INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENT RESEARCH COUNCIL)

NCC/NERC CONTRACT HF3/03/190
ITE PROJECT 181
Annual Report to Nature Conservancy Council

BIRDS OF PREY AND POLLUTION

Part I Birds-of-prey
II Toxic chemicals in gannet eggs
III Mersey bird mortality - Autumn 1979

I NEWTON, D OSBORN, A A BELL & K R BULL

Monks Wood Experimental Station
Abbots Ripton
Huntingdon
Cambs. PE17 2LS

July 1980

INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENT RESEARCH COUNCIL)

NCC/NERC CONTRACT HF3/03/190
ITE PROJECT 181
Annual Report to Nature Conservancy Council

BIRDS OF PREY AND POLLUTION

Part I Birds-of-prey
II Toxic chemicals in gannet eggs
III Mersey bird mortality - Autumn 1979

I NEWTON, D OSBORN, A A BELL & K R BULL

Monks Wood Experimental Station
Abbots Ripton
Huntingdon
Cambs. PE17 2LS

July 1980

C O N T E N T S

INTRODUCTION

This report is presented in three sections, covering the three separate aspects of the programme, dealing with raptors, gannets and waders respectively. The waders derive from the incident on the Mersey in autumn 1979, and this part of the report includes details of the development of the programme, and the role of different organisations in its investigation.

SUMMARY

1. During the year under review, livers from 159 predatory birds were analysed for organochlorine residues, including those from 53 sparrowhawks, 44 kestrels and 13 herons. The results were used with those of previous years to determine trends in residue concentrations. Among sparrowhawks, DDE, PCB and HEOD levels seem to have declined in the period since 1975, but in kestrels and herons no declines in the levels of these compounds were apparent.

   Four areas were checked for the presence of breeding sparrowhawks; in 3 of these areas no signs of birds were found, and in the fourth only 3 nests were found in 25 territories examined. It is hard to draw conclusions on population status with respect to pesticides, because in this year numbers were low anyway after a hard winter.

2. In gannet eggs from St Kilda, Ailsa Craig and Bass Rock, DDE concentrations seemed higher in 1979 than in previous years. PCB, cadmium and mercury levels were about the same, and (at Ailsa Craig) HEOD levels increased.

3. In autumn 1979, more than 2000 birds were washed up dead on the shores of the Mersey estuary. Tissues from 13 dunlin and 2 redshank were analysed, and found to contain unexpectedly high levels of lead.

INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENT RESEARCH COUNCIL)

NCC/NERC CONTRACT HF3/03/190
ITE PROJECT 181
Annual Report to Nature Conservancy Council

BIRDS OF PREY AND POLLUTION

Part I Birds-of-prey

I NEWTON & A A BELL

Monks Wood Experimental Station
Abbots Ripton
Huntingdon
Cambs. PE17 2LS

July 1980

1 BIRDS-OF-PREY

1.1 Organochlorines in livers

The main objective of this work was to analyse the carcasses of predatory birds, supplied by members of the public, in order to continue the monitoring of organochlorine residues in livers. During the year under review, the livers from 159 birds were analysed, including those from 53 sparrowhawks, 44 kestrels, 5 merlins, 2 peregrines, 6 long-eared owls, 18 great-crested grebes, 18 kingfishers, and 13 herons. Most of these birds were obtained during 1979-80, but we also took the opportunity to analyse other birds which had been received, but not analysed, in previous years. These analyses helped to ensure continuity of the data throughout the decade.

The results from individual birds are listed in Table 1, and those for sparrowhawks, kestrels and herons are given in Figure 1, alongside data from previous years. From the trends in organochlorine use, one might expect declines in PCB and HEOD residues during the last few years, but not necessarily in DDE residues.

As in previous years, wide variation in organochlorine concentrations occurred among the individuals of each species, and the year-to-year differences in concentrations were not statistically significant. However, in some cases, longer term trends in residue levels were apparent, though these were not always consistent between species.

Among sparrowhawks, the data suggested a decline in all 3 residue types during the period since 1975, but the levels in 1977 were lower than those in the preceding or following year. Among kestrels, no long term declines in residue levels were apparent, the liver concentrations of all 3 types being lower in 1978 than in the preceding or following years. Similarly, among herons, no long term declines in residue levels were apparent, and in this species, liver concentrations of all 3 compounds were lower in 1977 than in the preceding or following year.

The apparent slight differences in trends between species could be an artefact of relatively small samples, resulting from differences in seasonal or geographical distribution, or they could be genuine, depending on ecological differences between the species. At the moment, we have no way of resolving this question.

In addition to the livers, eggs were received from 4 peregrines, and one merlin (Table 2). Organochlorine levels were within the range of those obtained in other recent years.

1.2 Sparrowhawk survey

The sparrowhawk suffered a marked population decline in the late 1950s, following the widespread introduction of cyclodienes (aldrin, dieldrin) in agriculture. Since 1964, in each of several areas, known territories have been checked periodically for details of occupation and breeding success. The aim was to find whether sparrowhawks were recovering in numbers, following successive restrictions in cyclodiene use. Four areas were surveyed in 1979.

In the New Forest, 25 known territories were checked and 3 active nests were found, whereas in the other 3 areas (Anglesey, East Midlands and Suffolk) 24, 19 and 9 territories were checked, and no active nests were found. However, note was also made of any old nests present, and these indicated that birds had bred in recent years in 2 of the 3 areas in which no active nests were found in 1979 (Table 3).

Sparrowhawks seem to have been generally scarce throughout Britain in 1979, perhaps because this breeding season followed a hard winter, in which most of the prey species declined. Ringing recoveries indicate that sparrowhawks themselves suffered unusually heavy mortality then, so one might have expected a low population in this year, irrespective of the organochlorine situation. We were surprised, however, at the lack of new nests in the Anglesey area. Only further work in later years can reveal whether populations are recovering satisfactorily.

TABLE 1

Residues of organochlorine insecticides (ppm wet weight) in the livers of birds of prey, results reported April 1979-March 1980.

Specimen number	Date	*pp'*-DDE	*pp'*-TDE	Dieldrin	Heptachlor-epoxide	HCB	PCBs
Kestrel							
5240	Oct 75	0.2	-	0.2	0.1	-	1
5476	Oct 75	0.4	-	0.1	0.2	-	1
5315	Dec 75	0.9	-	1.3	0.2	-	2
5287	Aug 77	1.4	-	0.9	0.2	-	2
5530	Aug 78	0.2	-	0.7	0.1	-	<1
5532	Aug 78	1.3	-	0.5	0.2	-	1
5533	Aug 78	1.9	0.1	0.5	-	-	2
5555	Aug 78	0.3	-	0.5	-	-	<1
5564	Oct 78	0.7	-	0.4	0.2	-	<1
5565	Oct 78	0.4	0.1	0.2	0.2	-	<1
5588	Nov 78	6.0	1.5	1.5	-	-	1
5597	Nov 78	0.2	-	0.1	0.1	-	<1
5603	Dec 78	0.2	-	0.4	0.2	-	<1
5611	?	0.2	-	1.3	0.1	-	<1
5821	Aug 78	Trace	-	0.1	-	-	-
5991	Apr 78	0.9	Trace	0.3	-	-	<1
5995	May 78	0.8	-	0.4	0.1	-	-
5996	May 78	0.5	-	0.2	-	-	-
5614	Jan 79	7.0	-	2.0	0.8	-	10
5802	Feb 79	10.0	0.5	0.5	0.4	-	8
5810	Mar 79	20.0	0.3	2.0	0.6	-	1
5828	Mar 79	5.0	-	1.5	0.4	0.2	11
5921	Aug 79	1.2	-	1.5	0.1	-	<1
5922	Aug 79	4.0	-	0.8	0.4	-	10
5925	Sep 79	1.0	-	0.2	0.2	-	1
5961	Jun 79	0.3	-	0.3	0.2	-	1
6000	Jan 79	0.2	-	0.3	-	-	1
6014	May 79	0.7	-	0.9	0.5	-	1
6015	May 79	0.1	-	0.1	-	-	-
6016	May 79	1.0	-	0.3	-	-	<1
6018	Jun 79	2.0	-	0.6	0.2	-	-
6040	Dec 79	Trace	-	0.9	-	-	-
6041	Dec 79	0.5	-	0.2	-	-	-
6046	Dec 79	4.0	-	0.6	0.2	-	2
6048	Dec 79	1.2	-	0.4	-	-	<1
6049	Dec 79	Trace	-	0.1	-	-	-
6058	Dec 79	1.2	-	0.6	0.4	-	4
6053	Jan 80	22.0	0.1	2.5	0.5	-	15
6054	Jan 80	0.5	-	0.4	-	-	<1
6059	Jan 80	20.0	2.5	1.4	0.3	0.1	7
6063	Jan 80	1.3	-	0.5	0.5	0.2	3
6065	Jan 80	5.0	0.5	0.8	0.6	-	3.5
6067	Jan 80	2.5	0.3	2.0	-	-	-
6069	Jan 80	7.0	0.3	0.3	-	-	1

Specimen number	Date	*pp'*-DDE	*pp'*-TDE	Dieldrin	Heptachlor-epoxide	HCB	PCBs
Sparrowhawk							
5250	Sep 77	1.4	0.2	0.1	-	-	<1
5263	Sep 77	1.0	Trace	0.2	-	-	<1
5264	77	2.3	-	0.1	0.1	-	2
5265	77	6.0	0.1	1.3	0.1	0.2	25
5266	77	4.0	0.2	1.6	-	-	5
5267	77	2.1	0.7	12.5	-	-	10
5268	77	1.4	0.1	0.1	-	-	1
5269	77	13.0	0.9	0.4	-	-	2
5527	Aug 78	1.0	-	0.2	-	-	1
5531	Jul 78	4.0	Trace	0.3	-	-	6
5558	Sep 78	40.0	3.0	4.0	-	0.1	35
5586	Oct 78	1.6	-	0.3	-	-	2.5
5596†	Nov 78	0.7	-	0.2	-	-	1
5601	Dec 78	10.0	-	2.0	0.1	0.1	15
5602	Dec 78	3.0	0.1	0.7	-	-	1
5985	Jan 78	1.2	0.1	-	-	-	<1
5986	Jan 78	9.0	0.6	0.4	Trace	-	1
5987a	Feb 78	40.0	1.4	1.9	0.3	0.2	9
5988	Feb 78	3.0	0.3	0.1	-	-	1
5989	Mar 78	4.0	0.4	0.2	-	-	<1
5990	Apr 78	16.0	0.7	0.4	-	-	6
5992	Apr 78	13.0	0.6	0.4	-	-	7
5993	Apr 78	120.0	8.0	1.0	0.3	0.3	20
5994	May 78	110.0	8.0	3.0	0.4	0.3	20
5618	Jan 79	150.0	4.0	3.0	0.3	0.1	15
5811	Mar 79	1.2	-	0.1	-	-	1
5814	Mar 79	2.5	-	0.2	-	-	<1
5825	Mar 79	0.9	-	-	-	-	1
5830	Mar 79	3.5	-	0.7	0.2	0.2	4
5856	Apr 79	2.0	0.1	0.1	-	-	1
5857	Apr 79	2.5	0.2	0.6	-	-	<1
5858	Apr 79	30.0	0.8	1.3	0.4	0.4	35
5862	May 79	30.0	1.0	0.5	-	-	15
5863	May 79	65.0	1.5	2.0	0.3	0.1	20
5869	Apr 79	12.0	0.4	0.7	-	0.1	3
5870	79	75.0	2.0	3.0	0.3	0.2	20
6001	Feb 79	4.0	0.2	0.2	-	-	1
6002	Feb 79	2.0	-	0.2	-	-	2
6006	Feb 79	30.0	0.5	1.3	0.2	-	25
6008	Feb 79	2.0	-	0.2	-	-	1
6009	Mar 79	1.1	-	Trace	-	-	1
6010	Apr 79	4.0	0.1	0.4	-	-	2
6011	Apr 79	2.0	-	0.7	-	-	<1
6017	May 79	7.0	0.1	0.3	-	-	8
6022	Sep 79	10.0	0.6	0.7	0.1	-	25
6023	Sep 79	4.0	-	0.1	-	-	2
6037	Nov 79	2.3	-	0.2	-	-	2
6043	Dec 79	1.6	-	0.1	-	-	<1
6044	Dec 79	0.1	-	-	-	-	-
6050	Oct 79	0.5	-	0.1	-	-	<1
6064	Oct 79	4.5	0.1	0.9	-	-	6

† sample 5596 contained 1.6 γ-HCH

Table 1 (contd)

Specimen number	Date	*pp'*-DDE	*pp'*-TDE	Dieldrin	Heptachlor-epoxide	HCB	PCBs
Sparrowhawk (Contd)							
6055	Jan 80	0.9	-	Trace	-	-	2
6062	Jan 80	3.5	-	0.5	0.1	-	3
Merlin							
5965	?	40.0	0.4	0.4	0.3	0.1	35
5497	May 78	120.0	0.3	6.0	2.0	0.5	20
5595	Nov 78	12.0	-	-	-	0.2	15
5868	May 79	55.0	1.0	3.0	1.5	0.7	30
6060	Jan 80	4.0	-	0.4	0.1	-	2
Peregrine							
5607†	Jul 78	0.2	-	Trace	0.3	-	-
5919	Aug 79	55.0	0.2	2.0	-	0.3	200
Long-eared owl							
5812	Mar 79	2.0	-	0.1	-	0.1	1
5832	Apr 79	50.0	0.1	2.0	0.2	0.1	9
5833	Mar 79	300.0	45.0	10.0	-	0.2	3
5835	Apr 79	370.0	11.0	5.0	-	0.2	10
5900	Mar 79	1.5	-	0.1	-	-	2
5901	Mar 79	0.4	-	Trace	-	-	-
Heron							
5500	Apr 78	0.6	-	Trace	-	-	<1
5508	Apr 78	50.0	1.5	7.0	-	0.2	120
5612	Jan 79	14.0	2.0	7.0	0.2	0.1	15
5615	Jan 79	5.0	0.2	0.6	-	0.2	9
5617	Jan 79	14.0	0.2	2.0	0.1	0.1	6
5797†	Feb 79	9.0	0.1	1.0	0.4	0.1	7
5801†	Feb 79	45.0	1.5	8.0	0.3	0.1	9
5804	Feb 79	4.0	-	0.2	-	-	2
5806	Feb 79	40.0	-	13.0	-	0.2	160
5816	Mar 79	1.1	-	0.1	-	0.1	2
5861	May 79	1.3	-	0.3	-	-	8
5867	May 79	1.2	-	3.0	-	-	1
6039	Dec 79	5.0	0.4	0.5	0.3	-	10
Great crested grebe							
5259	Apr 77	1.3	-	-	-	-	10.8
5362	Feb 78	0.6	-	-	-	-	5.1
5363	Feb 78	0.9	-	-	-	-	8.8
5364	Feb 78	0.4	-	-	-	-	4.7
5365	Feb 78	0.2	-	-	-	-	2.4
5366	Feb 78	0.2	-	-	-	-	3.2
5367	Feb 78	0.4	-	-	-	-	6.5
5368	Feb 78	0.3	-	-	-	-	3.0
5369	Feb 78	0.9	-	-	-	-	1.4
5370	Feb 78	0.6	-	-	-	-	5.8
5431	Feb 78	0.3	-	-	-	-	2.3

† sample 5607 contained 0.6 ppm γ-HCH
sample 5801 contained 0.3 ppm *pp'*-DDT

Table 1 (contd)

Specimen number	Date	*pp'*-DDE	*pp'*-TDE	Dieldrin	Heptachlor-epoxide	HCB	PCBs
Great crested grebe (contd)							
5432	Feb 78	0.2	-	-	-	-	1.0
5452	Mar 78	0.1	-	0.1	-	-	3.0
5799	Feb 79	0.4	-	-	-	-	14.9
5803	Feb 79	2.9	-	-	-	-	29.0
5808	Feb 79	3.0	-	-	-	-	27.1
5865	May 79	2.0	-	0.1	-	-	3
6052	Dec 79	0.6	-	0.1	-	-	2
Kingfisher							
5031	Mar 77	5.4	-	23.3	-	-	117.1
5189	Jul 77	1.0	-	1.3	-	-	10.4
5214	Jun 77	4.9	-	-	-	-	20.8
5217	Feb 77	3.0	-	1.2	-	-	14.8
5221	Aug 77	1.3	-	1.2	-	-	15.0
5249	77	0.6	-	0.4	-	-	8.5
5261	Sep 77	1.9	-	3.1	-	-	33.4
5288	Oct 77	2.7	-	1.0	-	-	17.3
5359	Jan 78	40.0	-	-	-	-	180.0
5433	Feb 78	12.0	-	4.3	-	-	83.2
5556	Aug 78	1.8	-	2.4	-	-	14.5
5599	Nov 78	2.2	-	1.0	-	-	11.0
5600	Nov 78	3.4	-	2.0	-	-	19.0
5815	Mar 79	3.2	-	-	-	-	12.9
5826	Feb 79	50.0	20.0	20.0	-	0.3	120
5913	Jul 79	0.5	0.3	0.5	-	-	1
5920	Aug 79	1.3	0.2	1.1	-	-	3
5924	Aug 79	2.5	0.2	0.9	-	-	5

TABLE 2

Residues of organochlorine insecticides (ppm wet weight) in the eggs of birds of prey, results reported April 1979-March 1980.

