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Oil Pollution and Seabirds in Denmark  
1971 - 1976

by  
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and  
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Med et dansk resumé: Olieforurening og søfugle  
i Danmark 1971-1976

Резюме на русском языке  
Загрязнения нефтью и морские птицы в Дании 1971-1976 г.

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## Introduction

In 1968 the Game Biology Station initiated studies on oil pollution in Denmark and its impact on seabirds, and a report covering the first three years (July 1968 – June 1971) was published in 1972 (JOENSEN 1972 a) simultaneously with a survey of seabird disasters during 1935–1968 based on literature etc. (JOENSEN 1972 b).

The present paper continues the theme of the former report and covers the five-year period July 1971 – June 1976. Some preliminary results have already been published in Danish in the annual reports of the Game Biology Station »Dansk Vildtforskning« (JOENSEN 1972 c, 1973 a, HANSEN & JOENSEN 1975), and by JOENSEN (1973 b).

During 1971–1976 the study of oil pollution and seabirds has been carried out in very much the same way as in 1968–1971. In later years, however, the registration and control of oil pollution undertaken by the Ministry of the Environment has gradually been intensified, and the close cooperation between the Ministry and the Game Biology Station has without doubt also led to improvement of the surveys concerning the seabird aspects of oil pollution.

During 1971–1976 information on seabirds and oil pollution was obtained in three types of survey:

- 1) Registration of seabird mortality in reported incidents of oil pollution, and in the case of major disasters, intensive field studies and examination of dead seabirds.
- 2) An evaluation of the frequency and

distribution of oiled seabirds through a questionnaire survey sent to diving-duck hunters.

- 3) Surveys of beached birds, i.e. counts of dead and contaminated seabirds along different stretches of coast, not associated with specific reported oil pollution incidents.

The authors are greatly indebted to other personnel at the Game Biology Station for participation in the fieldwork. Thanks are due to the game advisers, police and many local hunters, coast wardens and ornithologists who reported oil incidents and helped in various ways during major disasters. The many hundred hunters who provided information on contaminated birds through the questionnaire survey are also to be thanked. For several years the authors have been advisers to the MINISTRY OF THE ENVIRONMENT in questions concerning oil pollution and seabirds, and Commanders P. S. STAMP, F. OTZEN and L. PALLE of the AGENCY OF ENVIRONMENTAL PROTECTION are thanked for their cooperation in a mutual effort to improve registration and control of oil pollution. Aerial surveys and counts of birds were conducted in connection with several pollution incidents, and thanks are due to the ROYAL DANISH AIR FORCE and the ARMY AIR CORPS for providing aircraft and pilots, and to the pilots of civil aircraft hired by the Game Biology Station. Dr. ROBERT RUSSEL is thanked for linguistic criticism of the English manuscript, and Mr. AXEL MORTENSEN for translating the Russian summary.

## General collection of information on oil pollution incidents

A large number of contributors, such as game advisers, police, coast wardens, hunters and ornithologists, pass information to the Game Biology Station about observations of contaminated seabirds, most often immediately after the observation is made. Such reports have been received since the beginning of the Station's survey in 1968, but without doubt the increased public knowledge of the current investigations and the growing interest in environmental problems have gradually led to improved reporting by such sources and made the registration more efficient. The steadily increased surveillance of Danish waters organized by the Ministry of the Environment has also resulted in improved reporting to the Ministry by many different sources such as local authorities and shipping and air traffic about accidents at sea or observations of oil patches.

In all cases of such reports which involve more than a very small oil patch or the presence of more than a very few oiled birds, the Ministry and the Station cooperate in immediate further evaluation of the incident. The Ministry organizes a closer search in the area through local authorities or from aircraft or ships, and simultaneously the Station organizes local contributors to evaluate the seabird situation in the vicinity. Supplementary reports are often received within a few hours. In the large majority of cases the incident proves to be of small dimension, and apart from maintaining some degree of local attention, further action is called off.

In some cases however the oil slick proves to be of major dimensions and/or involving large numbers of birds. In such cases surveys are continued and inten-

sified, on the part of the Ministry with the aim of determining the source of the pollution and evaluating the need for pollution control measures, which eventually may lead to a major operation involving several local and governmental organizations according to established emergency plans.

Whenever an incident shows signs of affecting or proves to affect large numbers of birds the Game Biology Station with the aid of local people initiates intensive surveys, including observations from coasts and if necessary from boats and aircraft, with the purpose of estimating as accurately as possible the extent of the pollution and the number of birds involved. The Station assists game advisers and police in organizing the eventual killing of suffering birds, carried out by local hunters, and subsequently collects as many perished or shot birds (whole birds or wings) as possible for examination. Besides illustrating the species composition of contaminated birds this examination contributes data on age- and sex-composition in materials of diving ducks, to be used in an evaluation of the annual production (JOENSEN 1974 p. 62). This latter aspect is not dealt with in the present report.

The results of investigations concerning two extremely large disasters occurring in 1972 are described below in special reports similar to those given in the report covering the years 1968-1971 (JOENSEN 1972 a). Data on an additional 23 incidents each with records of from one hundred to a few thousand contaminated seabirds, have been summarized briefly in Appendix 1, and information on the species composition of birds examined is given in Table 5. It should be emphasized

that the number of birds given affected by oil are those recorded and therefore in general must be considered minimal. In particular for many medium-sized incidents listed in Appendix 1 the surveys were inadequate and the actual losses due to oil may have been considerably larger than the estimated numbers. Without doubt this is also true for many smaller

incidents, which according to available information affected less than one hundred birds and are not listed in Appendix 1. In several cases no satisfactory surveys could be carried out because of adverse weather conditions, a very common phenomenon in Denmark in autumn, winter and spring.

## Reports on two disasters in 1972

### MARCH 1972 – NORTHERN AND CENTRAL KATTEGAT

*Area:* East coast of Jutland from Skagen in north to Ebeltoft in south (ca. 250 km of coastline), and the islands Hirsholmene, Nr. Rønner – Læsø, Anholt, Hjelmsø and Samsø. Largest concentrations of oiled birds were found in the central part of this area, from the N coast of Djursland to Voerså (see Fig. 1).

*Period:* The first contaminated birds were seen in the first days of March. Large numbers came ashore from 12–13 March, and killing of suffering birds mainly took place from 13–18 March. In several areas large numbers of oiled birds were still present about 25 March, but later in March and in early April only small numbers were observed.

*The pollution:* Source unknown, probably a ship. During aerial survey on March 13th patches of oil in open water were seen N of Læsø (50 × 1000 m), at Hirsholmene (50 × 500 m), E of Øster Hurup (75 × 500 m), and N of Fjellerup (several patches of about 25 × 1000 m). On March 24–25 a vessel and a helicopter from the Royal Danish Navy searched parts of the Ålborg Bugt, but no oil patches were found. During an aerial survey on March 28th a very large slick (1000 × 6000 m) was observed 6–8 km SW of Læsø. Scattered oil patches were found on many shores, particularly off N Djursland and Himmerland, where fishing nets and boats were also affected. In most areas, particularly the central part of the pollution area, a large proportion of the birds were very heavily soaked in oil and thus quite immobilized, while still alive. The oil contained very heavy components, being probably crude or heavy fuel oil.

*Observations from shores:* During most of March weather conditions were favourable for

coastal observations. However, along most of the coast affected sand bars only periodically covered by water are present up to several kilometres from the mainland coast, and over such large distances it is very difficult to count the birds, determine species, and evaluate their degree of oil contamination. In most cases the

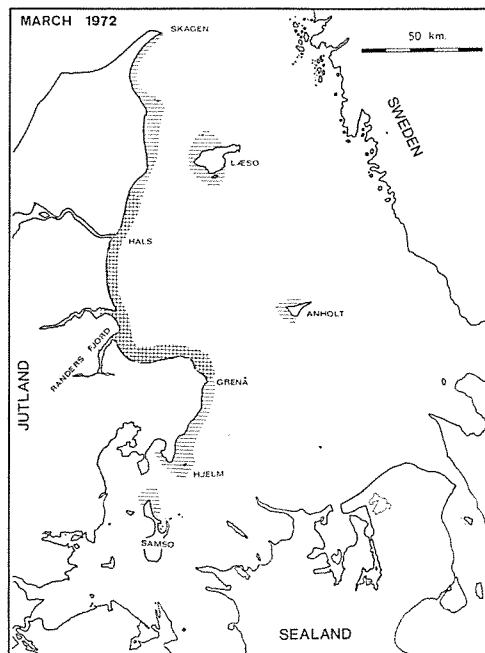


Fig. 1 The distribution of oiled birds during the disaster in the northern and central Kattegat in March 1972. Cross-hatched: main concentration areas, hatched: smaller numbers of birds affected.

	March 1972 Kattegat	Dec. 1972 Waddensea
<i>Gavia stellata</i>	26	23
<i>Gavia arctica</i>	14	4
<i>Gavia sp.</i>	6	1
<i>Gavia</i> total	46 10%	28 0.3%
<i>Podiceps griseigena</i>	112	11
<i>Podiceps cristatus</i>	2	—
<i>Podiceps auritus</i>	—	1
<i>Podiceps</i> total	114 2%	12 0.1%
<i>Fulmarus glacialis</i>	—	4
<i>Phalacrocorax carbo</i>	—	1
<i>Somateria mollissima</i>	683 14%	4413 48%
<i>Melanitta nigra</i>	2663 56%	4500 49%
<i>Melanitta fusca</i>	1129 24%	89 1%
<i>Clangula hyemalis</i>	63	11
<i>Aythya marila</i>	14	7
<i>Aythya fuligula</i>	—	6
<i>Bucephala clangula</i>	21	16
<i>Mergus serrator</i>	22	5
<i>Mergus merganser</i>	2	1
Diving ducks total	4597 96%	9048 99%
<i>Anas platyrhynchos</i>	1	3
<i>Anas crecca</i>	—	1
<i>Anas acuta</i>	—	2
<i>Branta bernicla</i>	—	1
<i>Cygnus sp.</i>	1	—
<i>Stercorarius skua</i>	—	1
<i>Stercorarius pomarinus</i>	—	1
<i>Stercorarius parasiticus</i>	—	1
<i>Larus marinus</i>	1	2
<i>Larus argentatus</i>	—	3
<i>Larus canus</i>	—	1
<i>Larus sp.</i>	—	1
<i>Rissa tridactyla</i>	—	9
Skuas, gulls total	1	19 0.2%
<i>Uria aalge</i>	2	24
<i>Alca torda</i>	3	4
<i>Plotus alle</i>	1	—
<i>Cephus grylle</i>	1	—
Auks total	7 0.1%	28 0.3%
<i>Haematopus ostralegus</i>	1	4
<i>Numenius arquata</i>	—	1
<i>Corvus corone</i>	—	1
Grand total	4768	9153

Table 1. The species composition (number of birds and percentage) of birds killed in two major disasters in 1972 and examined by the Game Biology Station.

number of oiled birds recorded are therefore absolutely minimal. Many hunters provided information on numbers of oiled birds observed along most shores, and in addition Game Biology Station personnel surveyed most of the coast between Hals and Fornæs. In all areas peak numbers were recorded in the period 13–16 March, and the minimum numbers of oiled birds observed are given in Table 2. Between Hals and Randers Fjord the species composition of contaminated birds was estimated as *S. mollissima* 50%, *M. nigra* 30%, *M. fusca* 15%, while other diving ducks, divers, grebes etc. comprised no more than 5%. In most other areas *S. mollissima* was greatly outnumbered by the two *Melanitta* species.

