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ORNIS SCANDINAVICA 12: 261–265. Copenhagen 1981

# An experiment on the recovery of dead birds from the North Sea

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Bibby, C. J. 1981. An experiment on the recovery of dead birds from the North Sea. – Ornis Scand. 12: 261–265.

Dead gulls marked either with leg rings or bill tags were dropped in the North Sea to simulate a mortality incident. Recovery rates were 0.3% for rings and 19.3% for the more durable and conspicuous tags. Recovery places were mainly in Norway but spread between 58° and 70°N. Reports were also spread over a long time with a median interval of 142 d. Most bodies had probably decomposed in six months and many in less so many reports probably referred to plastic markers alone.
The distribution of recoveries was broadly in line with that predicted by wind vector analysis. Bodies moved at 11.9% of the wind speed as measured at Bergen, but it was 3.0 times more windy in the North Sea, so the real relative drift rate was 4.0%. It is concluded that a major bird mortality incident in the North Sea would not readily be detected or measured by emergency beached bird surveys.

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## Introduction

For many years, the effects of oil pollution on birds have been assessed by counts of beached birds in various north European countries (Bourne 1976 and references therein). Historically, the major sources of oil have been in shipping lanes fairly close to land. In recent times, development of fields in the North Sea has produced fears of accidental oil discharges in new and remoter areas where birds may be seasonally abundant though rather little is known of them.

What detectable effects might arise from a large bird-kill in the North Sea? Any birds killed would have to drift a long way before reaching land and unless they moved south and west towards Scotland and England, they might come ashore on the heavily dissected and thinly populated coasts of Norway where beached bird counts are not very practicable. The present experiment aimed to illuminate the problem, by dropping dead marked birds in the North Sea and assessing their subsequent recoveries.

## Methods

Six batches, each of 100 dead gulls mainly *Larus argentatus* and some *L. fuscus* were dropped at uniform intervals into the North Sea from a Newcastle-Bergen ferry between 2000 hours on 16 February 1976 and 0945 on 17 February (Fig. 1). The bodies had been stored in deep freeze since their death in a poisoning campaign the previous summer.

In each batch, 50 birds were marked with ordinary bird rings issued by the British Trust for Ornithology. The other 50 were marked with a sealed plastic specimen tube (75 × 25 mm, weight 17.4 g) tied with nylon through the nares. The tubes were painted bright yellow, with the words 'open' and 'attention' painted in black. Inside, each contained a sheet of paper bearing a unique reference number and requesting return with details of finding place and date. The coordinates of each recovery were measured as accurately as possible from the described finding place. Displacements and tracks were then computed trigonometrically.

Accepted 14 October 1980

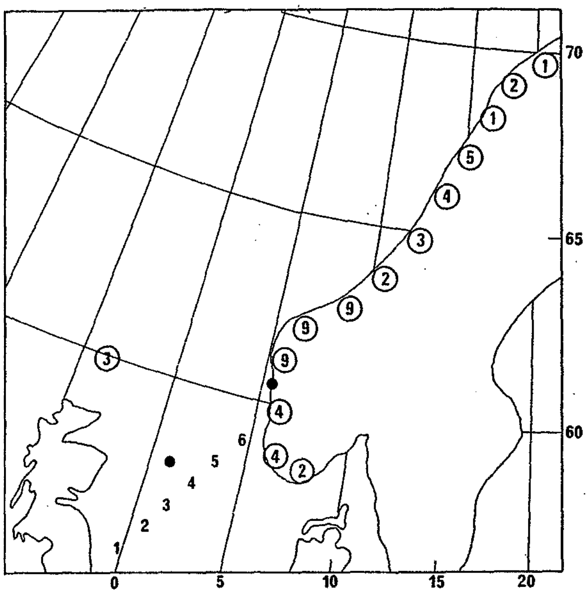


Fig. 1. Map showing location of the six points at which bodies were dropped. Wind data were collected at the Forties oilfield and Bergen, marked as dots. Numbers within circles denote number of recoveries.

Wind records from Bergen Airport were supplied by the Norwegian Meteorological Institute in the form of hourly mean strengths and directions to the nearest ten degrees. Over the period from the drop to 30 April winds were added vectorially on a daily basis to investigate the effects of wind on speed and direction of drift of the bodies. Spot recordings of the wind speed taken daily at 0700 hours at the forties oilfield (57°44′N 0°55′E) were used to check whether the Bergen readings might be good measures of winds in the North Sea.

## Results

### Distribution and timing of recoveries

The overall recovery rate was 9.8% (59/600), with no significant variation between dropping sites ($\chi^2_5 = 5.78$).

All but one of the recoveries were of birds marked with bill tags, so these had a recovery rate of 19.3% (58/300) compared with only 0.3% (1/300) for ringed birds ($\chi^2_1 = 55.07$, $P < 0.001$).

