

Firth of Forth Oil Pollution Incident, February 1978

L. H. CAMPBELL, K. T. STANDRING and C. J. CADBURY

The Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire

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Where seaducks and other waterfowl are highly concentrated, even small quantities of oil can be a major hazard. A pollution incident on the Firth of Forth in February 1978 was notable in that it affected 241 Great Crested Grebes *Podiceps cristatus* (a high proportion of those present at the time) as well as 700 diving ducks. Evidence is provided indicating that the slick passed close to the main wildfowl feeding area at night, oiling nocturnal-feeding Scaup *Aythya marila* and Pochard *A. ferina* and a raft of roosting grebes, while Eider *Somateria mollissima* and Goldeneye *Bucephala clangula*, which had moved elsewhere to roost, largely escaped. The behaviour of freshly oiled birds is described. Heavily oiled Pochard flew 7 km inland to a loch before they were incapacitated. This is the sixth oil pollution incident to affect a large number of birds on the Forth since January 1970.

The southern shore of the Firth of Forth between Leith and Cockenzie (southern Scotland) is a well-known site of international importance for wintering wildfowl (Thom, 1969; Milne & Campbell, 1973; Pounder, 1976; Campbell, in press). Large flocks concentrate at Leith and Seafield in the vicinity of Edinburgh's three main sewer outfalls (Fig. 1). Although peak numbers have

decreased since the late 1960s the area still holds in excess of 15 000 birds in mid-winter. Scaup *Aythya marila*, Eider *Somateria mollissima*, Goldeneye *Bucephala clangula* and Pochard *Aythya ferina* (which commute at night from Duddingston Loch) are the most numerous species. In addition to small populations of scoters *Melanitta nigra* and *M. fusca* and Long-tailed Duck *Clangula hyemalis*, there are also important gatherings of Great Crested Grebes *Podiceps cristatus* both at Seafield and at Cramond (Fig. 1). Over 700 of these grebes have been recorded in the Forth in recent winters.

On the north shore, the Methil-Largo Bay area (Fig. 1) is also of considerable importance for wintering wildfowl and regularly holds peak numbers in excess of 6000 birds; Eider, Scaup and scoters are the main species. In addition, the East Lothian coast from Cockenzie to North Berwick (Fig. 1), holds small, but probably important winter populations of Red-throated Divers *Gavia stellata* (maxima of over 100), Slavonian Grebes *Podiceps auritus* and Red-necked Grebes *P. grisegena* (maxima of 50–100 each). Offshore waters within the Forth are also important feeding areas in winter for Guillemots *Uria aalge* and Razorbills *Alca*

