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Studies on Oil Pollution and Seabirds in Denmark
1968-1971

by
ANDERS HOLM JOENSEN

Med et dansk resumé: Studier af olieforurening og
søfugle i Danmark 1968-1971.

Резюме на русском языке
Исследования загрязнения нефтью и морских птиц в Дании с 1968 по 1971 г.

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Author's address: mag. scient. A. Holm Joensen
Game Biology Station, Kalø
8410 Rønne, Denmark

Introduction

In 1968, the Game Biology Station began a series of investigations on diving ducks in Danish waters. A major aim was to investigate the size, distribution, and composition of the populations, and of the bags obtained by hunters. Part of the programme was a study of oil pollution at sea and its effect on seabirds; oil pollution during the period 1935-1968 has been described in a previous paper (JOENSEN 1972). It was there shown that the number of birds killed by oil has steadily increased during the last decades, and that certain species are killed in large numbers almost every year.

The purpose of the studies on oil pollution started in 1968 was twofold: firstly, to examine the extent of oil pollution and obtain as good an estimate as possible of the number of birds killed, and secondly, by examination of the dead birds, to obtain information on the age- and sex-composition of the seaduck populations.

In this paper, the results of studies made during July 1968-June 1971 are given. In addition to general recording of cases of oil pollution, detailed studies have been made of five large disasters. Further important information has been obtained through a questionnaire survey of hunters.

Although the studies made during 1968-1971 give a much better idea of the extent of the problem than the records

from previous years, the present material is still insufficient to allow several major questions to be answered. However, the material is published at this stage for two reasons: a) new information has been gained with regard to the frequency and extent of oil pollution, and b) established knowledge on environmental pollution is greatly needed in these years.

Some information from the studies of 1968-1971 has been given in preliminary reports in »Dansk Vildtforskning« (JOENSEN 1970, 1971).

Several institutes and persons have assisted in gathering information for this paper, and the author would especially like to thank the game advisers for collecting information connected with many cases of pollution. Thanks are also due to the Game Council and to many policemen and hunters for information on birds destroyed. Special thanks are due to Pol. ass. K. JACOBSEN (Læsø), P. BOYE JØRGENSEN (Rørvig), and K. ALEXANDERSEN (Samsø). In the five disasters, observations were made from the shores and from aircraft by staff of the Game Biology Station, and the author especially thanks assistant E. BØGEBJERG HANSEN. Finally, many thanks are due to the Royal Danish Air Force and the Danish Army Air Corps for supplying aircraft and pilots for the aerial surveys. The manuscript was translated into English by ROBERT RUSSEL, M. sc.

Material and results

GENERAL COLLECTION OF INFORMATION

Records of oil pollution cases were kept by »Dansk Havjagtförening« until 1967 (JOENSEN 1972), and the Game Biology Station has collected similar information since then. Cases of pollution have been

brought to light by reports in newspapers and information from hunters, and in each case as much information as possible has been sought from game advisers, police, hunters, coastguards, and ornitholo-

gists. From this information the extent of the pollution and the number of oiled birds have been estimated. In many cases information was subsequently obtained from the Game Council on the number of birds destroyed, as hunters are reimbursed for the cost of cartridges by money from the Game Foundation (see JOENSEN 1972 p. 5). The Ministry of Trade has announced (pers. comm. 1971) that no systematic records have been kept of the cases of oil pollution which are occasionally reported. From that source there is

thus no information on the frequency of oil pollution at sea in later years.

Since 1966 the Game Biology Station has used small aircraft for waterfowl counts over the sea (JOENSEN 1968). In the period July 1968 – June 1971 a total of 600 hours of aerial survey was conducted. During such flights oil patches have often been observed on the sea, but the data obtained is incomplete, and a reasonable estimate of the frequency and extent of such pollution cannot be made.

STUDIES OF FIVE DISASTERS IN THE KATTEGAT

During 1969–1971, detailed studies were made of the effects of five extensive cases of oil pollution in the Kattegat, including the four most serious in Danish waters during this period. As soon as the observation of oiled birds was reported to the Game Biology Station, investigations were begun in the area of pollution. Surveys were made from the shores and from small aircraft, and hunters, police, etc., were contacted in the surrounding areas to enable accurate mapping of the extent of pollution. Dead and destroyed birds were collected by hunters in various parts of the pollution area and most were later examined by the staff of the Game Biology Station (see Table 1 & 5). In most cases the entire birds were present for examination, but in some cases only the

wings were collected and mailed to the Station. The species-, sex- and age determination was based on plumage and other external characters; the same criteria have been used also for the classification of several thousand bagged birds (at game dealer firms) since 1968. For most species three or four categories are easily separated (ad ♂, ad ♀ and juv. (in some species also juv ♂ and juv ♀)), and in *Somateria mollissima* ad ♂ are furthermore divided into three categories (subadult 1-2 years old, subadult 2-3 years old, and 3+ years old birds with fully developed plumage).

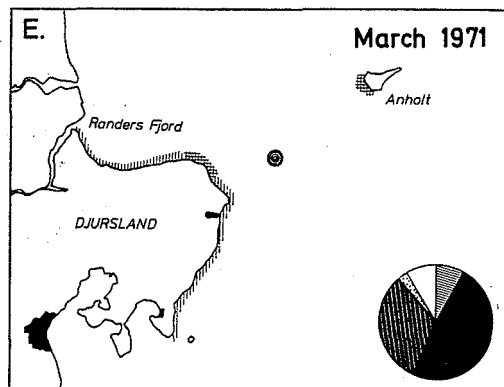
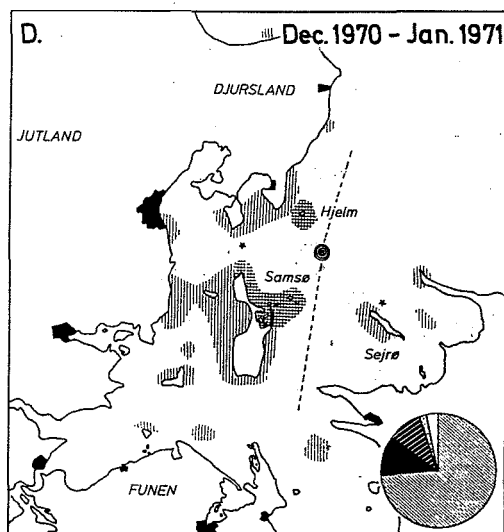
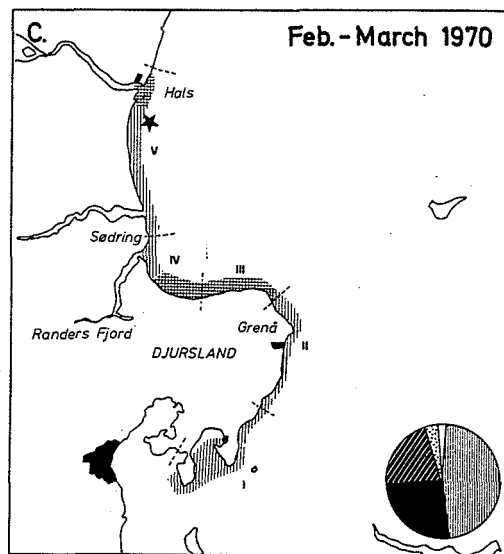
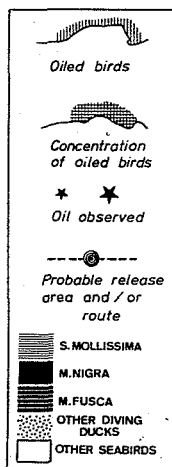
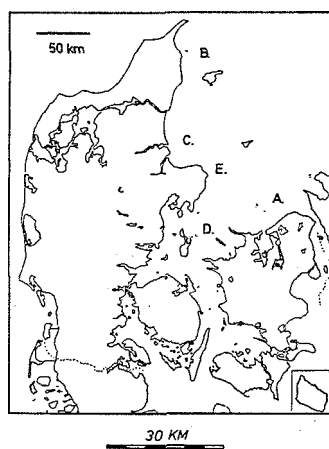
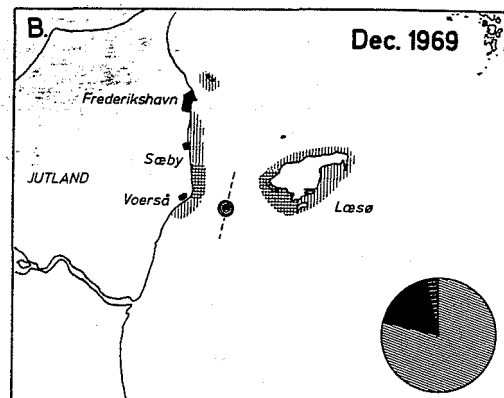
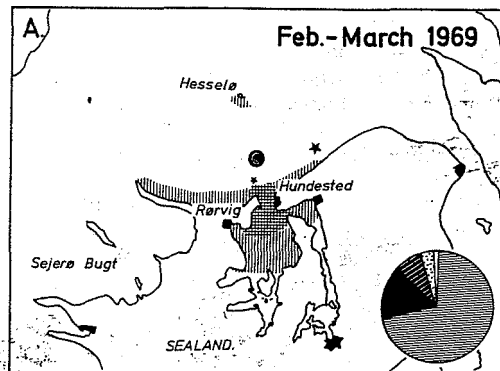
In the following five special reports, all the data found necessary for an estimate of the extent of each disasters is presented.

Fig. 1. Information concerning the five oil disasters in Kattegat in 1969–1971 described in special reports p. 6–12. The distribution of oiled birds, observations of oil at sea, and probable release area. The percentage occurrence among birds killed of *S. mollissima*, *M. nigra* and *M. fusca*.

Fig. 1. Oplysninger vedrørende de fem store oliekatastrofer i Kattegat 1969–71 beskrevet i specialrapporter side 6–12. Udbredelsen af olietilsøede fugle, iagttagelser af olie på havet og sandsynlige forureningsområde. Ederfuglens, sortandens og fløjlsandens procentvise andel af de omkomne fugle.

Фиг. 1. Сведения о пяти крупных нефтяных катастрофах в Каттегате в 1969–71 г., описанных в специальных отчетах на стр. 6–12. Распространение птиц, запачканных нефтью, наблюдения нефти на море и вероятный район загрязнения. Проценты числа погибших птиц, составляемые *S. mollissima*, *M. nigra* и *M. fusca*.

Oil Pollution and Seabirds 1968-1971



1969 Feb.-March North Sealand

Area: Coasts of N Sealand between Griben, Hesselø, Asserbo, and Orø. Heaviest pollution in N part of Issefjorden (Rørvig-Nakkehage-Kulhuse-Hundested) where about 75 % of the birds were destroyed by shooting (see Fig. 1 A).

Period: First oiled birds seen and shot late Feb., whereafter no oiled birds were seen for about ten days. From 5th March flocks appeared in all parts of the area, and shooting mainly took place in the following ten days. Oiled birds were seen until the end of March.

The pollution: Source unknown. No oil was analysed, but was seen to contain heavy components (found on shores at Rørvig and on many birds practically soaked in oil). Judging from the species composition among oiled birds, the oil was released in the open sea, probably between N Sealand and Hesselø. On 12th March a large patch of oil was observed on the sea north of Asserbo plantation. Elsewhere only very few small patches of oil were seen on the water, but a lot was found on the shore.