Most bodies were reported from the west coast of Norway between latitudes of 58°N and 69°N. Three were found in the Shetlands and none elsewhere (Tab. 1). There were no systematic differences of recovery place between the six drops. The most distant bodies had moved well into the arctic with displacements of 1000–2000 km.

The first recovery was reported after 11 d, and the last in November 1978, two years and nine months later. Fig. 2 shows that the timing of recoveries broadly coincided with the exponential pattern that would be expected. The median delay to reporting was 142 d with quartiles of 58 and 349.

Were these long delays a reflection of the time for corpses to travel large distances or the time for them to be reported once ashore? The relationship between displacement and elapsed time is shown in Fig. 3. Overall there was a small but significant correlation between displacement and time ($r_{55} = 0.369$, $P < 0.005$), though considering the first 100 d alone, there was not ($r_{21} = 0.351$, $P \sim 0.10$). Although the fastest moving bodies had covered more than 1000 km in the first 100 d, recoveries at displacements below 400 km continued to be reported in the next year. Recoveries reported after the first year were however more displaced than those reported previously ($t_{54} = 2.78$, $P < 0.01$). This was

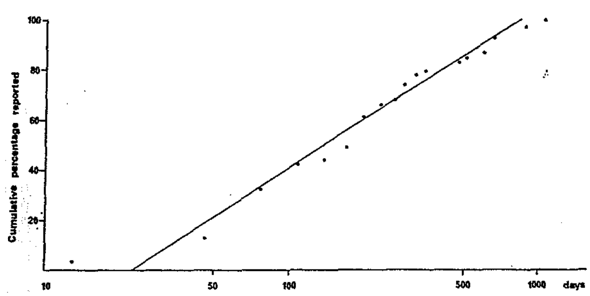


Fig. 2. Cumulative percentage of recoveries reported by elapsed time. Fitted line $y = 27.8 \ln x - 87.8$.

Tab. 1. Finding places of all birds recovered from 100 in each drop. All recoveries from the west coast of Norway except three from drop 1 in the Shetlands. See Fig. 1 for locations.

| Drop No. | Latitude °N 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 3 | 1 | 1 | 2 | | | 1 | | | | | 8 |
| 2 | | | | | 1 | 3 | 2 | 1 | | | | 1 | 1 | 9 |
| 3 | 2 | 3 | 2 | 1 | 2 | 3 | | | | 1 | 1 | | | 15 |
| 4 | | 1 | 2 | | | 1 | | 2 | 2 | 3 | | | | 11 |
| 5 | | | | 2 | | | | | 1 | 1 | | 1 | | 5 |
| 6 | | | | 5 | 5 | | | | | | | | | 11[1] |

1. One recovery from drop 6 on 'west coast of Norway'.

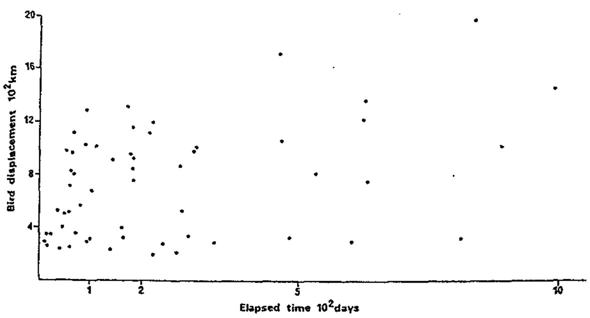


Fig. 3. Displacement of corpses plotted against time elapsed before their reporting.

because of a lack of the shorter possible movements rather than a further extension of recovery range (Fig. 3).

### State of bodies

With such long periods before reporting it was natural to enquire whether it was bodies or merely the bill tags that were being reported. Regrettably, this information was not requested on the enclosed forms but in five cases it could be inferred that there was a bird and in six that there was only the tube with fragments of bird attached. The dates of these reports (Tab. 2) show that birds could have disintegrated in as little as 35 d but one was still reported as a body after 170 d. There was no significant difference in the timing of reporting of bodies and of tubes alone (Mann-Whitney U-test). Thus, it is impossible to know whether it was bird bodies or tubes that were being found and reported, but it is probable that a high proportion of the later reports were of tubes alone.

### Effect of the wind

The wind vector measured at Bergen from the drop in mid-February to the end of April 1976 is shown in Fig. 4. In orientation, this broadly predicted the observed pattern of recoveries. In the first five weeks until 27 March the total vector departed little from due north which accounts for recoveries in Shetland from drop one only. Birds from drop six came ashore on the north-south oriented coast of Norway south of 62°N. All other birds would have avoided either coast and travelled into the open Norwegian Sea. In the last few days of March and again in late April, the winds had westerly and even northerly components sufficient to beach corpses in places well to the north and slightly to the east of their origins. Some of the easterly movement might have been due to the North Atlantic Drift, but no allowance was made for this. Because of expected cumulative errors it was not felt appropriate to sum the wind vectors over a longer period.