Specimen number	Date	*pp'*-DDE	*pp'*-TDE	Dieldrin	Heptachlor-epoxide	HCB	PCBs
Merlin							
5592	Jun 78	40.0	0.1	0.5	0.2	0.3	20
Peregrine							
5884	Jun 79	3.5	-	0.5	-	-	4
5885	Jun 79	3.0	-	0.4	-	-	2
5890	Jun 79	1.1	-	0.1	-	-	1
5891	Jun 79	1.1	-	Trace	-	-	1

TABLE 3

Occupancy of sparrowhawk territories, 1979.

	New Forest (Hants)	East Midlands (Hunts, Cambs)	Breck (Suffolk)	Anglesey
Total territories checked	25	19	9	24
Number with successful nests	2	0	0	0
Number with failed nests	1	0	0	0
No new nest but other signs	4	0	0	-
No sign	18	19	9	21
Number territories with old nests	20	0	3	2
Proportion of territories with old nests	0.8	0	0.3	0.1

Figure 1. DDE concentrations in livers of sparrowhawks, 1975-80. Those for 1980 refer only to the first quarter of the year. The 3 categories at the base of the graph refer to lowest quantifiable level, trace levels (T), and nil levels (0).

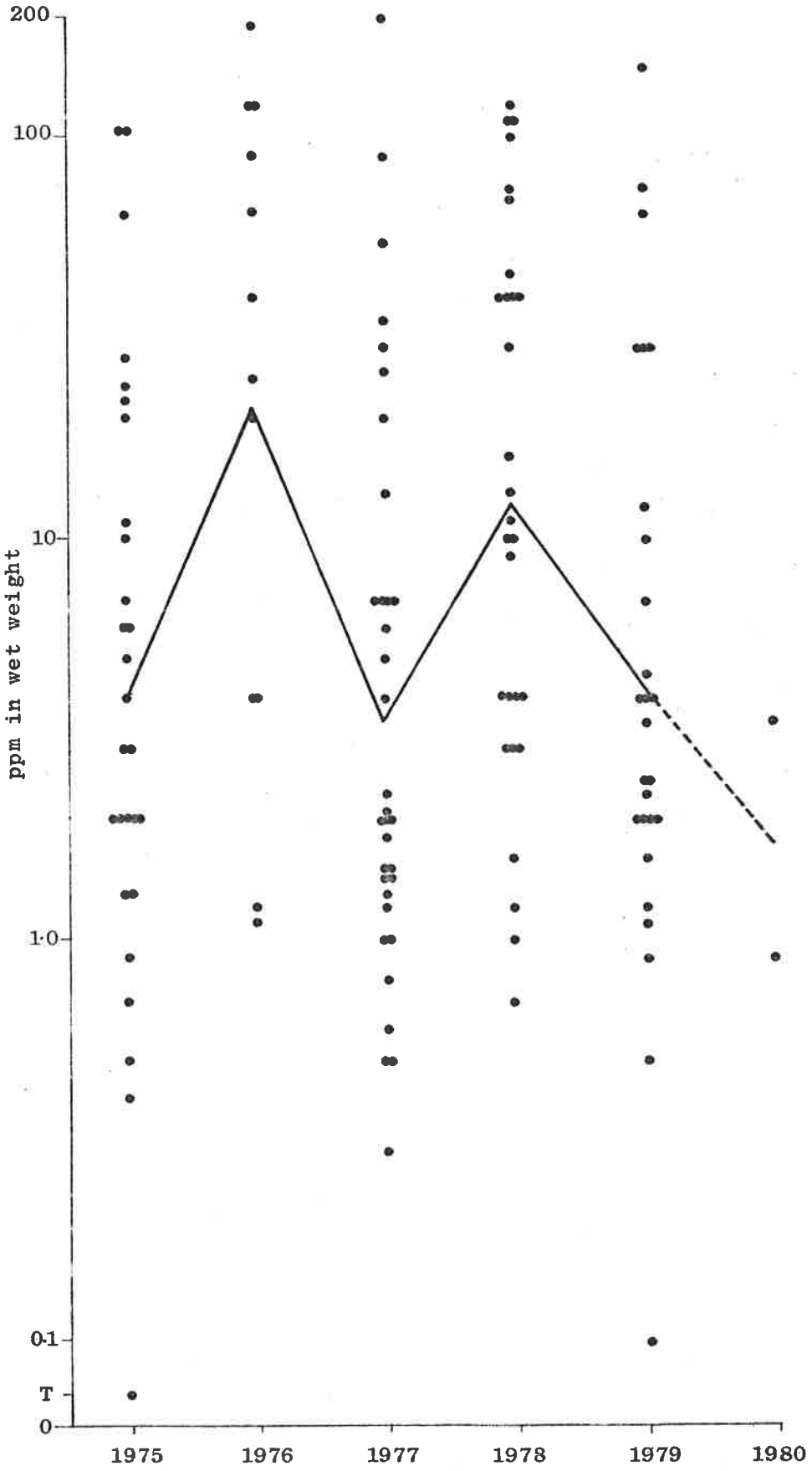


Figure 2. PCB concentrations in livers of sparrowhawks, 1975-80. Those for 1980 refer only to the first quarter of the year. The 3 categories at the base of the graph refer to lowest quantifiable level, values less than this, and nil levels (0).

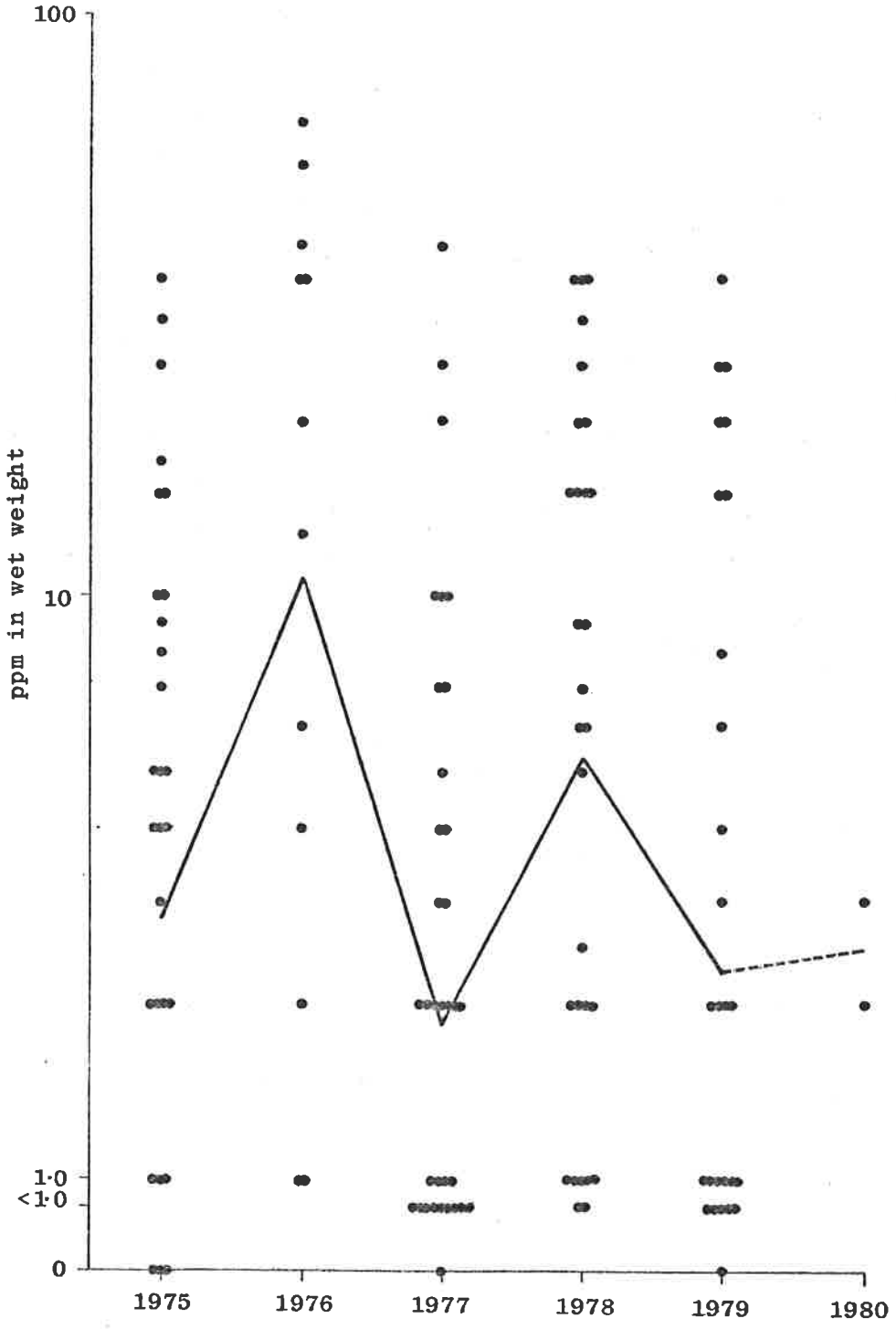


Figure 3. HEOD concentrations in livers of sparrowhawks, 1975-80. Those for 1980 refer only to the first quarter of the year. The 4 categories at the base of the graph refer to lowest quantifiable level, values less than this but more than trace levels, trace levels (T), and nil levels (0).

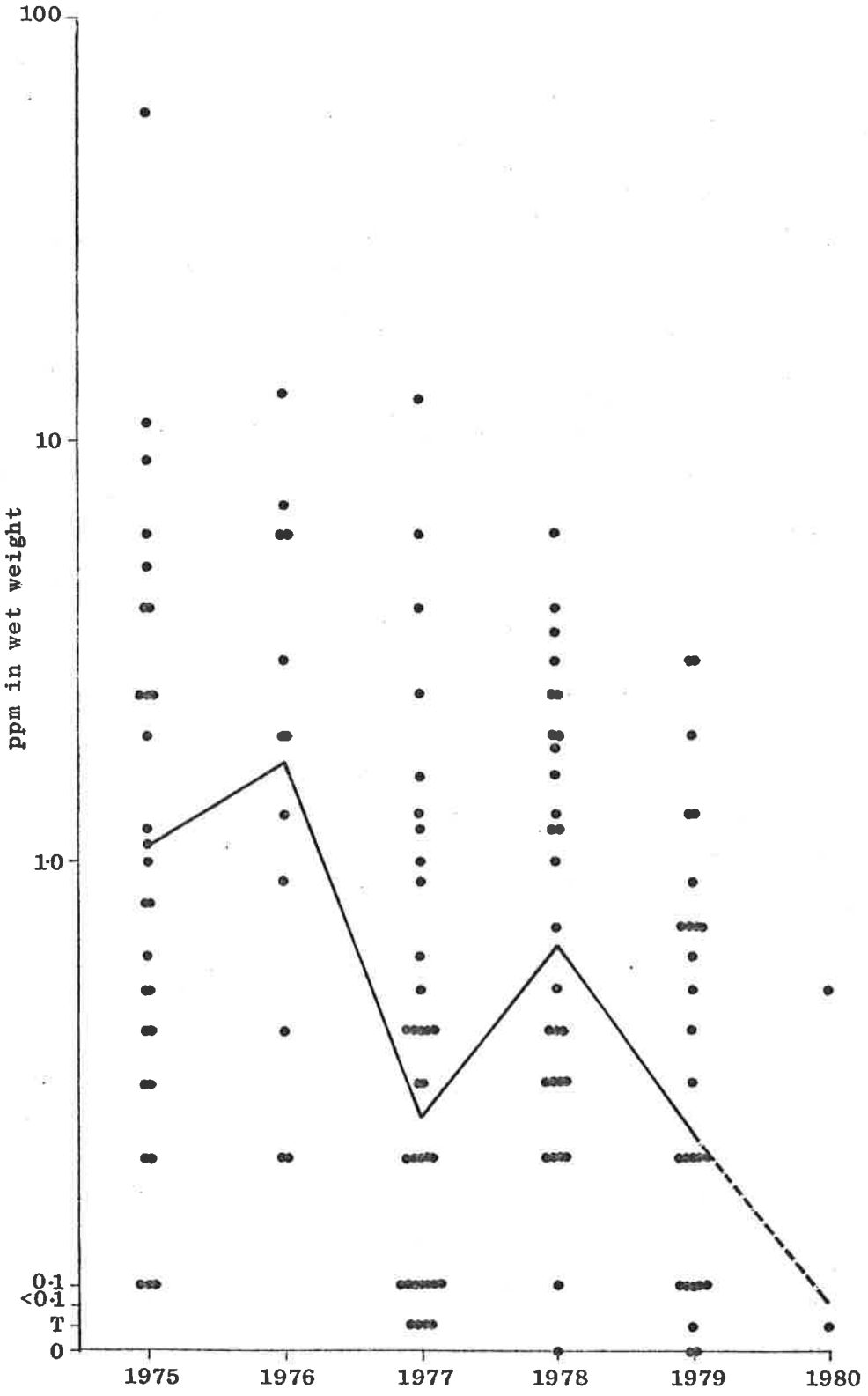


Figure 4. DDE concentrations in livers of kestrels, 1975-1980. Those for 1980 refer only to the first quarter of the year. The 3 categories at the base of the graph refer to lowest quantifiable level, trace levels (T), and nil levels (0).

