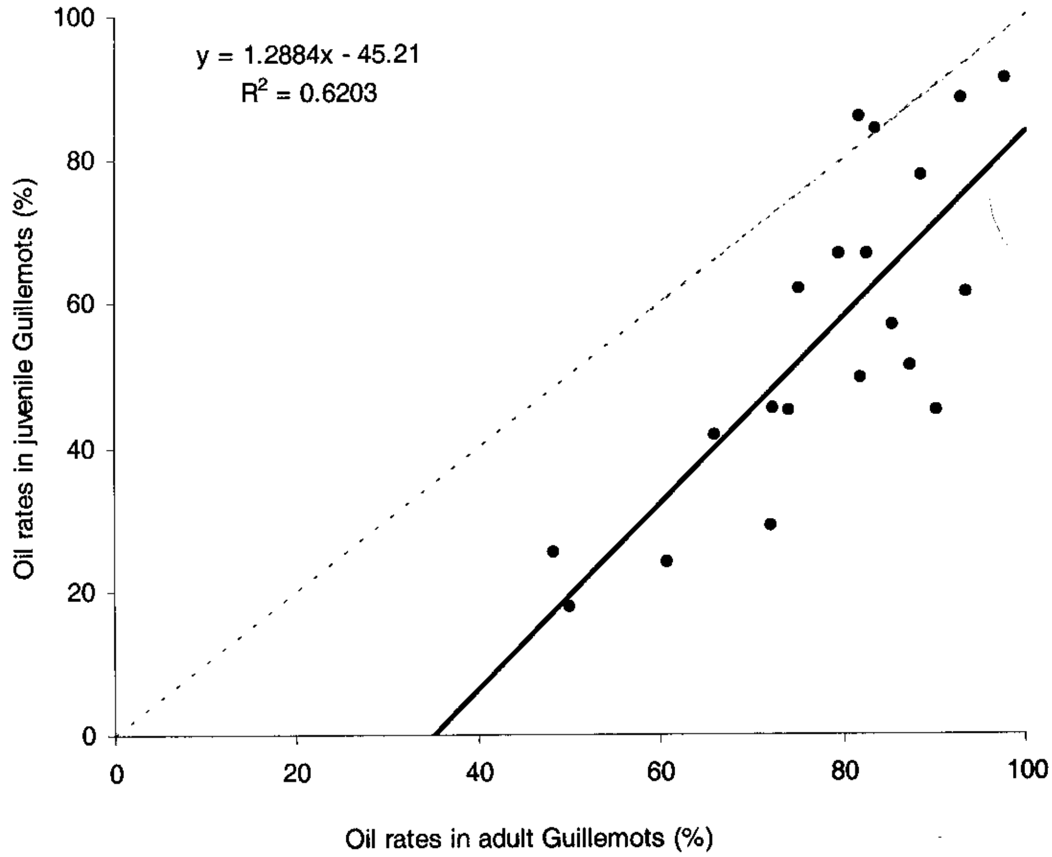


Figure 7. Correlation between oil rates in adult and juvenile Guillemots in The Netherlands, winter 1980/81 – winter 2001/02 (see Table 5). The dashed line indicates an equal level (oil rates similar), whereas values to the right of the dashed line indicate winters in which adults had a higher oil rate than juveniles.

Methodological recommendations (2) the assessment of sources of pollution

No standardised methods for investigating oil in the feathers of seabirds or on beaches exist. There is, however, experience from previous work conducted within the framework of research projects (Dahlmann *et al.* 1994; Camphuysen & Dahlmann 1995; Dahlmann & Sechehaye 2000):

- From oiled seabirds, samples should be taken by clipping some oiled feathers with a cleaned pair of scissors from the birds. Contamination of the samples by natural biogenic esters of the birds should be avoided by taking samples as far away as possible from the uropygial gland (also called preen gland, or oil gland; sits at the base of the spine on the dorsal surface of the tail's fleshy stub) of the bird. Samples from beaches should be immediately and individually stored in the glass jar. Cross-contamination between different samples should be avoided by cleaning hands and all instruments which came in contact with the oil after each sample was taken.
- Oil samples are taken in small glass jars (10 to 50 ml), sealed with a plastic cap.
- The amount sampled should be in the lower ml-range. For beach samples this would mean a few drops of oil, for samples taken from beached birds this would mean a few contaminated small feathers.
- Samples should be unequivocally identified by a label containing (1) location, (2) sampling date and (3) sample number.