*Aerial surveys:* On March 13th a four-hour aerial survey was conducted covering Læsø, Nr. Rønner and Hirsholmene, and the coast of Jutland from Frederikshavn in the north to Ebeltøft and Sletterhage in the south. Weather conditions during the survey were very favourable. More than 80,000 seabirds were recorded including 26,500 *S. mollissima*, 9,600 *M. nigra*, 7,200 *M. fusca*, 500 *B. clangula*, 100 *M. serrator*, 100 *C. olor* and 38,000 *Larus sp.* (mainly *L. argentatus*). About half of the diving ducks were sitting on sand bars, and it was estimated that nearly all *M. nigra* and *M. fusca* and probably half of the *S. mollissima* were contaminated. 1500 dead or extremely weak birds were observed. The distribution of birds presumably contaminated with oil is given in Table 2.

On March 28th a two hour aerial survey was carried out under rather poor weather conditions covering Anholt and open waters between Djursland and Læsø. Oiled birds were only seen at Anholt (30 *S. mollissima*).

*Birds shot:* According to reports sent to the Game Council and direct information from hunters, the number of destroyed birds was estimated at about 7,500 (for distribution see Table 2). In addition a few thousand dead birds were found along the coast. Probably more than three quarters of the birds were shot within six days (13–18 March). In several areas, particularly in the central and northern parts, only a small proportion of the suffering birds could be reached by the hunters, and many of those shot could not be retrieved. During the operation the wind was from an easterly direction, but during 12–13 March and 21–22 March a SW wind and higher water level caused many dead and dying birds to drift out into the open sea.



	No. contaminated birds observed from coasts 13-16 March <sup>1)</sup>	No. contaminated birds recorded in aerial survey 13 March	No. birds killed by hunters (ca.)	No. birds examined by GBS
Skagen - Hals	3-4,000	4,000	2,000	1,128
Hals - Randers Fjord	>15,000 <sup>2)</sup>	16,000	3,000	2,193
Randers Fjord - Fornæs	2,000	6,000	2,000	1,211
Fornæs - Elsegårde	200	200	300	212
Hirsholmene	?	100	?	-
Nr. Rønner - Læsø	?	200	?	-
Anholt	-	30 <sup>3)</sup>	24	24
Hjelm	200	?	-	-
Samsø	200	?	-	-

Notes: <sup>1)</sup> In some areas large numbers of contaminated birds had already been shot and removed at the time of the coastal count. - <sup>2)</sup> In addition to the 15,000 contaminated birds, 5-8,000 birds possibly contaminated were observed. - <sup>3)</sup> Aerial survey at Anholt conducted on 28th March.

Table 2. The number of contaminated birds observed (minimum figures) in counts from the coasts and in aerial surveys, the estimated number of birds killed (mainly shot) by hunters, and the number of birds examined by the Game Biology Station (GBS) along different sections of the Kattegat coast during the disaster in March 1972.

*Birds examined:* 4,768 birds were examined by the Game Biology Station (see Table 1 for species composition and Table 2 for geographical distribution). In most cases the entire bird could be examined, although 20% of the material consisted of wings or heads. The entire material consisted mainly of three species (*S. mollissima* 14%, *M. nigra* 56% and *M. fusca* 24%), while other diving ducks (3%), *Gavia sp.* (1%), *Podiceps griseigena* (2.4%) and *Alcidae* (0.1%) were much less abundant. The proportion of each of the three dominant sea-duck species varied according to their general distribution pattern in the pollution area, *S. mollissima* being commoner in the central part, while the two *Melanitta* species were predominant in the southern and northern parts.

*Total number of birds lost:* Considering the degree of contamination of birds, the type of oil involved, and the low temperature of the sea water at the time of the pollution, it is realistic to assume that all contaminated birds perished. The best estimate of numbers affected by oil was obtained during the aerial survey on March 13th, when a minimum of 30,000 contaminated birds were recorded, including 12-15,000 *S. mollissima*, nearly 10,000 *M. nigra*, ca. 7,000 *M. fusca*, plus a few hundred other seabirds.

By comparing the proportions of the three dominant species recorded by aerial survey with

those in birds collected and examined (summarized in Table 3) a considerable discrepancy between the proportions in the two groups was found, viz. the two *Melanitta* species are much more abundant in birds collected and examined. This is probably mainly due to the fact that collection of contaminated birds was carried out during a rather short period in the very beginning of the pollution incident. Since the *Melanitta* species occur further out at sea they were probably struck by oil earlier than *S. mollissima*, and furthermore the *Melanitta* species are obviously less robust than the latter species and consequently seek the shores sooner than *S. mollissima* (see p. 10). Due to the short period of collection of suffering and dead birds a large proportion of the contaminated *S. mollissima* have not been included in this material.

Such apparent differences in the vulnerability to oil of different species emphasizes the need for surveys to be conducted over a rather long period when actual losses and the proportion of each species among victims are to be evaluated.

In the case of the Kattegat disaster the actual loss of the different species cannot be accurately assessed, but it can be concluded that it was not less than 30,000 individuals, comprising the above-mentioned numbers of the three dominant species. These figures can be considered as absolutely minimal, the actual loss possibly being several thousand birds more.

*Remarks:* The parts of the Kattegat affected by oil pollution in March 1972 contain several very important concentration areas for wintering waterfowl, particularly for the three species of sea-duck most seriously affected by the disaster (JOENSEN 1974). For *S. mollissima* and *M. nigra* the estimated losses, although very high, do not comprise critically high proportions of the populations normally present in these waters. The loss of at least 7,000 and possibly a considerably larger number of *M. fusca* is however much more serious. The total winter population of this

species in Danish waters is 20–40,000 birds, which constitutes a very large proportion of the total population in W Europe, and within Danish waters the area affected by oil in March 1972 normally holds more than half of the total population. Without doubt a considerable proportion of this local population was killed, and this disaster illustrates the seriousness of the oil pollution problem, particularly in relation to species which tend to concentrate in very few areas (c. f. JOENSEN 1972 a p. 26).

## DECEMBER 1972 – THE WADDENSEA

*Area:* The entire Danish Waddensea, particularly waters around the islands of Rømø, Mandø and Fanø, and the peninsula Skallingen, with smaller numbers of birds also recorded north of Blåvand (Fig. 2).

*Period:* The first oiled birds were seen in several areas on Dec. 1st and 2nd. Numbers increased during the following week, large numbers of

contaminated birds being present until 20–25 Dec., whereafter numbers gradually decreased, being much smaller in early Jan.

*The pollution:* Source unknown, probably a ship. On Dec. 6th a helicopter of the Royal Danish Navy covered waters W of Rømø, Fanø and Mandø as well as the W coast of Jutland from Skallingen to Ringkøbing, but detected no oil patches on the sea. Small patches of oil were found on several shores. The degree of contamination of most birds was fairly light, but some however were quite heavily soaked in oil containing heavy components.

*Observations from coasts and boats:* On Dec. 5th–7th Game Biology Station personnel took observations along the shores of Rømø and Fanø, and throughout the months of Dec. and Jan. several hunters and ornithologists took observations from shores and boats in most parts of the pollution area. Such reports contained information about flocks of hundreds, and occasionally a few thousand contaminated birds, mainly *S. mollissima* and *M. nigra*. These occurred particularly around the islands, with smaller groups in the interior parts of the Waddensea and small flocks of *M. nigra* along the coast north of Blåvand. Without doubt small groups of contaminated *M. nigra* recorded in remoter waters, particularly Ringkøbing Fjord, Nissum Fjord and the western part of the Limfjord, originated from the Waddensea disaster.

Most land or boat observations covered only a small part of the pollution area, and as they were scattered over a fairly long period they do not form a sufficient basis for estimates of total numbers of contaminated birds.

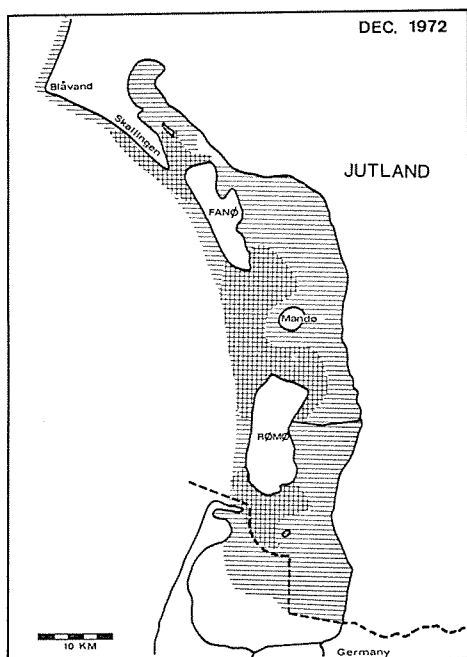


Fig. 2. The distribution of oiled birds during the disaster in the Waddensea in December 1972. Cross-hatched: main concentration areas, hatched: smaller numbers of birds affected.

*Aerial surveys:* On Dec. 6th and 7th the Game Biology Station conducted a three-hour aerial survey, the first day covering most of the Waddensea and parts of waters west of the islands, and on the second day covering the west coast of Jutland from Skallingen to Hvide Sande. In spite of rather strong winds the observation conditions were favourable. In the western part of the Waddensea, and in particular around the islands and their adjacent sandbanks, large numbers of oiled sea-ducks were observed, consisting almost exclusively of *S. mollissima* and *M. nigra*. The map Fig. 2 shows the distribution of contaminated birds. Altogether about 74,000 *S. mollissima* were recorded of which an estimated 19,000 were affected by oil. In the waters west of Rømø and Skallingen two huge rafts of *M. nigra* were observed, estimated to contain 160,000 and 40,000 birds respectively; apparently these birds were not affected by oil. However further east, and in particular around Rømø and its adjacent sands, a minimum of 3,500 contaminated birds were recorded. Small numbers of *M. fusca* (totalling ca. 1150 of which at least 150 were contaminated) were found together with *M. nigra*. Between Blåvand and Hvide Sande only a few oiled *M. nigra* were seen.

Besides the three sea-duck species mentioned, large concentrations of other waterfowl were recorded in the Waddensea, but these were largely unaffected by oil. The most numerous species were *A. platyrhynchos* 38,000, *T. tadorna* 9,300, *A. penelope* 8,100, *B. bernicla* 1,800, *A. crecca* 1,600, *H. ostralegus* 23,600, *C. alpina* 3,700, *Larus sp.* 135,000 (mainly *L. argentatus*).

On Jan. 4th 1973 an aerial survey of the Waddensea and Ringkøbing Fjord was conducted; only a few hundred oiled birds were recorded, in the central part of the Waddensea.

*Birds shot:* In the entire Waddensea area from the Danish-German border to Blåvand a minimum of 10,000 birds were killed by hunters, who reported that in some areas considerable numbers of suffering birds could not be reached, and that many of those killed could not be retrieved. North of Blåvand probably less than 300 were shot.

*Birds examined:* More than 9,000 birds, destroyed by hunters or found dead, were examined by the Game Biology Station, including 1,400 whole birds and 7,800 wings. At least 90% of these had been shot or found around Rømø, Mandø and Fanø. More than thirty species were in-

	Contaminated birds recorded in aerial survey (see note)		Killed birds examined by GBS	
	No.	%	No.	%
<b>Kattegat March 1972</b>				
<i>S. mollissima</i>	12-15,000	45	683	15
<i>M. nigra</i>	10,000	33	2,663	60
<i>M. fusca</i>	7,000	22	1,129	25
<b>Waddensea Dec. 1972</b>				
<i>S. mollissima</i>	20,000	74	4,413	49
<i>M. nigra</i>	7,000	26	4,500	50
<i>M. fusca</i>	200	1	89	1

Note: Figures in first column for the Waddensea include birds which had been killed at the time of the aerial survey.