Birds shot: 4200 shot were reported to the Game Council. In addition probably close to a thousand were killed by hunters. Total: at least 5000.

Observations from shore: On 12th March some coasts W of Issefjorden were surveyed by the Game Biology Station (GBS) staff. At Griben and Ebbeløkke about 150 oiled seaducks were seen. Along the coast from Skærebj Strand to Nakkehage (18 km intensively surveyed) 2100 oiled diving ducks (about 80 % *S. mollissima*) were sitting on the shore. In the sea between Rørvig and Hundested three large flocks (total 22,000 *S. mollissima*) were observed; judging from their behaviour (intensive preening) many of these were oiled.

Aerial survey: On 13th March a two hour survey was conducted in very favourable weather covering coasts from Rønæs to Gilleleje (incl. Hesselø and Issefjorden). No oiled birds were seen in Sejerø Bugt and areas S and W of it. In the whole area affected by oil (see Fig. 1A) about 30,000 birds were observed: *S. mollissima* 25,200, *Larus* sp. 2,400, *M. nigra* 1,100, *B. clangula* 440, *C. olor* 290, *A. platyrhynchos* 210, *Ph. carbo* 120 (all on Hesselø), *T. tadorna* 80, *M. merganser* 50, *M. serrator* 25, *M. fusca* 9 and *Cl. hyemalis* 1. Largest concentrations of *S. mollissima* and *M. nigra* were found in the central part of the pollution area (see Fig. 1 A). Close to 2,000 *S. mollissima* and at least 100 *M. nigra* were sitting



Fig. 2. Oiled birds killed along the shore of N Sealand March 1969 (Phot: AHJ).

Fig. 2. Oliefugle dræbt ved Nordsjællands kyster i marts 1969.

Фиг. 2. Запачканные нефтью птицы, убитые у берегов Северной Зеландии в марте 1969 г.

on the shore, and in the flocks of *S. mollissima* on the sea between Rørvig and Hundested (total about 20,000) several thousand birds appeared to be affected by oil.

Birds examined: 2,380 collected birds were determined to species (see Table 1), and 2,159 of these to sex and age (see Table 5). They were practically all collected in the central part of the pollution area. The three most numerous species were *S. mollissima* (70.1 %), *M. nigra* (16.3 %) and *M. fusca* (8.3 %) accounting together for 95 %. *B. clangula* is very abundant in the central and northern part of Issefjorden during winter. The presence of only few individuals of this species indicates that the birds killed were mainly contaminated with oil N of Sealand and later sought shelter in the fjord.

Total number of birds lost: By 13th March at least 4,000 birds had been shot. On that day an additional 2,100 oiled birds, still alive but with no chance of survival, were counted on the shore. Furthermore, several thousand birds on the water were affected by oil. 10,000 must be regarded as the minimum number of birds lost and 15,000 or even more is quite possible.

Remarks: The northern part of Issefjorden together with the shallow bar Grønnerevle N of Rørvig forms one of the very important haunts for wintering *S. mollissima* in eastern Denmark. In the fjord *B. clangula*, *M. merganser* and *Cl. hyemalis* also occur in large flocks, but at the time of the pollution most had left the area.

1969 Dec. Læsø-Vendsyssel

Area: Coast of Læsø (particularly SW part) and the E-coast of Vendsyssel between Frederikshavn and Voerså (see Fig. 1 B).

Period: First oiled birds seen at Sæby, Voerså and Læsø 1st-5th Dec. Rapid increase in numbers until about 20th Dec. Very few oiled birds seen late Dec. and early Jan. 1970.

The pollution: Source not stated with certainty. No oil was examined, but it was seen to contain heavy components (many birds heavily soaked in oil). Judging from the distribution of oiled birds, wind and currents, the pollution must have taken place in Læsø Rende or waters just S or W of Læsø.

Birds shot: On Læsø about 2,000 (mostly along SW coast). Sæby-Voerså, about 400. Frederikshavn about 20.

Observations: Owing to bad weather during most of Dec., GBS personnel did not make observations in the area, neither was aerial survey undertaken. From local observers the following information has been received: Along the E coast of Vendsyssel 500-800 oiled birds were seen, and in addition to those killed by hunters about 250 were found dead on the shores. In addition to those shot on Læsø about 2,500 were found dead on the shores of the island. Observations from land are very difficult because of the large distance of birds from the shore, and

furthermore in Dec. 1969 visibility was in general very poor. Several hundred birds, apparently oiled were observed around Læsø, but undoubtedly many more have been contaminated.

Birds examined: For species determination GBS received 1362 wings (one wing from each bird) (see Table 1). *S. mollissima* (79.4 %), *M. nigra* (17.7 %) and *M. fusca* (2.4 %) together accounted for 99.5 % of the birds. The proportion of *S. mollissima* was higher on Læsø than at Sæby-Voerså, whereas for *M. nigra* the opposite was the case. All wings of *S. mollissima* could be aged, subadult and adult birds also sexed. However, presence of oil on the feathers prevented a detailed determination of *M. nigra* (only divided into two categories: ad ♂ and other) and *M. fusca* (certain determination not possible). See Table 5.

Total number of birds lost: The lack of observations from land or air makes it very difficult to estimate the total number of birds killed. The number of birds shot and found dead exceeds 5,000, but it is quite likely that twice as many or even more have been lost.

Remarks: The area affected by oil is a very important wintering area for diving ducks, particularly *S. mollissima* and *M. nigra*, which in the shallow waters S of Læsø occur in tens of thousands.

1970 Feb.-March E-coast of Jutland

Area: E coast of Jutland from Helgenæs and Ebeltøft in S to Hou and Hals in N. Coastline about 150 km. Most birds were lost along the N coast of Djursland and at Hals (see Fig. 1 C).

Period: First oiled birds were seen about 25th Feb., and in the next five days large flocks were seen and many birds were shot in the whole area. In the period 1st-10th March only few birds were seen and very few shot.

The pollution: Source unknown. No oil was examined, but was seen to contain heavy components. A patch of oil was seen on the sea S of Korsholmene during aerial survey on 27th Feb. (see below).

Birds shot: According to reports sent to the Game Council and information from hunters' associations about 3,000 birds were shot. The approximate figures for each part of the pollution area are (see Fig. 1 C): I 200, II 200, III 1100, IV 500 and V 1000. Probably more than 75 % of the birds were shot within three days (26th-28th Feb.). Because of the presence of ice along the shores, shooting was extremely difficult and dangerous, and many areas with large flocks of oiled birds were not visited. Particularly in the N part of the area, hunters maintain that only a small proportion of the oiled birds could be reached and were actually shot.

Observations from shore: Because of ice cover along the coast it was very difficult to make observations and counts of oiled birds. 26th-28th Feb. GBS personnel visited shores at regular intervals in the S part of the pollution area. From Randers Fjord to Ebeltøft Vig about 28 km (i. e. $\frac{1}{3}$ of the coastline in this part of the pollution area) were surveyed. Along 18 km coast between Randers Fjord and Grenå well over 3,000 oiled birds were seen. Many were sitting on the ice, and also most of the birds on the water appeared very weak. *S. mollissima* accounted for about 2,000, *M. nigra* and *M. fusca* for about 1,000. Other species were seen only in very small numbers. The observations indicate that the bird »density« was very uniform along this coastline, and if correction is made for coasts not surveyed, there must have been close to 7,000 oiled birds between Randers Fjord and Grenå.

The coasts S of Grenå had much fewer oiled birds, only about 300 were observed on 10 km

coastline. At Ebeltøft Færgehavn a flock of about 600 oiled birds were seen, but other flocks (about 600 birds) in Ebeltøft Vig were apparently not affected by oil.

Aerial survey: On 27th Feb. a two hour aerial survey along the coast from Ebeltøft to Hou (N of Hals) was conducted. In spite of rather strong wind (14 kts) conditions were favourable. Altogether about 31,000 waterfowl (incl. 29,800 *Anatidae*) were counted along the edge of the solid ice 100-500 metres from the shoreline. Of these 2,800 were sitting on the ice and were definitely affected by oil. The species registered in the survey were (oiled birds on the ice in brackets): *S. mollissima* 22,000 (920), *M. nigra* 3,900 (750), *M. fusca* 140 (100), *Melanitta* sp. (1030), *M. merganser* 250 (0), *B. clangula* 330 (0), *A. marila* 100 (0), *M. serrator* 22 (0), *Cygnus olor* 33 (0), *C. cygnus* 142 (11), *Cygnus* sp. (mostly *olor*) 318 (7), *A. platyrhynchos* 1,375 (5), *T. tadorna* 20 (0), *Branta bernicla* 100 (0), *Ph. carbo* 77 (0) and *A. torda* 1 (1). Very many birds on the ice were »dripping« with oily water, seen as dark spots beneath the birds. In addition to the birds dying on the ice, many corpses were seen, and undoubtedly hundreds have been concealed by ice and snow. Many birds (probably a few thousand) sitting in flocks on the water appeared very weak (did not react as normally on the approach of the low flying aircraft) and had probably also been affected by oil.

Seaducks were seen along the whole coastline surveyed, and oiled birds were present in the whole area. The largest concentrations of *S. mollissima* and *Melanitta* sp., however, were found in the following areas (oiled birds on ice in brackets):

	<i>S. mollissima</i>	<i>M. nigra et fusca</i>
Ahl Hage-Gåsehage	5,000 (80)	260 (20)
Bønnerup-Fjellerup	2,900 (300)	1,500 (350)
E of Sødring	3,300 (200)	2,200 (1100)
Korsholmene	8,700 (200)	100 (100)

Largest numbers of oiled birds on the ice were seen in the three last mentioned areas, while much fewer were found S of Grenå.

About 3 km of Korsholmene a patch of oil 200 m wide and 800 m long was seen on the water.

Birds examined: 1996 birds were determined to species (see Table 1), including most of the birds shot along the coasts of Djursland, but only a



Fig. 3. Nearly 2000 birds killed along the shore of Djursland in Feb.-March 1970 were collected at the Game Biology Station. (Phot. E. BØGEBJERG HANSEN).

Fig. 3. Næsten 2000 fugle dræbt langs Djurslands kyster i feb.-marts 1970 blev indsamlet på Vildtbiologisk Station.

Фиг. 3. Почти 2000 птиц, убитых вдоль берегов полуострова Дьюрсланд в феврале-марте 1970 г., были собраны на Станции Исследования Биологии Дичи.

small sample (wings) from the northern part of the pollution area (area V). Apart from 87 wings of *M. nigra* and *M. fusca* from this area all birds were determined to sex and age also (Table 5). *S. mollissima*, *M. nigra* and *M. fusca* together comprised 94.4 %. All other species were present only in very small numbers. The *Melanitta* species were most abundant in the northern part of the pollution area.

Total number of birds lost is very difficult to estimate. At least 3,000 were shot, and when the data from coastal and aerial surveys are combined, an extra total of at least 9,000 birds were oiled. The total of 12,000 thus obtained, however, only includes birds very close to the coast or ice edge. At the time of the pollution the temperature of both the air and the water was extremely low, and the process of dying after contact with oil was unusually rapid. Seaducks

(particularly *Melanitta* species) often occur several kilometres from the coasts of Djursland, and it is very likely that many birds have perished in the open sea and have not been recorded in the surveys. During the pollution period wind direction was W, and many birds which succumbed drifted away from the shore.