How fast did the corpses move in relation to the wind? Fig. 5 shows the displacement of all bodies reported before 30 April 1976 plotted against the resultant wind movement in the period up to midnight before the day each was reported. It is presumed that corpses

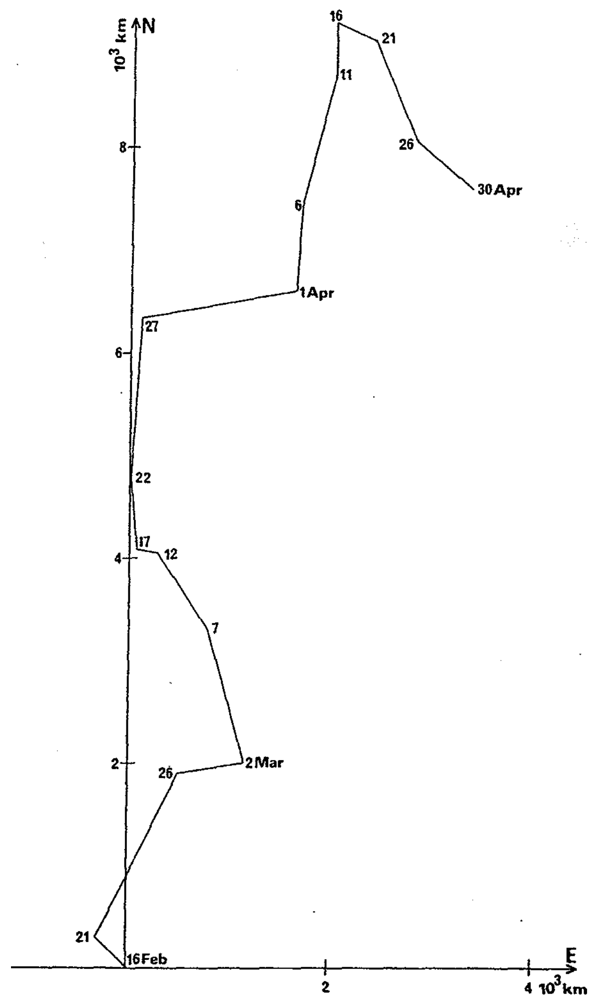


Fig. 4. Cumulative wind vector at Bergen Airport plotted at 5-d intervals. Dated points show the resultant at midnight on that day.

Tab. 2. State of body where known. All dates but one refer to 1976, following the drop on 16–17 February.

| | | | | | | |
|---|---|---|---|---|---|---|
| Bird present: | 28 Feb | 10 Apr | 4 May | 18 May | 5 Aug | |
| Bill tag only: | 23 Mar | 11 Apr | 23 May | 6 Jun | 2 Aug | 8 Oct 77 |

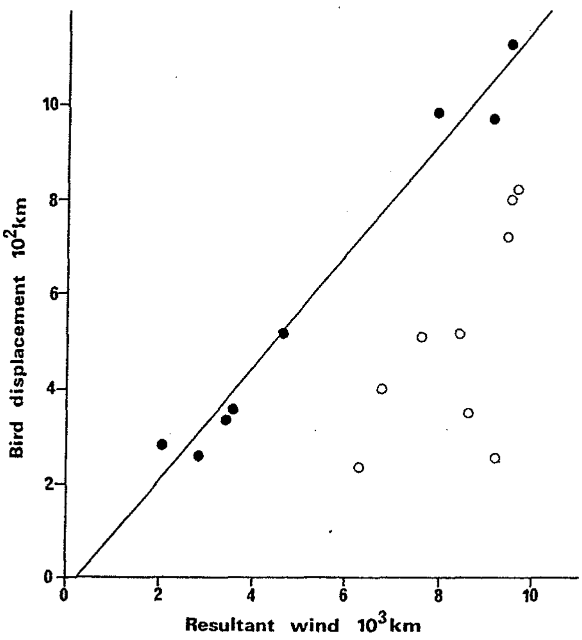


Fig. 5. Displacement of corpses recovered before the end of April 1976 plotted against the resultant wind at Bergen from the drop time to the end of the day before the body was reported. The line $y = 0.1187\,x - 32.2$ is fitted to the eight points shown in black, which were selected for reasons explained in the text.

showing the greatest ratio of total displacement to total wind were those reported soon after reaching land. Those with less displacement relative to the resultant wind had probably been ashore a while before discovery and were stationary while the wind blew on. The group of eight fastest moving birds showed a narrow range of drift rates with respect to the wind over a range of displacements of 300–1100 km. From a regression calculation, the mean rate of corpse drift was 11.9 ± 0.7% of the wind speed.