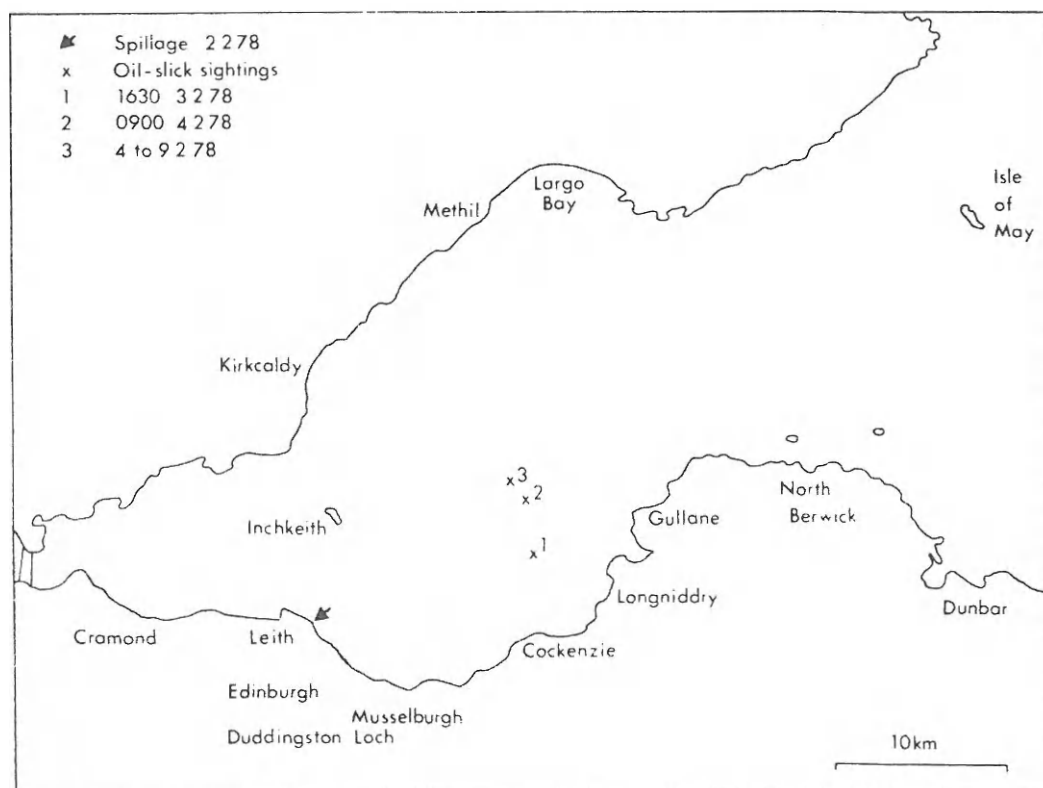


Fig. 1 Map of the outer Firth of Forth, showing the point of oil-spillage and subsequent sightings of oil-slicks.

TABLE 1

Oil pollution incident affecting numbers of birds in the Firth of Forth since January 1970.

Date	Minimum numbers affected	Main species involved	Area	Type of oil	Source
Jan. 1970	c.1000 ¹	Auks, Eider	Outer Forth	Heavy fuel	Unknown (outside Forth)
Feb. 1972	281	Scaup, Eider	South	Diesel	Unknown
Jan. Feb. 1975	275	Scaup, Eider	Largo Bay	Diesel	Unknown
Dec. 1975	850	60 Eider, many waders & gulls	South	Medium-heavy fuel	Onshore installation?
Jan. 1978	249 (18 spp)	Inc. 57 Eider, 42 Goldeneye, 9 Great-Crested Grebes	South	Medium-heavy fuel	Onshore installation
Feb. 1978	1387 (27 spp)	Great-Crested Grebes, Scaup, Pochard, Guillemots, Razor-bills	Mainly South & Largo Bay	Medium-heavy fuel	Industrial premises

¹ Part of a much larger number involved in this incident which extended from Yorkshire to Aberdeenshire.

² South implies the shore between Leith and Aberlady Bay.

torda, Cormorants *Phalacrocorax carbo*, Shags *P. aristotelis* and Red-breasted Mergansers *Mergus serrator*. The distribution of these species is variable but they are known to concentrate to feed over shoals of Sprats *Clupea sprattus* during the January–March period. Auks, Cormorants and Shags also breed on islands in the outer Forth and are present throughout the year.

With steadily increasing shipping activity, a crude oil trans-shipment terminal, a major oil refinery and petrochemical complex, three power stations with jetties for loading oil, as well as a number of industrial premises on its shores, the Forth has many potential sources of oil spills. Over a number of years, concern has been expressed over the extreme vulnerability of the large concentrations of seaduck and other waterfowl in the area to such pollution (Bourne, 1972).

The recorded history of oil pollution incidents in the Firth of Forth extends back to 1919 (RSPB, 1920). Since January 1970 there have been five oil spill incidents other than the one which is the subject of this paper (Table 1).

On 2 February 1978, a small quantity (c. 250 gallons) of medium/heavy fuel oil was spilled within industrial premises at Leith Docks and some of this eventually entered the sea, via a surface water drain, at the north-east corner of the docks (Fig. 1). This spillage was not reported but the next morning, during a routine seaduck census, one of us (LHC) became aware of unusual numbers of oil-affected birds in an area east of Leith towards Musselburgh. Simultaneously, the Royal Society for the Protection of Birds (RSPB) began to receive reports of sick birds from members of the public. During the following week many oiled birds were recovered and destroyed by the Scottish Society for the Prevention of Cruelty to Animals (SSPCA), on the shore between Leith and Cockenzie. Oiled birds were also reported elsewhere in the Forth, particularly in Largo Bay (Fig. 1). Close cooperation between the RSPB, Nature Conservancy Council, SSPCA, the East Lothian District Council ranger service and the Birds of Estuaries Enquiry counters ensured that most of the coastline east of the Forth bridges was covered during the week following the spillage. A further count of dead

TABLE 2

Oiled birds recorded in the Firth of Forth, 3–19 February 1978.