Remarks: Along the 150 km long coastline struck by oil in Feb. 1970 there are several very important haunts for wintering seaducks. Areas N of Djursland have some of the largest concentrations of *M. fusca* wintering in Denmark, and the area from Grenå in S to Hou in N generally have the largest number of *M. nigra* in Denmark. *S. mollissima* occur in large concentrations several places in the area, although these waters are less important for this species than for the *Melanitta* species.

Dec. 1970 - Jan. 1971 South Kattegat

Area: Many coasts and waters in southern Kattegat (see Fig. 1 D). Centre of pollution with most oiled birds on N Samsø including the small

islands to the east, the island Tunø and the S coast of Djursland including the small island Hjelme. Oiled birds also recorded along the E

and N coast of Djursland, in Sejersø Bugt, Storebælt, waters N of Funen, around Endelave and along coasts S of Århus.

Period: The first oiled birds were seen at Issehöved, N Samsø, about 26th Dec. 1970. A few days later large flocks of oiled birds came ashore on the small islands E of Samsø, and at the same time hundreds were seen on the S coast of Djursland, on Hjelm and Tunø. On Samsø most birds were shot in the period 28th Dec. – 5th Jan. After 5th Jan. numbers decreased in most areas, but a few thousand oiled birds were still present on Samsø and Hjelm on 9th Jan. On 12th Jan. only a few hundred were seen on Hjelm, and in late Jan. and early Feb. very few oiled birds were seen around Samsø.

The pollution: Source unknown. Oil in small patches was seen on the water between Samsø and Djursland, and has also been reported from other areas. Along the coast near Ebeltoft oil washed ashore. No detailed analysis of samples was undertaken. Judging from the distribution of oiled birds, wind and currents, it is assumed that most oil was released between Samsø and Hjelm, but the wide distribution of oiled birds also indicates that oil was discharged over quite a long period during voyage between central Kattegat (E of Djursland) and Storebælt.

Birds shot: Samsø: Mr. KAI ALEXANDERSEN reports that in the period 27th Dec. – 17th Jan. 4,400 birds were killed by hunters along the N and E coasts of Samsø and the small islands to the east. Along the S and SW coast of Samsø at least 250 were shot. – Hjelm: About 200 were shot and in addition about 130 were found dead. – Coasts at Ebeltoft and Helgenæs: About 300 were shot. – Sejersø and Sejersø Bugt: About 200 were shot. – Endelave and Svanegrunden: At least 200 were shot. – Tunø: 562 were shot. – In waters between Samsø and E coast of Jutland at least 300 birds were shot from boats. – About 6,500 oiled birds have been shot or otherwise killed by hunters in the whole area.

Observations from land and boats: Reports were received from several parts of the pollution area: Samsø: Thousands seen at Issehöved 26th–27th Dec. and E of Samsø in the following days. – 1st–2nd Jan. GBS personnel surveyed the coasts of N Samsø and most of the island E of Samsø. Nearly 15,000 seaducks were seen, and at least 10,000 appeared to be oiled (mostly sitting on shore): *S. mollissima* > 7,500, *M. nigra* > 1,000,

M. fusca > 850. – Hjelm was visited by GBS personnel on 12th Jan. (500 oiled *S. mollissima*), and on 4th Feb. (75 *S. mollissima*, of which only about 10 seemed affected by oil). – Coasts near Ebeltoft were visited several times in early Jan., and up to 500 oiled birds were seen. – Sejersø: A few hundred oiled birds in early Jan. – Tunø: In early Jan. several hundred *S. mollissima* sitting on shores, and thousands seen on the sea. – Endelave: 8th Jan. 35 found dead and about 100 oiled birds (mostly *S. mollissima*) seen along E coast. – Oiled birds were also reported from Sjællands Odde, N Storebælt, Æbelø, coast S of Århus, Hov Røn, Katholm, Gjerrild and Mejlgård.

Aerial surveys: Various parts of the pollution area were surveyed from air on several occasions during Jan. and Feb. 1971, total 12.5 survey hours, partly in connection with the international mid-winter census.

9th Jan.

On a 2½ hour flight the S coast of Djursland was surveyed, and also the islands of Hjelm, Samsø and Tunø. The following observations were made (number of oiled birds on the shores in brackets): Between Helgenæs and Gåsehage about 8,000 ducks, incl. 6,100 *S. mollissima*, 300 *M. nigra*, 200 *M. fusca*, 300 *B. clangula*, 750 *A. marila* and 100 *M. serrator*, but no birds seemed affected by oil. – Hjelm: *S. mollissima* 4,500 (1,500). – Islands E of Samsø and Besser Rev: *S. mollissima* 2,680 (1,480), *Ph. carbo* 380 (0), *B. clangula* 65 (0), *M. nigra* 150 (0). – S part of Samsø: 400 (250). Tunø: 7,600 (65).

12th Jan.

Hjelm was surveyed: *S. mollissima* 1,900 (480), *B. clangula* 50 (0), *Ph. carbo* 30 (0).

All other parts of S Kattegat were surveyed from air on 20th Jan., but very few birds affected by oil were seen. On aerial surveys 2nd–3rd Feb. in S Kattegat no oiled birds were observed.

Birds examined: For species determination GBS collected 1,291 birds (Samsø, Hjelm, Ebeltoft and Helgenæs). Wings from 382 birds were received from Samsø, and information was obtained from Mr. K. LARSEN (Vejrø, 616 shot birds) and Mr. F. NIELSEN (Endelave 35 birds found dead). The total number of birds used to elucidate the species composition in the disaster is thus 2,324 (see Table 1). ALEXANDERSEN and LAMBERG (1971) examined 1,551 birds on Samsø, most of which had probably already been examined by GBS. Their findings are very similar to those shown

in Table 1. Among all birds examined three fourths were *S. mollissima*, and this species together with *M. nigra* and *M. fusca* accounts for 95 % of all the birds in the sample. 1,494 diving ducks were sexed and aged (Table 5).

Total number of birds lost: Aerial surveys and other observations indicate that at least 12,000 birds were oiled, and this figure does not include at least 3,000 birds already shot. 15,000 birds lost must, however, be regarded as a minimum figure. In areas surveyed many birds not registered as definitely oiled may well have been contaminated, and furthermore it is quite likely that a number of small or large flocks of oiled birds have been overlooked in the very large pollution area.

Remarks: In the pollution period 42 ringed *S. mollissima* were recovered in waters around Samsø (report received by Zoological Museum, Copenhagen, and Game Biology Station before

1st Jan. 1972). 35 of these were definitely oiled, and 7 birds probably were oiled too, although this was not stated by the finder. They were all adult females. 21 had been ringed in 1970 on the breeding areas on Samsø, but there were also recoveries from other Danish breeding grounds (Saltholm 4, Bornholm 1) as well as from Finland (14), Holland (1) and Sweden (1). Samsø (Stavns Fjord) has the largest breeding colony of *S. mollissima* in Denmark (about 2,000 nests, cf. JOENSEN in prep.). In 1970 the main breeding areas were surveyed thoroughly, and 504 adult females were ringed. 4.2 % were recovered oiled in the following winter, and considering that total reporting rate over many years for ringed adult females is about 10 % (according to information from N. O. PREUSS, Zoological Museum, Copenhagen), one might assume that the local population had suffered greatly. A thorough count in 1971 however showed no significant decrease in breeding population on Samsø.

1971 March Djursland-Anholt

Area: Coast of Djursland from Gåsehage to Randers Fjord (90 km coastline) particularly from Fornæs to Bønnerup (20 km), and W coast of Anholt (see Fig. 1 D).

Period: First oiled birds seen at Gjerrild 4th March. Most birds seen and shot during the following week. No oiled birds reported later than 20th March.

The pollution: Source unknown. No oil was observed on the sea or shores. Oil on birds was not examined, but did not seem to contain very heavy components. Discharge of oil probably took place between Grenå and Anholt.

Birds shot: About 250 birds were reported shot, two thirds at Gjerrild-Stavnshoved.

Observations from land: 5th-7th March at least 600 oiled seaducks were seen at Gjerrild and Stavnshoved. From all other parts of the Djursland coast at most 200 have been reported. Along the W coast of Anholt about 200 oiled seaducks were seen on 12th March.

Aerial survey: On 10th March a 1½ hour survey along the coast from Ebeltøft to Hals was conducted. Strong wind (W 15-22 kts) made observations difficult, and many birds may have been overlooked. A total of 6,550 *Anatidae* were counted. Oiled birds, sitting on the shores, were

seen from Gåsehage to Randers Fjord, and the following numbers were registered along this 90 km coastline (figures in brackets are oiled birds): *S. mollissima* 223 (64), *M. nigra* 257 (255), *M. fusca* 117 (117), *B. clangula* 42 (2), *M. merganser* 6 (4), *M. serrator* 1 (1), *Cl. hyemalis* 4 (4), *Gavia sp.* 10 (10), *A. platyrhynchos* 713 (0), *T. tadorna* 108 (0), *A. marila* 12 (0), and *C. olor* 3 (0). Total for the pollution area was 1,496 birds, of which 457 were oiled. 75 % of the oiled birds were seen along 20 km coastline between Fornæs and Bønnerup.

Birds examined: 242 birds (237 from Djursland and 5 from Anholt) were determined to species, sex and age. *M. nigra* accounted for about 50 %, *M. fusca* for nearly 40 %, while few *S. mollissima* (8 %) were killed (see Table 1 and 5).

Total number of birds lost: Observations indicate that at least 1,000 and probably as many as 1,500 birds were oiled.

Remarks: The centre of the pollution area is an important wintering area for *M. nigra* and *M. fusca*, while *S. mollissima* is normally much less abundant. After a mild or normal winter (1970-71) the number of seaducks in March is however comparatively low in the area, which explains that although widely distributed, the oil did not kill very large numbers of birds.

Year År Period Måned Area Område	1969 Feb.-March N Sealand	1969 Dec. Læsø-Vendsyssel	1970 Feb.-March E coast of Jutland					1970-71 Dec. 1970 - Jan. 1971 S Kattegat				1971 March Djursland- Anholt	Total	
Min. no. lost <i>Min. antal dræbt</i> No. shot <i>Antal aflivet</i> No. examined <i>Antal undersøgt</i>	> 10.000 > 5.000 2.380	> 5.000 2.400 1.362	> 12.000 3.000 1.996					> 15.000 > 6.500 2.324	1.500 242 242				> 43.500 > 17.142 8.304	
	No. % Læsø	No. % Vend- syssel	Total	I	II	III	IV	V	Total	Samsø	Ende- lave	Total	No. % No. % No. %	No. % No. % No. %
<i>Gavia stellata</i> <i>Gavia arctica</i> <i>Gavia sp.</i> <i>Podiceps griseigena</i> <i>Podiceps cristatus</i> <i>Phalacrocorax carbo</i> <i>Anas platyrhynchos</i> <i>Anas clypeata</i> <i>Aythya marila</i> <i>Clangula hyemalis</i> <i>Melanitta nigra</i> <i>Melanitta fusca</i> <i>Somateria mollissima</i> <i>Bucephala clangula</i> <i>Mergus serrator</i> <i>Cygnus olor</i> <i>Cygnus cygnus</i> <i>Fulica atra</i> <i>Larus</i> <i>Alca torda</i> <i>Uria aalge</i> <i>Cephus grylle</i>	1 2 4 4 2 2 35 1.5 387 16.3 197 8.3 1683 70.7 3 48 2.0 10 1 1 1	 1 65 7 117 3 1 1 1	 2 241 17.7 33 2.4 1081 79.4 3 17 1 1	3 26 25 95 2 17 3 17 17 1 2	2 55 17 63 1 3 1	1 1 1 1 1 1 2 7 273 173 485 17 17 4 2 1 1 2	3 79 117 190 4 2 1	 88 85 114 8 4 2 2	9 2 1 1 6 26 1.3 521 26.1 417 20.9 947 47.4 13 28 1.4 17 1 2 2	 239 196 1162 5 21 1 4	1 4 7 14 2 2 2 3 262 11.3 223 9.6 1713 73.7 9 28 1.2 1 5 13 12 17	4 1.7 8 3.3 8 3.3 4 1.7 77 31.8 119 49.2 19 7.9 2 2 1 1 13 1 20	15 16 5 21 1 20 4 2 8 73 1488 17.9 989 11.9 5443 65.5 28 106 1.3 28 1 9 13 14 20	
<i>S. mollissima</i> & <i>M. nigra</i> & <i>M. fusca</i> % of total	95.3	99.5	94.4	94.6	88.8	95.4								

Table 1. The species composition of 8304 birds examined in connection with five disasters in the Kattegat 1969-1971.