Such a drift rate was unexpectedly fast so a comparison was made between the winds at Bergen and in the North Sea. The latter were instantaneous values recorded once per day at 0700 hours on the BP Forties field. Wind strengths at Bergen and in the North Sea were correlated ($r_{71} = 0.591$, $P < 0.001$), and over the period to the end of April it was 3.0 times more windy at sea than on the coast. Thus corpses were estimated to have moved at 4.0% of the actual wind speed or 11.9% of that recorded at Bergen.

## Discussion

As in previous experiments (Bibby and Lloyd 1977) the wind was found to account for the distribution of recoveries without major discrepancy. Measurements in the North Sea, overlapping with the area of this experiment have confirmed that residual water movements here are mainly wind determined (Riepma 1978). The rate of drift at 4.0% of the wind speed was broadly in line with previous estimates of 2.2% (Hope Jones et al. 1970) and 2.55% (Bibby and Lloyd 1977), though the latter found some bodies moving as fast as 4.6%. These other results were obtained in the Irish Sea where timed journeys were mainly less than 100 km accomplished in less than ten days, thus leaving more chance for error caused by delayed finding after landing. As yet, no one has measured the drift rate of corpses with respect to the wind by a more direct method. This would obviously be desirable to test previously published observations. Results from this experiment emphasize a major difference between wind strengths in the North Sea and at Bergen Airport on the Norwegian coast. The importance of this difference hardly need be mentioned to anyone attempting to calculate tracks of bodies in an oiling incident. The use of wind data from a coastal station is thus open to criticism both in analysing this experiment and for future interpretation of patterns of beached birds. Systematic wind data are not however available from sea areas.

The spread in distance (Tab. 1) of recoveries was greater than expected. This was perhaps facilitated by the coincidence of a wind blowing approximately parallel to a long coastline. The fact that from any drop, recoveries could be spread over 1000 km or more seems a good indication that not all corpses were beached at the point where they first reached land, or they were beached and then subsequently taken back to sea. The factors which influence the probability of a corpse actually being beached once just offshore remain unknown.

Coincident with a great spread in distribution of recoveries was their spread in time (Fig. 2). This was not caused by the large distances travelled, since after ten weeks of the experiment, the expected displacement of corpses still at sea was 1100 km or sufficient to account for the movements of all but eight of the recoveries. Since most of the corpses could have been onshore within ten weeks, and since, if they were not, they would have drifted further north, continuing reports at displacements below 500 km spread over a whole year is taken to indicate that bodies or bill tags were ashore but unnoticed for long periods. The tendency for the very long delayed reports (over a year) to be well displaced (Fig. 3) may indicate some further movement of bodies or tags that had previously been ashore. Perhaps they were taken back to the sea in stormy weather.

The overall recovery rate of birds was difficult to compare with previous findings. At 0.3%, the recovery rate of rings was low, even compared with rates for live birds. By comparison, the recovery rate of almost 20% for birds marked with bill tags was good compared with previous findings: 10% of gulls dropped in the Bristol Channel (Beer 1968), 25% of Shags *Phalacrocorax aristotelis* known to have died in Northumberland (Coulson et al. 1968), 11%, 44% and 58% in separate drops of gulls (Bibby and Lloyd 1977) and 20% of auks (Hope Jones et al. 1970) in the Irish Sea. Evidently most people in Norway, and presumably elsewhere, are remarkably interested in man's artifacts on the tideline and somewhat averse to rotting bird corpses.

How then in the light of these results would a major bird-kill in the north North Sea reveal itself? With sufficient wind in the appropriate directions, the birds would come ashore even if drifted towards the Norwegian coast. The direction of the wind could be taken as a good predictor of the tracks of corpses. Their velocity might be up to 12% of that of the wind measured from a coastal station. If the drift was to any extent parallel to a coast, a large spread of recovery places could be expected even from a concentrated source of dead birds. Although the oil causing the mortality might denature and disappear without coming ashore a large proportion of the dead birds would eventually come ashore. The time for which they would remain detectable is unknown. Their spread in time and place as well as their unpleasant nature would, no doubt, ensure that they attracted rather little public attention. Emergency arrangements by ornithologists as carried out for coastal tanker accidents such as the wreck of the Amoco Cadiz (Hope Jones et al. 1978) and many others would not be profitable. An incident well offshore in the North Sea would give an impression more like the 'chronic' oil pollution detected by routine systematic beached bird surveys. The situation should thus be monitored by ensuring the continuation and extension of such surveys especially in Scotland and Norway. Cognisance should be given to the winds preceding such counts before interpreting the results. More attention should go to typing the oils on birds found in such surveys, to discriminate between possible sources.

*Acknowledgements* – I am indebted to C. S. Lloyd who, assisted by G. J. Thomas executed the experiment. Meteorological data were provided by the Norwegian Meteorological Institute and BP Petroleum Development Ltd.

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