- Samples should be kept in a dark, cool place (*i.e.* refrigerator) and should be sent as soon as possible to a specialised laboratory for analysis.

Which birds to sample?

With respect to the sampling of oil and other substances, it is important that *representative* samples are taken. It is practically impossible and certainly too costly to sample every corpse encountered. Therefore, a selection is required that does provide an unbiased sample. Particular incidents may lead to a larger number of casualties all affected by the same spill. For non-monitoring purposes, but to evaluate the scale and impact of a spill, it is sensible to collect many samples from a wide area within the time-span of the event. For monitoring purposes, as requested with the framework of the Guillemot – oil – EcoQO, random sampling is more appropriate. Because random sampling is practically impossible to organise while using volunteer networks (Sutherland 1996), it is proposed here to perform *systematic* sampling instead. To avoid bias caused by individual volunteers during the selection of corpses scanning certain external features, certainly because 'other' substances causing feather disruption and bird mortality may not be quite so obvious on carcasses than mineral oil, while considering that at least tens, but possibly several hundreds of surveys are conducted annually, it is proposed to **sample only the first complete corpse encountered on any 5 km of survey**. When the corpse is apparently clean, a set of potentially disrupted feathers should be collected. When clearly fouled with oil or some other substance, a sample of contaminated feathers should be taken.

Based on Dutch material over the last 12 years, assuming that all volunteers participate in this approach and that only Common Guillemots are sampled that are also rather evenly distributed, the upper level of the anticipated number of samples obtained would be 259 (Table 6). In practice, many volunteers will not be prepared to take samples, or samples may go lost between sampling and analysis. Therefore, a maximum anticipated number of samples somewhere in the range of 100 samples annum^{-1} is probably more realistic for a country like The Netherlands. It is with this expected upper level of samples (100 samples for 600 km 'available' coastline annum^{-1}) that a work plan and a financial budget for Guillemot – oil – EcoQO has been made here. So, for Belgium, with a coastline of approximately 60 km, a maximum number of 10 samples may be foreseen.

Table 6. Anticipated maximum number of oil-samples obtained per annum from Common Guillemots in The Netherlands, based on monthly variability in mean densities washing ashore and assuming complete participation of volunteers sampling the first corpse encountered on each 5 km of survey (1990/91-2001/02 data, NZG/NSO database, unpublished material).

	Complete Guillemots (*n*)	Km surveyed	Mean density (*n* km^{-1})	*n* Guillemots 5km^{-1}	Max samples year^{-1}
November	341	1791	0.19	0.95	30
December	1661	3264	0.51	2.54	54
January	2272	2892	0.79	3.93	48
February	3538	3553	1.00	4.98	59
March	1468	2580	0.57	2.85	43
April	231	1480	0.16	0.78	25
	9511				259

Chemical analysis

The purpose of chemical analysis is to identify the source of the oil as far as possible and to identify unknown chemical substances. Possible sources of oil pollution on beaches are oil production/exploitation (platforms, pipelines, *i.e.* crude oil), tankers (crude oil, pure products), and other ships (including tankers; pure products, bunker oil and lubricating oil and mixtures of oil, waste oil or sludge, both originating from machinery rooms). Oil from these sources can be differentiated in a stepwise manner. The first step must be the differentiation between crude oil and oil products or mixtures of oil products. Crude oil can often be further differentiated as originating from either oil production/exploration or from tank-washings of tankers. Furthermore, it is often possible to identify the type of crude oil involved up to the individual well where it was exploited.

After transferring the sample into a 250 ml glass bottle, extraction is performed by adding a few ml of a solvent (*n*-hexane) and shaking. Since the amount of oil is unknown, the final concentration of oil in *n*-hexane can only be 'guessed' by means of the colour of the solution. An aliquot of the solution is transferred into a 10 ml glass flask which is filled up to 10 ml. The analytical scheme consists of two screening methods and a method for proper identification. First a spectroscopic method (UV-F) is used because UV-F spectra give a first indication of the type of oil involved, and so that the concentration of the sample can be more properly settled, by comparing the spectrum of the sample with spectra of samples of known oil concentrations.

Capillary gas-chromatography (CGC) is used as a first identification method. Gas chromatograms show the boiling range of the oil compounds and oil products are in a first step characterized by their boiling ranges. 'Special' products, like the commonly used heavy fuel oil, can be identified by distinctly pronounced compounds (aromatic hydrocarbons), which originate from refinery processes. If there is the suspicion that crude oil is found, or the sample is not yet fully identified, the final identification method, i.e. gas-chromatography/mass-spectrometry (GC/MS), is used. The suspicion that crude oil is involved can be confirmed or refuted. If crude oil is involved, it is possible that its source can be found, up to the individual well, where it was exploited. GC/MS is also used for identifying unknown chemicals in the feathers of birds or on beaches.