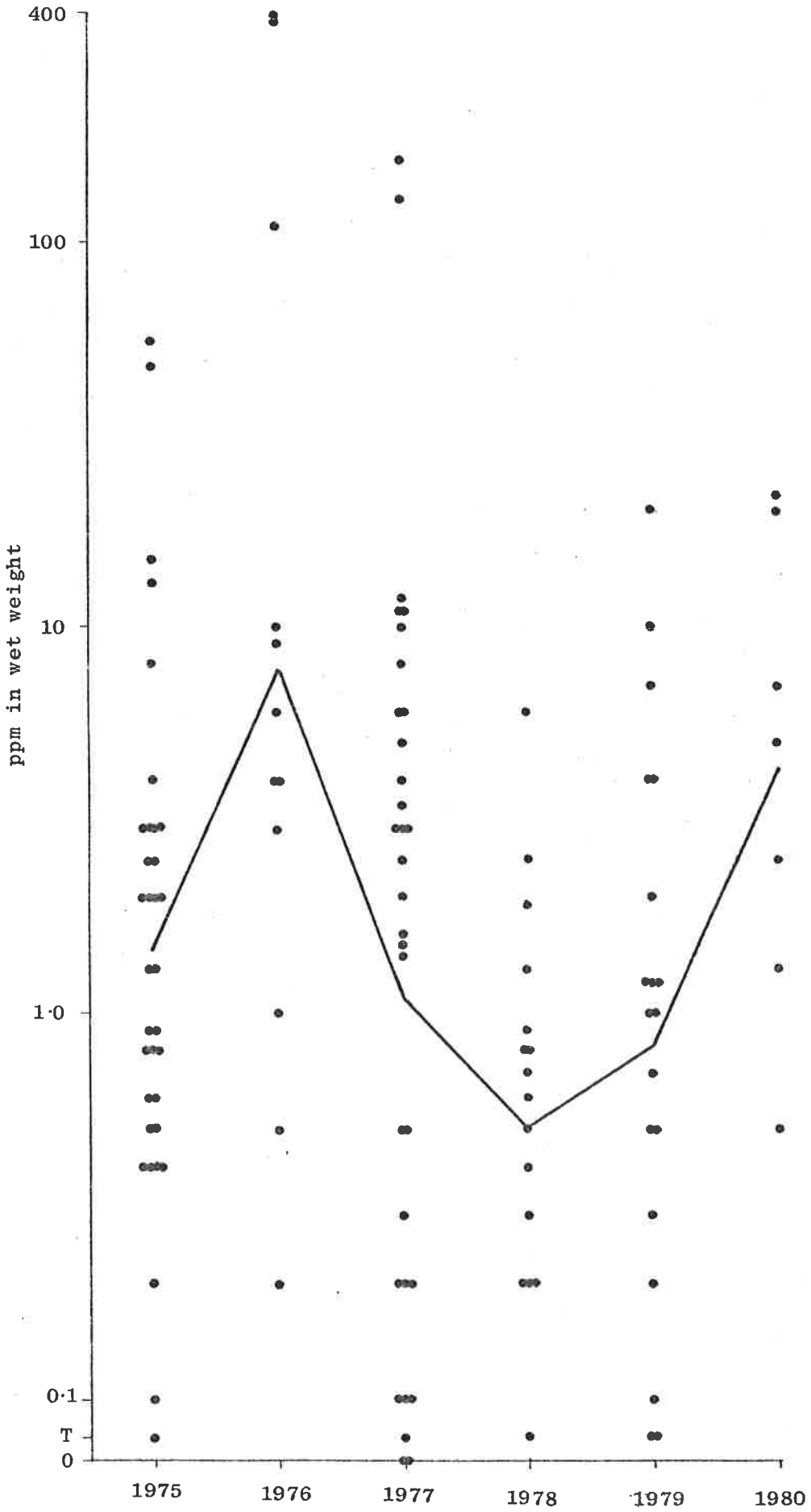


Figure 5. PCB concentrations in livers of kestrels, 1975-1980. Those for 1980 refer only to the first quarter of the year. The 3 categories at the base of the graph refer to lowest quantifiable level, values less than this, and nil levels (0).

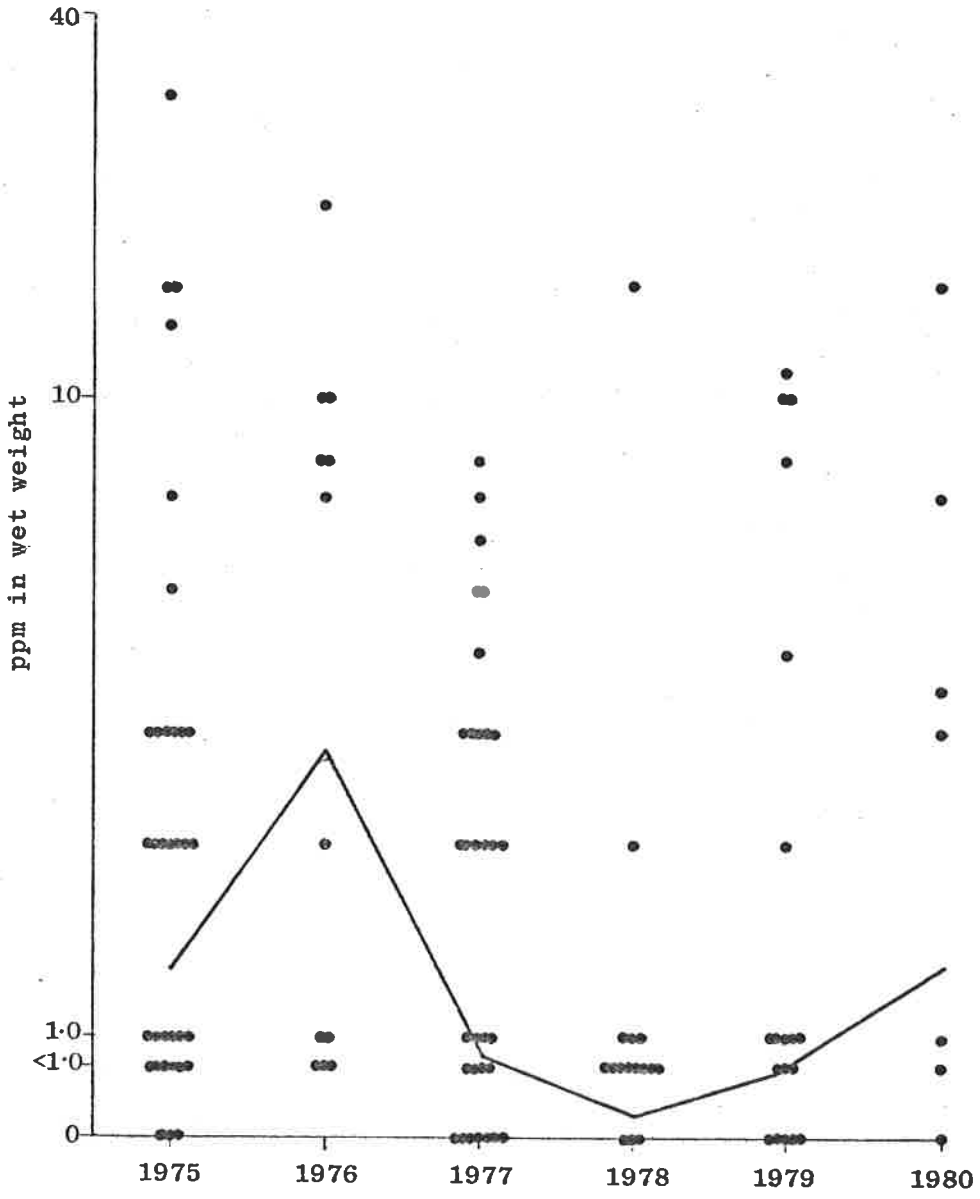


Figure 6. HEOD concentrations in livers of kestrels, 1975-1980. Those for 1980 refer only to the first quarter of the year. The 3 categories at the base of the graph refer to lowest quantifiable level, trace levels (T), and nil levels (0).

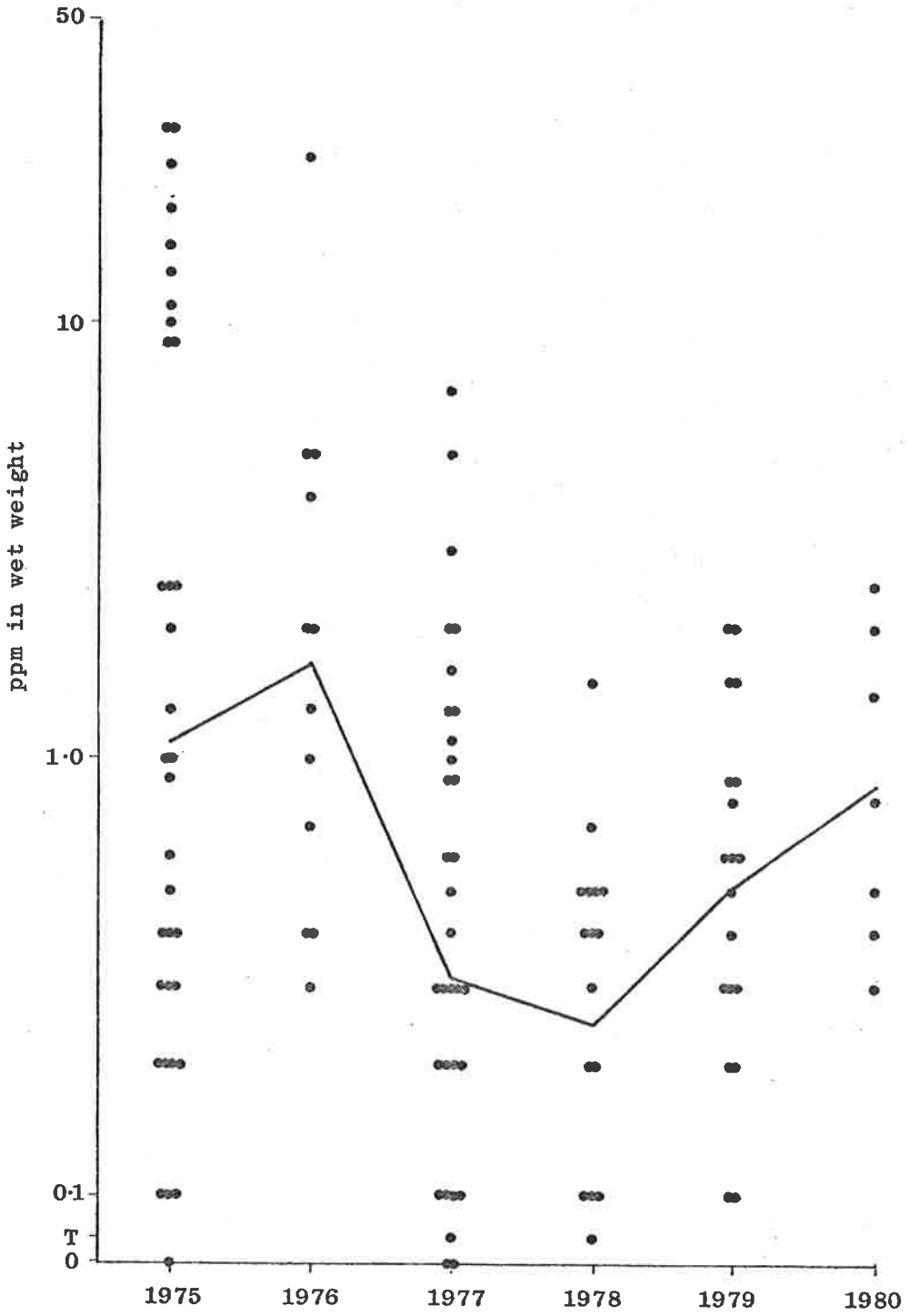


Figure 7. DDE concentrations in livers of herons, 1975-79.

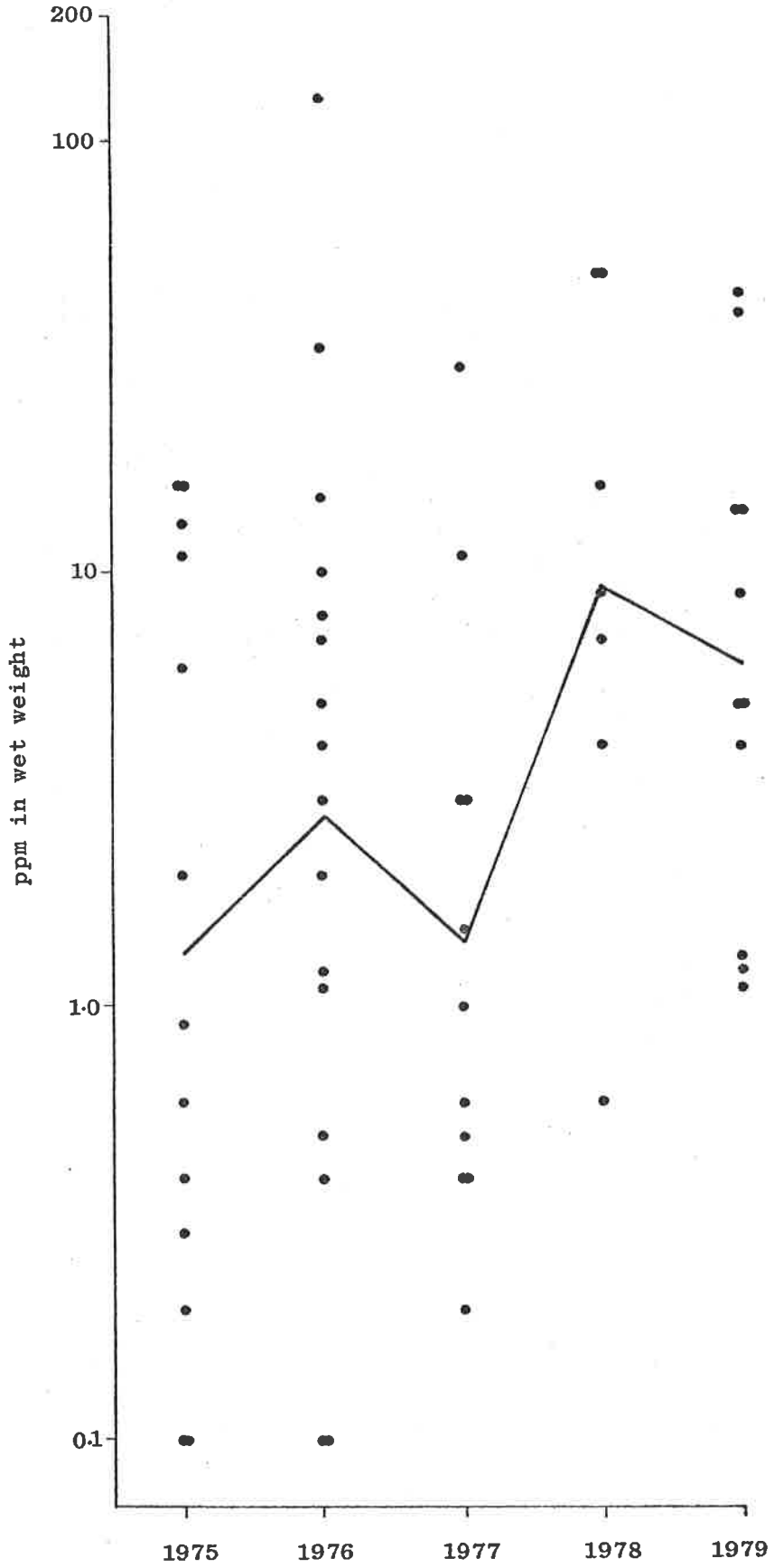


Figure 8. PCB concentrations in livers of herons, 1975-1979. The 3 categories at the base of the graph refer to lowest quantifiable level, values less than this, and nil levels (0).