Table 3. The proportions of *S. mollissima*, *M. nigra* and *M. fusca* among contaminated birds observed in aerial survey and in birds collected and examined in the two major disasters in 1972.

Sample period	1-16	17-31	1-15	Total
	Dec.	Dec.	Jan.	
No. birds examined of the two species	2,501	2,291	493	5,285
<i>S. mollissima</i>	14%	68%	79%	44%
<i>M. nigra</i>	86%	32%	21%	56%

Table 4. The ratio of *S. mollissima* and *M. nigra* in samples which could be accurately dated, killed in the Waddensea disaster in Dec. 1972 and early Jan. 1973. (Birds examined by the Game Biology Station).

involved, but *S. mollissima* and *M. nigra*, represented in equal numbers, together comprised 97% of the material (Table 1). In March 1973 a survey of beached birds was conducted along many coasts of the Waddensea (see p. 14), and without doubt a very large proportion of the beached birds recorded originated from the disaster in Dec. 1972.

*Total number of birds lost:* Although the weather was relatively mild and thus prolonged the process of dying it is assumed that all or

nearly all the contaminated birds perished in the course of Dec.-Jan. On Dec. 6th-7th a minimum of 19,000 *S. mollissima* and 3,500 *M. nigra* positively affected by oil were observed during aerial surveys. These birds were all sitting on shores and sandbanks, and without doubt some of the birds seen in the water were also contaminated. A cautious estimate of at least 25,000 birds still alive but contaminated can thus be established. At the time of the aerial surveys about 5,000 oiled birds (at least 1,000 *S. mollissima* and 3,500 *M. nigra*) had already either been shot or found dead.

As in the case of the Kattegat disaster (March 1972, see p. 7) there is a discrepancy between the proportions of the dominant species in contaminated birds observed during aerial survey in the beginning of the pollution period, and their proportions in birds collected and examined (see Table 3). During the Waddensea disaster the collection of birds was carried out over a much longer period than in the case of the Kattegat disaster, and consequently the discrepancy between materials is not so pronounced. Table 4 illustrates changes in the proportion of the two dominant species in the course of the period of collection. The more vulnerable *M. nigra* (which may also have been contaminated earlier on its haunts further out at sea) is quite predominant

in the beginning of the period, whereas the more robust *S. mollissima* survives longer but gradually as the contaminated birds are weakened becomes the predominant species later in the period of collection.

The actual losses of the two main species can not be accurately assessed, but it is concluded that at least 30,000 birds perished, comprising at least 20,000 *S. mollissima* and 7,000 *M. nigra*, the actual figures being possibly much higher.

*Remarks:* The Waddensea is one of the most important waterfowl concentration areas not only in Denmark, but in the whole of Europe. In the interior regions tens of thousands of dabbling ducks and waders and thousands of *B. bernicla* occur, the Waddensea being the most important haunt for these waterfowl in Denmark. None of these were affected by the oil in Dec. 1972. In winter 50,000 - 100,000 *S. mollissima* occur in waters around and between the islands, and in more open waters further west *M. nigra* regularly occurs in very large numbers. During the disaster in Dec. 1972 the local population of *S. mollissima* suffered very heavy losses, estimated to be at least 25%, whereas a much smaller proportion of the very large concentration of *M. nigra* present in the area were affected.

	Samsø Dec. 1971	Djurs- land Jan. 1972	Hals - Djursland Feb. 1973	Langeland - Lolland March 1974	Øresund Feb. 1975	South Kattegat Jan.-Feb. 1975	W. Lol- land April 1975
<i>Podiceps sp.</i>	-	-	1	1	-	-	-
<i>Phalacrocorax carbo</i>	1	-	-	-	-	-	-
<i>Somateria mollissima</i>	57	86	121	391	11	109	51
<i>Melanitta nigra</i>	4	7	106	119	-	1	308
<i>Melanitta fusca</i>	4	5	34	2	-	-	6
<i>Clangula hyemalis</i>	-	-	1	87	-	-	11
<i>Aythya marila</i>	-	-	1	2	-	-	-
<i>Aythya fuligula</i>	-	-	1	-	14	-	-
<i>Bucephala clangula</i>	-	-	1	1	11	-	-
<i>Mergus serrator</i>	-	-	2	-	16	-	1
<i>Alca torda</i>	-	1	-	-	-	1	-
<i>Cephus grylle</i>	-	-	-	-	-	1	-
<i>Fulica atra</i>	-	1	-	-	17	-	-
Total	66	100	268	603	69	112	377

Table 5. Species composition of birds shot in connection with some pollution incidents in the Kattegat, Øresund and W. Baltic Sea, and examined by the Game Biology Station.

## The questionnaire survey to diving-duck hunters

Information on the dispersed occurrence of oiled birds in Danish waters in 1968/69 and 1969/70, obtained through a questionnaire survey to diving-duck hunters, has been described by JOENSEN (1972 a). Similar information from the subsequent six seasons (1970/71 - 1975/76) is presented in this report. The main objective of the questionnaire survey is to obtain supplementary information to the official bag-record on the species composition among bagged diving ducks other than *S. mollissima*. However the hunters are also asked for information about oiled birds.

Table 6 summarizes data on the hunters' reports on oiled birds from all eight

seasons now investigated. Each year questionnaires were sent to about half of those hunters who gave information to the official bag-record about more than ten »other diving ducks« bagged. Over the eight seasons the proportion of this category of hunters replying has increased slightly as a result of more questionnaires mailed and an improved reply rate. Section C in the table giving the number and proportion of replies with detailed information on cases of oiled birds, is particularly important for an evaluation of the overall pollution situation, and also sections D-E giving information on the number of occurrences of oiled birds and the total number of

	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
A. No. questionnaires mailed	1392	1411	1608	1479	1717	1300	1122	1195
B. No. questionnaires replied	986	957	1139	1080	1158	1030	928	990
C. Replies with reports on oiled birds	{ No. 180 169 % of B. 18 18		173	186	236	109	81	64
			15	17	20	11	9	6
D. No. occurrences reported total	191	172	175	188	243	110	81	70
1-5 oiled birds	109	112	113	119	138	79	53	45
< 20 oiled birds	158	143	138	155	208	101	75	64
20-100 oiled birds	29	20	33	31	31	9	6	6
> 100 oiled birds	4	9	4	2	4	-	-	-
E. No. oiled birds shot	1100	1300	1900	2100	3100	500	350	500

Table 6. Information on oiled birds obtained through the questionnaire survey to hunters, who claimed the category »other diving ducks« bagged during eight seasons. Notes: A) Questionnaires were sent to half of those hunters, who had reported > 10 »other diving ducks« bagged. - B) Number of replies received (excluding a few percent which did not contain any information). - C) Including only replies with reports on oiled birds in the season in question, omitting for example letters with general statements not referring to that particular year. - D) The number of occurrences of oiled birds is higher than the number of replies, because some hunters reported more than one occurrence of oiled birds. Occurrences with exact information on locality (90-95%) are marked on Fig. 3. - E) Total number of oiled birds killed by hunters and reported in the questionnaire survey, including only reports with exact numbers given.

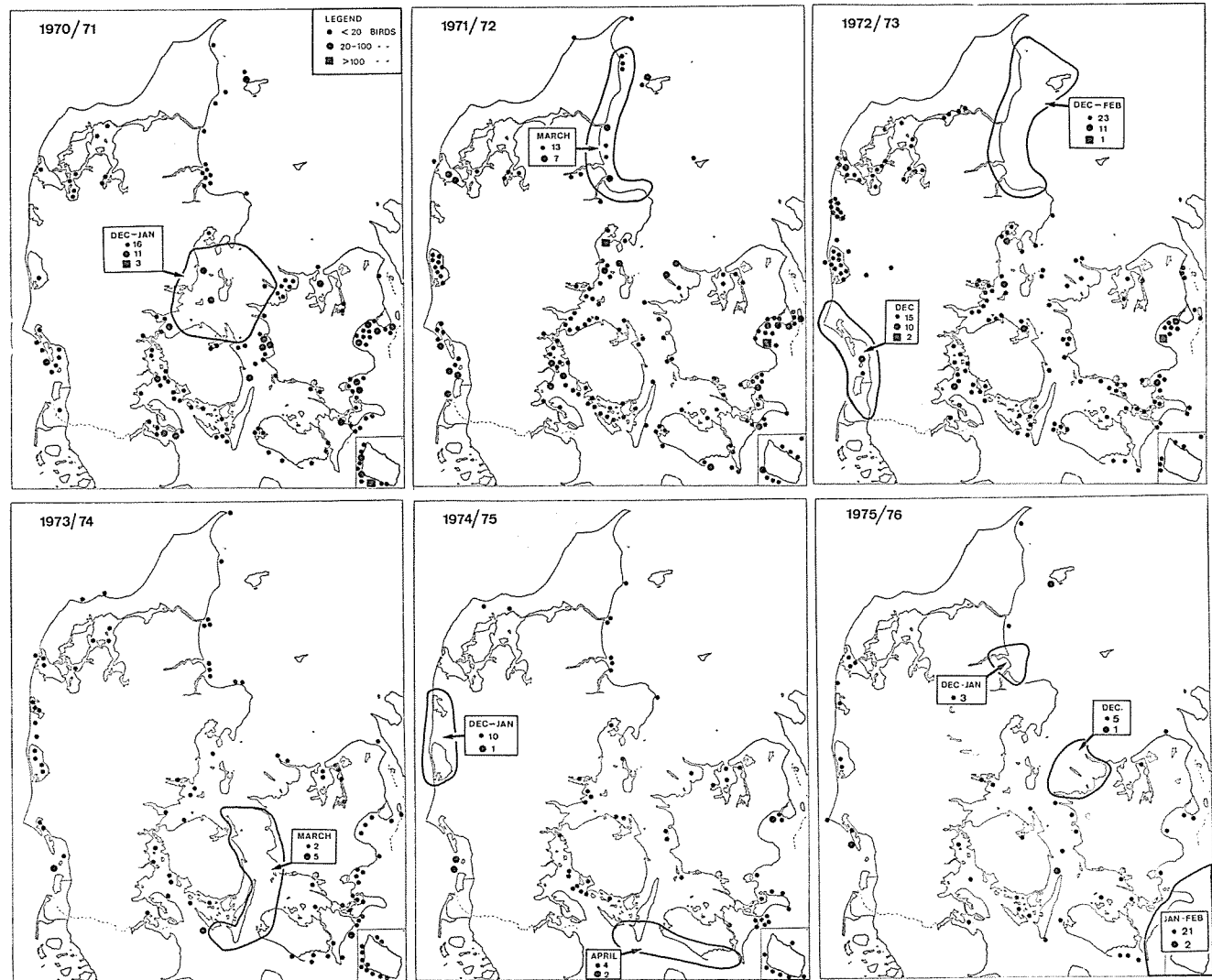


Fig. 3. The geographical distribution of oiled birds, reported by hunters in questionnaire survey over six seasons (1970/71 - 1975/76). Reports connected with organized destruction of birds in connection with larger pollution incidents are specially indicated on the maps.