Reporting results

Results should be reported for each sample by indicating one of the following categories: (a) crude oil (if possible oil production (platform/pipeline) or tanker and crude oil type (origin)), (b) oil product or mixture of products (waste oil), (c) type of chemical substance, (d) mineral oil (type questionable), (e) other substances or (f) 'nothing found' (for example biogenic esters of birds). In addition, an attempt could be made to identify 'matching' samples (*i.e.* samples originating from the same spill or discharge).

Risk of failure / false alarm

As indicated above, oil rates are under the influence of several factors, many of which may be assumed constant or near-constant, some of which are not. Gradual changes in the amounts of oil released into the marine environment are reflected in gradual changes in oil rates. Two important factors may dramatically influence oil rates at least in the short-term: seabird wrecks and oil incidents. Beached bird surveys should therefore be organised in such a way that either effect cannot go unnoticed, to minimise the risk of mis-interpretation of results. As a rule of thumb, however, sudden changes in oil rates (dramatic drops or rises from one year to the next) should always be treated with caution. In case of any doubt, the mortality and oil rates of taxonomically related seabirds need to be simultaneously evaluated.

Mortality incidents and the effect of oil spills

In Common Guillemots, several large scale wrecks have been reported, leading to much higher numbers washing ashore in countries bordering sea areas in which the birds became lost (Camphuysen 1989ab, 1990a; Underwood & Stowe 1984; Mudge *et al.* 1992; Camphuysen *et al.* 1999). These wrecks are characterised by exceptional densities of severely emaciated corpses of birds. Seabird wrecks occur mainly in winter and are often thought to be food-driven (Blake 1984; Camphuysen 1990b, 1992). In heavily polluted sea areas, many of the casualties are only slightly contaminated with oil. Seabird wrecks potentially lower the oil rate in the affected species. A clear example was the effect on oil rates in Common Eiders *Somateria mollissima* facing structural food-shortages in the early 21st century, where substantial extra-mortality in the Wadden Sea among these birds devaluated the index for that species (Camphuysen 2001; Camphuysen *et al.* 2002).

Oil incidents (large spills or substantial mortality due to small slicks at unfortunate locations) are usually well reported and stand out in relatively high oil rates. The effect (a higher oil-rate) is typically short-lived and will stand out in the material quite clearly.

Low levels of oil pollution

Gradual trends are not easy to detect with certainty in material that is under the influence of several factors determining overall numbers or in small samples. A power analysis (power of trend test versus number of years sampled) of Dutch beached bird surveys of oil rates in Common Guillemots showed that significant trends were to be expected over time-series of *c.* 12 years (Camphuysen 1995). Many countries around the North Sea have time series spanning at least a similar period and significant trends are therefore expected in most areas (Camphuysen & Van Franeker 1992).

It is to be predicted, however, that a very low level of oil pollution and, hence, very low levels of oil rates produce more variable results than high levels, particularly with the sample size anticipated. As indicated above, small local spills of oil, widely spaced in time, will lead to relatively marked shifts in oil rates when the overall levels are very low, especially if the sample size is low. Small spills in heavily polluted areas (with correspondingly high oil rates) will individually go largely unnoticed because the oil rates are very high anyway.

Oil sampling, types of oil

Although random sampling is a preferred method to obtain a representative set of samples from which a picture may emerge of the oils and other substances causing seabird mortality, it is proposed to perform a systematic sampling without visual selection of contamination on corpses. So, where every first complete Common Guillemot corpse on each 5 km of survey is sampled, irrespective of the fact whether any oil or another substance is visible on the plumage, an acceptable number of representative samples will be obtained for most areas. This approach will minimise the risk of 'oversampling' specific (oil) incidents, and it will minimise the chance that difficult to see substances are overlooked.

What information can be made available?

Beached bird surveys have been conducted in many countries around the North Sea and large sets of data are currently available. The level of publication and, hence, the access to these data is far from perfect, however. Two interesting sets of data would require analysis, one on an international level and one on a national or regional level. The material of International Beached Bird Survey (IBBS), being mid-winter surveys in a large number of countries, as accumulated in recent years in Denmark, is available for analysis. This material would update our present knowledge of geographical differences in oil pollution levels (*cf.* Figures 2-4).