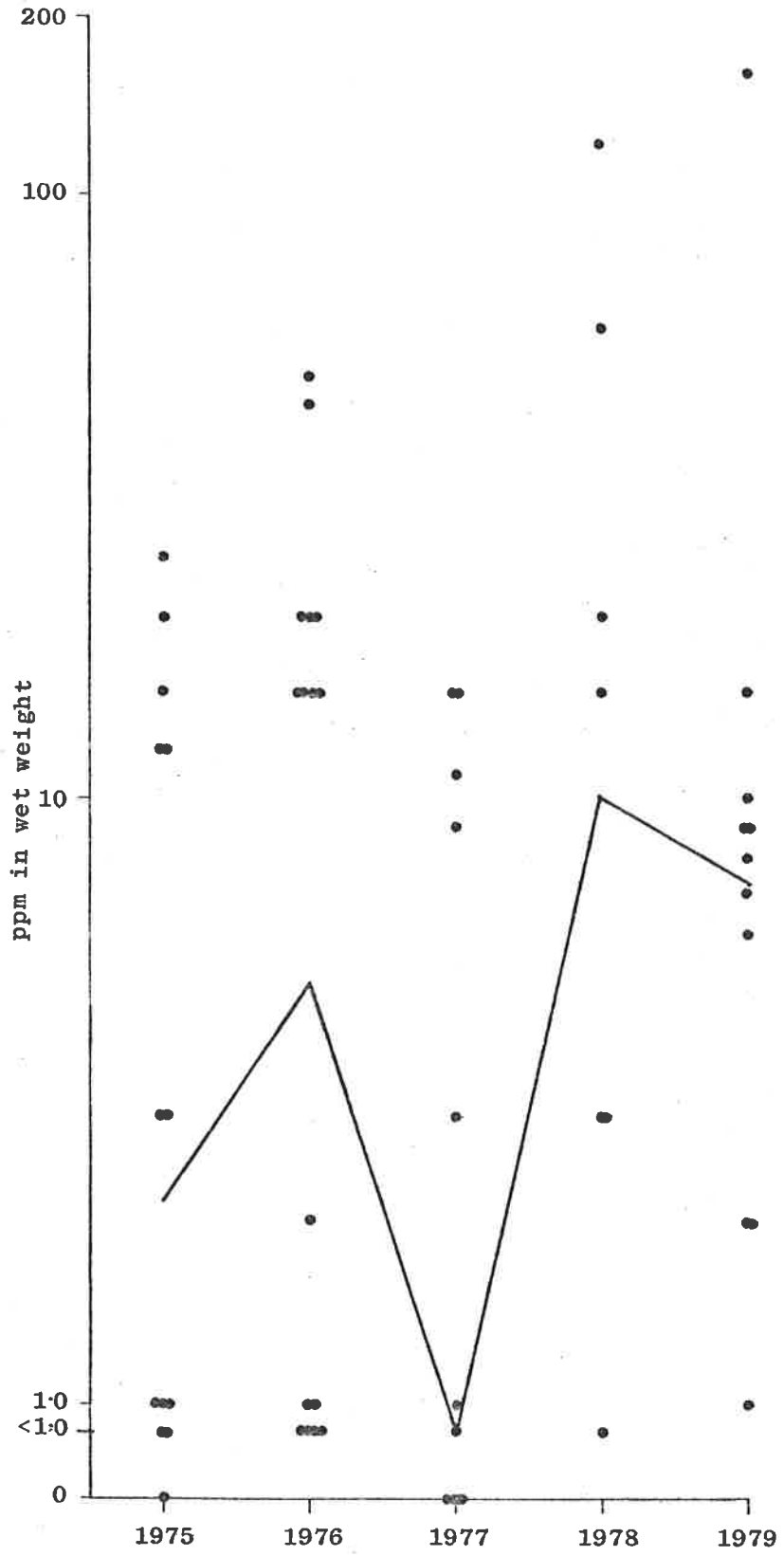
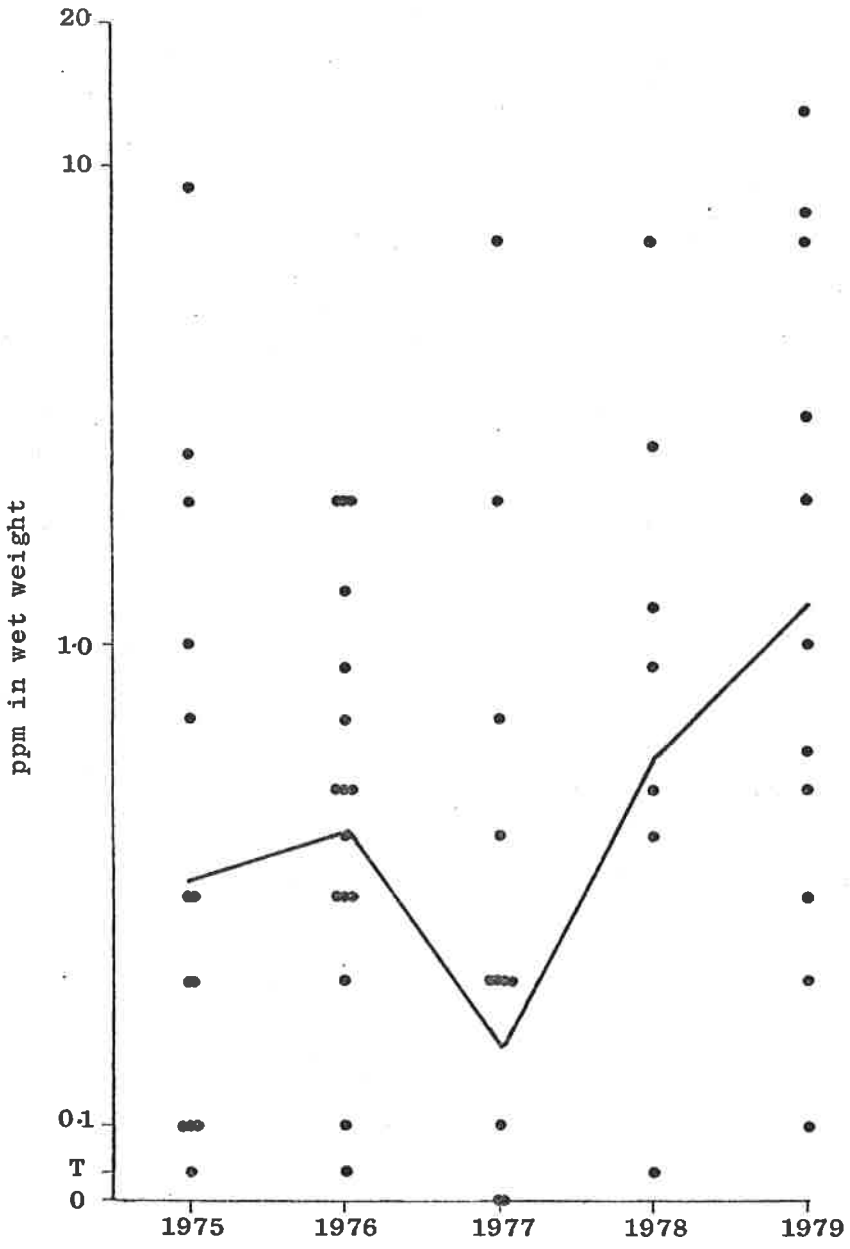


Figure 9. HEOD concentrations in livers of herons, 1975-79. The 3 categories at the base of the graph refer to lowest quantifiable level, trace levels (T), and nil levels (0).



INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENT RESEARCH COUNCIL)

NCC/NERC CONTRACT HF3/03/190
ITE PROJECT 181
Annual Report to Nature Conservancy Council

BIRDS OF PREY AND POLLUTION

Part II Toxic chemicals in gannet eggs

D OSBORN & A A BELL

Monks Wood Experimental Station
Abbots Ripton
Huntingdon
Cambs. PE17 2LS

July 1980

2 TOXIC CHEMICALS IN GANNET EGGS

2.1 Introduction

A full presentation of the 1972-78 data was given last year; so the 1979 data are only tabulated (Table 1).

In 1979 samples were obtained from St Kilda (Boreray) as well as from Ailsa Craig and Bass Rock.

Attempts are in hand to locate Eulan residues in Ailsa Craig eggs, since effluent from mothproofing industries enters the sea in this area. No results are available.

2.2 PCBs and organochlorine pesticides

2.2.1 PCB

The possible upward trend in Bass Rock values, 1975-78, was not continued in 1979. Ailsa Craig eggs have as much PCB as in several earlier years. There is no sign for either colony that concentrations are declining.

2.2.2 Organochlorine pesticides

Detectable residues of DDE and HEOD were found this year, although none were found in the years 1976-78. This is possibly because of recent increases in the use of DDT in some parts of Scotland. In particular Ailsa Craig eggs contained 1.43 mg kg^{-1} wet wt (geometric mean) - enough perhaps to cause some degree of eggshell thinning, if previous relationships still hold (Parslow & Jefferies 1977).

Concentrations of DDE (and also PCB) in the St Kilda sample may not be greatly different from those found in puffins (Osborn & Harris 1980) and other seabirds at remote sites.

HEOD concentrations are probably not very different from the non-detected values repotted in 1976-78, in St Kilda and Bass Rock samples; but Ailsa Craig values are as high in the early seventies. We cannot explain this latter finding.

2.3 Metals

Cadmium was detected in many eggs, but usually at very low levels. Analytical equipment was working well and probably lower values than normal were detected in these samples. Cadmium values were higher in the west than in the east, a difference also noted for cadmium in puffin tissues (Osborn 1979). The gannet eggs had lower concentrations of cadmium than some puffin eggs (Harris & Osborn 1980).

Mercury concentrations were also higher in the west coast colonies. Values for both Ailsa Craig and Bass Rock were similar to those found in earlier years.

2.4 Conclusions

1. DDE concentrations have suddenly increased perhaps to the point where egg-shelling thinning might be found.

2. The apparent increase in HEOD on Ailsa Craig cannot be explained.

3. PCB concentrations have not declined.

4. Metal concentrations show no sign of changing.

2.5 References

HARRIS, M.P. & OSBORN, D. 1980. *The effects of sub-lethal doses of chemicals on the breeding success and survival of puffins* (Fratercula arctica). Natural Environment Research Council contract report to the Nature Conservancy Council. Banchory: Institute of Terrestrial Ecology (unpublished).

PARSLOW, J.F.L. & JEFFERIES, D.J. 1977. Gannets and toxic chemicals. *Br. Birds*, 70, 366-372.

OSBORN, D. 1979. The significance of metal residues in wild animals. In: *Control and management of heavy metals in the environment*, 187-190. Edinburgh: CEP Consultants.

TABLE 1

Concentration in eggs, mg kg^{-1} wet wt

	DDE	HEOD	PCB	Hg	Cd
Bass Rock	0.80	0.10	3.8	0.15	0.04
n = 14	0.89	0.12	5.2	0.45	0.04
	0.45	0.09	3.4	0.30	0.05
	0.68	0.21	4.8	0.33	0.03
	0.39	0.25	2.9	0.25	ND
	0.47	0.03	3.0	0.24	ND
	0.28	<0.02	1.8	0.33	ND
	0.33	<0.02	1.9	0.24	0.05
	0.30	<0.02	2.7	0.40	ND
	0.50	0.20	3.8	0.40	0.08
	0.19	<0.02	1.6	0.37	ND
	0.41	<0.02	2.5	0.35	ND
	0.57	<0.02	2.8	0.38	0.06
	0.28	<0.02	2.1	0.34	0.03
G.M.	0.42	0.03	3.3	0.31	0.02
	(0.37,0.47)	(0.02,0.05)	(2.9,3.7)	(0.29,0.33)	(0.01,0.03)
Mean ± S.E.	0.46±0.05	0.07±0.02	3.0±0.3	0.32±0.02	0.03±0.01
Ailsa Craig	1.1	0.14	5.7	0.68	0.04
n = 10	1.2	0.24	6.9	0.42	ND
	2.4	0.39	14.9	0.96	0.04
	1.1	0.09	5.2	0.52	0.08
	1.2	0.28	7.6	0.38	0.11
	1.2	0.24	5.4	0.48	0.08
	1.2	0.20	6.5	0.67	ND
	2.4	0.34	11.2	0.71	0.10
	1.1	0.21	4.8	0.81	0.12
	2.2	0.10	8.4	1.37	0.17
G.M.	1.43	0.20	7.2	0.65	0.05
	(1.29,1.59)	(0.17,0.24)	(6.4,8.1)	(0.57,0.74)	(0.03,0.07)
Mean ± S.E.	1.51±0.18	0.22±0.03	7.7±1.0	0.70±0.09	0.08±0.02
St Kilda (Boreray)	0.38	<0.02	1.75	0.40	0.08
n = 10	0.26	<0.02	1.93	0.43	0.06
	0.71	ND	2.21	0.29	0.03
	0.11	ND	ND	0.52	0.03
	0.09	ND	ND	0.45	0.05
	0.24	ND	0.64	0.55	0.04
	0.71	0.09	3.12	0.55	0.05
	0.17	<0.02	0.74	0.48	0.06
	0.58	<0.02	2.65	0.42	ND
	0.07	0.31	6.47	0.34	0.03
G.M.	0.24	0.01	0.59	0.44	0.04
	(0.18,0.32)	(0.01,0.02)	(0.26,1.33)	(0.41,0.47)	(0.03,0.05)
Mean ± S.E.	0.33±0.08	0.05±0.03	1.95±0.61	0.44±0.03	0.04±0.02

Notes: G.M. = geometric mean with, in parentheses, the range with 1 S.E.
ND = non detected.
To calculate the means <0.02 was taken as 0.01, and ND as 0.005 throughout.

INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENT RESEARCH COUNCIL)

NCC/NERC CONTRACT HF3/03/190
ITE PROJECT 181
Annual Report to Nature Conservancy Council

BIRDS OF PREY AND POLLUTION

Part III Mersey bird mortality - Autumn 1979

D OSBORN & K R BULL

Monks Wood Experimental Station
Abbots Ripton
Huntingdon
Cambs. PE17 2LS

July 1980

3 MERSEY BIRD MORTALITY - AUTUMN 1979

3.1 Preamble

In Autumn 1979, over 2 000 birds were washed up on the shores of the Mersey estuary. This report outlines the development of the enquiry to date (June 1980). The data in this report originating from AOC analysts should not be quoted elsewhere or reproduced elsewhere without their permission.

3.2 Preliminary Note of Acknowledgement

Mass mortalities of wild animals are not common, and when they occur they attract public and institutional attention. When the institutions attempt to unravel the causes of the mortality, identify the source of the agent - if pollution is responsible - and finally produce a policy for reducing adverse effects to an acceptable minimum, efforts are often duplicated, or dissipated in unnecessary inter-institutional wrangles. To date, the investigation of the Mersey Bird Mortality, Autumn 1979, has suffered from few of these problems and thanks are due to the following who have made substantial contributions to the data presented in this report and made a continuing co-ordinated investigation possible. We are particularly grateful to AOC for allowing us to quote in summary form their analytical data.

Associated Octel Company (AOC)	-	Mr A.G. Hewitt Dr J. Gething
Nature Conservancy Council (NCC)	-	Dr A.S. Cooke
North West Water Authority (NWWA)	-	Mr A.D. Buckley Mr P.J. Osbaldertone Dr P.C. Head Dr K. Wilson
Royal Society for the Protection of Birds (RSPB)	-	Mr T. Stowe Mr G. Williams

Our thanks must also go to Mr R. Cockbain and Mr P. Lord who made great efforts counting and collecting dead and dying birds. It was these two and the staff of Liverpool Polytechnic, Dr Hale and Dr P. Smith, who first brought the incident to light.

3.3 Introduction

There are 3 main geographical components in the problem. Their relationships are probably the key to resolving it.

3.3.1 The Mersey

The Mersey has a catchment area which includes Warrington, Widnes, parts of the Manchester area, Runcorn and Liverpool. It is thus served by run-off from one of the world's most intensely industrialised zones. Major multi-nationals with a Mersey waterfront include Shell, Associated Octel, several other brand leading petrochemical companies, and ICI. Nearby can be found factories owned by firms which include Rio-Tinto Zinc and British Leyland.

NWWA data made available to ITE shows that, despite the presence of so much heavy industry, the river is improving in quality, mainly through sewage effluent control policies. Surveys carried out by ICI's Brixham Laboratory suggest an increase in the numbers and diversity of wildlife inhabiting the mud banks (eg Craig, Tapp & Taylor 1979).

3.3.2 The Manchester Ship Canal

The Manchester Ship Canal is a complicating factor in the analysis of the 1979 incident. It receives effluent direct from some industries, and, depending on the tide and time of year, interacts variably with the main body of Mersey water and the water of the River Weaver. At the time of high spring tides in the autumn, near the time of the incident, there is probably a great amount of interchange between the Ship Canal and the Mersey itself. In these circumstances, effluent from companies which usually is emptied into the Canal possibly has a chance of entering the main river before the usual settling and dredging procedures have occurred. These procedures might normally serve to reduce the toxicity of any effluent that reaches the main river via the ship canal.

3.3.3 The Manchester Ship Canal Company Dumping Grounds

The MSC Dumping Grounds, yet another complicating factor, are situated on the south bank of the Mersey alongside the Ship Canal. Dredgings from the Ship Canal are pumped to the settling grounds and there sediment is allowed to resettle before the water is drained back directly into the Mersey. A major release of water occurred in early Autumn 1979, a few days or weeks before the first mortalities were recorded; NWWA representatives have recently stated this was not the normally approved practice.

3.3.4 General geography

The map (Figure 1) shows the general relationships between the Mersey and adjacent industrial sites. The positions of companies are only approximate.

3.4 Account of the Incident

3.4.1 The incident occurred over almost a 2 month period September-November 1979. Data for the very early period may not be accurate, but the main progress of the incident can be summarised thus and all reliable data are incorporated in Section 3.5.

a. Mr Cockbain and friends found numbers of dunlin *(Calidris alpina)* dead on beach soon after a high spring tide on or about 16 September 1979.

b. This initial observation was repeated on subsequent days, and, after consultations with the RSPCA and RSPB, corpses were dispatched to the CVL (MAFF).

c. The finding of more corpses led to the involvement of Liverpool Polytechnic who contacted NCC (Dr Cooke). Dr Cooke brought the matter to the attention of ITE, requesting that analysis for toxic chemicals be carried out on birds collected from the north shore of the Mersey.

d. Both CVL and ITE Monks Wood then established the presence of high levels of lead in the birds. Two different analytical techniques had been used which lent confidence to the results.

e. On 6 November, Dr J. Harradine (WAGBI) organised a meeting of most of the interested parties at Liverpool Polytechnic. (Minutes attached: Appendix 1).