	Bornholm	Sealand - Lolland-Falster	Funen	Jutland	Total
<i>Gavia sp.</i>	-	2	9	17	28
<i>Podiceps sp.</i>	-	-	6	6	12
<i>Phalacrocorax carbo</i>	-	1	1	1	3
<i>Somateria mollissima</i>	1	314	82	235	632
<i>Melanitta nigra</i>	23	238	124	858	1243
<i>Melanitta fusca</i>	14	76	33	105	228
<i>Clangula hyemalis</i>	560	436	23	20	1039
<i>Aythya marila</i>	-	41	-	14	55
<i>Aythya ferina</i>	-	9	3	1	13
<i>Aythya fuligula</i>	-	168	6	113	287
<i>Bucephala clangula</i>	2	36	4	37	79
<i>Mergus serrator</i>	-	28	10	30	68
<i>Mergus merganser</i>	-	12	-	5	17
<i>Cygnus sp.</i>	-	1	-	4	5
<i>Anas sp.</i>	-	-	-	3	3
<i>Uria aalge</i>	-	-	-	1	1
<i>Alca torda</i>	-	4	-	6	10
<i>Cephus grylle</i>	-	-	1	3	4
<i>Fulica atra</i>	-	3	-	1	4
<i>Larus sp./Rissa</i>	-	5	-	27	32
Total	600	1374	302	1487	3763

Table 7. Species composition of oiled birds killed by hunters in six seasons (1970/71-1975/76), based on information from the questionnaire survey to diving-ducks hunters. Reports concerning birds killed in connection with major pollution incidents indicated specially on the maps in Fig. 3 are not included.

oiled birds reported shot are important. This information however includes both reports on the dispersed occurrences of oiled birds and reports from major disasters in which hunters took part in organized killing of suffering birds.

The maps of Fig. 3 illustrate the geographical distribution of reported occurrences of oiled birds in each of the six seasons 1970/71 - 1975/76; reports concerning the major actions have been specially indicated. Information on locality was too inaccurate for inclusion in Fig. 3 for 5-10 % of the reported occurrences.

Table 7 illustrates the species composition of oiled birds killed in four regions of Denmark in all six seasons as a whole (1970/71 - 1975/76). It should be emphasized that because the questionnaire survey was selectively sent to hunters shooting »other diving ducks« and not to a similarly representative sample of hunters who shot *S. mollissima*, the information on species composition is biased accordingly.

## Surveys of beached birds

In later years some countries in NW Europe have organized surveys of beached birds, i.e. regular counts of dead seabirds (oiled or otherwise) along certain (often very long) stretches of coastline, the purpose being to provide general information on the seabird/oil pollution problem, and to establish an index of oil pollution (see e.g. ANON 1976, BIBBY 1972). Such in-

vestigations have been carried out with the voluntary aid of large numbers of ornithologists etc.

In Denmark the problem of oil pollution and seabirds has mainly been studied by methods described in previous chapters, but in later years some surveys of beached birds have also been carried out with the aim of obtaining additional

information on the problem. The methods applied are not standardized as for example are those of the British scheme, and accordingly the results presented here from one survey along the west coast of Jutland in March 1973 and several other surveys of smaller scale cannot realistically be compared with the results of surveys in other countries. Furthermore due to heterogeneity the quantitative aspects

of the different Danish surveys should not be compared. So far it has not been possible to organize major, regular surveys of beached birds in Denmark similar to those conducted elsewhere e.g. in Great Britain. Also, since the problem is quite intensively studied by other methods there is perhaps not such a great need for additional surveys of beached birds in Denmark.

#### WEST COAST OF JUTLAND, MARCH 1973

In the period 3rd–7th March 1973 a British-Danish team of twelve people (leaders E. BØGEBJERG HANSEN and NORMAN HAMMOND) surveyed almost the entire west coast of Jutland from Skagen in the north to the Danish-German border in the Waddensea in the south. Of a total coastline of 560 km about 470 km were surveyed (see Fig. 4).

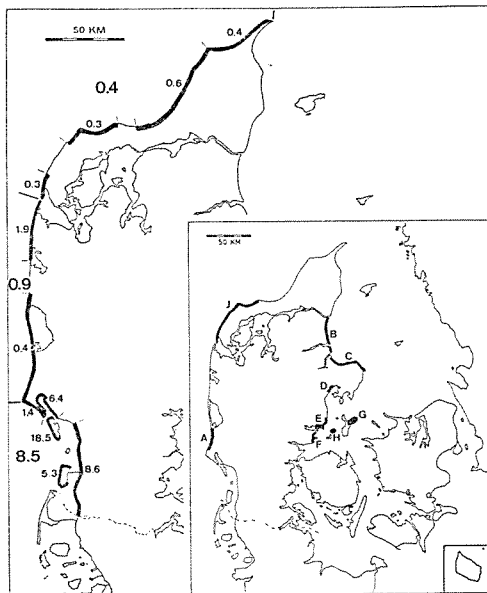


Fig. 4. Stretches of the west coast of Jutland surveyed for beached birds in March 1973. Figures indicate no. birds/km recorded along shorter sections, and the three main sectors. — The insert map shows the localities of other surveys of beached birds (cf. Table 9).

The coastline was divided into three main sectors and many smaller sections. The northern and central sectors (Skagen-Thyborøn and Thyborøn-Blåvand) consist mainly of broad (50–150 m) sandy beaches, narrower and stony beaches being only present along shorter stretches. In these two sectors a large proportion of the dead birds present on the shore were recorded although some older corpses covered by sand were without doubt overlooked. In the southern sector (the Waddensea) conditions were much more difficult. The exposed western coasts consist of vast sandflats (up to several kilometres broad) and the protected coasts behind the islands are broad marshlands with concealing vegetation. Although the southern sector was quite intensively surveyed, often by several parallel routes, a large proportion of beached birds present were without doubt overlooked. The total length of the survey routes in all three sectors was considerably longer than the length of the beaches surveyed, probably close to one thousand kilometres.

For each bird found the species and if possible the age and sex were recorded, and notes were also made on the part of the birds present, the age of the corpse (newly dead, rotten or mummified), the presence of oil on plumage (a: oil not



## Oil Pollution and Seabirds 1971 – 1976

Sector	Skagen – Thyborøn (193 km)	Thyborøn – Blåvand (115 km)	Waddensea (162 km)	Total (470 km)	% birds with visible traces of oil
<i>Gavia sp.</i> <sup>1)</sup>	–	3	24	27	74
<i>Fulmarus glacialis</i>	20	14	27	61	31
<i>Morus bassanus</i>	3	3	11	17	71
<i>Phalacrocorax carbo</i>	–	2	1	3	33
<i>Somateria mollissima</i>	1	–	484	485	
<i>Melanitta nigra</i>	2	–	324	326	
<i>Melanitta fusca</i>	–	–	8	8	
<i>Clangula hyemalis</i>	–	–	3	3	
<i>Mergus serrator</i>	–	–	1	1	
Diving ducks total	3	–	820 (63%)	823	33
Other Anatidae <sup>2)</sup>	–	1	67	68	1
<i>Larus argentatus</i>	14	22	44	80	
<i>Larus fuscus</i>	1	–	1	2	
<i>Larus marinus</i>	9	5	37	51	
<i>Larus canus</i>	10	12	100	122	
<i>Larus ridibundus</i>	–	3	12	15	
<i>Larus sp.</i>	2	–	26	28	
<i>Rissa tridactyla</i>	7	6	24	37	
Gulls total	43 (53%)	48 (47%)	244 (19%)	335 (22%)	17
<i>Uria aalge</i>	7	18	42	67	
<i>Alca torda</i>	2	7	8	17	
<i>Plotus alle</i>	–	4	–	4	
Auk sp.	–	–	1	1	
Auks total	9 (11%)	29 (28%)	51 (4%)	89 (6%)	85
Waders <sup>3)</sup>	–	2	31	33	3
Other <sup>4)</sup>	3	–	31	34	3
Grand total	81	102	1307	1490	31
Birds per km beach surveyed	0.4	0.9	8.1		

Notes: <sup>1)</sup> *Gavia sp.* comprised 17 *G. stellata*, 1 *G. arctica*, 2 *G. immer* and 7 undetermined. – <sup>2)</sup> Other Anatidae comprised 47 *Tadorna tadorna*, 18 *Anas platyrhynchos*, 1 *A. crecca*, 1 *A. acuta* and 1 *Anser caerulescens*. – <sup>3)</sup> Waders comprised 17 *Haematopus ostralegus*, 13 *Numenius sp.*, 1 *Calidris alpina*, 1 *C. alba* and 1 *Tringa totanus*. – <sup>4)</sup> Other comprised 3 *Ardea cinerea*, 1 *Falco tinnunculus*, 1 *Perdix perdix*, 1 *Columba palumbus*, 19 *Corvus corone*, 1 *C. corax*, 1 *C. frugilegus* and 7 undetermined birds.

Table 8. The number of beached birds recorded in each of the three main sectors of the west coast of Jutland in March 1973, and the proportion with oil on plumage.

present, b: oil not recorded, but may have been present, and c: oil present, the last category being divided into different degrees of contamination). In addition notes were made on the type of beach, location of bird on beach etc.

The results of the survey are summarized on a map (Fig. 4) showing the density of birds in the different sectors and sections, and in Table 8 giving the species composition and proportion of

birds with positive traces of oil on plumage. It should be emphasized that the enormous difference in the number of birds recorded in the three sectors is due to the fact that most of the birds recorded in the southern sector (the Waddensea) originated from the disaster which took place 2-3 months prior to the survey. Thus in this part of the survey area results are quite atypical.

#### OTHER SURVEYS

In later years the Game Biology Station has visited and patrolled stretches of coasts on a large number of occasions, mostly in connection with other investigations. Table 9 summarizes the results obtained in some areas which have been visited many times, although in most areas at different intervals, including also information collected by members of the Naturalist Society of NW Jutland.

It should be emphasized that the material presented in Table 9 is very heterogeneous. For some materials the length of the coastline is not accurately known, and in the case of some small

reefs and islands which attract suffering birds from vast areas of surrounding water the length of the coastline is irrelevant. In some areas surveyed in the spring (G and H) most corpses were of birds perished during the preceding winter, and it was not possible to state the presence or absence of oil on the plumage. In contrast the surveys conducted by one of the authors (A, B, C, D, E and F) were mainly concerning newly-dead whole birds, on which the presence or absence of oil could be stated accurately, but omitted older corpses and fragments of birds.

Area	A W Jutland (Henne) 1969-76 21/230 km		B Himmer- land 1970-76 15/170 km		C Djursland 1970-76 32/370 km		D Egå Strand 1973-76 158/474 km		E Horsens Fjord 1971-76 18/130 km		F As - Sand- bjerg Vig 1971-76 12/145 km		G Besser Rev Vejrø etc. 1971-76	H Svane- grund 1971-76	J NW Jutland Hansthalm 1970-73 ??	
	T	Oil	T	Oil	T	Oil	T	Oil	T	Oil	T	Oil	T	T	T	Oil
<i>Gavia sp.</i>	11	8	2	2	6	2	1	-	2	2	1	-	1	1	17	8
<i>Podiceps sp.</i>	1	-	8	3	13	8	1	-	21	13	3	-	2	-	4	1
<i>Fulmarus glacialis</i>	21	6	-	-	1	-	-	-	-	-	-	-	-	-	114	16
<i>Morus bassanus</i>	4	2	1	-	-	-	-	-	-	-	1	-	-	-	17	7
<i>Phalacrocorax carbo</i>	-	-	3	2	2	2	2	2	28	9	8	3	8	6	2	-
<i>Somateria mollissima</i>	-	-	86	40	121	25	56	23	39	20	25	11	465	154	2	-
<i>Melanitta nigra</i>	28	21	53	36	71	38	19	12	25	11	19	8	98	5	51	27
<i>Melanitta fusca</i>	1	1	21	13	38	21	2	1	13	9	17	5	52	4	1	-
<i>Clangula hyemalis</i>	3	2	8	4	15	6	1	1	8	5	9	3	1	-	1	-
Other diving ducks	-	-	16	9	26	11	38	25	21	8	16	3	11	-	15	3
Other Anatidae	2	-	21	2	13	2	12	6	21	3	9	2	49	3	7	1
<i>Fulica atra</i>	-	-	3	1	2	-	8	3	12	5	3	-	20	-	1	-
<i>Larus sp.</i>	28	4	111	21	153	30	213	20	93	10	89	11	100	18	218	19
<i>Rissa tridactyla</i>	20	9	3	-	1	1	-	-	1	-	2	1	-	1	16	5
<i>Uria aalge</i>	31	25	4	3	9	3	1	-	1	1	2	1	-	-	60	40
<i>Alca torda</i>	13	9	17	8	6	2	1	1	2	-	8	2	-	-	12	7
Other and undet. auks	4	4	5	2	3	2	1	-	1	-	3	3	-	-	16	9
Total, no. birds	167	91	362	146	480	153	356	94	288	96	215	53	807	192	554	143
Birds/km	0.7	0.4	2.1	0.9	1.3	0.4	0.8	0.2	2.2	0.7	1.5	0.4			?	?
% with oil	54		40		32		26		33		25				26	
Waders	3	-	4	-	3	-	1	-	9	-	1	-	1	-	11	-
Land birds	20	-	12	-	17	1	21	-	31	-	8	-	1	-	79	-

Table 9. The number of beached birds recorded in nine areas, which were surveyed several times at irregular intervals, areas A-H by the Game Biology Station, area J by members of The Naturalist Society of NW Jutland (source HOLGER SØNDERGAARD). - T = total number of birds recorded. Oil = number of birds with oil on plumage. - For method etc. see text p. 16.