Tabel 1. Artssammensætningen blandt 8304 fugle undersøgt i forbindelse med fem katastrofer i Kattegat 1969-1971.

Табл. 1. Распределение по видам 8304 птиц, обследованных в связи с 5 катастрофами в Каттегате 1969-1971 г.

INFORMATION FROM A QUESTIONNAIRE SURVEY OF HUNTERS

In later years, the Game Biology Station has sent an annual questionnaire to hunters who have filled in the heading »other diving ducks« on their game licences. On the licence there are only two headings for diving ducks, »eiderducks« and »other diving ducks«. The purpose of the questionnaire survey was to gain information on the species composition and geographical distribution of these »other diving ducks« shot.

The main items of the questionnaire concerned information on species and numbers and the area involved, but in addition the hunters were asked about the kind of shooting practised, the occurrence of diving ducks, and the occurrence of oiled birds.

In connection with the present analysis, material from the shooting seasons 1968/1969 and 1969/1970 has been examined (the season runs from August 16 to February 28), and information on oiled birds collated. The results are given in Tables 2 and 3, and the following remarks refer to Table 2:

- A: The total number of »other diving ducks« shot, based on returns from all hunters in the whole country, and corrected for non-returned game licences (about 15 %) (cf. STRANDGAARD 1964).
- C: Questionnaires were sent to 50 % of those hunters in each police district, who had noted more than 10 »other diving ducks« shot on their game licence.
- D: In both years, about 75 % of the hunters who received the questionnaire replied.
- E: Includes all replies with »oil« mentioned, whether information is positive or negative.
- G: The number of hunters who stated »only a few birds oiled« etc., giving no exact details on numbers, areas, etc. In most cases the statement is very general, with no particular reference to the year in question.
- H: Positive records of oiled birds in the year in question and with information on locality and at least one of the following items: spe-

cies, number of oiled birds shot or seen (or order of magnitude), month or season.

- J: The minimum number of incidents with oiled birds, i.e. the number of cases well-spaced either geographically or in time. Since not all hunters have reported the month of kill, it is most likely that the actual number of cases reported in the questionnaires is somewhat greater.

Table 4 is based on reports from those hunters who have given detailed information on oiled birds shot, such as the number shot and the species composition.

The maps Fig. 4 illustrate the geographical distribution of the oiled birds reported. Each symbol represents one hunter's observations in one area; some hunters have reported oil in several areas. However, the same case of pollution is often reported by several hunters, and the number of symbols on the map is therefore greater than the estimated number of different occurrences of oiled birds (Table 2, J). There are 183 symbols for 1968/1969, and 145 for 1969/1970. The number of birds on which information was given is indicated by the size of the symbol. Where no information on numbers was given, the smallest symbol (less than 20 birds) has been used. The dark areas with a number represent hunters who through the questionnaire survey informed about birds destroyed in connection with the large disasters described in the special reports p. 5-12.

Some comments are necessary regarding the value of the material. Firstly, information on oil pollution was not the main aim of the questionnaire survey, and this has no doubt meant that some hunters who knew of cases of pollution did not report them, but have instead confined themselves to the main questions asked. Furthermore, the material comprises only some (15 %) of the hunters who

	1968/69					1969/70				
	Bornholm	Sealand Lolland, Falster Møn	Funen	Jutland	Total I alt	Bornholm	Sealand Lolland, Falster Møn	Funen	Jutland	Total I alt
A. No. of „other diving ducks“ bagged according to bag record <i>Antal „andre dykænder“ nedlagt iflg. vildtudbyttestatistikken</i>	1.872	56.517	28.038	46.098	132.525	3.594	58.202	28.868	49.904	140.568
B. No. hunters <i>Antal jægere</i>	121	3.268	1.442	4.978	9.809	126	3.093	1.346	4.807	9.372
C. No. hunters who shot > 10 <i>Antal jægere, som skød > 10</i>	42	1.047	501	1.059	2.649	70	1.109	560	1.058	2.797
D. No. replies total <i>Antal svarbreve i alt</i>	18	414	184	390	1.006	31	398	206	377	1.012
E. No. replies with "oil" mentioned <i>Antal svarbreve med „olie“ nævnt</i>	18	115	46	127	306	17	107	47	93	264
F. No. replies: "no oiled birds" <i>Antal svar: „ingen olieflugle“</i>	0	41	8	54	103	0	34	18	26	78
G. No. replies: "few oiled birds" <i>Antal svar: „få olieflugle“</i>	0	10	8	5	23	0	6	6	5	17
H. No. replies with details on oiled birds <i>Antal svar med detaljer om olieflugle</i>	18	56(+8)	30	68	172(+8)	17	67	23	50(+12)	157(+12)
I. Min. no. of oil incidents <i>Min. antal olieforureninger</i>	ca.10	ca.35(+1)	ca.18	ca.35	ca.100(+1)	ca.6	ca.30	ca.15	ca.38 (+2)	ca.90(+2)

Table 2. Information on the bag of „other diving ducks“ and the results of the questionnaire survey concerning oiled birds. Further comments on the table are given page 13.

Tabel 2. Oplysninger om jagten på „andre dykænder“ og resultatet af spørgebrev-undersøgelsen vedrørende olieflugle. Nærmere forklaring af tabellen se side 13.

Табл. 2. Сведения об охоте на „других нырковых уток“ и результат анкеты о птицах, запачканных нефтью. Более подробное объяснение таблицы, см. стр. 13.

	1968/69				1969/70				Total 1968/69 and 1969/70 Total I alt begge år No. %
	Bornholm	Sealand Lolland, Falster Møn	Funen	Jutland	Bornholm	Sealand Lolland, Falster Møn	Funen	Jutland	
No. of hunters who informed about number of oiled birds shot Antal jægere, som oplyste om antal nedlagte olie fugle	8	44(+8)	27	37	14	47	15	38(+12)	230
No. of birds det. to species Antal artsbestemte fugle									
<i>S. mollissima</i>		144(+37)	89	111	4	50	109	3(+42)	510
<i>M. nigra</i>	25	34(+20)	10	93	5	30	21	61(+178)	279
<i>M. fusca</i>	2	12(+9)	7	21		18		5(+40)	65
<i>Cl. hyemalis</i>	31	53(+7)		3	148	109		7	351
<i>B. clangula</i>			5	8		2		12	27
<i>M. serrator</i>		34	1	2		7		7	51
<i>M. merganser</i>		3	4	4	6	4		3	24
<i>A. marila</i>		3		3			7		13
<i>A. ferina</i>		1		2		3		2	5
<i>A. fuligula</i>		29	4	13		16	6	8	76
<i>Podiceps, Gavia, F. atra, Larus</i>		7	12	16		17		5	57
Total (i alt)	58	320(+73)	132	276	163	256	143	113(+260)	1461
No. of birds not det. to species Antal ikke artsbestemte fugle	100	169	21	7	35	422	77	103(+400)	934
Total no. birds Totalt antal fugle	158	489(+73)	153	283	198	678	220	216(+660)	2395

Table 3. The number of hunters who gave detailed information on the number of oiled birds shot, and the distribution on species. Figures in brackets are additional hunters and birds in connection with the major disasters studied by the Game Biology Station (see page 5-12).

Tabel 3. Antallet af jægere, som gav udførlige oplysninger om antallet af nedlagte olieforurettede fugle, samt fordelingen på arter. Tal i parentes omfatter yderligere jægere og fugle fra de store katastrofer, som undersøges af Vildtbiologisk Station (se side 5-12).

Табл. 3. Число охотников, давших подробные сведения о числе убитых запачканных нефтью птиц, и распределение по видам. Цифры в скобках включают добавочное число охотников и птиц при крупных катастрофах, обследованных Станцией Исследования Биологии Дичи (см. стр. 5-12).

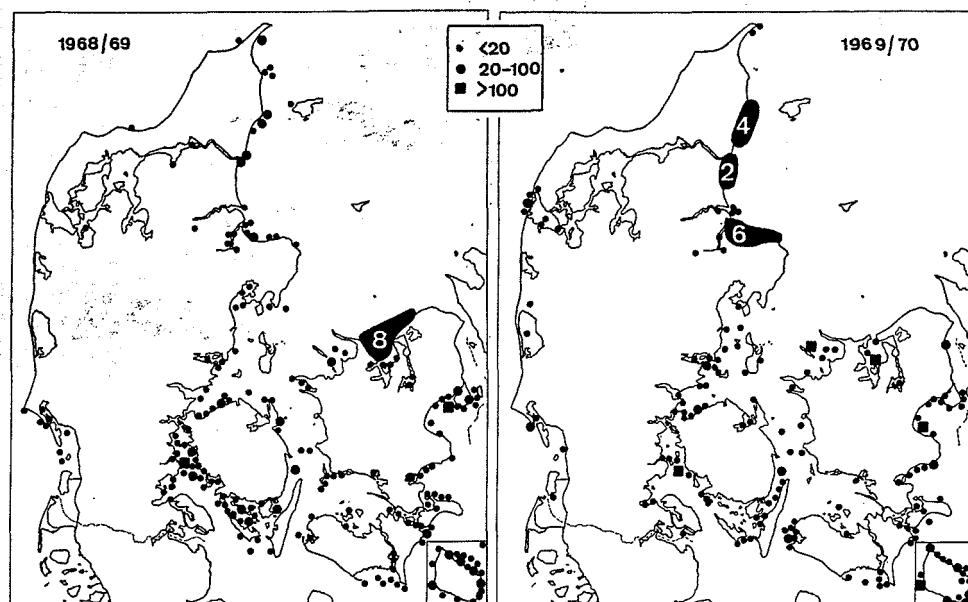


Fig. 4. The geographical distribution of oiled birds, reported by hunters in the questionnaire survey in the hunting seasons 1968/69 and 1969/70.

Fig. 4. Den geografiske fordeling af olieflugle rapporteret af jægere i forbindelse med spørgeskemaundersøgelsen i jagtsæsonerne 1968/69 og 1969/70.

