Ten years of intensive late-winter surveys for waterfowl corpses on the north-west shore of the Wash, England

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Introduction

The exceptional severity of the weather in western Europe during early 1963 lead to many studies of its effect on waterfowl populations. One contribution (Pilcher, 1964) was based on a survey of waterfowl corpses at the end of that cold spell. It was clear that the Shelduck and Redshank* had suffered severe losses, but detailed analysis was not possible because of lack of data on the numbers of waterfowl then frequenting the Wash—a notoriously difficult area to 'count' thoroughly.

Nowadays we have the Birds of Estuaries Survey, jointly organized by the Royal Society for the Protection of Birds, the British Trust for Ornithology and the Wildfowl Trust (see e.g. Prater, 1973) and a much clearer picture is emerging of present populations. The Wash is being especially thoroughly surveyed in connection with proposals for bunded water storage reservoirs along its coast. The effects of a future severe cold spell will therefore be relatively easy to assess. However, data on present-day populations can give but little indication of those passing through or staying in the Wash area during the winter of 1962–1963.

It was therefore decided to repeat the corpse count over the same stretch of coast for 9 more years, until 1972. This 10-year run of data would include the period in which populations severely affected by the cold-induced mortality should recover to normal levels. It would also be long enough to see how other factors such as wind and tides would vary the number of corpses beached in winters of comparable severity.

Since 1969 the Royal Society for the Protection of Birds has been organizing a much more extensive, indeed international, Beached Birds Survey (see e.g. Bibby & Bourne, 1974). However, it was felt desirable to publish our results since, although smaller in scope, our survey was always carried out over exactly the same stretch of coast and by the same personnel. Our findings could therefore have inferences applicable to the wider study, as well as providing connecting data through the period of overlap.

A secondary aim of our study was to collect a sample of corpses fresh enough to allow meaningful post-mortem examinations. From these it was hoped to throw some light on the natural incidence of waterfowl diseases, to compare with that in the captive flocks of the Wildfowl Trust.

Methods

The survey was carried out each year in late February or early March on the first suitable day following the highest tide at that season. The area covered extended from 52°58′N/00°04′E to 53°03′N/00°14′E along the north-west side of the Wash. The search fell into three natural sections: (a) east from Freiston shore to Glebe Farm, Benington (4·0 km); (b) north-east to Sailors' Home, Wrangle (4·8 km); and, in the same direction, (c) to Friskney flats (6·4 km), making a total of 15·2 km of tidal wrack examined.

This wrack consists of vegetable debris such as the heads and stems of grasses, mainly *Agropyron pungens*, sea purslane *Halimione portulacoides*, seaweed *Fucus* spp., and of man-made litter such as plastic containers, bottles, broken netting, packing cases and timber. Sometimes there may be a belt 2 m wide and $\frac{1}{2}$ m deep. Many small birds could have been overlooked in such a mass, but passerines are not dealt with in this report, nor are the homing pigeons *Columba livia*, three Pheasants *Phasianus colchicus* and three Red-legged Partridges *Alectoris rufa* found, since these certainly are not waterfowl.

It was arbitrarily decided that a major portion of a carcase with appendages conconstituted a body, whereas one or both detached wings did not (even when the species was identifiable). Only birds that had died within the past 4 months were included in the body-count, though again some arbitrary decisions were needed.

It was obvious from local knowledge that the tides would carry corpses to the seawall during calm periods or with winds from NNE round to SW; other winds would tend to blow them away. However, the efficiency of the spring tides as transporters of corpses was tested by marking twelve dead birds and

*Scientific names of these and other species dealt with in this paper will be found in Table 2.

dropping three on the exposed mudflats; three on the *Salicornia* fringe; three on the short grass area; and three in the high marsh amongst sea purslane and tall grasses. Three days later after five high tides and north-easterly winds the area was revisited and the high-water wrack searched. None of those from the mud-flats was found, presumably having been eaten by scavenging gulls and crows. But two out of three corpses from each of the other three sites were found again. The figures are small but did indicate that a seawall search would recover a good proportion of the birds dying on the outmarsh.