Lead appeared to be the only chemical involved, and the only possible cause of death. None of the veterinary work had suggested any disease as a cause.

Unfortunately, the Associated Octel Company (AOC) were not present at this early meeting. However, they were at this stage undertaking organic lead analyses of wildlife to help determine whether effluent from AOC was in any way responsible for the high lead levels in the birds.

At this meeting, WAGBI undertook to supply ITE with wildfowl, and RSPB to co-ordinate further counts and collections of affected dunlin.

A press release was issued by WAGBI (Appendix 2).

f. Towards the end of October, and during November, deaths of birds appear to have ceased.

g. ITE staff and Dr Cooke of NCC paid two visits to the various dumping grounds (one in November 1979, one in January 1980) surrounding the Mersey area. The data collected confirmed the findings of NWWA on lead levels in sediments, and thus they are not presented here. It was clear that chemicals were leaking into the waterways from these grounds. The nature of escaping effluent could not be established. The flow was not large.

h. On 21 January 1980, a second meeting of all the interested parties was held at NWWA offices Warrington (Minutes attached: Appendix 3). Considerable discussion on the results found to date ensued. Peculiarly, although ITE results were offered to the meeting by Dr Cooke of NCC and Dr Osborn of ITE, the meeting's chairman (Mr Buckley, NWWA) did not incorporate them either into discussion at the meeting or the minutes.

However, the meeting was useful in that AOC agreed to have a smaller meeting with ITE, NCC, and RSPB to discuss in more detail the data they had collected. Also, the initial apparent reluctance on the part of NWWA and AOC to consider seriously lead as a cause of death was countered at this meeting and a press release agreed by all the parties was prepared. This was released by NWWA (Appendix 4).

i. On 21 February, a meeting at AOC Ellesmere Port was held. This was a useful meeting (Minutes attached: Appendix 5) and a programme of future work was outlined. Many confidential data were presented, and are summarised elsewhere in this report.

j. Progress has been made since the February meeting and it is now clear that NWWA are mounting a detailed investigation of the problems the wildlife incident has brought to light. AOC appear to be actively involved in analytical support. ITE has received dunlin and wildfowl from estuaries other than the Mersey and lead analyses are currently in progress. Exchange of material with AOC for organic lead is imminent. A relatively clear set of communications between the various organisations involved now exists.

On the negative side, it has proved impossible to collect sufficient live dunlin from near the site of the mortalities and it has not been possible to collect any wildfowl. ITE will attempt to do this after consultations with WAGBI.

k. Consultation between Dr Cooke (NCC), Dr Bull (ITE) and Dr Osborn (ITE) led to the production of a memorandum by Dr Cooke. It summarises the events and some of the data, and suggests areas for future study (Appendix 6). Earlier memoranda from Dr Cooke are also appended (Appendices 7 and 8).

l. At present, responsibility for the current work and that on future incidents seems to be distributed as follows:

i. NWWA/AOC - investigations to determine the distribution of lead and its organic compounds in the Manchester Ship Canal, the Dumping Grounds, and the Mersey, and also in some of the invertebrates and algae present.

ii. NCC/ITE - investigations into the toxicity of lead and its organic compounds to birds.

iii. RSPB - counting and collection of affected birds.

m. MAFF Food Sciences have been informed, and have alerted DHSS to the potential problem. WAGBI have been advised by ITE and others to ban shooting and consumption of Mersey birds, at least temporarily. A meeting may take place between Dr Osborn (ITE) and DHSS Mr Wiggins and a medical adviser during the next few weeks.

3.5 Effects on wildlife

3.5.1 Effects on mammals

Effects on mammals were not documented. One captive ferret was reported dead after consuming part of a duck. There were reports of rats taking dead and dying dunlin. There were no reports of mortalities.

3.5.2 Effects on birds

A. Mortality

a. Waders, gulls, and wildfowl

Effects on birds were the most dramatic. The RSPB prepared a note on mortality (Appendix 9). Dunlin and black headed gulls *(Larus ridibundus)* were the most numerous casualties. In addition to the total of about 2 000 from RSPB, WAGBI estimate 500 wildfowl from the south shore also died. The estimates of mortality are not very precise because of the removal of corpses by scavengers, loss of corpses to the river and to deaths in inaccessible places. Total mortality could have been as high as 25 000 birds, although probably only 5 000 birds were killed. A map was prepared at the meeting on 6 November showing the areas where dead and dying birds were found (Figure 1). It is of interest that this may be a "slack water" area of the Mersey - water moves slowly through the Esturary anyway

b. Post-mortem observations

Dead birds and sick birds

Not all dead and sick dunlin were emaciated: some were, but some had what appeared to be reasonable fat and protein reserves. This observation eliminates starvation through food shortage as a major and primary cause of death. Strikingly, the intestines of the dunlin and pintail examined live at Monks Wood before being killed were stained green, consistent with lead poisoning.

c. Birds of prey

Some reports of peregrine falcons *(Falco peregrinus)* and kestrels *(Falco tinnunculus)* in the area feeding on dead and dying dunlin could not be confirmed. Two kestrels were seen in the vicinity of Hale Point on the November visit. No mortalities were reported.

B Sublethal effects

a. Waders, gulls, and wildfowl

Unco-ordinated movements, notably "shivering" and "head-shaking" or "head trembling" were reported for birds involved in the incident. One dunlin and one pintail duck *(Anas acuta)* were examined at Monks Wood. They were both unable to stand, made no attempt to fly and the duck could not hold its head erect. The droppings of both birds were green. These observations are consistent with lead poisoning.

3.5.3 Effects on invertebrates

A. Mortality

A large number of *Macoma* were washed ashore on the river banks at the time of the incident.

3.6 Toxic chemicals in wildlife and in the Mersey environment

3.6.1 Birds

ITE analyses to date have concentrated on dunlin. Data obtained by ITE are summarised in Table 1 (organochlorines and PCBs), Table 2 (mercury, cadmium, copper, zinc and iron) and Table 3 (lead). AOC have also concentrated on dunlin from the Tees as well as from the Mersey. The data are summarised in Table 4. Further details are contained in a confidential AOC report which was shown to us at the Ellesmere Port meeting on 21 February 1980. For comparison, Table 4 also summarises data from earlier analyses of waders carried out at Monks Wood.

3.6.2 Invertebrates

ITE has not examined invertebrates. However, we have seen data from AOC, again from the confidential report, and the findings are summarised in Table 5.

3.6.3 Lead in the General Mersey Environment

AOC/NWWA data are summarised in Table 6. Again, the data are from confidential reports.

3.7 Toxicological significance of lead in the wildlife

3.7.1 Toxicity of lead and its organic compounds

Despite the long knowledge of lead toxicity, little is understood of its effects. Summaries can be found in Casarett & Doull (1975) and Underwood (1977). The toxicity of organic lead is even less well understood. Some of the more significant experiments seem to be those of Schepers (1964), Cremer (1965) and Bolanowska (1968). These papers strongly suggest that trialkyl lead compounds are the organic species which are the effective agents and that the trialkyl compounds are relatively stable in saline solutions - and hence biological tissue. In common with most metals, the highest loads accumulate in liver and kidney. Bone also accumulates substantial amounts of lead. Whether bone accumulates organic lead remains unknown at present. The most susceptible tissue may be the Central Nervous System, the most likely biochemical site of action, at least for inorganic lead, is the - SH groups on proteins (mainly enzymes).

Generally, lead intoxication is characterised by loss of co-ordination, central nervous system dys-function, anorexia (some reports that birds would not eat were received), and blood disorders.

There are few data on the effects of lead on wildlife, or on the persistence of organic lead in the environment. There are no data on the effects of organic lead compounds on birds. Bird studies are urgently required (and are being undertaken in a preliminary form by ITE under an NCC contract). Environmental chemistry studies are also needed to determine persistence of organoleads, which may be greatly affected by pH and salinity.

The dearth of information on organic lead compounds makes interpretation of the results difficult. However, from the data tables and from reviews made by Dr Cooke (Appendices 6-8), it is reasonable to conclude that:

1. Levels in dunlin from the Mersey, live sick and dead, are higher than those in dunlin collected from the Tees.

2. Levels in dunlin from the Mersey are higher than those in dunlin and similar birds previously examined by ITE.

3. The percentage of organic lead in the birds is surprisingly high.

4. The most probable cause of the incident was the high levels of organic lead birds accumulated in their tissues, since lead was the only agent identified which could have caused death.

3.8 Acknowledgements

Drs I. Newton, J.P. Dempster and Mr J.N.R. Jeffers for comments, Mrs S. Haiek and Mr A.A. Bell for dissection, and Mr P. Freestone and Mr L.A. Sheppard for analysis of lead.

3.9 References

BOLANOWSKA, W. 1968. Distribution and excretion of triethyllead in rats. *Br. J. ind. Med.*, 25, 203-208.

CRAIG, N.C.D., TAPP, J.F. & TAYLOR, D. 1980. *An investigation of the Inner Mersey Estuary in connection with the 1979 bird mortality incident.* ICI confidential report to the Associated Octel Company. Brixham: ICI Laboratory.

CASARETT, L.J. & DOULL, J. eds 1975. Toxicology, the basic science of poisons. New York: Macmillan; London: Baillière.

CREMER, J. 1965. Toxicology and biochemistry of alkyl lead compounds. *Occup. Hlth. Rev.*, 17, 14-19.

SCHEPERS, G.W.H. 1964. Tetraethyllead and tetramethyllead: comparative experimental pathology. 1. Lead absorption and pathology. *Archs envir. Hlth*, 8, 277-295.

UNDERWOOD, E.J. 1977. Trace elements in human and animal nutrition. New York & London: Academic.

TABLE 1

Organochlorine levels and PCBs in livers of dunlin and redshank from Mersey, mg kg^{-1} wet wt

	PCB	DDE	HEOD	Others[1]
Dunlin	ND	ND	ND	ND
Dunlin	"	"	"	"
Dunlin	"	"	"	"
Redshank	"	"	"	"
Redshank	"	"	"	"

All birds were found dead on the shore

Notes

1. **One small, and probably insignificant, unidentified peak was observed in 3 of the birds.**
2. **Analytical procedure by standard Monks Wood technique.**
3. **Wet wt values used to allow comparison with data from other labs. Dry wt conversion factors available if needed.**
4. ND = <0.2 mg kg^{-1} (approx).

TABLE 2

Toxic and essential metal levels in livers of dunlin and redshank from Mersey. Mg kg^{-1} wet wt

	Hg	Cd	Cu	Zn	Fe	Pb
Dunlin	2.1	ND	4.25	29.9	544	18.5
"	2.7	"	8.00	26.3	383	31.0
"	1.4	"	6.25	22.2	370	12.8
Redshank	0.8	"	7.75	15.2	812	7.5
"	4.7	"	30.0	45.2	1867	20.2

Notes See Table 1.

1. ND = <0.1 mg kg^{-1} (approx).
2. **The last bird, a redshank, was badly emaciated, with very low protein reserves, as judged from the pectoral muscle. Metal levels in this bird are probably high because of the low level of fat in the liver (Osborn 1979).**

TABLE 3

Levels of Pb (mg kg^{-1} wet wt) in tissues of dunlin from the Mersey

No.	Species	Approx. coll'n date	Status	Lead (total) in tissues, mg kg^{-1}, wet weight basis				
				Liver	Kidney	Muscle	Brain	Bone
1	Dunlin	Sep/Oct 1979	Dead	18.5	na	na	na	na
2	"	"	"	31.0	"	"	"	"
3	"	"	"	12.8	"	"	"	"
4	"	"	Sick	10.8	6.0	1.4	2.9	20.9
5	"	"	"	7.0	5.8	1.0	1.9	40.0
6	"	"	"	6.0	5.5	0.6	1.1	24.3
7	"	"	"	10.6	8.3	1.5	2.1	22.0
8	"	"	"	7.5	7.8	0.9	1.5	20.7
9	"	"	"	11.2	8.6	1.8	2.6	10.8
10	"	Jan 1980	Live	2.8	6.5	0.6	1.2	11.5
11	"	"	"	5.7	13.2	1.1	2.5	9.4
12	"	"	"	7.6	14.1	1.3	2.5	23.3
13	"	"	"	1.9	3.8	0.6	0.9	18.2

Notes: Collectors Sep/Oct 1979 Liverpool Poly et al.
Jan 1980 Cockbain et al.

na = tissue not yet analysed

N.B. Birds 1-9 Flame AA, Birds 10-13 Flameless AA

TABLE 4

Summary of total and organic lead in livers of waders from Tees, Mersey and Wash. Pb, mg kg^{-1} wet wt

Location/ year/status	Species, n	Tissue	Total Pb	Trialkyl Pb	Analysts
Wash/ early 1970s/ live	Redshank 4	Liver	<0.02	-	ITE
	Dunlin 16	"	<0.02(15) 1 had 6.3	-	
	Knot 22	"	<0.02	-	
Mersey/ 1979/ dead	Dunlin 3	Liver	22	-	ITE
	Redshank 2	"	13	-	
Mersey/ 1979/ sick	Dunlin 6	Liver	9	-	ITE
Mersey/ 1979/ live	Dunlin 4	Liver	5	-	ITE
Mersey/ 1979/ dead or dying	Dunlin 10	Liver	11-21	6-14	AOC
Mersey/ 1979/ sick	Dunlin 5	Liver	21-34	8-15	AOC
Tees/ 1979/ live	Dunlin 5	Liver	0.3-0.7	0.03-0.1	AOC

TABLE 5

Lead in Mersey invertebrates (mg kg^{-1} wet wt)

Species	Total Pb	Trialkyl Pb	Analysts
Macoma	2-8	0.7-1.3	AOC
Oligochaetes	18-22	0.08-0.22	"

TABLE 6

Lead in General Mersey Environment (mg kg^{-1} dry wt)

Sample	Location	Total Pb	Trialkyl Pb	Analysts
Sediment	Dumping Ground	up to 300+	up to 5[a]	AOC
"	Ship Canal	up to 230+	c. 0.02	"
"	Mersey	up to 300[b]	c. 0.05[b]	"
Water	Mersey	10-29[c]	4-6[c]	"

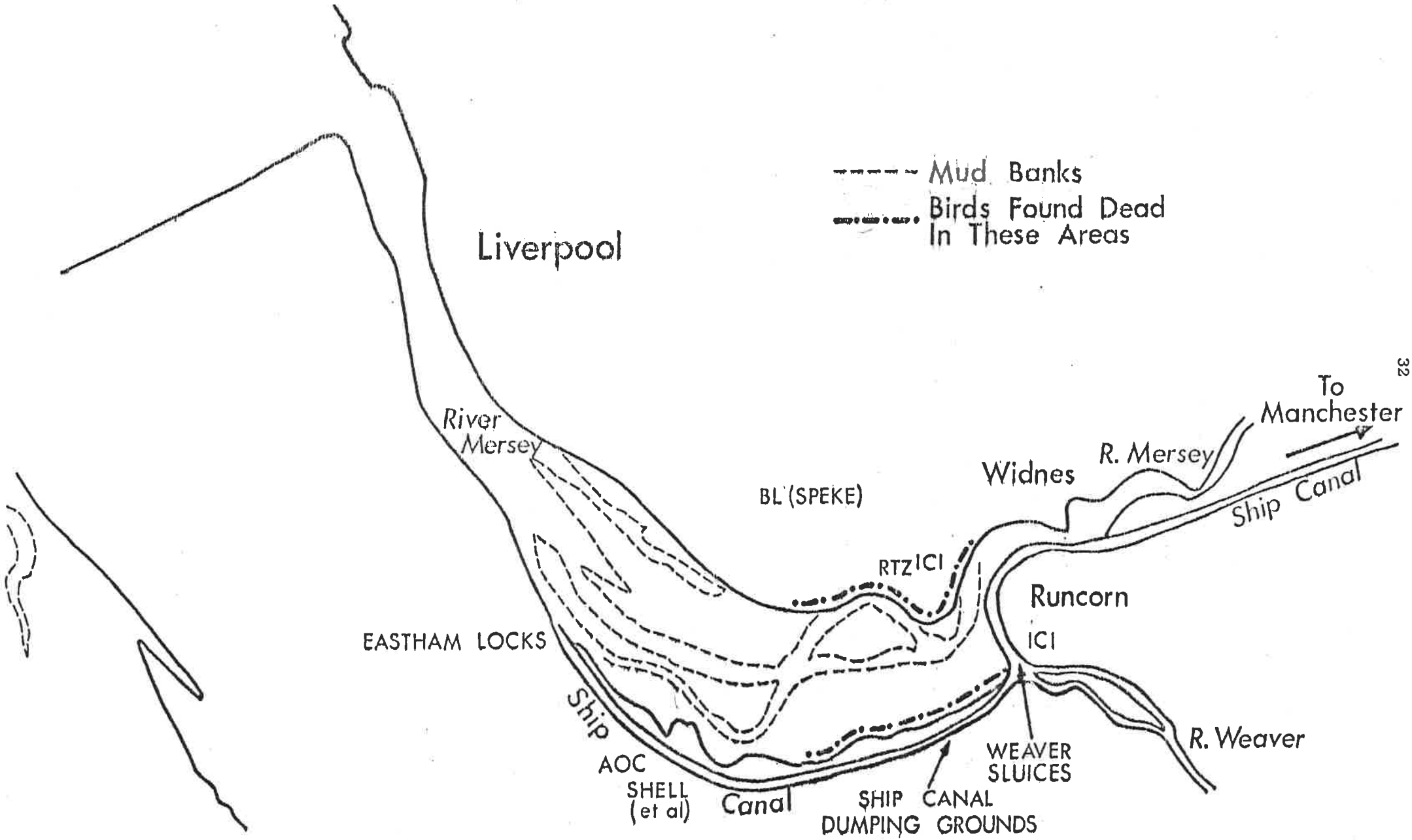
[a]Also up to 5 mg kg tetra alkyl Pb.