Фиг. 4. Географическое распределение запачканных нефтью птиц по сообщениям охотников в анкетах за охотничьи сезоны 1968/69 и 1969/70 г.

had shot »other diving ducks«, and none of the many hunters (several thousand) who only shot »eider ducks« were sent a questionnaire. Considering that the eider is the species most often affected by oil, it is to be expected that those hunters which concentrate their efforts on this species must possess knowledge of many cases of oil pollution.

The material can thus scarcely be considered as representative of records of oil pollution by Danish hunters. It illustrates the situation as being less serious than it would be if the main question asked concerned oiled birds, and if a sample of those hunters who only shoot eiders had also been taken into account.

Discussion

The different methods of collecting material described in previous sections give a much more detailed picture of oil pollution in Danish waters, and its effect on seabirds, during July 1968 - June 1971, than records from previous years. This should be borne in mind when the present material is compared with that obtained during 1935-1968 (JOENSEN 1972).

A brief review is given in Appendix I of all cases of pollution involving more than 100 birds, which occurred during 1968-1971. Not included in the list are

a large number of minor cases of pollution, on which information was gained via the general collection of information and the questionnaire survey.

The maps Fig. 5 illustrate the geographical distribution and extent of the cases of pollution listed in Appendix I. It should be noted that the collection of data has not been the same in each of the three years, as no information was collected via the questionnaire survey for 1970/1971.

GEOGRAPHICAL DISTRIBUTION

It is evident from Figs. 4 & 5 that oiled birds were to be found in all Danish waters during the period 1968-1971. Of six disasters which affected more than 1000 birds, five occurred in the Kattegat and one in the South Funen archipelago. Information from hunters for the shooting seasons of 1968/1969 and 1969/1970 (Fig. 4) indicate that numerous minor cases of pollution have occurred in all waters east of Jutland. Bornholm appears to have been especially affected in both years, and around Copenhagen and other places there have also been several cases recorded. From the Limfjord there are only a few cases, and for most of the W

coast of Jutland there is only very little information as shooting of diving ducks is practically absent here. In this area shooting is only practised in the Wadden Sea, from which several observations of oiled birds were reported. In the Lillebælt only a few cases of pollution were recorded during 1935-1968 (JOENSEN 1972, Fig. 2), whereas in 1968/1969 and 1969/1970 oiled birds were reported by many hunters. Cases of pollution are frequent but usually minor in extent, which may explain their not being recorded previously. It is clear from Fig. 4 that the Lillebælt is not unaffected by oil.

SEASONAL DISTRIBUTION

The seasonal distribution of major cases of oil pollution causing bird deaths in 1968-1971 is quite similar to the distribution in previous decades (JOENSEN 1972, Table 2). In 1968-1971 30 cases of pollution involving more than 100 birds were recorded, and of these 25 occurred between December and March. In addition,

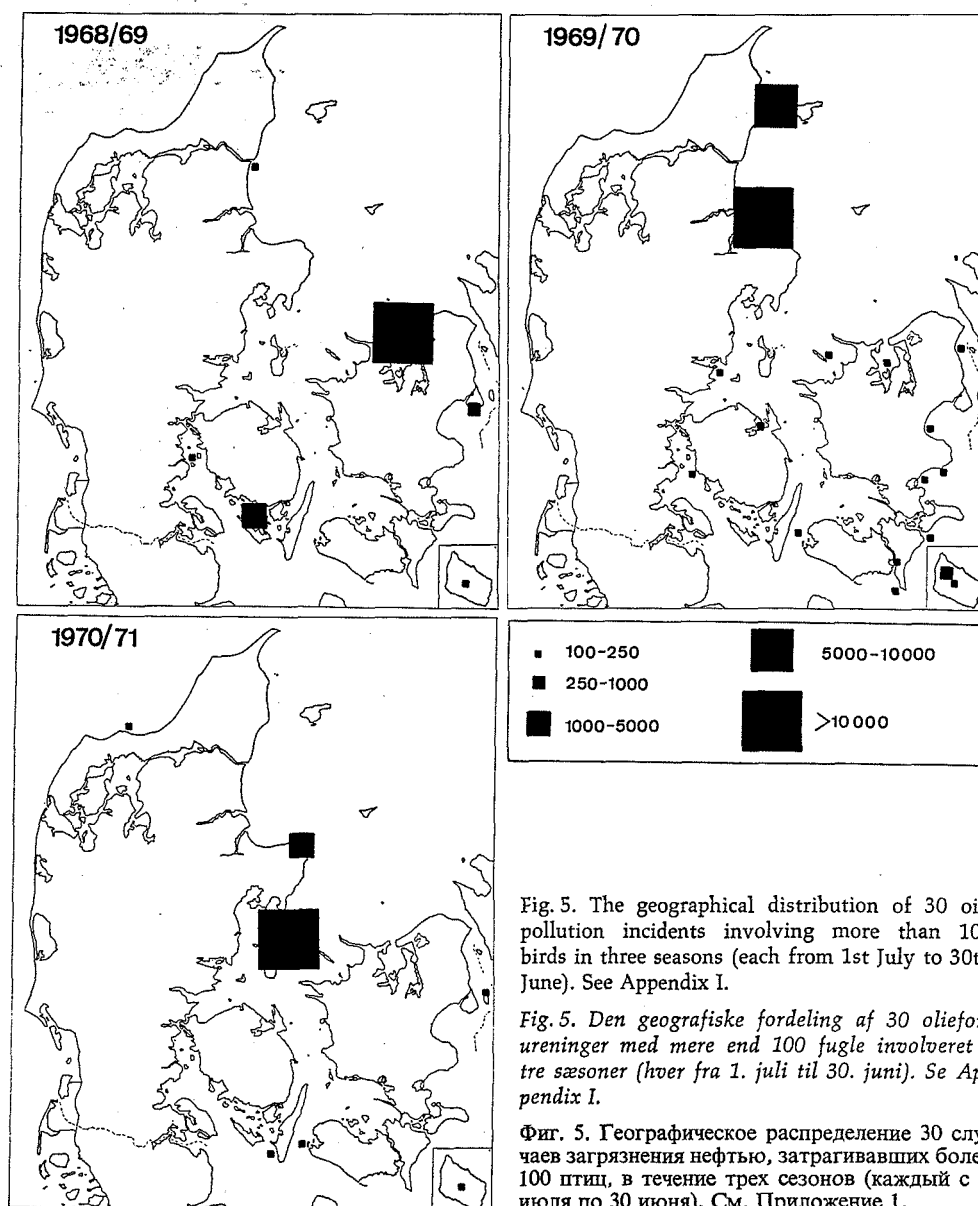
there were two in November, two in July, and one in August.

Information obtained via the questionnaire survey gives little exact information on the seasonal distribution of minor oil incidents, but it is quite apparent from the reports that these are more uniformly distributed throughout the shooting season

(from August to February) than the large disasters.

It is assumed that release of oil in Danish waters is evenly distributed over most of the year. In the autumn months the water temperature is still so high that

some oil fractions evaporate rapidly, and also the frequent and strong winds will disperse the oil patches. Furthermore, there is reason to believe that unless heavily soaked in oil, the birds will still be able to move away from the area of



pollution and thus not occur in very dense concentrations. During winter, when the water temperature is close to freezing, the chances of oil evaporating and dispersing are much lesser, and at the same time the cold water paralyses the birds quite rapidly, so that they are less capable of leaving the polluted area.

THE NUMBER OF BIRDS KILLED BY OIL 1969-1971

Naturally one of the most important questions in recording the extent of oil pollution is the number of birds whose death has been caused by oil during 1968-1971. It must be admitted at once that it is impossible to give an accurate estimate, but the following section describes how the available material has been used to calculate minimum numbers of killed birds.

The five disasters in the Kattegat

In a previous section, a detailed description was given of the way in which information on dead and destroyed birds was combined with that from surveys from land, boats and aircraft, to obtain a minimum estimate of the number of birds lost. The five disasters took place in the coldest winter months and it has been presumed that all birds which were contaminated by oil subsequently died. This assumption is based on many observations of birds which have had only a little oil on their plumage and yet have succumbed in the cold weather. In the five disasters, at least 43,500 birds have been lost (cf. the reports on each disaster). At Læsø-Vendsyssel (Dec. 1969) it was not possible to make a survey, and instead the number of birds found dead and destroyed has been used as the minimum number in the extent of the disaster; the actual number of birds killed was no doubt much greater. In two other disasters (E coast of Jutland, Feb.-March 1970 and S Kattegat Dec. 1970 - Jan. 1971) the field observations have probably not covered the whole polluted area sufficiently, and it is presumed that the actual num-

ber of birds lost exceeds the minimum numbers given here.

The extent of the under-estimation can only be guessed at, but even 50,000 birds killed can be taken as a cautious minimum estimate for the five disasters. It seems probable that the actual number has been higher by several thousands.

It is evident from the special reports on disasters that the number of oiled (and killed) birds is much greater than the number destroyed or found dead on the shore. The majority of birds must be presumed to die and disappear at sea, and only through detailed observations (mainly from small aircraft) it is possible to form a reasonably reliable impression of the extent of a disaster. There is no doubt that the reports of previous years, which were usually based on numbers of dead and destroyed birds and only seldom included observations from land, have in general under-estimated the number of birds lost (cf. JOENSEN 1972 p. 6).

Other major cases of pollution

The extent of 25 of the 30 major disasters listed in Appendix I is illustrated by numbers of birds found dead or destroyed, and in a few cases supplemented by occasional observations from the shore. It must thus be presumed that the total of 5,000 which is obtained by addition of the listed minimum numbers is actually well under the real number of birds killed. Even if this number is doubled to 10,000 it is probably still well under the actual number of birds lost.

Information from the questionnaire survey

It was mentioned previously that information gained from hunters via the questionnaire survey is scarcely representative. However, in spite of certain faults, the information gained gives a disconcerting idea of the extent and frequency of oil pollution in Danish waters. Approximately 1/6 of the hunters answering the questionnaire have provided information on the occurrence of oiled birds, and the majority of these hunters gave many details. In 1968/1969 116 hunters (about 13 % of those who replied) destroyed a total of about 1,100 birds, and in 1969/1970 114 hunters destroyed about 1,300 oiled birds. For the two shooting seasons, hunters have reported about 100 and 90 different occurrences of oiled birds respectively. These comprise records which are separated geographically and in time. Although they are minimum numbers, it should be noted that birds from the same source of pollution can be found far apart. The numbers listed here do not include hunters or birds included in the major disasters described in the reports p. 5-12.

The total number of oiled birds destroyed by hunters in Denmark cannot be calculated with any certainty, but there is no doubt that it comprises several thousand birds, and perhaps tens of thousands every year.

The material from both years (Table 2 & 3 and Fig. 4) is so similar in many

ways that it suggests that events in these years are typical.

It was stated in 201 communications from hunters whether oiled birds were included in the numbers reported on their game licence, or not. 135 hunters had included these birds in their game bag, and two-thirds of these had only shot between 1-5 birds each. Only very few hunters, who had shot more than 20 oiled birds, had included these in their game bag. 66 hunters reported that oiled birds were not included in their game bag. Almost all birds destroyed in shooting organized by the police in connection with major pollutions belonged to this latter category, and in addition some hunters who had destroyed only a few oiled birds had not included these in their game bag.