General deposition of corpses

Over the 10 years a total of 1,443 waterfowl corpses of forty-six species were found along this stretch of coast (Table 1). The yearly totals showed considerable variations, reflecting the different tide and wind conditions. There is, however, some trend for the totals to rise as if the populations were indeed being restored to former levels after the 1963 catastrophe. However, even the highest total, 184 in 1972, was less than a third of the cold year. The very low figure in 1965 was explained by the virtual absence of tidal wrack over long stretches of the seawall. Similar conditions prevailed in 1967, but not in 1968 when there was plenty of wrack but rather few bodies.

Table 1. The incidence of corpses on the survey stretch of coast

Year	Total corpses	Total species	Corpses per km
1963	601	34	39·5
1964	86	21	5·7
1965	27	16	1·8
1966	114	24	7·5
1967	55	16	3·6
1968	52	17	3·4
1969	91	22	6·0
1970	128	24	8·4
1971	105	24	6·9
1972	184	31	12·1
Total	1,443	46	–

In the last 7 years, note was made of which of the three sections contained the most corpses. Section (a) was the most prolific, having 47%, as against 22% in (b) and 31% in (c). Expressed in corpses per kilometre, the respective mean annual values were 12·6, 4·8 and 4·9. Undoubtedly section (a) was so favoured because the saltings are wide (up to 2·5 km) at this southern end, being built up by the turbulence of the converging channels of the rivers Witham and Welland.

Variation between species

The forty-six species found in the course of the 10 years are set out in Table 2. As the numbers of any one species found per year are often small, they have been grouped, after 1963, into two runs, the first of 4 years, 1964–1967, the second run of 5 years, 1968–1972. The year 1963 was clearly exceptional and could not be included with the first run. If there were re-building of populations to be done, this would probably occur within the following 4 years (or even more quickly). The second 5 years should therefore give a long enough run under 'normal' conditions to iron out chance fluctuations and give a reliable base-line for comparison both with 1963 and with any future winter of severity. No such weather occurred during the 10 years of our observations; indeed the period has been characterized by the mildness of the winters.

Clearly, for many species the numbers of corpses found were still too small for any meaningful analysis. Further analysis has therefore been concentrated on the eighteen species for which more than twenty corpses were found in the 10-year period. These are marked with an asterisk in Table 2.

The numbers of corpses of each species found in 1963 may be compared with their mean annual totals for the 5 years 1968–1972 when the populations could be considered to be of 'normal' size. This is done in ratio form in the first column of Table 3. In all but three species the corpse-counts in 1963 were at a considerably higher level than they were in the last 5 years of the study. Because the data are somewhat crude, not too much emphasis should be placed on species in which the 1963 corpse count was two to four times the 'normal', but any species for which it was five times or more was certainly suffering an unusual mortality in the area that year. This, quite conservative, statement holds for half the species so examined.

The species are listed in descending order of magnitude of this 'mortality ratio'. While not too much emphasis should be laid on relative positions within the order, some species were predictably hit (or not hit) by the cold conditions. Thus the Dunlin, at the top of the table, Knot and Redshank are all feeders in the intertidal mudflats which were frozen over during the worst of the cold

Table 2. The species composition, and variation with period, of the corpses found