Secondly, a detailed trend analysis of the areas where high quality data have been collected during all or most of the winter in the past 10-15 years would provide base-line data for the Guillemot – oil –EcoQO that can be used for comparison. This analysis, different from any that has been done previously, should take age composition of the material into account.

Base-line data from oil-sampling programmes are sparse and much of the material has been published already. However, and inventory of non-published data should be made and analysis and publication of these data should be stimulated.

Connection of Guillemot-oil-EcoQO and Fulmar-litter-EcoQO

Since its start in 1982, a Dutch study on stomach contents of Fulmars has been possible thanks to the existence of a beach bird survey organised by the Dutch Seabird group (NZG/NSO). Beached bird survey participants collected Fulmars for this specific study. In the the Fulmar-litter-EcoQO (where the presence of plastic particles in bird stomachs is monitored), the collection of birds from many locations at no or low extra cost is only possible in co-operation with existing beached bird survey schemes (now continued also to provide data for the Guillemot-oil-EcoQO). The planned implementation of the Fulmar-Litter-EcoQO will further increase the awareness among BBS participants that their efforts are worthwile and will thus generate extra support. Since search activities for Fulmar corpses on beaches largely overlap with requirements for the Guillemot-Oil-EcoQO this increases opportunities for a good North Sea spatial coverage in the collection of Guillemot oiling rates.

Experience learns that where there is a good system of data-usage and publication of data collected by amateur ornithologists, that a rather inexpensive system of data-collection is possible, supported by volunteers and organisations that incorporate activities in their standard program. (National) costs for maintenance of a particular monitoring system are limited to incidental material support, co-ordination, data-maintenance and analysis and reporting. The main expenses the Common Guillemot EcoQO will originate from professional time needed for co-ordination, manual production, statistical analysis and publication of results. As indicated, 'cross-fertilization' is important. When beached bird surveys are continued, the Fulmar-Litter-EcoQO will remain possible at relatively low cost. The detailed Fulmar studies for litter can give important additional information on trends in oil pollution in the offshore environment based on Fulmar data, not only on the proportion of birds fouled, but also on the amount of oil on individual birds or the presence of oil remains in stomachs. Vice versa, Guillemot surveys as a part of the BBS systems will supply information of entanglement rates of organisms on beaches as additional litter indicators. When both the Guillemot-Oil-EcoQO and the Fulmar-Litter-EcoQO become formal international and frequently published monitoring tools used in environmental policies, this will be the best possible guarantee for continued volunteer and organisational support for a relatively inexpensive system of beached bird surveys.

Workplan Guillemot – oil - EcoQO, 2003-2005

The workplan Guillemot – oil – EcoQO consists of the international co-ordination of beached bird surveys around the North Sea (Belgium, UK, The Netherlands, Germany, Denmark, and Norway, with possible work in Sweden (Kattegat/Skagerrak) and France (The Channel)). Apart from this, a workplan is proposed for the analysis of existing data and the analysis of data collected within the programme. Finally, it was requested to fine-tune these studies with the Fulmar – litter – EcoQO, because that programme also very heavily leans on the continuation of a beached bird survey.

Beached bird surveys are built on national volunteer networks and these national schemes form the backbone of the present work programme. The maintenance of these networks will be the responsibility of the respective OSPAR members and therefore any of the regular costs incurred will have to be managed nationally. Only *extra work* to be done on this national scale (e.g. the annual preparation of data), specific travel expenses (e.g. participation in the steering group meeting) and particular material costs for the oil sampling should be refunded through this project.

More or less complete beached bird surveys in place have: Shetland Islands (SOTEAG, Martin Heubeck), Orkney Islands (RSPB, Erik Meek), Germany (Nationalparkamt, David Fleet), The Netherlands (Dutch Seabird Group, Kees Camphuysen), and Belgium (Instituut voor Natuurbehoud, Eric Stienen). All these have indicated their interest in an international monitoring programme. Within the UK, an annual mid-winter survey is organised by the Royal Society for the Protection of Birds (Sabine Schmidt), as a contribution to the IBBS. Norway, France and Denmark also participate in the IBBS, with irregular effort outside this programme. Until recently, the IBBS was co-ordinated by Ornis Consult in Copenhagen (Henrik Skov), but this firm is no longer in existence. Danish, Norwegian, Swedish and French contributions to this programme have to be worked out before their participation can take place.