## Conclusions and discussion

In several respects the findings of this study of oil pollution and seabirds during 1971 – 1976 show similar characteristics to those of previous periods (JOENSEN

1972 a, 1972 b), and are therefore described rather briefly in the present report.

### GEOGRAPHICAL AND SEASONAL DISTRIBUTION OF SEABIRD MORTALITY

Fig. 3 shows the scattered occurrence of seabirds contaminated with oil as reported by hunters during six years (1970/71 – 1975/76), and the map Fig. 5 shows the approximate location of 25 oil pollution incidents reported to have affected more than 100 birds during the five years (July 1971 – June 1976) treated in the present report (cf. Appendix 1, p. 29).

It is seen that in later years, as in previous periods, contaminated birds are regularly recorded in almost all Danish waters, and that the heaviest bird mortality caused by oil takes place in the Kattegat, the Waddensea, and the Baltic Sea and its adjacent waters.

Contaminated seabirds may often wander long distances, particularly during mild weather when they are not immediately paralyzed by cold water. During the Waddensea disaster (Dec. 1972) oiled *M. nigra* were observed in several waters far from the main pollution area, even as far as the southern Kattegat. Several hunters have reported that the *M. nigra* occurring in the fiords of W Jutland (Ringkøbing Fjord, Stadel Fjord and Nissum Fjord, which are not normally visited by this species) are almost always oiled individuals (see Fig. 3). This illustrates that the distribution of oiled birds, particularly the scattered occurrence of smaller numbers (see e.g. Fig. 3) is not necessarily identical with the distribution of actual pollution incidents.

The seasonal distribution of seabird mortality caused by oil during 1971 – 1976 is quite similar to that of previous periods, the phenomenon being practically only registered in the period from October to April. The two major disasters described in the present report took place in December and March, and the 23 other incidents involving more than 100 birds

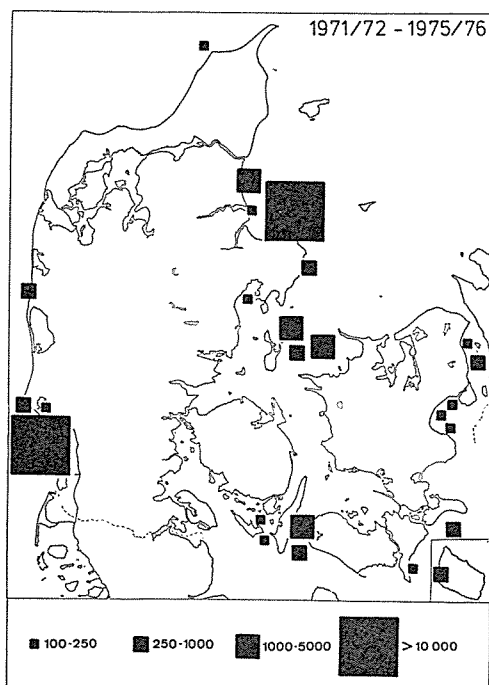


Fig. 5. The geographical distribution of 25 oil pollution incidents involving more than 100 birds in five years (July 1971 – June 1976).

show the following monthly distribution (Appendix 1): Oct. 2, Nov. 3, Dec. 6, Jan. 7, Feb. 2, March 2, April 1. This distribution is confirmed by information obtained through the questionnaire survey to diving duck hunters. During the months May - September very few reports of oiled birds, in all cases involving only a few individuals, were received during 1971 - 1976.

Throughout the year Danish waters hold substantial concentrations of seabirds but for most species numbers are generally larger and concentrations are more dense from late autumn to spring. Oil pollution probably occurs throughout the year, although it is logical to assume that for example illegal discharges from

ships are more frequent during winter when long nights and periods of fog in combination with sparse traffic make detection of such offences less efficient. It must however be assumed that the main reason for oiled birds occurring almost exclusively during October - April is the low water temperature, which implies that oil disperses and evaporates much slower than in summer, and that the contaminated birds are quite rapidly paralyzed. Without doubt seabirds are also contaminated with oil during summer months, but their chances of survival are greater than during the colder season of the year, when presumably almost all birds contaminated with oil will subsequently die.

#### SPECIES AFFECTED BY OIL POLLUTION

Tables 1, 5, 7, 8 and 9 show the species composition of various samples of seabirds killed by oil. In all cases recording was done along coasts and consequently the proportion among actual oil victims of species which have their main concentration areas far out at sea is generally under-represented, since in the case of contamination corpses are likely to disappear without trace before currents and tides bring them ashore. Without doubt this is particularly the case for *Alcidae*, *Gaviidae*, *F. glacialis*, *M. bassanus* and *R. tridactyla*. Even in diving ducks there are apparent differences in the distribution of species and in their vulnerability to oil (see p. 7), and it is assumed that for example the proportion of *Cl. hyemalis* is generally under-represented as compared to for example *S. mollissima*.

In spite of such errors the various materials show good agreement and without doubt illustrate quite well the species

which are most severely affected by oil in Danish waters. Again the findings are quite similar to information from previous periods (JOENSEN 1972 a, 1972 b).

Without comparison the true sea-ducks and in particular four species (*S. mollissima*, *M. nigra*, *M. fusca* and *Cl. hyemalis*) are killed by oil in larger quantities than any other group of birds. In the two large disasters of 1972 the first three species accounted for 94% and 98% of the recorded victims (Table 1), and in most other material the four species comprised substantial proportions of the birds recorded. *Cl. hyemalis* is particularly abundant among oil victims in the Baltic Sea and its adjacent waters. The four species of sea-duck are extremely abundant in Danish waters, and since they occur further out at sea than most other species of *Anatidae*, it can be concluded that most oil spillages take place rather far from shore. Other diving ducks are also regularly found among victims of oil

pollution, most often *M. serrator* and *B. clangula*, but their numbers are generally much smaller. Considering the large numbers of *A. fuligula* wintering in coastal Danish waters (JOENSEN 1974), the sparse occurrence of this species among oiled birds confirms that large oil spillages near coasts are relatively infrequent. Of other *Anatidae*, particularly swans (mainly *C. olor*) are occasionally affected by oil, whereas contaminated dabbling ducks have only seldom been recorded.

Divers, grebes (mainly *P. griseigena*), auks (particularly along the North Sea coast, see Table 8 and 9) are often af-

ected, but in surveys along shores (see above) fairly small numbers are mostly recorded. Along the North Sea coast small numbers of contaminated, *F. glacialis*, *M. bassanus* and *R. tridactyla* are regularly found, and in the interior Danish waters *F. atra* and *Ph. carbo* are regularly recorded in small numbers.

Gulls (*Larus sp.*) are regularly oiled in small numbers, but in collections of beached birds a much smaller proportion of the dead gulls than of other species mentioned appear to have actually died from oil pollution (Table 9).

#### TRENDS IN SEABIRD MORTALITY DURING 1968–1976

A very important objective in studying the problem of oil pollution and seabirds in Danish waters has been to estimate the number of birds killed by oil. However it must at once be admitted that it is impossible to give an accurate estimate of the total mortality caused by oil. In the case of some major disasters intensive surveys made it possible to estimate minimum losses, and probably such disasters generally account for a large proportion of the total losses. In addition to such well-defined pollution incidents, there are many smaller ones, some of which are registered and fairly carefully surveyed. But in many cases no satisfactory surveys could be carried out, and moreover it is assumed that an unknown number of incidents (mainly of smaller dimensions) have remained unrecorded. From the extent of Danish waters, the scattered distribution of seabirds over vast areas of sea, and the fact that many areas are sparsely visited by man, it is believed that a relatively large proportion of minor oil pollution incidents are in

fact never recorded, and as a result of their frequent occurrence, together they may cause bird mortality of quite considerable dimensions.

The magnitude of seabird mortality can be more realistically illustrated by comparison of figures from different years during the eight-year period studied by the Game Biology Station. Table 10 summarizes some of the information contained in the report covering 1968–1971 (JOENSEN 1972 a), and the present report. It should be emphasized that in the course of the investigation period both the survey methods and the general registration of oil pollution incidents in Danish waters have improved (see p. 4), and trends should be considered with this in mind.

It has previously been demonstrated that the annual seabird mortality caused by oil has been increasing continuously over the last decades (JOENSEN 1972 a, 1972 b). A culmination in this development was reached in 1972, when large concentrations of seaducks were struck by oil in the Kattegat in March and in

the Waddensea in December, in both cases a minimum of 30,000 birds being killed.

In the three years following 1972/73 the recorded seabird mortality has however decreased (Table 10). During 1973/74 – 1975/76 there have been no disasters involving over 10,000 birds, as against one disaster per year in the preceding five year period. The number of incidents involving more than one thousand and more than one hundred birds respectively also declined after 1972/73. The reports from hunters show a similar trend and this is without doubt the best index available to illustrate the amount of minor oil pollution incidents. It should be mentioned that in the year July 1976 – June 1977 also, not otherwise treated in the present report, only a few cases of seabird mortality were reported, thus continuing the trend of the three preceding years.

The effect of water temperature both on the stability of oil patches on the sea and on the vulnerability of birds has already been mentioned (see p. 18). In some winters of recent years (particularly 1972/73, 1973/74, and 1974/75) the climate was milder than is usual for Denmark, and this may have increased evaporation and dispersion of oil spills as compared to years with colder weather and subsequently caused less damage to birds. Furthermore, many seabirds disperse more during mild winters than in severe ones, and while they are paralyzed immediately in cold water, the process of dying under warmer conditions takes longer, and the contaminated birds tend to spread over larger areas and they are thus more liable to be overlooked. It cannot be entirely ruled out that in some winters climatic conditions have thus led to a decreased efficiency in the recording of oiled birds. However it is difficult to

Year	% of hunters reporting oiled birds	Incidents of oil pollution with		
		> 100 birds	> 1000 birds	> 10,000 birds
1968/69	18	6	2	1
1969/70	18	17	2	1
1970/71	15	7	2	1
1971/72	17	9	2	1
1972/73	20	4	2	1
1973/74	11	2	1	–
1974/75	9	6	1	–
1975/76	6	4	–	–

Table 10. Index of seabird mortality due to oil during eight years, in which the Game Biology Station surveyed the problem in Danish waters. The % of hunters reporting oiled birds is from a questionnaire survey to diving duck hunters. Incidents of oil pollution with > 100, > 1000 and > 10,000 birds involved are listed in JOENSEN 1972 a (Appendix 1), and in Appendix 1 of the present report.

imagine that this factor alone could result in such a marked decline in numbers of contaminated birds as is seen in data presented here. These data leave little doubt of an actual decrease in the number of seabirds killed annually in the years after mortality culminated in 1972, and it is obvious to attribute this development to a decline in the amount of oil discharged into the sea.