	Total 1963	Total 1964–1967	Total 1968–1972	Total 1963–1972
*Red-throated Diver *Gavia arctica*	12	8	7	27
*Black-throated Diver *Gavia stellata*	12	4	5	21
Great Crested Grebe *Podiceps cristatus*	9	0	2	11
Red-necked Grebe *Podiceps grisegena*	2	0	0	2
Slavonian Grebe *Podiceps auritus*	0	0	1	1
Fulmar *Fulmarus glacialis*	1	5	8	14
Gannet *Sula bassana*	1	2	2	5
Cormorant *Phalacrocorax carbo*	0	0	3	3
Shag *Phalacrocorax aristotelis*	0	1	1	2
Heron *Ardea cinerea*	2	0	1	3
Mute Swan *Cygnus olor*	1	0	2	3
Pink-footed Goose *Anser brachyrhynchus*	2	3	7	12
Canada Goose *Branta canadensis*	0	0	1	1
*Brent Goose *Branta bernicla*	12	12	21	45
*Shelduck *Tadorna tadorna*	58	7	38	103
*Mallard *Anas platyrhynchos*	7	5	15	27
Teal *Anas crecca*	1	0	3	4
*Wigeon *Anas penelope*	35	8	21	64
Tufted Duck *Aythya fuligula*	2	0	0	2
Scaup *Aythya marila*	0	1	1	2
Eider *Somateria mollissima*	0	2	2	4
Common Scoter *Melanitta nigra*	10	1	7	18
Goldeneye *Bucephala clangula*	0	0	2	2
Red-breasted Merganser *Mergus serrator*	1	1	0	2
Water Rail *Rallus aquaticus*	1	0	0	1
Moorhen *Gallinula chloropus*	2	0	0	2
Coot *Fulica atra*	0	1	0	1
*Oystercatcher *Haematopus ostralegus*	1	5	29	35
Golden Plover *Pluvialis apricaria*	0	4	3	7
Grey Plover *Pluvialis squatarola*	7	2	0	9
Lapwing *Vanellus vanellus*	2	7	4	13
*Knot *Calidris canutus*	104	34	53	191
*Dunlin *Calidris alpina*	33	23	13	69
Bar-tailed Godwit *Limosa lapponica*	2	5	8	15
*Curlew *Numenius arquata*	15	15	18	48
*Redshank *Tringa totanus*	144	9	113	266
Turnstone *Arenaria interpres*	0	2	3	5
*Black-headed Gull *Larus ridibundus*	26	40	41	107
*Common Gull *Larus canus*	51	34	60	145
*Herring Gull *Larus argentatus*	8	12	17	37
*Great Black-backed Gull *Larus marinus*	6	11	11	28
*Kittiwake *Rissa tridactyla*	9	9	9	27
*Guillemot *Uria aalge*	19	3	9	31
*Razorbill *Alca torda*	3	5	15	23
Little Auk *Alle alle*	0	0	1	1
Puffin *Fratercula arctica*	0	1	3	4
Totals	601	282	560	1,443

period. So too are Shelduck. However, the Oystercatchers were unaffected and the Brent Geese much less than expected in view of their rigid intertidal feeding habits. Wigeon, on the other hand, suffered severely even though they quite usually will move inland to graze winter cereals or grass fields when intertidal plants, *Zostera* and *Enteromorpha*, are not available. Again, several off-shore feeders, whose food supply should not have been rendered inaccessible or otherwise affected, apparently had high mortalities, namely Black-throated Divers, Guillemot and Red-throated Divers. Thus other factors must have been affecting the level of the kill than simple food deprivation on a relatively local basis.

Table 3. Comparison between the incidence of corpses when populations were 'normal' (1968–1972) with that in 1963 and in the 4 succeeding years (1964–1967)

Species	Ratio 1963 to mean 1968–1972	Ratio mean 1964–1967 to mean 1968–1972
Dunlin	12·7	0·5
Black-throated Diver	12·0	1·0
Guillemot	10·5	2·6
Knot	9·8	1·3
Red-throated Diver	8·5	0·7
Wigeon	8·3	2·2
Shelduck	7·6	4·2
Redshank	6·3	10·3
Kittiwake	5·0	0·8
Common Gull	4·2	1·4
Curlew	4·2	1·0
Black-headed Gull	3·2	0·8
Brent Goose	2·8	1·4
Great Black-backed Gull	2·7	0·6
Herring Gull	2·3	1·1
Mallard	1·4	4·2
Razorbill	1·0	2·5
Oystercatcher	0·2	4·6