The **overall co-ordination** will be in the hands of a lead country and would consist of (1) chairing the steering group and organising the international contacts, (2) managing the international aspects of the field work (e.g. manual production and quality checks of data arriving), (3) analysis and reporting of the material, and (4) financial management of the project. The Netherlands (Kees Camphuysen, CSR/Dutch Seabirds Group) would be prepared to organise the overall co-ordination.

Oil analysis should be performed at a highly specialised laboratory. Usually, the number of oil samples in any laboratory is not the key issue leading to extra costs, but technical staff has to be freed from other work, or has to be employed. The most cost-effective solution would be to have a single, central laboratory involved in the oil sampling and in the present proposal it is suggested to use the expertise of the Bundesamt für Seeschiffart und Hydrographie in Hamburg (Dr Gerhard Dahlmann).

Table 7. Proposed organisation structure for Guillemot – oil – EcoQO with systematic oil sampling in place. A central co-ordinating body is foreseen (lead country), as well as a central, highly specialised laboratory that is responsible for the oil sample analysis. A steering group, with representatives from the (main) participating countries, and optional with a representative from OSPAR, will meet annually to monitor progress and quality and to agree on the analysis and conclusions in the annual report. The annual report is presented to OSPAR. Countries in parentheses could optionally participate in this programme.

Steering group

Financial responsibility ← **Lead country** (co-ordination) → *annual report to OSPAR*

↓ *financial matters* ↓ *manual and materials* ↓ *annual report*

↑ *data*	↑ *data*	↑ *data*	↑ *data*	↑ *data*	↑ *data*	↑ *data*	↑ *data*
(France)	**Belgium**	**Netherlands**	**Germany**	**Denmark**	**Norway**	**UK**	(Sweden)
national co-ordination	national co-ordination	national co-ordination	national co-ordination	national co-ordination	national co-ordination	national co-ordination	national co-ordination
↓ *samples*	↓ *samples*	↓ *samples*	↓ *samples*	↓ *samples*	↓ *samples*	↓ *samples*	↓ *samples*

Central oil analysis laboratory → *reporting to co-ordinator for annual report*

The **timing of activities** is best organised in accordance with the demand of the field work. With a winter-season programme (Nov-Apr), the analysis and annual reporting should be scheduled for the summer months (August).

The **analysis of historical data** would comprise either an analysis of the International Beached Bird Survey (IBBS), or an analysis of existing high quality data for entire winter periods (as required within this programme) in Shetland, Orkney, Germany, The Netherlands and Belgium, or both. For the IBBS analysis, Henrik Skov would be available. The analysis of high quality data would necessarily be a joint effort of five BBS co-ordinators, leading to a jointly produced report.

Budget Guillemot – oil – EcoQO, 2003-2005

An important assumption for the budget presented below is that budgeted costs include only costs that are necessary for the successful completion of the project. These costs must clearly be on top of existing national beached bird survey programmes and the maintenance of national volunteer networks. These national networks are the responsibility of the countries represented at the North Sea Ministers Conference.

The main (annual) costs include: overall (international) co-ordination, a manual, an annual report and materials for oil sampling, an annual steering group meeting with all representatives, and the costs incurred for the analysis for oil samples at one, central laboratory. *Additional* costs are calculated for the analysis of existing data (IBBS, high quality winter data or both), and these are only if required for the first year of the project.

	days/costs*	Euro	Subtotal	Remarks
Overall (international) co-ordination				
steering group participation	1	750		
travel costs (to steering group)	1x 1000	1000		
expendable materials (e.g. sample containers)	1x 1000	1000		
mailing, printing, production report		1500		
production of a manual (work time)	5	3750		*only for first year of programme*
project co-ordination (work time)	10	7500		
			€ 15,500	
National co-ordination (Shet, Orkn, UK, Belg, Neth, Germ, DK, Norw)				
co-ordination BBS (work time)	p.m.	0		*national expenses*
extra work to participate in EcoQO (3 days)	24	18000		
steering group participation (1 day)	8	6000		
travel expenses (steering group)	8x 1000	8000		
materials	8x 100	800		
			€ 32,800	
Chemical analysis of oil and other substances				
technician		40000		BSH, Hamburg
supervision of work and reporting	5	3750		BSH, Hamburg
			€ 43,750	
Total sum for annual working programme (VAT excl.)			**€ 92,050**	
Analysis and reporting old data				
(1) IBBS analysis (1965-2002)	12	9000		
			€ 9,000	
(2) Analysis high-quality data all winter				
- analysis (B, NL, Germ, Orkn, Shetl)	15	11250		
- reporting	5	3750		
			€ 15,000	
Both studies			**€ 24,000**	

**Budgeted working days are estimated at Euro 750 excl. VAT; it depends on the subsequent contractors whether this is accurate.*

A desired chemical analysis of 25 stomach samples of Northern Fulmars (see Fulmar – litter – EcoQO) can be completed within this framework at no extra costs.