[b]Highest near Dumping ground drain.

[c]Water values, µg/l.

Figure 1

SKETCH MAP OF R. MERSEY SHOWING SOME RELEVANT FEATURES



Some of the details contained herein are not accurate

WAGBI - For Shooting and Conservation

MERSEY ESTUARY/POLLUTION INCIDENT

Report of meeting held at Liverpool Polytechnic on Tuesday 6th November 1979.

Present:	Representing:	
Dr J Harradine (Chairman)	WAGBI for Shooting and Conservation	WAGBI
Mr A Laws	"	
Mr P Osbaldeston	North West Water Authority	NWWA
Mr B D'Arcy	"	
Mr R MacCauley	"	
Mr A Cooke	Nature Conservancy Council	NCC
Dr D Osbourne	Institute of Terrestrial Ecology	ITE
Mr P Freantone	"	
Mr K Bull	"	
Mr T Beverley	Ministry of Agriculture, Fisheries and Food	MAFF
Mr D Gibbons	Veterinary Investigation Centre, Liverpool	VIC
Dr J Cadbury	Royal Society for the Protection of Birds	RSPB
Mr J Armitage	"	
Mr M Brummage	Merseyside County Council	MCC
Mr E Hampson	"	
Mr R Smith	Cheshire County Council	CCC
Mr M Lee	"	
Dr J Baker	Liverpool University	LU
Dr P Smith	Liverpool Polytechnic	LP
Mr E Wilkinson	Frodsham and District Wildfowlers' Club	FDWC
Mr R Cockbain	Local ornithologist	O
Mr M Lord	"	

1. Introduction

The chairman opened the meeting and thanked every body for attending it at short notice. The purpose of the meeting was to draw together the available information relating to the die-off of birds on the Estuary so as to help identify the cause(s) and hence ensure a similar incident does not recur.

2. Normal Procedure in the Event of a Seabird Incident

(Although brief reference was made, a fuller description is included for completeness from NCC's Oil Pollution Manual).

Where a seabird incident occurs not involving oil first reports are transmitted to RSPB HQ. RSPB then contacts NCC GB HQ which informs its appropriate Regional Oil Pollution Officer. Through the RSPB a Beached Bird Survey is conducted if appropriate and the results sent to NCC GB HQ.

RSPB or NCC normally advise on where analyses of corpses could take place outside ITE's facility in Abbots Ripton. ITE has a contract from NCC for small scale autopsy and analysis work; if appropriate it may seek the assistance of other laboratories.

3. History and Scale of the Current Incident

The first birds, redshank and dunlin, appeared on the 16 September; by 24th some 180 birds, mostly mud-feeders, had been found. Morbid and dead birds have been found particularly after spring tides: the numbers found after each of the last four tides were 354, 325, 205, 214.

To date, on the north side of the Estuary, approximately between Speke airport and the Runcorn bridge, about 1700 birds, representing 23 species have been recorded. Of 61 dead ducks 37 have been teal; 7 dead and 12 sick pintail have also appeared. Of 968 dead waders 837 have been dunlin; also 74 redshank and 36 curlew. Of 296 dead gulls 266 have been black-headed gulls. It was noted that no lapwings have been found and that most of the curlew and redshank appeared between the 20th and 25th October.

It was concluded a) that many birds had not been accounted for, through scavenging and being washed away, so that the total recorded was only a proportion of the total affected and b) that the smaller species were being recorded more frequently among totals that showed no signs of declining.

On the south side of the Estuary, on the saltmarsh, counting and retrieving of birds is more difficult. Some 500 perhaps have been affected with the species including curlew, knot, dunlin, teal and gulls. Very few birds have appeared south of the Manchester Ship Canal.

The main conclusion was that the incident has been very localised. No confirmed reports have been received of affected birds from the area being found outside it.

4. Secondary Poisoning

The possibility that such poisoning was occurring was discussed. Many birds, especially the smaller species, are assumed to have been lost to scavengers and circumstantial evidence suggests crows and rats have been affected. Kestrels and cats have been active in the area.

5. Symptoms

The main symptoms observed include headshaking, loss of balance and coordination with an early loss of flying ability, and uncharacteristic behaviour.

6. Post-mortem and Chemical Analysis Results

Various laboratories presented the results of their investigations.

a. VIC: copy attached

b. VIC (Weybridge): total Lead (ppm wet tissue) in the liver –

n	Material	ppm
1	wigeon	12
1	wigeon	15
1	redshank	30
1	redshank	20

No evidence of organic lead

c. LU: 1) postmortems on 1 mallard, 1 redshank, 2 dunlin, 1 curlew, 2 black-headed gulls – no significant findings

2) analysis for lead (ppm, liver) – dunlin 20.9, redshank 36.5, black-headed gull 13.2

No secondary effect on mice

3) Analysis for mercury – all < 1ppb.

d. ITE: 1) postmortems and screening programme for organchlorine, Fe,Zn, Cu,Hg,Cd – no significant results

2) Analysis for lead – 11 dunlin

n	Material	ppm
7	whole	c.10
4	whole	5–10
6	liver & kidney	c.30
6	bone	58 (33–96)

e. NWWA: 1) Analysis of water and sediments – results attached

2) mean ~~water~~ sediment lead levels (mg/kg) –

1978 1977 1976 1975 1974

72.2 63.2 69.2 65.8 82.2 but considerable variation:

for example, 1976 8.8–741

3) analysis for shellfish (Macoma) for lead (2 replicates) – no elevated levels

4) analysis of birds and sediments for organic lead – results awaited

7. Interpretation of Results

In general (ITE): background levels of lead in birds usually 2–3 ppm, and not usually in livers.

high levels in liver and kidney suggest recent exposure; 5-10 ppm suggest acute intoxication

ingested lead shot studies suggest that > 10ppm implicate lead as contributory mortality factor; mortality in wildfowl usually associated with 30-40ppm.

8. Conclusions from Results

ITE: -All results indicate unusually high levels of lead which, in relation to background levels from the Tees, Wash and other studies, suggest lead is an important contributory factor in the observed mortality. They indicate a need for further study of lead's involvement. Even then it may prove difficult to establish any cause and effect.

NWWA: All possible sources of lead have been investigated but no abnormal levels have been found. Advice would be welcomed on further lines of investigation.

Further study: In the absence of a clear early solution to the problem a comprehensive study might be needed, at a cost of £10-15,000 for one man for the first year. ITE is operating under financial constraints and further investigation by NWWA is subject to statutory constraints, especially in the light of the negative results to date. NCC stated a willingness to contribute to further study and CCC indicated a possibility of contributing to further study.

In order to assist the interpretation of future results, nutritional status should be taken into account.

9. Risks to People

Concern was expressed at the levels of lead found in the birds in relation to the statutory limits for lead in food (≤2ppm), especially in view of the imminent lowering, by about half, of the limits. The levels in some bird musculature was approaching current limits and were considerably higher in such organs as the liver and kidney.

Variations in peoples' eating habits and other circumstances such as nature of work, may raise or lower the possibility of secondary poisoning.

WAGBI reported that its advice to its members in the area was not to eat shot birds showing any signs of unhealthiness. In such circumstances they should inform WAGBI and consider ending their shooting. The responsible action of NWC was noted in their ending their shooting on Frodsham marshes after the first reports of birds dying had been received.

10. Rehabilitation of Birds

Discussion on the feasibility of treating birds for lead poisoning followed an apparently successful treatment of a heron at the VIC with sodium versinate. Since the RSPCA has been attempting the rehabilitation of affected birds liaison between the group and the RSPCA might be fruitful.

11. Recommendations

a) In order to understand more about the distribution of the birds being affected, in both time and space, and hence to help identify the source of the problem, a more comprehensive monitoring of both north and south sides of the Estuary should be conducted, especially during the spring tide periods.

This monitoring will be effected by both ornithologists and wildfowlers and further experimental work on disappearance rates and dispersal of corpses will be done.

b) In order to further the understanding of lead's involvement fresh corpses from a few species only (teal in particular) should be supplied to ITE. This will be effected by FDWC and O.

c) In order to evaluate the risks of secondary poisoning corpses of rats, crows and gulls should be studied.
Corpses will be supplied by FDWC and O to the LU.

d) In order to help rationalise the collection and dissemination of information a coordinating/publicity role should be adopted by one or more of the bodies represented. Publicity should also help to indicate to administrators where further study is required.

WAGBI will undertake this role for the time being and will issue statements to the press and media immediately.

Finally, thanks were expressed to all present and to Dr Phil Smith for arranging the facilities for the meeting. It was agreed that another meeting of the group would be convened in a few weeks subject to the results of the continuing monitoring and laboratory studies.

JPH/BH.
13.11.79
Issued from
WAGBI, MARFORD MILL,
ROSSETT CLWYD LL12 OHL.

Rossett 570881.

WAGBI For Shooting & Conservation

FOUNDED IN 1908 BY STANLEY DUNCAN, F.Z.S.
INCORPORATING THE GAMEKEEPERS' ASSOCIATION OF THE UNITED KINGDOM, FOUNDED IN 1909

PATRON: HIS ROYAL HIGHNESS, THE PRINCE PHILIP, DUKE OF EDINBURGH, K.G., K.T., O.M.
PRESIDENT: THE VISCOUNT OF ARBUTHNOTT, D.S.C., M.A., J.P.
DIRECTOR: JOHN ANDERTON, O.B.E., V.R.D.
NATIONAL HEADQUARTERS: MARFORD MILL, ROSSETT, WREXHAM, CLWYD, LL12 0HL
TELEPHONE: ROSSETT 570881 (STD 0244)

Press Release

FOR PUBLICATION: IMMEDIATE.

CONTACT: DR. JOHN HARRADINE
RESEARCH CO-ORDINATOR

MERSEY ESTUARY/POLLUTION INCIDENT

The cause and source of the pollution which already has killed thousands of waterfowl on the Mersey Estuary are not yet known. This was one of the conclusions of a meeting held at the Liverpool Polytechnic on Tuesday 6th. November. Concern was expressed not only over the harmful effects on local bird population, but also over the possibility of people, under certain circumstances, being at risk from eating wildfowl shot in the area, given the levels of lead found in the birds that have been analysed. The meeting endorsed the view that any bird appearing to be unhealthy should not be eaten. It also concluded that the incident is local, confined largely to the middle reaches of the Estuary.

In view of the absence of a solution it was decided that detailed monitoring of the birds being affected on the Estuary should be carried out jointly by the ornithologists and wildfowlers and more analysis of corpses should be conducted to help answer questions still hanging over this incident.

The meeting, which was called by WAGBI - For Shooting and Conservation, and chaired by its Research Co-Ordinator, Dr. John Harradine, was attended by representatives of government and voluntary bodies concerned with conservation and with land and water use, local authority planning departments, veterinary and research laboratories and local ornithologists and wildfowlers.

To date, a minimum of 2,200 birds of 23 species, which depend entirely or partially on the Estuary for feeding or roosting, have been found dead or affected in this area. Reports were first received on the 16th. September and there is no sign yet that the problem is abating.

Investigations on the bodies of birds collected mainly by ornithologists and by members of the WAGBI Affiliated Frodsham and District Wildfowlers Club, consistently have revealed high levels of lead in the tissues but no other unusual concentrations of toxic agents and no evidence of disease. It was generally agreed that the levels of lead are likely to have contributed to the deaths of the birds. On the other hand samples of water, sediments and invertebrates from the Estuary, especially from near the industrial complexes, as yet have not revealed any abnormal levels of lead.

JH/JS. 7.11.79

A copy of the journal in which this information is published would be appreciated

NORTH WEST WATER AUTHORITY

DIRECTORATE OF SCIENTIFIC SERVICES

MERSEY ESTUARY BIRD MORTALITY 1979

Minutes of a meeting held at Dawson House, Warrington on Monday 21st January, 1980 at 11.00 a.m. in Committee Room 1.

Present: A.D.Buckley (Chairman)	North West Water Authority
P.J.Osbaldeston	" " " "
P.C.Head	" " " "
P.Gregory	" " " "
E.Harper	Rivers Division N.W.W.A.
J.R.McCauley	" " "
A.Wither	" " "
J.Kennerley	Associated Octel Ltd.,
J.Gething	" " "
A.G.Hewitt	" " "
T.Lock	Cheshire Ornithological Assoc.
K.Bull	Institute of Terrestrial Ecology
P.Freestone	" " " "
Mrs.S.Haiek	" " " "
D.Osborn	" " " "
I.Bonner	Nature Conservancy Council
A.Cooke	" " "
T.Stowe	Royal Society for Protection of Birds
G.Williams	" " " " " "
J.Harradine	Wildfowlers Assoc. of Gt.Britain & Ireland
R.Cockbain	Local Wildfowler
J.L.Cranshaw (Secretary)	North West Water Authority

The Chairman introduced and welcomed the representatives of the various bodies to the meeting.

ASC1

The Chairman opened the meeting by briefly describing the area of the bird mortalities. The River Mersey was a polluted river drained a population of 2½ million before receiving untreated sewage and industrial effluents from the Warrington and Widnes areas. Downstream the river estuary showed a slight improvement until it received a further pollution load from both sides of the estuary in the vicinity of Liverpool and Birkenhead. Also associated with the River Mersey is the Manchester Ship Canal which enters the estuary at Eastham and includes the River Weaver, itself draining a large area of the Cheshire plain. Near Runcorn the Weaver Sluices allow water from the Ship Canal and river Weaver to enter the estuary depending on canal levels and the height of tide.

In late September the North West Water Authority became aware of a number of bird deaths in the middle reaches of the Mersey estuary, which rose to a peak in early October. The affected birds comprised mainly Dunlin, a lesser number of Black-headed gulls and ducks. Early examination of the birds by RSPB/Liverpool V.I/ITE detected elevated levels of lead. Although little background knowledge of lead levels in birds was available, it was known from previous surveys of the river that varying concentrations of lead were present in the silts of the estuary. As this concentration did not appear to have changed, it could not therefore be linked with the elevated levels found in the birds and other possible sources were investigated. It was known that a number of small users discharged lead indirectly to the estuary and that Associated Octel who manufacture tetra-ethyl lead discharged their effluent to the Manchester Ship Canal. Although the confluence of the Ship Canal and the Mersey at Eastham was not in the vicinity of the bird deaths, the ebb and flow of the canal under the effect of high spring tides could result in overflow of the canal into the estuary at Beaver Sluices near the area of the bird deaths. Due to the expertise and knowledge of Association Octel in the use of lead in their manufacturing process, the Company was approached to provide assistance and found the tri-alkyl lead derivative in the birds.