A decrease in oil pollution of Danish waters can probably be ascribed to 1) increasing oil prices and improved recycling methods (e.g. cleaning of tanks), 2) increased sympathy for environmental protection by the public (probably including those categories who have been responsible for a great number of illegal oil spills in the past), and 3) not least, the improved control and surveillance of the oil pollution problem, which has recently been established by the Ministry of the Environment in Denmark (see p. 4), and similar bodies in other countries. In some cases of oil pollution control, carried out by the Agency of Environmental Protection, da-

mage to seabirds has possibly been reduced. However in this context the preventive psychological effect of established

surveillance and readiness to control actual cases of oil pollution should not be under-emphasized.

### CONCLUDING REMARKS

Developments in the oil pollution situation in Danish waters in recent years as regards seabirds give some reason for optimism. After several years with heavy and increasing seabird mortality, culminating in two disasters of frightening dimensions in 1972, three to four seasons in succession have shown considerably lower seabird mortality. Whether this is due to the random way in which oil and bird concentrations come together, or whether it is a result of a real decrease in oil pollution of the sea, only the future will show.

Danish waters hold extremely large concentrations of seabirds, and particularly some concentrations of ducks and swans comprise substantial proportions of the entire Palaearctic populations of certain species. Studies during 1965–1973 have shown that in most winters Danish waters contain between 1 million and 1½ million ducks (including three-quarter million *S. mollissima*, up to a few hundred thousand *M. nigra*, and tens of thousands of *M. fusca* and *Cl. hyemalis*) (JOENSEN 1974). More than one-quarter million diving ducks are bagged by hunters every year, including about 140,000 *S. mollissima*, 15,000 *M. nigra*, 8,000 *M. fusca*, and 10–12,000 *Cl. hyemalis*. Although the total annual mortality caused by oil cannot be accurately estimated, it is relevant to compare the minimum numbers available with those available on populations and the hunters' bag-records. During the years of heaviest oil mortality, for example 1971/72 and 1972/73 when the number of birds killed

by oil may well have considerably exceeded fifty thousand per year, this represented a quite heavy loss by the total bird populations. In the last three winters treated in the present report losses have been considerably smaller, and tentatively estimated as not exceeding a few tens of thousands. Losses of this magnitude do not appear alarmingly high considering the huge populations present, and in comparison to the mortality caused by hunting.

Large-scale transportation of oil through the shallow Danish waters will however always constitute a potential threat to the existence of these populations. Even small amounts of oil can kill substantial numbers of birds when released at certain times and places. Up until now in most cases of oil pollution, the source of pollution has remained unknown to authorities. In the Kattegat in March 1972 a substantial proportion of the NW European population of *M. fusca* probably perished, and in the Waddensea in December 1972 one-quarter of the local population of *S. mollissima* was destroyed. In both cases probably relatively small amounts of oil of unknown origin were involved. In all Danish waters larger spills, for example in connection with shipwrecks, could be absolutely disastrous for bird populations of the entire Palaearctic region.

Another aspect causing increasing concern is the rapid build-up in later years of oil development in the North Sea. So far surveys along Danish coasts have not



shown any marked increase in seabird mortality which might derive from the oil fields of the North Sea. Distances are however so great that there would be little possibility of tracing such effects by coastal survey. In fact very little relevant knowledge on bird populations of the more open parts of the North Sea is available today, but it is quite likely that particularly for some populations of *Alcidae* these waters are of extreme importance.

In April 1977 a blowout in the Norwegian Ekofisk field discharged about 21,000 tons of oil and 10,500 tons of gas. From preliminary reports available it appears that fortunate circumstances led to much less environmental damage than might have been expected with such a large amount of oil (ANON 1977). At the moment of preparation of the present report (June 1977) only insufficient data

are available on the effect of the disaster on seabirds in the North Sea.

With these serious aspects for seabirds in mind, it must be recommended that the control and surveillance of oil pollution already initiated by the Danish authorities should be further increased, in respect of surveillance to a level where the origin of illegal spills can regularly be traced, and in respect of control of oil spilled on the sea, the readiness should be expanded to facilitate successful operations to deal with realistically large amounts of oil, i.e. several thousand tons. Furthermore, the seabird aspects of the oil pollution problem should be continuously followed up, and the ornithological aspects connected with North Sea oilfields in particular need immediate evaluation on the basis of research involving all countries around the North Sea.

## Dansk resumé

### Olieforurening og søfugle i Danmark 1971-1976

1) Siden 1968 har Vildtbiologisk Station foretaget undersøgelser over olieforurening i relation til søfugle i danske farvande. I en tidligere artikel (JOENSEN 1972 a) er beskrevet perioden juli 1968-juni 1971, og nærværende artikel omhandler på tilsvarende måde fem-års perioden juli 1971-juni 1976.

I perioden 1971-1976 er indsamlingen af oplysninger om olieforurening og søfugle foregået på samme måde som i årene 1968-1971. Den udbygning, som i de senere år inden for Miljøministeriet er foregået vedrørende overvågning af danske farvande og etablering af et beredskab til bekæmpelse af olieforureninger, har imidlertid også medført en mere effektiv registrering af søfugle-mæssige aspekter, idet Miljøministeriet og Vildtbiologisk Station arbejder nært sammen om problemernes løsning.

2) Fra en lang række oplysere (politi, trafik til søs og i luften, jægere, jagtkonsulenter, ornitho-

loger, strandfogeder m. fl.) indgår regelmæssigt oplysninger om tilfælde af olieforureninger og forekomster af olietilsølede fugle. I sådanne tilfælde iværksættes fra Miljøministeriets side undersøgelser af forureningens omfang m. v., og Vildtbiologisk Station belyser med lokales bistand søfuglesituationen, idet der foretages observationer fra kyster, og om nødvendigt fra både og mindre fly. I forureningstilfælde omfattende større antal fugle organiseres gennem jagtkonsulenter, politi og lokale jægere aflivning af tilsølede individer, og Vildtbiologisk Station indsamler dødfundne og aflivede fugle til undersøgelse.

I perioden 1971-1976 forekom to tilfælde af olieforurening, som udviklede sig til fuglekatastrofer, nemlig i marts 1972 i Kattegat og i december 1972 i Vadehavet. I begge tilfælde skønnes mindst 30.000 fugle at være omkommet. Disse katastrofer er beskrevet i rapporter side 5-10, og oplysninger om omkomne fugle er givet i Tabel 1, 2, 3, 4 og Fig. 1 og 2.

Appendix 1 (og Fig. 5) rummer summariske beskrivelser af 23 andre forureningstilfælde, som hver har involveret mere end 100 fugle, og Tabel 5 viser artssammensætningen blandt fugle indsamlet i forbindelse med syv af disse forureningstilfælde. Det bør understreges, at alle talangivelser er minimale, idet de omfatter observerede tilsølede, dødfundne eller aflivede fugle. I en række tilfælde har det bl. a. på grund af vejrforholdene ikke været muligt at gennemføre tilfredsstillende undersøgelser over forurenernes omfang, og der er ingen tvivl om, at de fremlagte oplysninger undervurderer det faktiske omfang af fugledød, ikke blot i flere af de tilfælde, som er medtaget i Appendix 1, men også i talrige tilfælde, hvor der har foreligget oplysninger om mindre end 100 tilsølede fugle, og som ikke har fået speciel omtale i denne rapport.

3) I forbindelse med henvendelser til et stort antal dykandejægere vedrørende disses jagtudbytte af dykænder blev jægerne også anmodet om at give oplysninger om olietilsølede fugle. For jagtsæsonerne 1968/69 og 1969/70 er disse oplysninger beskrevet i en tidligere rapport (JOENSEN 1972 a), og de er i nærværende artikel suppleret med tilsvarende materiale fra de efterfølgende seks sæsoner, således at der har kunnet gives en samlet fremstilling af jægernes indberetninger i otte sæsoner (1968/69–1975/76). Tabel 6 summerer disse oplysninger, og Fig. 3 viser den geografiske fordeling af olietilsølede fugle, jvf. jægernes indberetninger for de sidste seks sæsoner. Den artsvisse fordeling blandt disse fugle er givet i Tabel 7.

4) Som supplement til ovennævnte undersøgelser er i denne rapport medtaget oplysninger fra en række optællinger af døde, specielt olietilsølede fugle langs danske strande. I flere lande i Europa, bl. a. Storbritannien, er der med henblik på etablering af et index for olieforurening og fugledød blevet gennemført systematiske undersøgelser af denne type igennem flere år. De danske materialer, som er fremlagt i nærværende rapport, er for de flestes vedkommende indsamlet i forbindelse med andre undersøgelser og ikke så systematisk som f. eks. i Storbritannien. De kan derfor ikke umiddelbart sammenlignes med oplysninger fra andre lande, og da de danske undersøgelser ydermere er ret heterogene, kan der ikke umiddelbart foretages sammenligning mellem de forskellige danske optællinger. Materialet tjener først og fremmest til at belyse hvilke arter, der hyppigst tilsøles af olie i forskellige danske farvande. Materialet omfatter en

større optælling langs næsten hele Jyllands vestkyst (marts 1973, se Fig. 4 og Tabel 8), samt en række optællinger langs Nordsøens og Kattegats kyster i årene 1969–1976 (se Fig. 4 og Tabel 9).

5) En række forhold vedrørende olieforurenernes relationer til søfuglebestande i danske farvande har været beskrevet i tidligere rapporter (JOENSEN 1972 a, 1972 b), og forholdene i årene 1971–1976 afviger ikke væsentligt fra tidligere perioder.

a) Den geografiske fordeling (Fig. 3 og 5) viser, at olietilsølede fugle forekommer i alle danske farvande, men at den største dødelighed forekommer i Kattegat, Vadehavet og Østersøen med tilstødende farvande.

b) Fugledød forårsaget af olie registreres næsten udelukkende i månederne oktober–april, hvilket må tilskrives oliens fysiske egenskaber og fuglenes større sårbarhed i koldt vand, samt måske i nogen grad, at en lang række arter optræder talrigere og mere koncentreret i vinterhalvåret, og at ulovlige forureninger fra f. eks. skibe kan tænkes at forekomme hyppigere om vinteren end om sommeren.

c) Artssammensætningen blandt olietilsølede fugle er belyst i en række materialer (Tabel 1, 3, 4, 5, 7, 8, 9), som alle stammer fra undersøgelser langs kysterne. Der er næppe tvivl om, at sådanne materialer undervurderer andelen af den faktiske dødelighed for visse arter, hvis opholdssteder fortrinsvis er langt til søs, og for hvilke chancen for at de driver ind til kysterne er ringe. Det drejer sig f. eks. om alkefugle. De foreliggende materialer viser, at olieforurening i danske farvande først og fremmest rammer fire arter af havænder, ederfugl, sortand, fløjlsand og havlit, her nævnt i rækkefølge efter størrelsen af de tab, som olien påfører bestandene. Disse fire arters andel af de foreliggende materialer er i næsten alle tilfælde over 75 % og overstiger i talrige tilfælde 90 %. Sammenlignet med disse havænder er tabet blandt andre arter, heriblandt flere som forekommer i stort tal langs danske kyster, relativt små.