To summarise the above table, the total costs for a monitoring programme Guillemot – oil – EcoQO would amount to € 48,300 per annum (of which € 3750 only in the first year). Oil analysis would require a further €43,750, so that a total sum of € 92,050 annum^{-1} would be needed.

Contact addresses

Contact addresses of national and regional beached bird survey co-ordinators are summarised below.

Martin Heubeck, AURIS/SOTEAG
East House Sumburgh Lighthouse
ZE3 9JN VIRKIE
Shetland Islands
Scotland U.K.
Tel: 00-441950460760

Eric Meek, Orkney Officer Royal Society for the Protection of Birds (RSPB)
Smyril Stenness
KW16 3JX STROMNESS
Orkney Islands,
Scotland U.K.
Tel: 00-44856850176

Henrik Skov
Ornis Consult Ltd
140A Vesterbrogade
DK 1620 COPENHAGEN V
Denmark
Tel: +45 33318464

Eric (E.W.M.) Stienen
Institute of Nature Conservation
Kliniekstraat 25
B-1070 BRUSSEL
Belgium
00-32-(0)2-5581828
00-32-(0)2-5581805
eric.stienen@instnat.be

Kees (C.J.) Camphuysen
Dutch Seabird Group (NZG/NSO)
c/o CSR *Consultancy*
Ankerstraat 20, 1794 BJ OOSTEREND (Texel)
The Netherlands
0222- 318744)
kees.camphuysen@wxs.nl

David Fleet
Nationalparkamt (Schleswig-Holsteinisches Wattenmeer)
Schlossgarten 1
D-25832, TöNNING
Germany
00-49-(0)4861.616-43
00-49-(0)4861.616.69
david.fleet@nationalparkamt.de

Kolbjörn Skipnes
Stavanger Museum
Musegt. 16
N-4005 STAVANGER
Norway
00-47-(0)45.26035
00-47-(0)45.29380
kolbjorn.skipnes@stavanger.museum.no

Sabine Schmidt
Royal Society for the Protecion of Birds (RSPB)
The Lodge, SANDY
Bedfordshire, SG19 2DL
England (UK)
Tel: +44767680551

References

Anonymous 1975. Cape colony hit by pollution. Birds, RSPB Magazine 5(8): 11.

Anonymous 2000. Un triste record! L'Oiseau Hors-Série 1(4), Spécial marée noire de l'Erika: 50-51.

Averbeck C. 1990. Nonylphenol in der Meeresumwelt. Seevögel 11(4): (44).

Averbeck C., Korsch M. & Vauk G. 1992. Der Einfluß von Ölverschmutzungen auf Seevögel an den deutschen Nordseeküsten von 1984 bis 1990. Seevögel 13(1): 12-16.

Averbeck C. & Voigt L.H. 1992. Auswirkungen der kostenlozen Schiffsentorgung gemäss MARPOL 1+2. Erebnisse der wissenschaftlichen Begleituntersuch. Seewirtschaft 1992/11: 74-80.

Begg G.S., Reid J.B., Tasker M.L. & Webb A. 1997. Assessing the vulnerability of seabirds to oil pollution: sensitivity to spatial scale. Colonial Waterbirds 20: 339-352.

Blake B.F. 1984. Diet and fish stock availability as possible factors in the mass death of auks in the North Sea. J. Exp. Mar. Biol. Ecol. 76: 89-103.

Bommelé M. 1991. Harmful effects on birds of floating lipophilic substances discharged from ships. In: Camphuysen C.J. & J.A. van Franeker (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.

Brink van den 1989. Oorzaak vogelsterfte voor de Nederlandse kust vastgesteld. Toegep. Wetensch. 5: 21.

Camphuysen C.J. 1981. Omvangrijke slachting onder de Zeekoeten (*Uria aalge*) eind 1980. NSO Jaarverslag 1980: 14-20.

Camphuysen C.J. 1989a. Olieslachtoffertellingen aan de Nederlandse kust, 1915-1988. Techn. Rapport Vogelbescherming 2, Werkgroep Noordzee, Amsterdam 21pp.