	Total oiled ¹	Dead
Black-throated Diver <i>Gavia arctica</i>	1	1
Red-throated Diver <i>G. stellata</i>	20	2
Great Crested Grebe <i>Podiceps cristatus</i>	241	200
Red-necked Grebe <i>P. grisegena</i>	2	2
Slavonian Grebe <i>P. auritus</i>	3	
Little Grebe <i>Tachyhaptus ruficollis</i>	1	1
Glannet <i>Sula bassana</i>	4	4
Cormorant <i>Phalacrocorax carbo</i>	1	1
Shag <i>P. aristotelis</i>	1	1
Mallard <i>Anas platyrhynchos</i>	1	1
Scaup <i>Aythya marila</i>	220	130
Tufted Duck <i>A. fuligula</i>	11	2
Pochard <i>A. ferina</i>	244	74
Goldeneye <i>Bucephala clangula</i>	26	18
Velvet Scoter <i>Melanitta fusca</i>	2	
Common Scoter <i>M. nigra</i>	23	4
Eider <i>Somateria mollissima</i> ²	179 (90 + 49)	72 (32 + 11)
Red-breasted Merganser <i>Mergus serrator</i>	9	4
Duck spp.	12	12
Oystercatcher <i>Haematopus ostralegus</i>	2	2
Herring Gull <i>Larus argentatus</i>	46	3
Common Gull <i>L. canus</i>	16	5
Black-headed Gull <i>L. ridibundus</i>	130	15
Kittiwake <i>Rissa tridactyla</i>	14	8
Razorbill <i>Alca torda</i> ³	68	68
Little Auk <i>Plautus alle</i> ³	5	5
Guillemot <i>Uria aalge</i> ³	100	100
Puffin <i>Fratercula arctica</i> ³	1	1
Auk spp. ³	4	4
	1387 (27 sp.)	740 (25 sp.)

¹ Total oiled is a synthesis of the optimum count of live oiled birds on 5 February plus birds known to have died on 3 and 4 February, together with obvious additions recorded during the period 6–19 February inclusive. Dead birds are included in these totals. Possible duplications have been excluded.

² Figures in parenthesis refer to Eiders which may have been oiled in two other incidents: in Largo Bay and in Aberlady/Gullane Bays respectively. These birds have been included in the totals.

³ Auk totals are for dead birds only.

birds was undertaken over the weekend of 18/19 February by RSPB Beached Bird Survey volunteers. Counts to 19 February indicate that a minimum of 1387 birds of 27 species were oiled, of which 740 of 25 species were known to have died. About 700 of the contaminated birds were diving ducks, and 241 were Great Crested Grebes. 178 auks are known to have died in the incident. Full details of the species and numbers affected during this period are given in Table 2.

The incident was of particular interest in demonstrating the differential vulnerability of various species in relation to their behavioural patterns and the timing of the movement of the oil slick. It also provided useful information on the behaviour of freshly oiled birds.

Table 3 shows the results of two comparable surveys carried out during the first two days of the incident. The first shows the numbers of the main species estimated to be present and the second the number of oiled birds observed.

These early surveys clearly showed that while few Eider and Goldeneye were oiled, the Scaup and Pochard population suffered more severely and the Great Crested Grebes were seriously affected. These differences can be explained in terms of the known behaviour

TABLE 3
Results of bird surveys between Leith and Musselburgh

Species	Numbers counted 3 Feb. '78 (census by L.H. Campbell)	Numbers oiled 4 Feb. '78 (survey by L.H. Campbell, R. Keymer & M. Nelson)
Great Crested Grebe <i>Podiceps cristatus</i>	178	143
Scaup <i>Aythya marila</i>	1074	80
Pochard <i>A. ferina</i>	2300 (458 on sea, rest at Duddingston Loch)	240 (218 at Duddingston)
Eider <i>Somateria mollissima</i>	1976	16
Goldeneye <i>Bucephala clangula</i>	1051	2

patterns of the different species. Moreover, the data also indicate the probable movements of the oil following the spillage.