6) I årene op til og med 1972 synes omfanget af olieforurening og søfugledød i danske farvande at have været tiltagende, og omfattede regelmæssig massedød blandt søfugle, ligesom der i mange farvande kunne konstateres næsten permanent forekomst af mindre antal olietilsølede fugle. Denne udvikling kulminerede i 1972, da danske søfuglebestande blev ramt af to meget omfattende katastrofer, der hver dræbte mindst 30.000 fugle. I årene herefter har fugledød som

følge af olieforurening imidlertid været svindende, jvf. de foreliggende oplysninger, som er summeret i Tabel 10. Siden december 1972 er der ikke forekommet katastrofer med over 10.000 fugle involveret (mod én katastrofe af sådanne dimensioner hvert af de foregående fem år omfattet af Vildtbiologisk Stations undersøgelser). Antallet af mindre forureningstilfælde med over 100 og over 1000 fugle involveret, har ligeledes været mindre, og denne tendens er fortsat i sæsonen 1976/77, som i øvrigt ikke behandles i denne artikel. Det bedste indeks for omfanget af mindre forureninger fås gennem de oplysninger, som er indkommet fra dykandejægere gennem spørgebrevsundersøgelsen, og både af Tabel 10 og kortene i Fig. 3 ser man et markant fald i antallet af rapporterede forekomster af tilsølede fugle.

Der er ingen tvivl om, at mængden af søfugle, som er omkommet i olie, har været betydeligt mindre i de sidste tre-fire vintre end i årene forud herfor, og at denne udvikling er udtryk for mindre olieforurening i danske farvande. En nedgang i olieforureningen kan formentlig tilskrives 1) stigende oliepriser og forbedrede genbrugs metoder (f. eks. ved rensning af tanke), 2) den voksende forståelse i befolkningen for miljøproblemer, samt ikke mindst 3) den øgede overvågning af farvandene og det stadig udbyggede beredskab til olieforureningsbekæmpelse, som er blevet etableret i de senere år. I denne sammenhæng bør overvågningsens forebyggende betydning ikke undervurderes.

7) Selv om udviklingen i omfanget af olieforurening og søfugledød i danske farvande i de senere år giver anledning til nogen optimisme, må man ikke undervurdere den trussel, som olie-transport gennem danske farvande til stadighed udgør mod fuglebestande, som er blandt de største og vigtigste i hele det Palæarktiske område.

I langt de fleste kendte tilfælde af omfattende fugledrab i de senere år har der formentlig været tale om udslip af relativt små mængder olie, og kun i få tilfælde er kilden blevet opklaret. Selv sådanne forureninger har kunnet decimere lokale fuglebestande mærkbart, og sådanne »mindre« forureninger udgør en særlig trussel mod arter, som f. eks. i vinterhalvåret har koncentreret en væsentlig del af deres samlede europæiske bestand i nogle få begrænsede danske farvandsområder.

Ydermere må det fastslås, at forureninger af større omfang, f. eks. i forbindelse med tankskibes forlis i de lavvandede danske farvande, vil kunne få uoverskuelige og katastrofale følger for bestande med oprindelse langt udenfor Danmark.

Også de senere års hastige opbygning af olieudvinding i Nordsøen giver anledning til voksende bekymring. Dette problems aktualitet blev stærkt understreget ved den forurening, som skete på det norske Ekofisk felt i april 1977, hvorved 21.000 tons olie og 10.500 tons gas strømmede ud. Som følge af en række heldige omstændigheder synes de miljømæssige skader at være mindre end det kunne forventes ved en så omfattende forurening. Hvad ornithologiske forhold angår, må det imidlertid fastslås, at vor viden om disse havområders betydning er særdeles mangelfuld i dag.

8) På denne baggrund må det stærkt anbefales, at de danske myndigheder foretager en yderligere omfattende udbygning af overvågningen af de danske farvande samt af beredskabet til bekæmpelse af olieforureninger på havet, og at de fuglemæssige aspekter i forbindelse med olieforurening følges fortsat, og at der fra alle lande omkring Nordsøen iværksættes forskning vedrørende de fuglemæssige perspektiver ved olieudvindingen.

## Резюме на русском языке

## Загрязнения нефтью и морские птицы в Дании 1971–1976 г.

1) С 1968 г. Станция Исследования Биологии Дичи предпринимала исследования загрязненной нефтью, касающихся морских птиц в датских водах. В предыдущей статье (Joensen 1972 а) описан период с июля 1968 г. по июнь 1971 г., а настоящая статья соответствующим образом описывает пятилетний период с июля 1971 г. по июнь 1976 г.

В течение периода 1971–1976 г. сведения о загрязнениях нефтью и морских птицах собирались таким же образом, как за 1968–1971 г. Однако, происшедшее за последние годы более широкое развитие деятельности Министерства Охраны Среды по надзору за датскими водами и готовности к борьбе с нефтяными загрязнениями также создало возможность более эффективной регистрации их последствий, касающихся морских птиц, так как Министерство Охраны Среды и Станция Исследования Биологии Дичи тесно сотрудничают по решениям проблем.

2) Из многочисленных источников сведений (полиции, морского и воздушного движений, охотников, консультантов по охоте, орнитологов, береговых надзирателей и т. п.) регулярно приходят сообщения о случаях загрязнения нефтью и встречах запачканных нефтью птиц. В таких случаях со стороны Министерства Охраны Среды принимаются меры для исследования объема загрязнения и т. д., а Станция Исследования Биологии Дичи с помощью местных жителей выясняет положение морских птиц, предпринимая наблюдения с берегов и, в случае надобности, с лодок и небольших самолетов. В случаях загрязнений, затрагивающих большие количества птиц, с помощью консультантов по охоте, полиции и местных охотников организуется умерщвление запачканных особей, и Станция Исследования Биологии Дичи собирает найденных мертвыми и убитых птиц для исследования.

За период 1971–1976 г. было два случая загрязнения нефтью, развившихся в катастрофы для птиц, а именно в марте 1972 г. в Каттегате и в декабре 1972 г. на морских отмелях у Югозападной Ютландии. В обоих случаях можно считать, что погибло по меньшей мере 30.000 птиц. Эти катастрофы описаны в отчетах на стр. 5-10, и сведения

о погибших птицах даются в таблицах 1, 2, 3, 4 и фиг. 1 и 2.

Приложение (и фиг. 5) содержат суммарные описания 23 других случаев загрязнений, каждый из которых затронул более 100 птиц, а табл. 5 указывает распределение по видам птиц, собранных в связи с 7 из этих случаев загрязнений. Следует подчеркнуть, что все указанные цифры представляют собой минимум, так как они составляют числа встреченных запачканных, найденных мертвыми или убитых птиц. В ряде случаев, между прочим вследствие условий погоды, было невозможно провести удовлетворительные исследования объема загрязнений, и нет сомнения о том, что данные сведения недооценивают фактическую численность погибших птиц, не только в нескольких из случаев, указанных в приложении 1, но также во многих случаях, где имелись сведения о менее чем 100 запачканных птицах, и не упомянутых специально в этом отчете.

3) В связи с анкетами, высланными к большому числу охотников о их добыче нырковых уток, охотников также просили дать сведения о птицах, запачканных нефтью. За охотничьи сезоны 1968/69 и 1969/70 г. эти сведения обсуждались в предыдущем отчете (Joensen 1972 а) и в настоящей статье они дополнены соответствующим материалом из шести последующих сезонов, так что было возможно дать полный отчет о сообщениях охотников за восемь сезонов (с 1968/69 по 1975/76). В табл. 6 собраны эти сведения, а фиг. 3 указывает географическое распределение запачканных нефтью птиц по сообщениям охотников за последние шесть сезонов. Распределение этих птиц по видам указано в табл. 7.

4) Как дополнение к вышеупомянутым исследованиям, в настоящем отчете также даются сведения, полученные рядом учетов мертвых, и в особенности запачканных нефтью птиц вдоль датских берегов. В нескольких странах Европы, между прочим в Великобритании, с целью создания индекса нефтяных загрязнений и гибели птиц, в течение нескольких лет проводились систематические исследования этого типа. Предъявленные в настоя-

шем отчете датские материалы большей частью собраны в связи с другими исследованиями, и не так систематически, как напр. в Великобритании. Следовательно, их нельзя непосредственно сравнивать со сведениями из других стран, а так как датские исследования кроме того довольно разнородны, невозможно непосредственное сравнение и между разными датскими учетами. Материал прежде всего служит для выяснения того, какие виды чаще всего бывают запачканы нефтью в разных датских водных районах. Материал включает довольно обширный учет вдоль почти всего западного берега Ютландии (в марте 1973 г., см. фиг. 4 и табл. 8), а также ряд учетов вдоль берегов Северного моря и Каттегата в 1969–1976 годах (см. фиг. 4 и табл. 9).

5) Ряд обстоятельств, касающихся связи между загрязнениями нефтью и популяциями морских птиц на датских водах были обсуждены в предыдущих отчетах (Joensen 1972 a, 1972 b), и обстоятельства в годах с 1971 по 1976 существенно не отличаются от обстоятельств в предыдущих периодах.

а) Географическое распределение (фиг. 3 и 5) указывает на то, что запачканные нефтью птицы встречаются на всех датских водах, но что наибольшая смертность наблюдается в Каттегате, на морских отмелях Югозападной Ютландии и в Балтийском море с соседними морскими районами.

б) Гибель птиц от нефти регистрируется почти исключительно в месяцах с октября по апрель, что следует отнести за счет физических свойств нефти и более высокой уязвимости птиц в холодной воде, а до некоторой степени и за счет того, что многие виды в зимнем полугодии встречаются более многочисленно и концентрированы, и что незаконные загрязнения, напр. с кораблей, вероятно чаще случаются зимой, чем летом.

в) Распределение по видам запачканных нефтью птиц выяснено рядом материалов (табл. 1, 3, 4, 5, 7, 8, 9), все которые получены исследованиями вдоль берегов. Едва ли можно сомневаться в том, что в таких материалах недооценена доля фактической смертности некоторых видов, местонахождения которых главным образом далеки от берегов, так что море только редко прибывает их к побережью. Так это обстоит напр. с *alcidae*. Имеющиеся в распоряжении материалы показывают, что от загрязнений нефтью датских вод страдают главным

образом четыре вида морских уток, *S. mollissima*, *M. nigra*, *M. fusca* и *Cl. hyemalis*, здесь названные в порядке численностей потерь, причиняемых их популяциям нефтяными загрязнениями. Доля этих четырех видов в имеющихся в распоряжении материалах почти во всех случаях больше 75%, а во многих случаях даже превышает 90%. По сравнению с этими морскими утками потери других видов, в том числе нескольких очень многочисленно встречающихся вдоль датских берегов, сравнительно незначительны.

б) Кажется, что в периоде до и включительно 1972 г. загрязнения нефтью и гибель морских птиц на датских водах происходили в возрастающей степени, и регулярно случалась массовая гибель морских птиц, а кроме того во многих морских районах небольшие количества запачканных нефтью птицы встречались почти постоянно. Это развитие кульминировало в 1972 г., в котором датские популяции морских птиц пострадали от двух очень тяжелых катастроф, при каждой из которых погибло по меньшей мере 30.000 птиц. Однако, в последующие годы смертность птиц вследствие загрязнений нефтью стала понижаться, судя по имеющимся сведениям, сводка которых дана в табл. 10. После декабря 1972 г. катастроф, затронувших более 100.000 птиц не произошло (а в каждом из предыдущих годов Станции Исследования Биологии Дичи приходилось исследовать по одной катастрофе таких размеров). Число менее серьезных случаев загрязнения, затронувших более 100 и более 1000 птиц, также уменьшилось, и эта тенденция продолжалась в течение сезона 1976/77 г. который, впрочем, в этой статье не обсуждается. Лучший указатель размеров менее значительных загрязнений получается из сведений, добытых анкетой среди охотников на нырковых уток, и как из табл. 10, так и из карт в фиг. 3 очевидно резкое уменьшение числа заявок о встречах запачканных птиц.