Camphuysen C.J. 1989b. Massale sterfte van Zeekoeten *Uria aalge* voor de Nederlandse kust, winter 1988/89. Sula 3(1): 22-25.

Camphuysen C.J. 1990a. Massastranding van Alk *Alca torda* en Zeekoet *Uria aalge* op de Nederlandse kust, jan-feb 1990. Sula 4(1): 23-25.

Camphuysen C.J. 1990b. Fish stocks, fisheries and seabirds in the North Sea. Techn. Rapport Vogelbescherming nr. 5, Vogelbescherming Nederland, Zeist.

Camphuysen C.J. 1992. Auk wrecks in the southern North Sea, 1981-1991: oil pollution or food shortage? In: Tasker M.L. (ed). Proc. Seabird Group Conference 'European Seabirds', Glasgow 27-29 March 1992: 23.

Camphuysen C.J. 1995. Olieslachtoffers langs de Nederlandse kust als indicatoren van de vervuiling van de zee met olie. Sula 9(special issue): 1-90, I-XX.

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. 2001a. Olieslachtoffers op de Nederlandse kust, 2000/2001: gevonden vogels mei 2000-april 2001 en oliebevuilingspercentages in de winter 2000/2001. CSR Consultancy Report 2001-05, CSR Consultancy, Oosterend, Texel, 14pp.

Camphuysen C.J. 2001b. Northern Gannets *Morus bassanus* found dead in The Netherlands, 1970-2000. Atlantic Seabirds 3(1): 15-30.

Camphuysen C.J., Barreveld H., Dahlmann G. & 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., C.M. Berrevoets, H.J.W.M. Cremers, A. Dekinga, R. Dekker, B.J. Ens, T.M. van der Have, R.K.H. Kats, T. Kuiken, M.F. Leopold, J. van der Meer & T. Piersma 2002. Mass mortality of common eiders (*Somateria mollissima*) in the Dutch Wadden Sea, winter 1999/2000: starvation in a commercially exploited wetland of international importance. Biological Conservation 106(3): 303-317.

Camphuysen C.J. & 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. & Franeker J.A. van 1992. The value of beached bird surveys in monitoring marine oil pollution. Techn. Rapport Vogelbescherming 10, Vogelbescherming Nederland, Zeist, 191pp.

Camphuysen C.J. & 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., Wright P.J., Leopold M.F., Hüppop O. & Reid J.B. 1999. A review of the causes, and consequences at the population level, of mass mortalities of seabirds. In: Furness R.W. & Tasker M.L. (eds) Diets of seabirds and consequences of changes in food supply: 51-66. ICES Coop. Res. Report No. 232, International Council for the Exploration of the Sea, Copenhagen.

Dahlmann G. & Sechehaye A. 2000. Verölte Seevögel an der deutschen Nordseeküste 1998/1999: Ergebnisse der Ölanalysen. Seevögel 21: 11-12.

Dahlmann G., Timm D., Averbeck C., Camphuysen C.J. & 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.

Danielsen F., Skov H., Durinck J. & Christensen K.M. 1990. Seks års overvågning af do/de havfugle. Dansk Orn. Foren. Tidsskr. 84: 8-9.

Dréan-Quénec'hdu S. le & L'Hostis M. 2001. Recherches mises en place sur les oiseaux mazoutes lors de naufrage de l'Erika. Service de parasitologie, zoologie appliquée/Centre de Soins et de sauvegarde, Ecole Nationale Vétérinaire de Nante, Nantes.

Dunnet G.M. 1987. Seabirds and North Sea oil. In: Hartley J.P. & Clark R.B.(eds). Environmental effects of North Sea oil and gas developments Proc. R. Soc. Disc. Meet. London Phil. Trans. R. Soc. Lond. B 316: 513-524.

Durinck J., Skov H., Jensen F.P. & Pihl S. 1994. Important marine areas for wintering birds in the Baltic Sea. EU DG XI research contract no. 224/90-09-01, Ornis Consult Report 1994: 1-110, Copenhagen.

Engelen K.A.M. 1987. Zeevogels op de Waddeneilanden het slachtoffer van lijmachtige substantie. Sula 1(4): 112-113.

Furness R.W. & Camphuysen C.J. 1997. Seabirds as monitors of the marine environment. ICES J. Mar. Sc. 54: 726-737.