Day and probable night flock distribution patterns are shown in summarized form in Figs. 2 and 3. Eider and Goldeneye are present in the Leith and Seafield area throughout the day but towards dusk the Eiders move off-shore or north-eastwards to unknown night roosting areas, while the Goldeneye flight east to roost inshore off Portobello and Musselburgh. The majority of Scaup and any Pochard not inland at Duddingston Loch spend most of the day resting in the bay west of the Seafield sewer and eastwards towards Portobello. At night both the Scaup and the Pochard, including those from inland, are believed to feed near the sewers and over the shallow, sewer-enriched inshore areas. More dense flocks may form over breaks in the sewer pipes where Goldeneye and day-feeding Pochard regularly occur. Great Crested Grebes feed throughout the day over a wide area between Leith and Cockenzie but in the late afternoon they tend to gather east of the Seafield sewer outfall, forming tight flocks, often closely associated with resting Scaup. They are believed to remain in this area overnight. Fuller details of seaduck distribution are given by Campbell (in press).

The following facts indicate that the slick passed close to the main feeding areas of the seaduck east of Leith after dusk.

- Low numbers of Goldeneye and Eider were affected, suggesting that most of those present during the day had moved elsewhere to roost.
- The majority of the Great Crested Grebes present at the time in the Leith-Cockenzie area were heavily oiled, indicating that they had been contaminated when roosting gregariously.
- Not only Scaup but a number of Pochard were oiled. The majority of the Pochard only frequent the Forth at night, except when Duddingston Loch is frozen overall.

The fact that only about 20% of the Scaup and 10% of the Pochard were oiled indicates that the scattered small flocks feeding east and west of the Seafield sewer outfall were affected, while the dense concentrations feeding inshore over breaks in the sewer pipes escaped.

TABLE 4
Analysis results of oil samples from the Forth of Forth, February 1978.
(Data courtesy of the Government Chemist.)

Sample	Location	Date	Oil characteristics ¹
A Drain outfall (near source of spill)	Leith Edinburgh	4.2	Medium heavy fuel oil, all samples similar and distinct from oil spilled in January 1978 (see Table 1)
B Scaup (plumage)	Seafield Edinburgh	3.2	
C Offshore slick	6 km E of Inchkeith	9.2	
D Guillemot (plumage)	Elie, Fife	7.2	
E Beach	Longniddry E. Lothian	14.2	Fuel oil, severely weathered
F Eider	Largo Bay, Fife	11.2	
G Beach	Ruddon's Point, Fife	28.2	Fuel oil, trace of petrol (different from A-E)

¹ Oil samples examined by gas-liquid and thin-layer chromatography.

This suggested track of the oil is consistent with tidal conditions over the period. A possible timetable of the slick's movements is as follows. The initial spillage occurred at 10.20 h after high tide at 08.59 h. Although it is not exactly known when the oil first entered the sea it did not pass inshore of or as far east as the Eastern Craigs (Figs. 2, 3) before the tide began to turn. On the incoming tide in late afternoon the slick probably remained off the northeast corner of the Leith docks. After high tide (21.35 h), the oil was carried eastwards, over the Eastern Craigs and past the Seafield sewer. Subsequent movement is less easily inferred but a slick was reported at 16.30 h on the following day (3 February) about 3 km north of Cockenzie and further offshore in the centre of the Forth between 4 and 9 February (Fig. 1). It thus appears that the bulk of oil passed quite rapidly through the main wildfowl wintering area.

There was some evidence of secondary oiling of gulls near to the point of discharge (3 oiled among 610 on 4 February, increasing to 181 (20%) out of 892 on 5 February), probably resulting from oil being lifted off the dock wall. However, the majority of the birds oiled at Leith and Seafield appear to have been affected during the 24 h following the spillage.

Birds were also contaminated when the slick drifted offshore. Following the appearance of live oiled auks along the Fife and East Lothian coasts on 5 February, one of us (KTS) observed 39 (27%) oiled birds out of a total of 245 Guillemots and Razorbills on the island of Inchkeith and to the east of it on 8 and 9 February. Oiled Red-throated divers in a roosting flock of about one hundred at Gullane on 5 February (E and S da Prato, pers. comm.) were probably affected by the same slick.