JAS C.

Consideration was also given to the food of the birds as being the source of lead. In the estuary there was a high population of Macoma, a small bivalve attractive to the birds and in 1979 an unusually high spat formation occurred in June/July, prior to the first notification of bird deaths in September.

The Chairman stated that this was the position as the Authority knew it and they questioned why the incident had occurred this year and not in previous years, or in fact had there been smaller kills in previous years which had been unreported.

Mr.Stowe (RSPB) tabled casualty statistics from the incident and a list of the principal foods of the major wader and wild fowl casualties. He stated that the size of the kill was comparable with incidents associated with major oil spillages and their experience from investigations carried out at sea, indicated that many more birds may have died as recovery rates from a major incident varied between 10 - 60%. The outbreak was a major kill and the first in Britain to affect waders and caused particular concern due to the importance of the Mersey estuary. Two previous, less serious incidents had occurred in 1977 and 1978 and Messrs.Stowe and Cockbain agreed there was an history of small incidents in the area. Mr.Osbaldeston

(N.W.W.A) referred to discussions with Dr.Hale at Liverpool Polytechnic, who had reported a similar kill on the Ribble Estuaries about 3 years ago. This was apparently not documented.

Mr.Harper (N.W.W.A.) mentioned the reference to the major food source of the affected birds and stated that Rivers Division had identified lead concentrations in Macoma collected from the estuary. In the absence of gut analyses it was difficult to interpret the evidence of the increased spat fall in 1979 with the outbreak. This was only one possibility and it appeared that this particular outbreak was now over. Attempts should be made to establish the cause of the outbreak and to prevent future occurrences. Mr.Stowe (RSPB) pointed out that Dunlin were not primarily Macoma eaters and would eat other food available on the mud flats. Dr.Osborn stated that the birds examined were not emaciated nor did they exhibit any pathological evidence of disease, which again implicated lead as the source of the trouble.

Mr.Kennerley (AOC) then outlined the position of Associated Octel. He stated that the factory was commissioned in 1954 and extensions were carried out in 1972 so that the Company now produced 70% of the world market of 'anti-knock' additive for petrol. After becoming aware of the bird deaths and the press reports associating the deaths with lead concentrations in the estuary they contacted the N.W.W.A. and requested samples of birds, fauna and flora for analysis. They were concerned about their own discharge but other sources of lead could not be ruled out and an aerial survey was undertaken to assist the investigations. After the initial contact with the N.W.W.A. close liaison was maintained with Mr.A.Wither, (NWWA) Senior River Inspector. Also a wide ranging programme of analysis was undertaken to investigate the inorganic and organic lead concentrations in birds, sediments and organisms from the Mersey Estuary and from other sources. Total lead levels detected varied between 20-500 p.p.m./dry weight in sediments (which was not at variance with information known to the Authority), the lead content of the liver of 15 Dunlins analysed ranged from 15-35 mg/kg wet weight of which organic lead in the tri-alkyl form varied between 30-70%. The foodstuff of the birds contained from 2-5 mg/kg wet weight lead of which the tri-alkyl form of organic lead varied between 20-60%. A report by Consultants (I.C.I) commissioned by Associated Octel to carry out a survey of the estuary was expected in about 2 weeks time. No data was tabled by other representatives other than an adjustment of the assessment of the number of birds killed.

Mr.Kennerley (A.O.C.) stated that as Environmentalists the Company were very concerned about the elevated lead levels, which had prompted the investigations. The discharge from their factory had improved over recent years and further studies were being carried out to increase performance levels. In spite of this, the question still remained why had this incident occurred this year and not in previous years ? Mr.Kennerley added that at the present time he did not wish to release detailed analytical information but stated that representatives of the organisation present were welcome to visit Ellesmere Port to discuss the data in more detail. The representatives of N.C.C I.T.E. and RSPB accepted the invitation which was acceptable to the other bodies present, since it was confirmed that the ITE laboratory was the principal laboratory for examination of bird mortalities when they occur at places other than on land. Mr.Lock (C.O.A.) referred to the concentrations of organic lead detected in bird livers and asked if this was sufficient to contribute to the death of birds and also what effect the concentrations would have on humans. Dr.Gething (A.O.C.) stated that the levels quoted were not as high as figures quoted in the U.S.A., but agreed the levels were elevated. He did not have the expertise to state what proportion of organic lead was attributable to the death of the birds and it was difficult to correlate the effects of organic lead from one species to another. Dr.Osborn (I.T.E.) stated that concentration of lead about 5 p.p.m. in the liver of birds would be associated with death. From the data supplied by Octel it would appear that the lead is in the organic form, which is more toxic than inorganic lead and would seem to be associated with the kill. He suggested that the absence of an history of incidents could be due to a developing 'hot-spot' situation with higher concentrations of lead than in surrounding areas.

Dr.Head (N.W.W.A) then explained the distribution of lead in the Mersey Estuary. A good correlation had been obtained between the trace metal concentrations and sediments hence reliance could be placed on the annual analyses. This relationship did not alter with increased amounts of sediments observed during the dredging operations referred to by Mr.Harper (N.W.W.A.)

From comments made in the meeting it was apparent that there was a lack of knowledge of the normal levels of tri-alkyl lead in birds and its toxicity to various species. There were many manufacturers in the Widnes area discharging various pollutants to the estuary and in spite of the present implications for lead as a contributary factor, Messrs.Harper and Osbaldeston suggested that all options should be kept open and other avenues continue to be explored. In this respect a number of compounds had been recommended to ITE for investigation, which had produced only a minimal analysis for organic materials such as PCB's and other chlorinated hydrocarbons. Dr.Osborne (I.T.E.) stated that birds had been examined for lead concentrations and had shown overt signs of toxicity. Higher levels of lead had been detected in the birds associated with this incident than with any previous incident. As other avenues had proved negative, he was convinced that lead was responsible for the bird deaths and further alternatives should be discarded. Mr.Stowe (RSBP) agreed that investigation of other avenues had proved negative and the available evidence pointed to lead. From the reports of bird mortalities throughout the country, nothing unusual had been observed and this outbreak was specific to the River Mersey.

In response to a question from Mr.Kennerley (A.O.C.) on the involvement of ITE and NCC, Dr.Cooke (N.C.C.) stated that both organisations heard of the incident relatively late. First impressions were that the outbreak was associated with toxic substances and ITE were requested to carry out analysis by N.C.C. The only parameter identified in significant quantities was lead and since then investigations had concentrated on this metal. Other avenues had been investigated but he was convinced that the culprit was lead. He suggested that future investigations should explore the background concentrations of lead in birds, to determine if all birds are affected or whether this incident in 1979 was due to the birds being in the wrong place at the wrong time. He agreed that little was known on organic lead and stated that toxicological tests would be carried out by ITE to investigate the breakdown of lead. Mr.Kennerley (A.O.C.) stated that this work would complement further investigations by Octel and he invited representatives to visit his Company to acquaint themselves with the method of analysis for the determination of organic lead. The Water Authority would also continue to analyse the water and sediments of the Estuary.

Mr.Osbaldeston (N.W.W.A) expressed the Authority's disappointment at this incident, in so much as a three year survey of the biological condition of the estuary by Salford University, had given some cause for optimism. Invertebrates were widespread and divergent in species, and fish were passing through the estuary to the Ship Canal on high tides.

Whilst the increasing number of birds seeking shelter on the Estuary was encouraging, it must be always recognised that with the polluted state of the estuary and the nature and quantity of input thereto, that the birds are, under present conditions and with the inadequacy of present legislation, at risk.

Mr.Osbaldeston then tabled a document outlining the proposals for a possible studentship, to study the feeding habits and metal uptake of Waders. Only Associated Octel indicated a willingness to contribute to such a project, although RSPB and ITE representatives did express an interest but could not commit their organisations to any expenditure. RSPB indicated that they felt that the proposed studentship was too large for one person to carry out.

Mr.Williams (RSPB) then questioned the action taken by Associated Octel to review its discharge to the estuary. Mr.Kennerley (AOC) replied that over the years the Company had invested heavily in plant development, which had resulted in the gradual decrease in lead concentrations being discharged to the estuary. This improvement was not gained by dilution effects and had been identified by the N.W.W.A. when fulfilling its monitoring obligations. The Company had not been associated with pollution incidents in the past on the Mersey Estuary. A fish-kill on the Wincham Brook , was originally thought to be associated with sodium chloride concentrations in the discharge from their Northwich factory. Subsequent analysis of sediments from the bed of the brook indicated the presence of inorganic lead and further investigations are continuing. Mr.Harper (N.W.W.A) added that the Mersey Estuary was a grossly polluted estuary and there was an history of persuasion for industrialists to take action on their polluting discharges which was now being reflected in the improving situation on the Estuary. The evidence gathered from the Wincham Brook incident indicated a possible connection with the discharger from Octel, but the possible connection with nearby salt marshes could not be ignored.

Mr.Osbaldeston (N.W.W.A) then explained the situation pertaining to the joint statement made by Associated Octel and N.W.W.A. on 2nd January, 1980 which was available to the public on demand. The meeting then decided that it would be advisable to prepare a further statement arising from these discussions for release to the press, setting out the future proposals. The meeting then prepared an agreed statement to be issued on Monday 21st January, 1980.

Finally the Chairman reviewed the investigation to be carried out by the respective bodies in the forthcoming months and thanked the representatives for their attendance before closing the meeting.

PRESS RELEASE FROM 21 JANUARY 1980 NWWA MEETING

MERSEY BIRD DEATHS - 1979

In late September and October increasing numbers of dead and dying birds were found in the middle reaches of the Mersey Estuary. Since then, there has been a substantial reduction and few dead birds are now found. The total number of casualties is about 2,500, comprising in the main 1300 waders, (of which 1100 were Dunlins) 350 Black Headed Gulls and several hundred duck.

Early examination of the dead birds by the Institute of Terrestrial Ecology, MAFF and Liverpool University showed elevated levels of lead and The Associated Octel Company Limited, Ellesmere Port, offered its help by way of analytical expertise to examine the dead birds and the affected area for lead. Their examination confirmed that lead was present in the dead birds at a level higher than normally found. Lead was also found in the food of the birds. Much of the lead was present as tri-alkyl lead which may have arisen from the production or use of lead anti-knock compounds or from activities associated with disposal of canal dredgings.

Extensive investigations have not revealed any accidents, either within the company's works or at adjacent oil refineries that use their product, which could result in additional discharges of tetra-alkyl lead but any occurrence can never entirely be ruled out.

The Ellesmere Port factory was commissioned in 1954 and extensions were carried out in 1972. Effluent treatment facilities have always been in use and in recent years a further £700,000 has been spent on new plant. As a consequence total lead levels in the discharge have been reduced appreciably. Some of the residual lead is in organic form.

- more -

The lead content of these birds is the most likely cause of their deaths. Despite intensive investigation no alternative cause of death has been identified. The exact relationship between the lead levels and the toxic effect seen in the birds awaits further investigation. The source of lead has not yet been identified.

The company will continue with its developments in the field of effluent improvements and in association with North West Water Authority, RTB NCC, ITE, WAGBI and other voluntary bodies will carry out further scientific investigation into the consequences of lead in the environment. In this respect, the services of the ICI marine laboratory at Brixham have already been commissioned by the company for a wider survey of the estuary.

MERSEY ESTUARY BIRD MORTALITY 1979

Notes of a joint AOC-ITE-RSPB meeting held at Ellesmere Port on 21/2/80

PRESENT

AOC	ITE	RSPB
A G Hewitt (Chairman)	D Osborne	J Armitage
J Gething	K Bull	T Stowe
F G Noden	P Freestone	B Williams
D Turner		
A Whittingham		
D E Lill (Secretary)		

The Chairman welcomed the ITE and RSPB representatives and proposed the following informal agenda:

1. Discussion of analytical results
2. ICI (Brixham) report
3. Publication of results
4. AOC effluent data
5. Analytical techniques
6. Any other business

1. Analytical Results

Copies of an AOC document, containing results of all the bird, fauna, sediment and water samples to date, were circulated for inspection and discussion. It was requested that the copies remained with AOC and the results were not for publication at this interim stage of the investigation.

ITE presented copies of an intermediate report, summarising some points of interest and tabulating their lead-in-dunlin data (Appendix 1). Part of the work had been carried out by ITE under contract to NCC.

Dr Gething queried the apparent anomalies in ITE's latest lead in healthy dunlin results, viz the relatively high lead values for kidney tissues, but the absence of lead in the liver. ITE had interpreted these data, based on previous work with other heavy metals, to infer that these dunlin had been subjected to a lead exposure situation which had ceased prior to their capture. It was suggested by Drs Gething and Turner that the distribution of lead, noting in particular the levels of lead in bone, was indicative of exposure to inorganic lead.

It was pointed out by AOC, that at the recent joint meeting with the NWWA, ITE had suggested >10 ppm in the organs of dunlin would cause death, yet two of the healthy dunlin had ca 15ppm in their kidneys. Dr Osborne for ITE stated that the >10 ppm should apply to the liver and promised to send samples of these

/contd

latest dunlin to AOC for further analyses.

Following some lively discussion, it was agreed that ITE's latest results were open to several (mis)interpretations and due to the lack of data it was essential that more specimens of healthy Mersey dunlin are made available. RSPB reported the difficulty they have been experiencing capturing dunlin, but promised to increase the effort to acquire the necessary samples.

ITE reported that samples sent to Oxford for virological investigations were still waiting to be analysed. Dr Gething suggested sending samples to another establishment; however RSPB pointed out that several birds had undergone general post-mortems with negative results.

2. ICI (Brixham) report

Copies of the report were given to the ITE and RSPB representatives. Dr Whittingham gave a brief summary of the report.

In the ensuing discussion, it was noted that the preferred food of dunlin, viz Macoma, were present in abnormally large quantities in autumn 1979. It was hypothesised that the outbreak of bird deaths may have been caused by their large intake of macoma containing ca lppm lead. Subsequently, as the macoma grew in size, the birds switched to an alternate diet and as observed the deaths ceased.

It was agreed, subject to agreement by the NWWA, that the recommendations in the report should form the basis of future investigational work in the Mersey estuary. Details are included in the list of recommendations at the end of these notes.

3. Publication of results

The NWWA had intimated to AOC that they wished to publish a general survey of results in Marine Pollution Bulletin. RSPB considered it important to report a description of the incident, supported by some analytical data, as soon as possible. ITE would prefer to publish all the data, without conclusions if necessary.

It was the firm opinion of AOC that publication of incomplete data could be misleading.

Mr Hewitt offered to contact the NWWA re.preparation of a draft report in the form suggested by NWWA and promised to circulate copies to ITE and RSPB for comment.

/contd.

4. AOC Effluent Data

Prior to the meeting, AOC had received written requests from both ITE and RSPB for additional data relating to effluent quantity, quality and monitoring procedures.

AOC furnished the relevant information for effluent quantity and monitoring procedures. In addition, copies of a graph of lead-in-effluent data for the period 1971-9 were circulated.

5. Analitical techniques
(Separate discussion between Messrs Freestone and Noden)

Following an inspection of AOC analytical facilities, Mr Freestone (ITE) and Mr Noden discussed analytical procedures. Methods for total lead, tetra-alkyl lead and tri-alkyl lead species in bird tissues were covered. The AOC method for total lead is the more rapid and possibly offers more efficient degradation.

ITE, who have not previously performed analysis for tri-alkyl lead species, were given details of the AOC method; however it will be necessary for them to develop an alternative final stage since they do not have the same polarographic equipment used by AOC.

AOC promised to provide ITE with organo-lead standards for calibration purposes.

6. Any Other Business

The question of human health hazard arose. RSPB agreed to supply samples of wildfowl to AOC, who will carry out analyses to establish background levels. Dr Osborne will report the details of this discussion to MAFF.