The total number of birds lost

From the numbers available, it is not possible to estimate with any certainty how many birds have died as a result of oil pollution in the period July 1968 - June 1971. As has been mentioned, it is presumed that the major cases of pollution listed in Appendix I have affected at least 60,000 birds. However, in addition to these, thousands of oiled birds are observed and destroyed yearly by hunters throughout Danish waters. Some of these oiled birds are included in game bag records, but the majority of oiled birds destroyed in connection with major cases of pollution are not recorded here.

SPECIES COMPOSITION

Kattegat

In the five disasters in the Kattegat, a total of 8,304 birds were collected and examined, representing 19 % (15-27 %) of the minimum number of birds lost (see Table 1).

In all of the disasters, the three species

S. mollissima, *M. nigra* and *M. fusca* comprise the majority of the birds lost (a total of 95 %). The proportion that each species forms of the total number of dead birds varies from disaster to disaster, as would be expected from what is known on the occurrence of the species in the

Kattegat from population counts in recent years (JOENSEN 1968, and unpublished material). The greatest percentages of *S. mollissima* were thus found in the areas where this species predominates (N Sealand, Læsø and S Kattegat), whereas *M. nigra* and *M. fusca* comprised rather larger proportions in areas where these species are numerous (E coast of Jutland from Ebeltoft to Vendsyssel).

In Table 4, estimates are given of the numbers of the three most numerous sea-duck species lost in the five disasters in the Kattegat. The estimates are based on the minimum numbers found. The greatest number lost has been of *S. mollissima* (approximately 28,000), and the two other species have also suffered considerable mortality, 8,000 for *M. nigra* and 5,500 for *M. fusca*. It should be again mentioned that these are minimum numbers.

Seventeen other species have been re-

corded, but all in rather small numbers. Considering the abundance of auks and *Clangula hyemalis*, it is particularly striking that the numbers of these species are so low, but this is probably due to the fact their haunts are further out at sea. Thus although they were undoubtedly lost in great numbers, they have very little chance of being observed or found along the shore.

The information gained from hunters via the questionnaire survey (Table 3) shows more or less the same species composition in oiled birds from the Kattegat as the studies of birds from the five major disasters.

Other Danish waters

Information from hunters show (Table 4) that in other waters several species of diving ducks are regularly reported oiled. Thus *Cl. hyemalis* is quite often found, particularly around Bornholm and the

Year Month Area	År Måned Område	1969 Feb.-March N. Sealand	1969 Dec. Læsø- Vendsyssel	1970 Feb.-March E-coast of Jutland	1970-71 Dec.-Jan. S-Kattegat	1971 March Djursland- Anholt	Total I alt
Min. no. of birds lost Min. antal fugle omkommet		10,000	5,000	12,000	15,000	1,500	
<i>S. mollissima</i>		71% 7,100	79% 3,950	47% 5,640	74% 11,000	8% 120	27,810
<i>M. nigra</i>		16% 1,600	18% 900	26% 3,120	11% 1,650	32% 480	7,750
<i>M. fusca</i>		8% 800	2% 100	21% 2,520	10% 1,500	49% 735	5,655
		9,500	4,950	11,280	14,150	1,335	41,215

Table 4. The minimum number of *S. mollissima*, *M. nigra* and *M. fusca* lost in five oil disasters in Kattegat 1969-71. (Calculated from the minimum total loss in each disaster).

Tabel 4. Antallet (minimum) af ederfugle, sortænder og fløjlsænder omkommet ved fem oliekatastrofer i Kattegat 1969-71.

Табл. 4. Количество (минимум) *S. mollissima*, *M. nigra* и *M. fusca*, погибших при пяти нефтяных катастрофах в Каттегате 1969-1971 г. Вычислено, исходя от минимума общего числа погибших птиц при каждой из катастроф.

Baltic coasts of Sjælland, Lolland, Falster and Møn. Even *Aythya fuligula*, in the period 1935–1968 (cf. JOENSEN 1972 p. 16) hardly ever reported oiled, was reported by several hunters in 1968/69 and 1969/70 and accounted for 5% of all birds determined to species.

Comparison with other Northeuropean waters

The number of reports of high bird mortality in connection with oil pollution of Northern European seas is very large, and this illustrates the widespread occurrence of the problem and its seriousness. In addition, it is interesting to compare information on species composition from different areas, as this is very much representative of the composition of seabird populations.

Several disasters involving tens of thousands of seabirds have been reported from the Baltic, and *Cl. hyemalis* has been the species most often affected (LEMME-TYINEN 1966). Oiled seaducks (especially *M. nigra*) are also found in large num-

bers in the southern part of the North Sea. In the 1950's 9,400 birds were determined to species along the German North Sea coast: *S. mollissima*, *M. fusca* and *M. nigra* comprised 78%, whereas auks (especially *U. aalge*) comprised 6% of the total (GOETHE 1961). Further south seaducks are replaced by auks. Of 23,000 birds mainly found along the coast of Holland during 1962–1968, the three seaduck species referred to comprised 41%, and 36% of these alone were *M. nigra*; the auks comprised 23% (16% were *U. aalge*) (information from J. J. C. TANIS). In February 1967 590 birds were recorded from the Belgian coast and the adjacent Dutch and French coast, 11.5% of these being *Anatidae* (*M. nigra* 9.8%), 30.3% were auks, and 48.9% were gulls (KUYKEN 1967). From Britain, a series of reports indicates that auks form the majority of birds affected by oil, although seaducks (especially *S. mollissima*) are also locally found oiled in great numbers (BOURNE 1968, JONES et al. 1970, GREENWOOD et al. 1971).

AGE- AND SEX-COMPOSITION OF THE POPULATIONS

In connection with the diving duck investigation programme started in 1968 the age- and sex-composition of the population has been studied. Most data has been collected by analyses of hunters' bags at game dealers. Because of differences in vulnerability to shooting of the various categories within the same species, an analysis of the bag does not give an absolute picture of age- and sex-composition in the wild population.

It is assumed that different species may have different vulnerability to oil, but that within one particular species the different sex- and age-categories are equally vulnerable. This means that the sex- and age-composition among oiled birds will

reflect the composition in the population much better than hunters' bags.

Most of the birds examined in connection with the five disasters in Kattegat were determined to age and sex, viz. 4,756 *S. mollissima*, 1,284 *M. nigra* and 733 *M. fusca* (see Table 5). Some wing samples of the *Melanitta* species are not included, because the conditions of the wings did not facilitate accurate distinction between all relevant categories (the wing sample of *M. nigra* from Dec. 1969 could only be divided into two categories, ad ♂ and ad ♀ plus juv. birds). The results will be discussed together with other data on age- and sex-composition in a later report.

Oil Pollution and Seabirds 1968-1971

	1969 Feb.-March North Sealand No. %	1969 Dec. Læsø- Vendsyssel No. %	1970 Feb.-March E-coast of Jutland No. %	1970-71 Dec. 70-Jan. 71 S-Kattegat No. %	1971 March Djursland- Anholt No. %
<i>S. mollissima</i> Total I alt	1554	1080	947	1156	19
juv. ♂	175	6	5	24	
juv. ♀	197	2	9	31	
juv. total	373 24.0	18 1.7	28 3.0	70 6.1	
ad. ♀	441	367	374	441	8
ad. and subad. ♂ ¹⁾	740	695	545	645	11
ad. total	1181 76.0	1062 98.3	919 97.0	1086 93.9	
¹⁾ subad. ♂	449 60.7	68 9.8	113 20.7	95 14.7	1
ad. ♂	291 39.3	627 90.2	432 79.3	550 85.3	10
<i>M. nigra</i> Total I alt	343	(241)	454 ³⁾	169 ⁵⁾	77
juv.	35 10.2	87 ²⁾	69 15.2	49 29.0	8 10.4
ad. ♀	107		163	39	29
ad. ♂	201 58.6	154 63.9	222 48.9	81 47.9	40 51.9
ad. total	308 89.8		385 84.8	120 71.0	69 89.6
<i>M. fusca</i> Total I alt	143	(33) ²⁾	332 ⁴⁾	139 ⁶⁾	119
juv.	25 17.5		41 12.3	25 18.0	15 12.6
ad. ♀	44		96	42	46
ad. ♂	74 51.7		195 58.7	72 51.8	58 48.7
ad. total	118 82.5		291 87.7	114 82.0	104 87.4

Notes

¹⁾ Males more than one year old separated into two age groups, viz. sub-adult birds, and adult birds (fully developed plumage).

²⁾ Determination to age and sex not possible.

³⁾ 67 wings (58.2 % ad. ♂) not included.

⁴⁾ 20 wings (65.0 % ad. ♂) not included.

⁵⁾ 59 wings (54.2 % ad. ♂) not included.

⁶⁾ 52 wings (55.8 % ad. ♂) not included.

Table 5. Age- and sex-composition of *S. mollissima*, *M. nigra* and *M. fusca* killed in five disasters in the Kattegat 1969-1971.

Tabel 5. Alders- og kønssammensætningen blandt ederfugle, sorttænder og fløjlsænder omkommet ved fem oliekatastrofer i Kattegat 1969-1971.

Табл. 5. Распределение по возрасту и полам *S. mollissima*, *M. nigra* и *M. fusca* погибших при пяти нефтяных катастрофах в Каттегате 1969-1971 г.

Conclusion and recommendations

Since the 1930's, cases of oil pollution in Danish waters involving seabirds have been recorded by hunters, ornithologists and game biologists. Recording has been especially thorough in the years after the Second World War (JOENSEN 1972), and during the years 1968-71 the extent of the problem has been determined by special investigations by the Game Biology Station.

The information available clearly illustrates that both the number of cases of oil pollution and the number of birds killed have steadily increased over the

last four decades, and in recent years a temporary culmination has been reached, comprising almost permanent cases of minor pollution in several waters, and annual disasters involving thousands of killed birds. These developments have happened in spite of the fact that national legislation and international regulations have been made more stringent since the 1950's, such that at present there are no possible legal grounds for releasing oil in the waters around Denmark.

OIL POLLUTION AND SEABIRD POPULATIONS UP UNTIL 1971

Any discussion of the effects of oil pollution on seabird populations ought to be divided into two major parts, considering first what has happened up to the present time and next what may happen in the future.

The problem has already been treated briefly by JOENSEN (1972) for the period 1935-1968, the conclusion reached being that nothing at all could be decided concerning the effects of oil on bird populations, as there is insufficient knowledge of the size of bird populations in the past and of changes in them. It has been claimed that the numbers of *Clangula hyemalis* have been reduced, and this has been ascribed to oil pollution in the Baltic (LEMMETYINEN 1966, CURRY-LINDAHL 1960). The species which is most often affected by oil in Danish waters is *Somateria mollissima*, and it has increased markedly as a breeding bird both in Denmark and the Baltic areas.

The Game Biology Station collected information on oil pollution and seabirds during 1968-71, and for this period, estimates of the number of killed birds are

better than for previous periods. Reliable information on the number of birds wintering in Danish waters is also available for recent years, just as there are accurate figures for the extent of the most important mortality factor, that of shooting.