Effect on the total population

A large number of corpses in the Wash area might simply reflect unusually large numbers of immigrants there, driven (and presumably already weakened) by harsh conditions further to the north and east. Similarly the virtual absence of Oystercatcher corpses might mean that the bulk of these birds had moved on further south and west, escaping the vicious conditions in East Anglia. By the same token, the birds actually dying on the Wash coast might not have been ones which normally would have wintered there. However, none of the corpses found had rings on their legs to indicate their geographical origins. Nor, as we indicated earlier, have we any idea of the size of populations from which the birds were drawn, and hence of the significance of the undoubtedly increased mortality in 1963.

We can make a stab at assessing the significance by comparing the level of corpse-incidence if the years immediately following the hard winter (1964–1967) with that in the years when the populations may be considered to have recovered to a 'normal' level, i.e. 1968–1972. This is done in the second column of Table 3. Of course, we have to discount any factors that may have *raised* the 1968–1972 populations (and corpse-counts) to an unusually high level and so made the 1964–1967 counts appear abnormally low. But in the absence of evidence to this effect the argument can be used as it stands.

If the ratio 1964–1967:1968–1972 was close to 1·0, then one can argue that the population level following the hard winter was little different from normal, i.e. natural replacements had rapidly offset the casualties and hard-weather mortality had been of little significance. If the ratio was considerably above 1·0 then the casualties had a more severe and lasting effect. Again, because of the crudity of the data, and because natural populations fluctuate quite widely in any case, only substantial values should be stressed. Thus the heavy mortality suffered by Redshank would appear to have given their population(s) a severe set-back. But the only others affected for a long time would seem to be the Oystercatchers, Mallard and the Shelduck; the first two thus did not escape the consequences by leaving the area. The Guillemot, Razorbill and Wigeon also have been affected to a lesser extent.

In summary, our data indicate that only the Shelduck and the Redshank suffered *both* abnormally high mortality in 1963 *and* a depression in their populations which extended over several years. In the case of the former we have the supporting data of the National Wildfowl Counts, organized since 1954 by G. L. Atkinson-Willes of the Wildfowl Trust. The circulated reports of the monthly winter counts on priority sites indicate that February 1963 had a United Kingdom population index for Shelduck of 148 (based on 1959 = 100), but in February 1964 it had fallen back to 98. It was not until 1967 that it was back to 140 and it maintained a mean of 150 over 1968 to 1972. This result, incidentally, is also justification for

our division of data into two groups of years, the recovery period and the period of 'normal' population, used in the earlier analysis.

Comparison with data of the Beached Bird Survey

In the 5 years 1968–1969 to 1972–1973 a much more extensive survey has been made, organized by the RSPB. Thus in NW Europe in 1973 a total of 3,317 km were searched, producing 3,651 corpses (Bibby & Bourne, 1974). For East Anglia, which gives the most meaningful comparison for our data, the length of coast searched varied from 131 km (1969) to 296 km (1972) and the corpses found from seventy-nine (1973) to 162 (1971). This was for the same late winter periods of high tides towards the end of February or early in March. When the corpses/kilometre figures (Table 4) are compared with the same index for our survey (Table 1), it is apparent that the latter were very much higher; seven, twelve, ten and twenty-four in the 4 years of overlapping data.