Analysis by the Laboratory of the Government Chemist of oil samples from the drain outfall at Leith, a Scaup from Seafield, the slick 6 km east of Inchkeith, a Guillemot from the Fife shore and the beach at

Longniddry, East Lothian, showed that all were medium/heavy fuel oil of a matching type (Table 4).

90 oiled Eiders in Largo Bay from 6 February are less easily explained. Oil from one of these birds was too weathered to be compared with the other analysed samples. The absence of equivalent numbers of oiled seaducks of other species suggests that the Eiders were not oiled in the bay itself.

Many of the birds which came ashore during the first two or three days following the spillage, although heavily oiled, were in good bodily condition and returned to the water when approached. While the grebes tended to make for the sand and shingle beaches, the oiled ducks scrambled out onto the sewer pipes, the rocky shores and particularly an old seawall within the Musselburgh lagoons, up to 5 km from where they were probably oiled. A few were observed as far as 26 km from Leith. The majority of contaminated Pochard were able to flight back to Duddingston, 7 km away, shortly after contact with oil, showing that heavily oiled birds may be able to move considerable distances in a short time before they become incapacitated. Although some of the Pochard were later found dead on the coast, many were apparently unable to return to feed in the estuary and subsequently died on the loch.

Apart from demonstrating the importance of detailed knowledge of bird behaviour in assessing the impact of an oil pollution incident, this event provided a dramatic example of how even small amounts of oil can be a serious hazard to densely concentrated bird populations. Had the oil passed eastward through the Seafield area in daylight fewer Great Crested Grebes and Pochard might have been contaminated, but the numbers of oiled Eider and Goldeneye would have been greater and at least as many Scaup would have been affected. Moreover, had the incident occurred in December or early January, when larger populations of Scaup and grebes are present, the scale of the mortality would have been magnified.

The possibility of preventing oil from entering the sea via the dock surface water drainage system existed. However, once the oil reached the Forth, active disturbance of the bird flocks at Leith and Seafield, a hazardous operation at night, could perhaps have reduced the

effects on the grebe population but might have displaced large numbers of Scaup into the path of the slick.

This incident alone is unlikely to have long term effects on the duck populations in view of the large numbers elsewhere in northwest Europe. The Great Crested Grebes wintering on the Forth may, however, represent a substantial proportion of the Scottish breeding population, which Smith (1974) estimated to be about 150 pairs. No other large wintering concentrations are known in Scotland. Judging by the white on the greater coverts (Kop, 1961), only 9 out of a sample of 34 oiled Great Crested Grebes that died on the Forth in February 1978 were considered to be adults. It should be pointed out that, over three weeks after the incident, a census by LHC on 27 February revealed not only 126 unoiled birds between Cramond and Leith but a further 435, also unoiled, between Leith and Musselburgh. This influx probably resulted from the cold spell of weather in mid-February.

The new disposal scheme for Edinburgh's sewage effluent, to come into operation in the next few years, may result in diminished concentrations of waterfowl at Leith and Seafield and thus reduce the hazard of oil pollution in this area.

We wish to thank the many people who helped to assess the number of birds oiled in this incident. Mr Dennis Green of the Department of Industry's Laboratory of the Government Chemist analysed the oil samples. We appreciate being allowed to quote the results. Mr. Anthony Bell of Monks Wood Research Station examined the plumage of a number of oiled Great Crested Grebes to assess their age, and the Institute of Terrestrial Ecology kindly allowed us to use the data.

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CONFERENCE

Monitoring the Monitors

Was it through mere misfortune or careless planning that the symposium 'Monitoring the Marine Environment', arranged by the Institute of Biology and held in London 28-29 September, should coincide not only with spring tides, but also the 13th European Marine Biology Conference at the Isle of Man, the Anglo-French symposium

'Biology of Molluscs of the Atlantic Ocean', and was followed two days later by the Oikos/NCE conference 'The Use of Ecological Variables in Environmental Monitoring'? But for those unable to be in London, there was at least a second chance of hearing Dr. R. Mitchell expound the Nature Conservancy Council's strategy for site selection of U.K. intertidal conservation areas, since a repeat performance of his paper was on the programme of