For *S. mollissima*, *M. nigra* and *M. fusca*, the three species which have been most severely affected by oil pollution in the period in question, the data concerning population size, shooting yield and number of birds killed by oil are presented in Table 6. The figures given are average values for the three years and should thus only be considered as orders of magnitude, giving a rough idea of the relationship between the winter population size on the one hand and the two presumably most important mortality factors on the other.

The following remarks concern different headings in Table 6: A) Population size is the average number of birds recorded in Danish waters in mid-winter counts from aircraft in January 1969, 1970 and 1971. No correction was made for waters not surveyed, and the figures

Oil Pollution and Seabirds 1968-1971

× 1000	Winterpopulation <i>Vinterbestand</i>	Bagged by hunters <i>Nedlagt af jægere</i>	Killed by oil <i>Omkommet i olie</i>	
<i>S. mollissima</i>	450	140	28	13.6
<i>M. nigra</i>	85	19	8	3.6
<i>M. fusca</i>	18	10	6	2.8

Table 6. The approximate size of the winterpopulation (average for January 1969, 1970 and 1971), the number of birds bagged by hunters (average for hunting seasons 1968/69, 1969/70 and (1970/71)), and number of birds killed by oil (left: total for three seasons in five disasters in the Kattegat, right: approximate annual average corrected for minor disasters. For *M. nigra* and particularly *M. fusca* the numbers passing Denmark on migration (from which the hunters' kill and the oil kill are taken) are larger than the winterpopulation. See also text page 24.

Tabel 6. Vinterbestanden (gennemsnit for januar 1969, 1970 og 1971), antallet af fugle nedlagt af jægere (gennemsnit for jagtsæsonerne 1968/69, 1969/70 og (1970/71)), og antallet af fugle dræbt af olie (venstre: total for tre sæsoner ved fem katastrofer i Kattegat, højre: omtrentlige årlige gennemsnit oprundet og korrigeret for mindre forureninger). For Sortand og især Fløjlsand er antallet af fugle, som passerer Danmark under trækket (som jagtudbyttet og oliedøden skal sættes i relation til) større end vinterbestandene. Se også teksten side 24.

Табл. 6. Приблизительная численность зимней популяции (среднее число за январь 1969, 1970 и 1971 г.), число птиц, убитых охотниками (среднее число за охотничьи сезоны 1968/69, 1969/70 и 1970/71 г.), и число птиц, погибших от нефти (слева: общее число за три сезона при пяти катастрофах в Каттегате, справа: приблизительные средние годовые числа, закругленные, с поправкой на незначительные загрязнения). У *M. nigra* и, в особенности, у *M. fusca*, число птиц, пролетающих Данию во время перелета (и в связи с которым следует рассматривать добычу охотников и число птиц, погибших от нефти), превышает зимние популяции. См. также текст на стр. 24.

must thus be considered as minimum values. B) The numbers of *S. mollissima* shot were taken directly from the bag record, and comprise the average of the shooting seasons in 1968/69, 1969/70 and 1970/71. For *M. nigra* and *M. fusca*, numbers were based on the results of a questionnaire survey sent to sportsmen who had shot »other diving ducks« (see p. 13), and the average for these two species was only calculated on the basis of the shooting seasons of 1968/69 and 1969/70. For all three species, the numbers given comprise birds shot, while the number of birds crippled and not retrieved is not known. Therefore the numbers given are minimum values in this case also. C) In the left-hand column, the total number of birds killed by oil in five disasters

in the Kattegat (see Table 5) during 1968-71 is given. In the right-hand column the annual average is given, the figures at the same time being rounded off and corrected for a total of about 10,000 birds killed in other cases of pollution (see p. 19 and Appendix 1). The figures given are minimum values in this case also.

As mentioned on p. 19-20, it is not possible to estimate either the actual or the maximum number of birds killed by oil during the three years. However, even if the least optimistic view is taken and the number of birds in the column to the far right is doubled, the number of birds killed by oil does not appear particularly large in relation to the existing populations and the number shot by hunters.

FUTURE PROSPECTS

To estimate the importance of the effects which oil pollution may have on seabird populations in the future, it is first necessary to consider the size and distribution of the populations and the importance of Danish waters in an international perspective. Following this, the kinds of oil pollution which have been experienced until now and which may be expected in the future can be considered.

According to European standards, Danish waters contain very large concentrations of seabirds for most of the year, and especially waterfowl. The most evident reason for this is the presence of very large shallow sea areas with a high productivity of marine organisms and a favourable climate. The majority of the birds which occur in Danish waters originate from and breed much further northwards in Scandinavia and in the northern and western parts of the U.S.S.R. In reality, many of these birds spend the greater part of their life in Danish waters.

In the breeding season, tens of thousands of gulls and terns and thousands of waders and ducks occur on islets and along the coasts. In July and August, the waters contain some of the greatest concentrations in Europe of moulting sea-ducks (especially *S. mollissima*, *M. nigra* and *M. fusca*), and mute swans (*C. olor*). Outside the breeding season, more than 250,000 *dabbling ducks* occur in Danish roosting areas during migration, and in most years the number of wintering diving ducks exceeds one million. The number of swans which winter in Denmark is close to 75,000. For certain species of diving ducks and swans, Danish waters contain a very large proportion of the total north-west European populations (JOENSEN 1968, ATKINSON-WILLES 1969).

With the exception of most of the

North Sea coast, all Danish waters contain large, internationally important concentrations of ducks (see JOENSEN 1968 pp. 22-23). However, the pattern of distribution varies greatly from species to species. Some species have important haunts in several areas; this is true of *M. nigra*, which occurs in large numbers off the southern part of the North Sea coast, several places in the Kattegat, and in the Storebælt. *S. mollissima* is found in large concentrations in the Waddensea, most parts of the Kattegat, and in the Storebælt, the Lillebælt, and the South Funen archipelago. *Cl. hyemalis* is numerous in all southern waters, although the largest concentrations are found at Bornholm and around Falster and Møn. Other species occur more concentrated at least at certain times of year. *Aythya marila* is an excellent example, as almost the whole population of up towards 50,000 birds sometimes gathers in a very small area in the Lillebælt. This concentration probably comprises about one-third of the total population of western Europe. A second example is that of *M. fusca*, the most important Danish (and presumably also European) haunts of which are in the mid-Kattegat, off Randers and Mariager fiords.

To illustrate the problem in the future, different types of oil pollution will be considered. Apart from a very few cases, including two wrecks in the southern part of the North Sea, all the cases of death from oil in seabirds which have been registered since 1953 and described by JOENSEN (1972) and in this paper were due to pollution which in other respects went unnoticed. In the majority of cases, there was no question of »oil disasters« in the sense this term is used by shipping companies and by the pollution authorities of the period. This can be explained

by the fact that the amount of oil released was small, and probably seldom more than a few tons. Only the frequent presence of large concentrations of waterfowl in or near the polluted area has led to mass mortality in birds. Even the large bird disasters in the Kattegat in 1968-71 were presumably caused by relatively small amounts of oil, and in no case was the source of pollution traced.

This type of minor pollution is due to the unavoidable loss of oil from ships, negligence, and deliberate flouting of the regulations, presumably done without knowledge of the tragic consequences for birds which even small amounts of oil on the sea can have. In addition, some oil pollution must be ascribed to the sewage outlets of larger towns and industries.

It is possible that some cases of pollution are due to the wrecks of ships, in which the oil tanks after a period of time have become so corroded that oil escapes. As far as is known, no real »oil disaster« (in the shipping sense) e. g. in connection with collision or grounding, with the immediate loss of hundreds or thousands of tons of oil, has ever occurred in inner Danish waters (i. e. the Kattegat and the waters to the south and south-east). In other countries such disasters have been experienced; a well-known example is that of the grounding of the »Torrey Canyon« in the English Channel in March 1967, when approximately 100,000 tons of crude oil polluted enormous areas of sea and very long stretches of coast (SMITH 1968). Similar shipwrecks with the subsequent release of several thousand tons of oil have been experienced in other places in the world.

There is little doubt that oil pollution by small amounts of oil, such as has been experienced in hundreds of cases in the last decades, will occur in Danish waters for many years to come. Studies in re-

cent years indicate that the mortality caused by such pollution has not had disastrous consequences for bird populations. However, the studies also show that cases of pollution have become more and more frequent, and that the number of birds killed by oil pollution has been steadily increasing over the last decades. If these developments continue, the stage will be reached where the mortality due to oil will be of such a size that the exploitation of the populations by shooting will be considerably reduced. Taking an even longer view, an increase in mortality due to oil will cause an actual limitation of the populations.

In addition, certain species are very vulnerable, as major proportions of their populations in Denmark or even Western Europe are concentrated in very small areas of the sea. Examples of this are the species *Aythya marila* and *Melanitta fusca* (see above). In such cases, even minor pollution can kill so many birds that populations would be reduced for several years.

It is realistic to believe that sooner or later, a really serious oil disaster will be experienced in Danish waters, involving hundreds or thousands of tons of oil on the sea. In making this prophecy, the intensive shipping traffic and the many shallow waters around Denmark which are difficult to navigate have been considered. In the case of such a disaster, a situation incomparable with the bird disasters already experienced would arise. The release of large amounts of oil, for example in the Southern Kattegat in winter, could kill over half of the wintering population of *S. mollissima*, with absolutely disastrous results for the population of the whole of Northern Europe, including the Baltic area, where the majority of these birds breed.

The situation has been emphasized to

indicate the necessity of controlling all kinds of oil pollution in the years to come. Biologists are not competent to advise the authorities with regard to the practical measures to be taken against oil pollution. However, there is good reason to emphasize that the maintenance of a rich fauna of seabirds, and especially sea-ducks, not only in Denmark but the whole of Western Europe, requires measures in Danish waters against the minor cases of pollution now occurring, such that the extent of these is decreased, and not increased, in the future.

In addition, comprehensive measures ought to be taken to prevent major disasters, and an organisation established which can quickly and effectively prevent the spreading of oil over large areas, in the event of such a disaster. To solve the problems concerning permanent pollution, an effective control of the shipping of oil will presumably be necessary, and with regard to the control of major disasters, realistic amounts of material should be stockpiled, which can absorb or dissolve oil on the sea surface.

Resumé

Undersøgelser over olieforurening og søfugle i Danmark i 1968-1971.

- 1) Siden 1968 har Vildtbiologisk Station som led i undersøgelser over dykænder i Danmark foretaget registrering af olieforurening i relation til søfugle i danske farvande. Artiklen beskriver materialet indsamlet for perioden juli 1968 - juni 1971.
- 2) Gennem dagspressen, politi, jægere, jagtkonsulenter, strandfogeder, ornithologer m. fl. indsamledes oplysninger om en række forureningstilfælde. Ved fem meget omfattende katastrofer i Kattegat blev der foretaget intensive feltundersøgelser (observationer fra land, små fly og både), og et stort antal omkomne og aflivede fugle blev undersøgt. Der blev foretaget arts-, køns- og alderbestemmelse (se Fig. 2-3). Materialet fra de fem store katastrofer er beskrevet i specialrapporter side 5-12, i Fig. 1 og Tabel 1. I perioden registreredes ialt 30 forureninger som involverede mere end 100 fugle. Disse er opført i Appendix 1 og Fig. 5.
- 3) I forbindelse med henvendelser til et stort antal dykandejægere vedrørende disses jagtudbytte af dykænder i jagtsæsonerne 1968/69 og 1969/70 indkom man-

ge oplysninger om tilfælde af olieforurening (se Tabel 2, Tabel 3 og Fig. 4), der viser næsten permanent forurening i flere farvande.