Harris M.P. 1997. Guillemot *Uria aalge*. In: Hagemeijer W.J.M. & Blair M.J. (eds) The EBCC Atlas of European breeding birds - their distribution and abundance: 368-369. T. & A.D. Poyser, London

King J.G. & Sanger G.A. 1979. Oil Vulnerability Index for Marine Oriented Birds. In: Bartonek J.C. and D.N. Nettleship 1979. Conservation of Marine Birds of Northern North America. Wildlife Research Report 11. Washington DC (Fish and Wildl. Serv.). pp 227-239.

McKelvey R.W., Robertson I. & Whitehead P.E. 1980. Effect on non-petroleum oil spills on wintering birds near Vancouver. Mar. Poll. Bull. 11(6): 169-171.

Mudge G.P., Crooke C.H. & Aspinall J. 1992. Non-oiling Guillemot mortality incidents in the Moray Firth, 1983-86. Seabird 14: 48-54.

Nettleship D.N. & Evans P.G.H. 1985. Distribution and status of the Atlantic Alcidae. In: Nettleship D.N. & T.R. Birkhead (eds). The Atlantic Alcidae: 54-154. Academic Press, London.

Newman G.G. & Pollock D.E. 1973. Organic pollution of the marine environment by pelagic fish factories in the western Cape. S. Afr. J. Sci. 69(1): 27-29.

Rozemeijer M.J.C., Booij K., Swennen C. & Boon J.P. 1992. Molecular features of environmental contaminants causing disruption of the plumage of sea-birds. NIOZ BEWON report no. 43, Netherl. Inst. Sea Res., Texel, 27pp.

Seys J., Meire P. & Kuijken E. 2001a. Focal species and the designation and management of marine protected areas: sea- and coastal birds in Belgian marine waters. In: Seys J. Sea- and coastal bird data as tools in the policy and management of Belgian marine waters: 40-67. PhD-thesis, University of Gent, Gent.

Seys J., Offringa H., Waeyenberge J. van, Meire P. & Kuijken E. 2001b. Long-term changes in oil pollution off the Belgian coast: evidence from beached bird monitoring. In: Seys J. Sea- and coastal bird data as tools in the policy and management of Belgian marine waters: 97-108. PhD-thesis, University of Gent, Gent.

Seys J., Offringa H., Waeyenberge J. van, Meire P. & Kuijken E. 2002. An evaluation of beached bird monitoring approaches. Mar. Poll. Bull. 44: 322-333.

Skov H. Danielsen F. & Durinck J. 1989. Dead seabirds along European coasts 1987-1988, Results of the International Beached Bird Survey. Sula 3(1): 9-19.

Snow D. & Perrins C. (eds) 1998. The Birds of the Western Palearctic, concise edition, 1. Oxford University Press, Oxford, 1008pp.

Stone C.J., Webb A., Barton C., Ratcliffe N., Reed T.C., Tasker M.L., Camphuysen C.J. & Pienkowski M.W. 1995. An atlas of seabird distribution in north-west European waters. Joint Nature Conservation Committee, Peterborough, 326pp.

Stowe T.J. 1982. Beached bird surveys and surveillance of cliff-breeding seabirds. Unpubl. RSPB report to the Nature Conservancy Council, Sandy 207pp.

Sutherland W.J. 1996. Ecological census handbook. Cambridge Univ. Press, Cambridge.

Timm D. & Dahlmann G. 1991. Investigations into the source of non-mineral oils in the feathers of seabirds. In: Camphuysen C.J. & J.A. van Franeker (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.

Underwood L.A. & Stowe T.J. 1984. Massive wreck of seabirds in eastern Britain, 1983. Bird Study 31: 79-88.

Williams J.M., Tasker M.L., Carter I.C. & Webb A. 1995. A method of assessing seabird vulnerability to surface pollutants. Ibis 137: S147-S152.

Zoun P.E.F. 1991. Onderzoek naar de Oorzaak van de Vogelsterfte langs de Nederlandse kust gedurende december 1988 en januari 1989. CDI-rapport nr. H121519, Lelystad, 55pp.

Zoun P.E.F., Baars A.J. & Boshuizen R.S. 1991. A case of seabird mortality in the Netherlands during the winter of 1988/1989 caused by a spillage of Nonylphenol and vegetable oils. In: Camphuysen C.J. & J.A. van Franeker (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): 47-48.

Zoun P.E.F. & Boshuizen R.S. 1992. Gannets victim to spillage of lubricating oil and dodecylphenol in the North Sea, winter 1990. Sula 6(1): 29-30.