Table 4. Data from the RSPB Beached Bird Survey: East Anglia only

Year	Corpses/km	Percentage oiled
1969	0·9	95
1970	0·7	73
1971	0·7	30
1972	0·5	69
1973	0·3	53

Such large differences cannot result from different assessments as to what constitutes a corpse. There may well have been differences in the degree of thoroughness of search. But probably our section of coast is particularly favoured by wind, tide and topography. Similar densities of corpses in the Beached Bird Survey were reported from, for example, SW Denmark. It would seem to emphasize that, as in many other biological surveys, if long term information is required, then it is best to concentrate intensive effort within circumscribed, favoured areas that produce a reasonable supply of data for effort expended. This is not to say that extensive surveys are not justified every so often, both to pinpoint the favoured areas initially and to check that they are continuing to provide data representative of the whole.

Aside from the immense difference in concentration of corpses, the two surveys agree that the level of mortality was similar in 1969, 1970 and 1971. Only in 1972 was there a radical difference, our data indicating a sharp up-turn, the Beached Bird Survey a decrease. There appears no obvious reason for this discrepancy.

The extent of oil pollution

One of the main aims of the Beached Bird Survey was to provide an indicator of the extent to which oil-pollution was still a factor of seabird mortality, despite restrictive measures imposed by various international conventions. Table 4 therefore includes data on the percentage of birds found oiled, around two-thirds. Of course this may well be an underestimate, since many species are not particularly at risk to oil pollution, or may be polluted subsequent to death from other causes. We preferred to concentrate on the species which, by feeding in the open sea, are especially prone to direct, mortal pollution by oil patches. These were, in Table 1, Black-throated Diver, Red-throated Diver, Common Scoter, Common Eider, Razorbill and Guillemot. Over the 10-year period these gave 124 corpses, but in thirty cases decomposition was too far advanced for a positive opinion to be expressed as to whether oil pollution had been sufficiently extensive to contribute to death.

In the 4 overlapping years, 1969–1972, 69% of twenty-six corpses were definitely oil-polluted. In the previous 5 years 82% or twenty-two. This may give some hope of a reduction of pollution in recent years, but certainly the data are too slender to rest much of a case on them. More interestingly, in the year of the big kill, 1963, the oiling incidence was slightly lower, 76% of forty-six. Thus, oiling mortality can at least be said not to have had an unusual incidence because of the cold-weakened condition of the birds. Oiling is generally sufficiently destructive in its own right, without help from nature.

Other causes of mortality

It proved possible to find only 115 bodies on which post-mortem examinations could reasonably be carried out. No diagnosis was possible in twelve cases. Twenty-four of the remaining 103 had been killed by gun-shot wounds, nine others died of injuries not attributable to shooting, and two were drowned.

In the remaining sixty-eight the pathological conditions found (sometimes more than one in the same bird) were, in descending order of importance: pneumonia (37),

nephritis (11), pulmonary congestion (9), enteritis and tuberculosis (7 of each), internal parasites (6), hepatitis (4), aspergillosis (3), pericarditis, atherosclerosis, peritonitis, visceral gout, and lead poisoning (2 of each), and single cases of anaemia, splenomegaly, and bacterial infection.

Clearly pneumonia, brought on by the extreme cold conditions, was of the greatest importance. But it may often have precipitated death in an already sick bird.

Avian tuberculosis was found in one Oystercatcher (of five examined), in four Knot (of nineteen), in one Lesser Black-backed Gull (of three) and in one Dark-bellied Brent Goose (of seven). Aspergillosis was found in one Common Gull (of nine), one Red-throated Diver (of ten) and in one Dark-bellied Brent Goose.

While these findings are of some interest, it must be admitted that the pathological aspects of the survey were disappointing. This was largely because scavengers had all too frequently been at the corpses before they were found, leaving little but skin, feathers and bone.

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Summary

A stretch of coast was searched for corpses late in the winter of 10 years. The results enable an assessment of the significance of waterfowl mortality in the extremely hard winter of 1962–1963. Only Shelduck *Tadorna tadorna* and Redshank *Tringa totanus* suffered mortality high enough markedly to depress their populations over several years. Comparisons are made with the results of other similar corpse surveys. The extent of oil pollution was measured and some information on the incidence of pathological conditions obtained.

References

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