- 4) Ved de fem store katastrofer i Kattegat omkom mindst 50.000 fugle. Ved de øvrige forureninger opført i Appendix 1 omkom yderligere mindst 10.000 fugle. Desuden foreligger fra jægere oplysninger om adskillige tusinde olietilsølede fugle, hvoraf nogle dog har været inkluderet i det jagtudbytte som er opført på jagttegnets spørgeskema.

- 5) I Kattegat er ederfugl, sortand og fløjlsand de arter, som er omkommet i størst antal, mens andre arter kun er repræsenteret med små tal. Langs Østersøkysterne (specielt Bornholm) dominerer havlit. I andre farvande er mange arter truffet olietilsølede, de fleste dog kun i ringe antal (se Tabel 1 og 3).

- 6) De fleste større katastrofer er sket i årets koldeste måneder (december, januar, februar, marts). Oplysninger fra jægerne viser, at olieforurening også træffes hyppigt om efteråret, omend mere spredt.

- 7) Alle registrerede tilfælde af olieforure-

ning i 1968-71 har formentlig omfattet små mængder af olie (op til nogle få tons), og i praktisk talt alle tilfælde har man ikke eftersporet forureningskilden.

8) Oplysninger om udviklingen i hele perioden 1935-71 (se også JOENSEN 1972) viser, at antallet af forureninger og mængden af omkomne søfugle er vokset. Endnu synes ingen bestande decimeret som følge af olieudslæt (se Tabel 5), men den kritiske grænse kan snart nås, såfremt udviklingen fortsætter. Visse koncentrationer af f. eks. bjergand og fløjlsand, som rummer betydelige dele af hele Vesteuropas bestand, er særlig sårbare og kan decimeres kraftigt selv af små mængder olie.

9) I de indre farvande (Kattegat, Bælter-

ne, Øresund og vestlige Østersø) har man endnu ikke oplevet større tankskibskatastrofer med udflydning af hundreder eller tusinder af tons olie på havet. En sådan katastrofe vil kunne få katastrofale følger for bestandene af en lang række arter, selv for de arter som har en vid udbredelse i danske farvande.

10) Danske farvande spiller en stor rolle for en række andefuglearter i Vesteuropa, og det vil være en forudsætning for disse bestandes fortsatte eksistens, at der i danske farvande både træffes foranstaltninger til en begrænsning af de permanente småforureninger og oparbejdes et beredskab der effektivt vil kunne begrænse virkningerne af en eventuel fremtidig tankskibskatastrofe.

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Резюме на русском языке

Исследования загрязнения нефтью и морских птиц в Дании с 1968 по 1971 г.

1) В связи с исследованиями нырковых уток в Дании, Станция Исследования Биологии Дичи с 1968 г. производила регистрацию загрязнений нефтью, касающихся морских птиц в датских водах. В статье обсуждается материал,

собранный в течение периода от июля 1968 до июня 1971 г.

2) При помощи газет, полиции, охотников, консультантов по охоте, береговых надзирателей, орнитологов и пр. были собраны сведения о ряде случаев загрязнения. При пяти очень обширных катастрофах в Каттегате проводились интенсивные исследования на месте (наблюдения с суши, с небольших самолетов и лодок), и было обследовано большое количество погибших и убитых птиц. Производилось определение видов, пола и возраста (см. Фиг. 2-3). Материал этих пяти крупных катастроф описан в специальных отчетах на стр. 5-12, в Фиг. 1 и Табл. 1. В течение периода зарегистрировано всего 30 случаев загрязнений, затравивших более 100 птиц. Они показаны в Приложении 1 и Фиг. 5.

3) В результате обращений к большому числу охотников о их добыче нырковых уток в течение охотничьих сезонов 1968/69 и 1969/70, было получено много сведений о случаях загрязнения нефтью (см. Табл. 2, Табл. 3 и Фиг. 4), указывающих на почти постоянное загрязнение нескольких участков моря.

4) При пяти больших катастрофах в Каттегате погибло по меньшей мере 50.000 птиц. Вследствие указанных в Приложении 1 других загрязнений, кроме того погибло не менее 10.000 птиц. Кроме того, имеются сведения от охотников о многих тысячах птиц, запачканных нефтью, хотя некоторые из этих птиц включены в добычу, указанную в анкетах к свидетельствам на право охоты.

5) В Каттегате, погибли больше всего *Somateria mollissima*, *Melanitta nigra* и *Melanitta fusca*, между тем как другие виды упоминаются только в незначительном числе. Вдоль берегов Балтийского моря (в особенности у Борнхольма) преобладает *Clangula hyemalis*. В других морских участках найдено много видов запачканных нефтью птиц, но в большинстве случаев только в незна-

чительном количестве (см. Табл. 1 и 3).

6) Большинство крупных катастроф произошло в самые холодные месяцы года (в декабре, январе, феврале и марте). Полученные от охотников сведения показывают, что запачканные нефтью птицы часто встречаются и осенью, но вразброс.

7) Кажется, что при всех случаях загрязнения нефтью с 1968 по 1971 г. шла речь о небольших количествах нефти (до нескольких тонн), и в почти всех этих случаях источник загрязнения не прослежен.

8) Сведения о развитии в течение всего периода с 1935 по 1971 г. (см. также Joensen 1972) указывают, что число загрязнений и количество погибших морских птиц возросли. Пока кажется, что никакие из составов не потерпели убыли вследствие гибели птиц от нефти (см. Табл. 5), но если развитие продлится, оно скоро сможет достигнуть критического предела. Некоторые концентрации, напр. *Aythya marila* и *Melanitta fusca*, включающие значительную часть состава всей Западной Европы, являются особенно уязвимыми, и даже небольшие количества нефти могут вызвать сильную убыль.

9) Во внутренних датских водах (в Каттегате, Бельтах, Зунде и западной части Балтийского моря) еще не случались крупные катастрофы танкеров, при которых в море вытекали сотни или тысячи тонн нефти. Такая может привести к катастрофическим последствиям для составов многочисленных видов, даже видов, широко распространенных в датских водах.

10) Датские воды играют важную роль для ряда видов утиных Западной Европы. Необходимым условием для дальнейшего существования этих видов является принятие мер для ограничения постоянных небольших загрязнений датских вод, и нужно быть наготове эффективно ограничить последствия возможной катастрофы танкера в будущем.

Appendix 1. List of all oil-pollution incidents in three years (1st July 1968 - 30th June 1971) each involving more than 100 birds (see Fig. 5). For »District» and »Category» see JOENSEN 1972, Appendix 1, Fig. 1 and page 6.

Appendix 1. Liste over olieforureninger i tre år (1. juli 1968 - 30. juni 1971) hvor med mere end 100 fugle involveret (se Fig. 5). M. h. t. »District» og »Category» se JOENSEN 1972, Appendix 1, Fig. 1 og side 6.

Приложение 1. Перечень всех случаев загрязнения нефтью в течение трех лет (с 1 июля 1968 по 30 июня 1971 г.), каждым из которых было затронуто более 100 птиц (см. Фиг. 5). Относительно »District» и »Category» см. Joensen 1972, Приложение 1, Фиг. 1 и стр. 6.

Period	Month Måned	Area Område	District Distrikt	Category Kategori	No. Antal	Remarks. Bemærkninger
1.7.1968-30.6.1969	11	Bastholm, Lillebælt	IX	D	Hu	oiled birds seen, at least 30 shot.
	1	Hals	V	D	> 100	oiled birds seen, at least 60 shot.
	1-2	Amager	XIII	D	Hu	several hundred <i>M. serrator</i> on W side, many swans and diving ducks on E side of the island oiled. At least 75 shot.
	1-2	Bornholm	XIV	D	> 100	shot.
	1-3	Islands S of Funen	XI	C	1500-2000	> 850 were shot on Langeland, Ærø, Billes Grunde and Fåborg. Observations of oiled birds: Langeland > 500, Ærø > 400, Billes Grunde > 200, Lyø > 200, Fåborg ca. 100, Hørne Land > 150. Mostly <i>S. mollissima</i> and <i>M. nigra</i> , also <i>M. fusca</i> , <i>Cl. hyemalis</i> , <i>M. serrator</i> and <i>A. tarda</i> . No special survey was undertaken, but according to several observers the total number of birds lost was probably > 2000.
	2-3	N Sealand	VII	A	> 10.000	see special report p. 6.

Period	Month Måned	Area Område	District Distrikt	Category Kategori	No. Antal	Remarks Bemærkninger
1.7.1969-30.6.1970	8	Fed, Præstø Fjord	XIII	D	150-250	137 birds were shot including <i>A. platyrhynchos</i> , <i>M. nigra</i> and <i>Larus</i> sp.
	11-12	Bornholm	XIV	D	> 100	oiled birds seen, at least 50 shot Gudhjem-Nekse.
	12	Issefjord	VII	D	> 150	<i>M. nigra</i> and <i>M. fusca</i> shot.
	12	Køge Bugt	XIII	D	162	birds shot at Køge.
	12	Læsø-Vendsyssel	V	B	> 5000	special report p. 7.
	1	Langlandsbæltet	XII	D	Hu	> 50 shot.
	1	Grønsund	XII	D	> 100	shot.
	1	Nivå Bugt	XIII	D	Hu	50-100 birds shot.
	1-2	Stevns, Faxe	XIII	D	> 200	birds shot.
	1-2	Hjarnø etc.	VIII	D	50-150	birds shot.
	1-2	Assens	IX	D	> 100	birds shot.
	1-2	Gedser etc.	XII	D	> 100	oiled birds seen, > 50 shot.
	1-3	Bornholm	XIV	D	Hu	at least 300 shot, probably more than one pollution.
	1-3	Sejerø	VIII	D	> 100	birds shot.
	2-3	E coast of Jutland	V, VI, VIII	A	> 12.000	see special report p. 8.
	2-3	Odense Fjord	VIII	D	> 100	oiled birds seen, mostly <i>M. nigra</i> and <i>M. fusca</i> .
	3	Nykøbing Falster	XII	E	abt. 100	oil from sewer polluting harbour. About 100 <i>C. olor</i> were oiled and died.
1.7.1970-30.6.1971	7	Saltholm	XIII	D	> 120	About 50 <i>C. olor</i> , 30-40 <i>M. serrator</i> , a few <i>T. tadorna</i> and several <i>Larus</i> sp. oiled.
	7	Thyborøn-Blokkhus	III	D	abt. 100	birds oiled. At Uggerby 25 <i>M. nigra</i> were shot. Elsewhere only small flocks of oiled birds (<i>M. nigra</i> and <i>Larus</i> sp.).
	12-1	Bornholm, E, S, W	XIV	D	150-250	found dead along SE coast in Dec. 1970. > 100 oiled birds seen at W and S coast in Jan. 1971, several of which were shot (mostly <i>Cl. hyemalis</i>).
	12-1	S. Kattegat	VIII	A	> 15.000	see special report p. 9.
	1-2	Langeland	XI	D	> 150	shot.
	2	Nakskov	XII	D	100-200	more than 100 oiled birds, mostly <i>M. nigra</i> and <i>M. fusca</i> . Several shot.
	3	Djursland-Anholt	VI	C	ca. 1500	see special report p. 11.

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