Не может быть сомнения о том, что число погибших от нефти птиц за последние три-четыре зимы было значительно меньше, чем в предыдущие годы, и что в этом отражается понижение степени загрязнения датских вод нефтью. Понижение степени загрязнений вероятно объясняется 1) повышением цен на нефть, создавшим более выгодную экономическую основу для вторичного использо-

вания нефтяных продуктов, 2) возрастающим сознанием проблем по охране среды у населения и, что не менее важно, 3) более эффективным надзором за морскими пространствами и постоянным повышением готовности к борьбе с загрязнениями нефтью, созданными в течение последних лет. В связи с этим следует не упускать из виду и предупредительное влияние надзора.

7) Хотя развитие размеров нефтяных загрязнений и числа погибших птиц на датских водах за последние годы дает основание для некоторого оптимизма, не следует недооценивать угрозу, которую транспорт нефти по датским водам постоянно представляет для популяций птиц, являющихся некоторыми из самых многочисленных и важных всей палеарктической зоны. В подавляющем большинстве известных за последние годы случаев массовой гибели птиц, вероятно были выпущены только сравнительно незначительные количества нефти, источники которой только редко были выяснены. Даже такие загрязнения смогли заметно уменьшить местные популяции птиц, и такие «небольшие» загрязнения в особенности угрожают тем видам, которые например в зимнее полугодие концентрируют значительную часть всей их европейской популяции на немногих ограниченных участках датских вод.

Кроме того следует отметить, что загрязнения более крупных размеров, например

в связи с аварией танкера в мелководных датских районах моря, могут иметь необозримые и катастрофические последствия для популяций, местности происхождения которых очень отдалены от Дании.

Быстро развивающаяся за последние годы добыча нефти в Северном Море также дает повод к возрастающему беспокойству. Актуальность этой проблемы была сильно подчеркнута загрязнением, происшедшим в норвежском нефтяном промысле Экофиск в апреле 1977 г., при котором вытекло 21.000 тонн нефти и 10.500 тонн газа. Благодаря ряду счастливых обстоятельств кажется, что причиненный среде вред был меньше, чем это можно было ожидать при таком значительном загрязнении. Что касается орнитологических последствий, нужно однако отметить, что наши знания о значении этих морских участков в настоящее время весьма недостаточны.

8) В виду вышеизложенного следует серьезно рекомендовать, чтобы датские власти еще шире организовали надзор за датскими водами и готовность к борьбе с загрязнениями моря нефтью, чтобы касающиеся птиц стороны вопроса о загрязнениях нефтью и в дальнейшем изучались, и чтобы со стороны всех стран вокруг Северного Моря были предприняты исследования последствий для птиц, возникающих из добычи нефти.

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Appendix 1. List of oil pollution incidents during five years (July 1971 – June 1976) reported to involve more than 100 birds. Roman numerals for district refer to the map Fig. 6 p. 31.

Period	Month	Area, district	No. birds	Remarks
July 71 – June 72	10	Køge Bugt, XIII	> 150	oiled birds killed by hunters near Køge, mainly <i>A. fuligula</i> , <i>M. serrator</i> , <i>S. mollissima</i> and <i>F. atra</i> .
	11–12	S Kattegat, VIII	1000–1200	oiled birds observed from shores and during aerial survey (Dec. 3rd), most along E and N coast of Samsø, smaller flocks also at Djursland, Sjællands Odde and Sejerø. Nearly 250 where shot, most on Samsø (150) and Sejerø (50). 66 birds examined by GBS (Table 5).
	12	Waddensea, I	100–200	oiled birds shot at Rømhø and Fanø, mainly <i>M. nigra</i> and <i>S. mollissima</i> .
	12–1	Amager-Greve, XIII	> 150	oiled birds shot by hunters, mainly <i>A. fuligula</i> , <i>F. atra</i> , <i>M. serrator</i> and <i>B. clangula</i> .
	1	Kalø Vig, VIII	ca. 150	oiled birds shot at Skødshoved and in Begtrup Vig, mainly <i>S. mollissima</i> .
	1	E Falster, XII	> 200	oiled <i>Cl. hyemalis</i> observed between Gedser and Bøtø. Oilpatch seen in Grøn-sund. > 20 birds shot.
	1–2	W Bornholm, XIV	> 300	oiled birds observed near Rønne. 146 shot, almost exclusively <i>Cl. hyemalis</i> .
	1–2	S Kattegat, VI, VIII	> 500	oiled birds observed from Mejlgård (N Djursland) to Vejro (Samsø). > 90 birds shot. 100 birds, mainly from Hjelm, examined by GBS (Table 5).
	3	Northern and Central Kattegat, V, VI, VIII	> 30,000	See special report p. 5.
July 72 – June 73	10	Waddensea, I	200–300	oiled birds observed and 30 shot (21 <i>M. nigra</i> , 9 <i>Gavia sp.</i> ) at Rømhø.
	11–12	Køge Bugt, XIII	> 150	oiled birds shot.
	12	Waddensea, I	> 30,000	See special report p. 8.
	12–2	Kattegat, V, VI, VIII	> 2,500	During Dec.-Feb. several flocks of oiled birds occurred in different parts of the northern and central Kattegat, probably as a result of several oil pollution incidents. Hirsholmene (> 75 oiled birds seen and > 40 killed in Dec.-Jan.), Læsø (> 300 killed in Dec.-Jan.), Hals – Bønnerup (> 1000 oiled birds seen, > 400 shot Dec.-Feb.), Hjelm and Samsø (small flocks observed in Jan.). – Adverse weather conditions made accurate surveys impossible. Aerial surveys on Jan. 19th and 25th. – > 800 birds were shot by hunters, of which 268 from Himmerland and Djursland were examined by GBS (Table 5). Birds killed at Læsø were mainly <i>M. nigra</i> and <i>M. fusca</i> . The estimate of > 2.500 affected birds is cautious and minimal, and actual losses may have been considerably higher.

Period	Month	Area, district	No. birds	Remarks
July 73 – June 74	11 3	S Funen, XI Baltic Sea and Store- bælt, X, XI, XII	> 200 1500–2000	oiled <i>S. mollissima</i> observed at Ærø. oiled birds observed from coasts, 500–1000 at Langeland (mainly <i>S. mollissima</i> ), 500 at W Lolland (mainly <i>Cl. hyemalis</i> ), 200 at Hyllekrog, 100 at Gedser, and smaller numbers at Vresen, Musholm and Romsø in the Storebælt. > 400 recorded during aerial survey on March 8th. 603 birds killed by hunters at Lolland and Langeland were examined by GBS (Table 5), and additional > 150 were killed in Storebælt.
July 74 – June 75	12–1  1  1–2  2  2 4	W Jutland, II  NW Jutland, III  S Kattegat, VII, VIII  Øresund, XIII  S Funen, XI Baltic Sea, XII	> 250  ?  > 1000  > 500  > 125 500–1000	Oiled birds were observed along the west coast between Hvide Sande and Bøvlingbjerg (mainly <i>M. nigra</i> and <i>Cl. hyemalis</i> ), and > 100 were shot, of which 38 were examined by GBS (Table 5). In Ringkøbing Fjord, Stadel Fjord and Nissum Fjord > 75 oiled <i>M. nigra</i> were shot. Actual losses may be considerably higher than the estimated > 250. Heavy oil with heavily soaked birds came ashore between Skagen and Hanstholm, most between Hirtshals and Tornby. On 55 km beach surveyed 175 birds were found: 90 <i>Uria</i> sp. (80 determined to <i>U. aalge</i> , but some <i>U. lomvia</i> were possibly present also), 36 <i>Plotus alle</i> , 19 <i>Alca torda</i> , 10 <i>Fratercula arctica</i> , 3 <i>Cepphus grylle</i> , 2 <i>M. nigra</i> , 1 <i>Morus bassanus</i> , 1 <i>Fulmarus glacialis</i> , and 13 <i>Larus</i> sp. oiled birds observed at Sjællands Odde (500), Rørvig (200), Samsø (200), and elsewhere in smaller numbers. Ca. 260 birds shot, mostly at Sjællands Odde, 112 were examined by GBS (Table 5). oiled birds observed from Helsingør to Amager. > 100 birds shot, 69 examined by GBS (Table 5). Several contaminated <i>C. olor</i> were rehabilitated. oiled birds shot at Flæskholm and Marstal (mainly <i>S. mollissima</i> ). At Albuen (W Lolland) > 500 possibly 1000 oiled birds were observed (mainly <i>Cl. hyemalis</i> and <i>M. nigra</i> ), at Rødsand (S Lolland) smaller flocks seen, and at S Langeland > 75 oiled <i>S. mollissima</i> were observed. Ca. 400 shot at Lolland, 377 of which were examined by GBS (Table 5).



Period	Month	Area, district	No. birds	Remarks
July 75 - June 76	11	Øresund, XIII	100-200	oiled birds observed in Nivå Bugt, including <i>S. mollissima</i> , <i>C. olor</i> etc. 12 <i>S. mollissima</i> shot.
	12	Central Kattegat, VI	ca. 100	oiled birds observed between Als and Sødring. Ca. 50 shot, of which 27 were examined by GBS (25 <i>M. nigra</i> , 2 <i>M. fusca</i> ).
	12-1	S Kattegat, VIII	> 500	In Dec. several hundred oiled birds were observed at Sejerø, a few also at Samsø. Ca. 100 were shot at Sejerø. In Jan. ca. 150 oiled birds were observed at Rønæs and ca. 50 at Sjællands Odde, where 14 <i>S. mollissima</i> , 1 <i>M. nigra</i> and 1 <i>L. argentatus</i> were shot.
	1-2	Bornholm, Møn, Falster, XII, XIII, XIV	> 500	Several flocks of oiled <i>Cl. hyperborea</i> were observed around Bornholm and some flocks also along the coasts of Møn and Falster. Probably part of a major pollution incident in Swedish waters. At least 250 birds were shot, almost exclusively <i>Cl. hyperborea</i> .

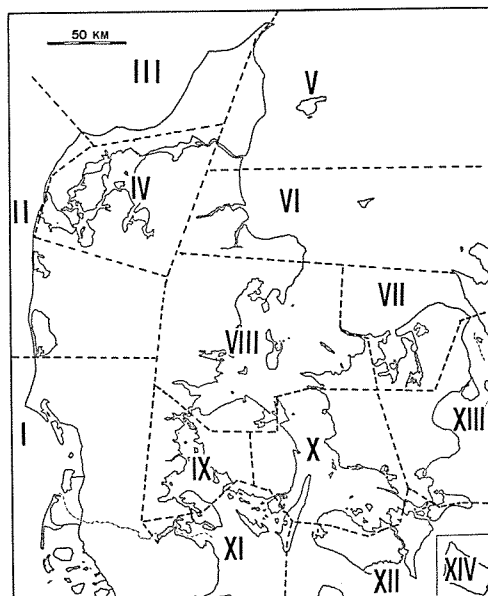


Fig. 6. Denmark and surrounding waters divided into districts referred to in Appendix 1.

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