ITE intend to carry out at Monks Wood a toxicological study of ingestion of tetra-alkyl lead by birds. This would assist in establishing a relationship between intake and concentration in organs.

7. Summary of Recommendations

	ACTION
1. Dunlin should be obtained from the estuary and analysed for trialkyl lead content in February, March and September 1980.	ITE/RSPB AOC
2. Sampling and analysis of macoma should continue for the next few months.	NWWA/AOC
3. Water samples from both the Mersey estuary and Manchester Ship Canal should be analysed regularly for several weeks and in addition, comparative data should be obtained from the factory effluent discharge.	NWWA/AOC

/contd.

7. Summary of Recommendations (contd)

		Action
4.	The presence of trialkyl lead compounds in control area tissue samples should be further investigated.	ITE/RSPB, AOC
5.	Serious consideration should be given to acquiring further data on the seasonal variation of benthic fauna in this section of the Mersey estuary in order to assess the significance of its trialkyl lead content.	AOC/NWWA
6.	Toxicological work.	ITE/AOC*
7.	Draft interim report.	NWWA/ AOC (to contact)
8.	Further analytical work on January 1980 dunlin.	ITE/AOC

*To provide lead alkyls

CIRCULATION

All present
Members MERC

DEL/jh

27.2.80

MERSEY BIRD MORTALITY INVESTIGATION: 1979-80.

INTERMEDIATE REPORT PREPARED FOR ITE-RSPB-CCTEL MEETING 21.2.80 at ELLESMERE PORT.

This report was prepared by D. Osborn (ITE, Monks Wood) and its contents are to be considered tobe subject to future changes or corrections.

MERSEY BIRD MORTALITY INVESTIGATION: 1979-80.

SUMMARY OF SOME POINTS OF INTEREST.

1. The incident has primarily involved dunlin, black-headed gulls and two wilfowl species, pintail and teal.

2. Lead levels in the birds found dead and sick suggest that the cause of death /the symptoms observed is probably lead.
This conclusion was reached after examination of existing data, both on lead levels normally found in birds and that relating to lead poisoning incidents in other countries as well as in the UK. This information was presented to the November meeting on this incident at Liverpool Poly.
Briefly: lead levels are normally below 1 - 3 mg/kg wet wt basis in bird liver. Levels above 5 mg/kg indicate intoxication, levels above 10 mg/kg indicate lead was the cause of death - both figures are for liver, wet wt.

3. There is little data on the effects of organic lead on birds. Filling this gap is considered a priority by ITE.

4. Even with the organic lead gap in our knowledge the levels of lead found in the birds, plus the fact that live birds examined at ITE showed many lead intoxication symptoms, it seems reasonable to conclude that lead was the cause of this incident.

5. Fairly extensive vet lab. work has ruled out obvious disease conditions, and adverse weather or food shortage also seem unlikely causes.

6. The source of the lead remains unknown. Attention should be paid to the Associated Octel effluent; its exact role needs to be defined, if only to prevent unfair criticism of the company who doubtless wish to avoid being accussed of damaging the environment when they were acting in good faith.

7. The ITE data on dunlin begin to suggest that birds were ingesting lead in Autumn 1979, and that few birds are now ingesting lead. However, it seems a heron found sick was treated with a 'lead antidote' and recovered in recent days (unconfirmed report), so the incident may not be completely over.

8. Arrangements need to be made to monitor the Mersey in Autumn 1980, or whenever tidal conditions similar to those prevailing in Autumn 1979 exist.

9. ITE consider the incident results should be published in the near future. A joint report from the main people involved is thought to be preferable.

10. There is an urgent need to assess human health risks arising from wildfowl consumption, for lead levels approach or exceed permitted levels in many cases.

MERSEY BIRD MORTALITY INVESTIGATION: 1979-80.

SUMMARY OF LEAD IN DUNLIN (Calidris alpina) EXAMINED BY ITE AS AT 20.2.80.

Species	Approx. Coll'n Date	Satus	Lead (Total) in tissues, mg kg^{-1}, wet weight basis. Liver	Kidney	Muscle	Brain	Bone
Dunlin	Sep/Oct 1979	Dead	18.5	na	na	na	na
Dunlin	"	Dead	31.0	na	na	na	na
Dunlin	"	Dead	12.8	na	na	na	na
Dunlin	Nov 1979	Very sick	14.8	X	9.5	X	23.2
Dunlin	"	Sick	10.8	6.0	1.4	2.9	20.9
Dunlin	"	Sick	7.0	5.8	1.0	1.9	40.0
Dunlin	"	Sick	6.0	5.5	0.6	1.1	24.3
Dunlin	"	Sick	10.6	8.3	1.5	2.1	22.0
Dunlin	"	Sick	7.5	7.8	0.9	1.5	20.7
Dunlin	"	Sick	11.2	8.6	1.8	2.6	10.8
Dunlin	Jan 1980	Live	ND	6.1	ND	ND	30.3
Dunlin	"	Live	ND	15.6	ND	ND	X
Dunlin	"	Live	7.4	13.8	ND	ND	42.6
Dunlin	"	Live	ND	5.9	ND	ND	43.2

Notes: Collectors Sep/Oct 1979 Liverpool Poly et al.
Nov 1979 Cockbain - RSPB.
Jan 1980 Cockbain et al.

na = tissue not yet analysed.
X = tissue used for alternative analysis e.g. virology.

ND = No lead detected. Limit of detection approx. 0.5 - 1.0 mg kg^{-1}. Exact limit will vary from batch to batch and is related to size of sample. Lower detection limits possible if required.

MERSEY BIRD MORTALITY INVESTIGATION: 1979-80.

SUMMARY OF VARIOUS SPECIES ANALYSED BY ITE AS AT 20.2.80.

Figures are lead mg kg^{-1}, wet weight basis. Total lead.

*Waders: Redshank (2) collected Sep/Oct 1979. Liver values 7.5, 20.2.

+Wildfowl: Pintail (1) collected Nov 1979. Liver 27.6; Kidney 25.8; [illegible]
Brain 15.9; Bone 11.3;
Muscle ND (to be confirmed).

* From same sample as dunlin of same date, also found dead.

+ Collected live same time as 'very sick' dunlin.

A number of other carcasses including curlews, knot, a plover and a merganser are also in store. These birds may not be analysed; they are in advanced states of decay.

One redshank from a previous year is also held in store. This will be analysed in the next batch of samples.

A number of wildfowl are available from various sources, and further wader collections will be made if possible.

RIVER MERSEY : DEATHS OF BIRDS

This further report has been written in collaboration with ITE staff. The main aim is to keep NCC staff as up to date as possible on the incident in which several thousand birds are known to have died on the River Mersey during the autumn and early winter of 1979. In addition I hope that the thoughts and suggestions contained here will stimulate further response from other organisations which have been involved.

I have delayed writing this particular report in order to wait for analytical results from ITE on Dunlin netted on the Mersey. ITE has experienced some recent problems with lead analysis.

On 21 February 1980 there was a meeting at Ellesmere Port at which there was a useful exchange of data and ideas. Suggestions were made for future work. Some of the data are referred to below.

Details of Analysis of Dunlin

For various reasons it has not proved possible to collect the full quota of live Dunlin from the Mersey and Dee estuaries for analysis by ITE and AOC. In fact, only four birds were collected and killed under licence from the Mersey. Tissues and organs have been analysed for total lead by ITE and samples will be sent to AOC for analysis of organic lead. In addition ten Dunlin from the Severn Estuary are awaiting analysis by ITE for comparison with the Mersey birds.

Details of Dunlin analysed by ITE are given in Tables 1 and 2. The following points can be made.

(1) All birds had unusually high total lead levels in their tissues (eg see data for Tees birds below).

(2) Liver lead levels in live birds were lower than those in sick or dead birds, while levels in kidney, muscle or brain were generally similar in sick and live birds. Bone levels were found to be somewhat lower in live birds, but this may have been due at least in part to interference from calcium and phosphate in the flameless atomic absorption method used, which could have resulted in less lead being detected than was actually present. In any event, the live Dunlin probably contained total body burdens of lead which were not appreciably different from the sick birds. There was however a marked difference in distribution of lead in the body; liver/kidney ratios varied from 0.96 to 1.80 in sick birds and from 0.43 to 0.53 in birds which appeared healthy. The size of the liver load probably reflected the metabolic pressure on the bird to do something about its lead burden.

(3) The precise significance of the lead in the 'live' birds is unknown since the amounts of organic lead are as yet undetermined and the toxicity of organic lead to birds has not been studied (although it is assumed to be likely to be more toxic than inorganic load). NCC will be funding ITE to study the toxicity of organic lead to birds this year.

(4) AOC have reported on the analysis of 15 dead or sick Dunlin. Liver levels ranged from 10.5 to 34.0 ppm total lead (about the same as the dead Dunlin analysed by ITE), with the organic lead fraction comprising from 27 to 78% of the total lead. It will be interesting to see how much of the

lead in the live birds collected was organic. ACC/NWWA have also given analytical data for 2 apparently healthy Teal. Liver levels were 1-2 ppm, with most of the lead being organic. Five Dunlin have also been analysed which were collected on the Tees in October 1979. Liver levels were <1 ppm, but small amounts of organic lead were detected in each bird. Liver/kidney ratios were ≤ 0.5 ie comparable to the live Dunlin from the Mersey.

(5) The high lead levels in the live birds from the Mersey suggests that the incident may have arisen from general lead pollution rather than localised pollution causing high levels and death in a small proportion of the birds present. However, as yet only a few birds have been analysed. It would have been useful to have caught and analysed apparently healthy Dunlin earlier in the season at the height of the incident since we need to know how tissue distribution changes with time either because of migration of birds or because of physiological changes. It would appear from the tissue distribution of the live birds collected in January 1980 that

all four had at some time been exposed to high environmental levels of lead.

Movement and residues of lead in the Mersey

Using data from many sources I have attempted to compile a flow diagram showing how lead in works effluent discharged into the Manchester Ship Canal might pass into the estuarine environment. (Figure 1). This is not intended to try to show that ACC might be responsible for the organic lead in the Dunlin, but is an exercise to trace the residues back from the birds to determine whether the MSC might be a route of movement of the organic lead. Invertebrates such as Macoma and Nereis which might be taken as food have been found in the estuary to contain several ppm total lead with about half being trialkyl lead. Salts of trialkyl lead, the form of organic lead found in highest amounts in Dunlin, are water soluble. In the presence of sediments they become absorbed (see Potter et al Water Pollut Control 1977). However, finding trialkyl lead in water from the Mersey suggests that these salts may be readily dispersed either in solution or absorbed on fine particulate matter. But by what route might trialkyl lead have come from the MSC?

At present I do not have any figures for water analysis; (a programme of water analysis of the MSC and the Mersey was suggested at the February meeting); but trialkyl lead has been detected in MSC sediment and in the 'dumping ground' sediment. There appear to be two main routes whereby trialkyl lead might move from the MSC to the Mersey. The first is by simple and regular exchange (in solution). There is daily movement of water from the MSC to the Mersey at Eastham Lock and Weaver Sluice, the extent presumably depending on tides, numbers of ships using the locks, extent of the many effluent discharges into the MSC etc. During times of high tides, there is movement in the reverse direction at Eastham, with estuary water entering the MSC. Mass movement of water from Hale to Eastham may take several days (Wat Poll Res, Tech Paper 7), ie there is much movement back and forth which must dilute and disperse only water soluble material entering from the MSC. The second possible route is via the dumping grounds. There, the MSC Co deposit sediment dredged from the canal. I have been told that MSC Co released 500 M gallons of effluent from the

dumping grounds into the Mersey in the autumn of 1979. Such an operation might release substantial amounts of organic lead into the estuary in solution or bound on to fine particulate matter. I shall be grateful for any comments about this potential route, including whether release in 1979 was just prior to the start of the incident. It may be better if this operation could be done gradually during the summer when relatively few birds are present rather than as a single operation in autumn at a time when migrants are arriving. Some sediment is dredged from the MSC by private contractors and dumped at sea. This would seem to be unlikely to contribute much to organic lead levels in the Mersey estuary, but I have no details of these operations.

To what extent can the residues of organic lead in the environment of the Mersey estuary be attributed to the discharge from AOC? The factory at Ellesmere Port discharges about 100 kg of organic lead per day into the MSC. To dilute this to 5 µg/l (approximately the level found so far in Mersey water) would require 20×10^9 l water/day (or 4,000,000,000 gallons). Potter et al (1977) surveyed the environment in the Birmingham area and could only detect organic lead in situations where these compounds might be expected eg in some drains on garage fore-courts. It was suggested that the material was washed by rain into the drains. Finding organic lead compounds to be widespread in the Mersey area gives cause for concern. However, it would be naive to blame all of the pollution on AOC. There are other possible sources in the area (eg petrochemical industries) and it should be remembered that organic lead was detected in Dunlin from the Tees, albeit in much lower amounts than in the Mersey birds.

Why the incident should have been so severe in 1979 is not clear. Total lead figures for sediments held by NWWA do not show an increase for recent years. No data are available for organic lead compounds separately. Total lead in the AOC effluent generally decreased during the 1970's, but no figures are available for trends for the organic lead component. There are several possible explanations. Levels in the sediments, water and invertebrates may have been building up for several years and are now becoming critical for birds. The overall improvement in the Mersey environment may now be encouraging larger invertebrate populations, and so opportunist bird populations may be exposed to poisoning; whereas in the past, lack of invertebrates meant few birds used the Mersey and the risk of significant numbers being poisoned was slim. The removal of water from the MSC dumping grounds may have been carried out at an especially sensitive time in 1979. However, it seems that small numbers of birds may have died in the autumn in previous years.

Further work by NCC/ITE

In the short term, ITE will be funded by NCC to undertake the following studies on birds. It is hoped that this will complement the programme on water, sediment and biota excluding birds which I have just been informed will be undertaken by NWWA.

1. Residues of lead in birds dead or dying in the Mersey area.

2. Residues in apparently healthy birds from the Mersey.

3. Residues of lead in the same species from other estuaries.

4. Toxicity of organic lead to birds. Laboratory studies to establish gross symptoms of poisoning and determine tissue levels and body distribution associated with symptoms and with death.

Arnold Cooke

A S COOKE
Chief Scientists Team
Huntingdon

22 May 1980

RO N W England
ARO Merseyside
RO W Midlands
England HQ
Mr Park GBHQ
Miss Ross GBHQ
Chief Scientist
Chief Advisory Officer
Dr Langslow, CST
Dr Batten, GBHQ
Dr Osborn, ITE
Dr Bull, ITE
Mr Stowe, RSPB
Dr Wilson, NWWA
Mr Hewitt, ACC
Mr Cockbain

TABLE 1

MERSEY BIRD MORTALITY INVESTIGATION: 1979-80

LEAD IN DUNLIN (Calidris alpina) EXAMINED BY ITE

No.	Species	Approx. Coll'n Date	Status	Lead (Total) in tissues, mg kg^{-1} wet weight basis				
				Liver	Kidney	Muscle	Brain	Bone
1	Dunlin	Sep/Oct 1979	Dead	18.5	na	na	na	na
2	Dunlin	"	Dead	31.0	na	na	na	na
3	Dunlin	"	Dead	12.8	na	na	na	na
4	Dunlin	"	Sick	10.8	6.0	1.4	2.9	20.9
5	Dunlin	"	Sick	7.0	5.8	1.0	1.9	40.0
6	Dunlin	"	Sick	6.0	5.5	0.6	1.1	24.3
7	Dunlin	"	Sick	10.6	8.3	1.5	2.1	22.0
8	Dunlin	"	Sick	7.5	7.8	0.9	1.5	20.7
9	Dunlin	"	Sick	11.2	8.6	1.8	2.6	10.8
10	Dunlin	Jan 1980	Live	2.8	6.5	0.6	1.2	11.5
11	Dunlin	"	Live	5.7	13.2	1.1	2.5	9.4
12	Dunlin	"	Live	7.6	14.1	1.3	2.5	23.3
13	Dunlin	"	Live	1.9	3.8	0.6	0.9	18.2

Notes: Collectors Sep/Oct 1979 Liverpool Poly et al.
Jan 1980 Cockbain et al.

na = tissue not yet analysed

N.B. Birds 1-9 Flame AA, Birds 10-13 Flameless AA

TABLE 2

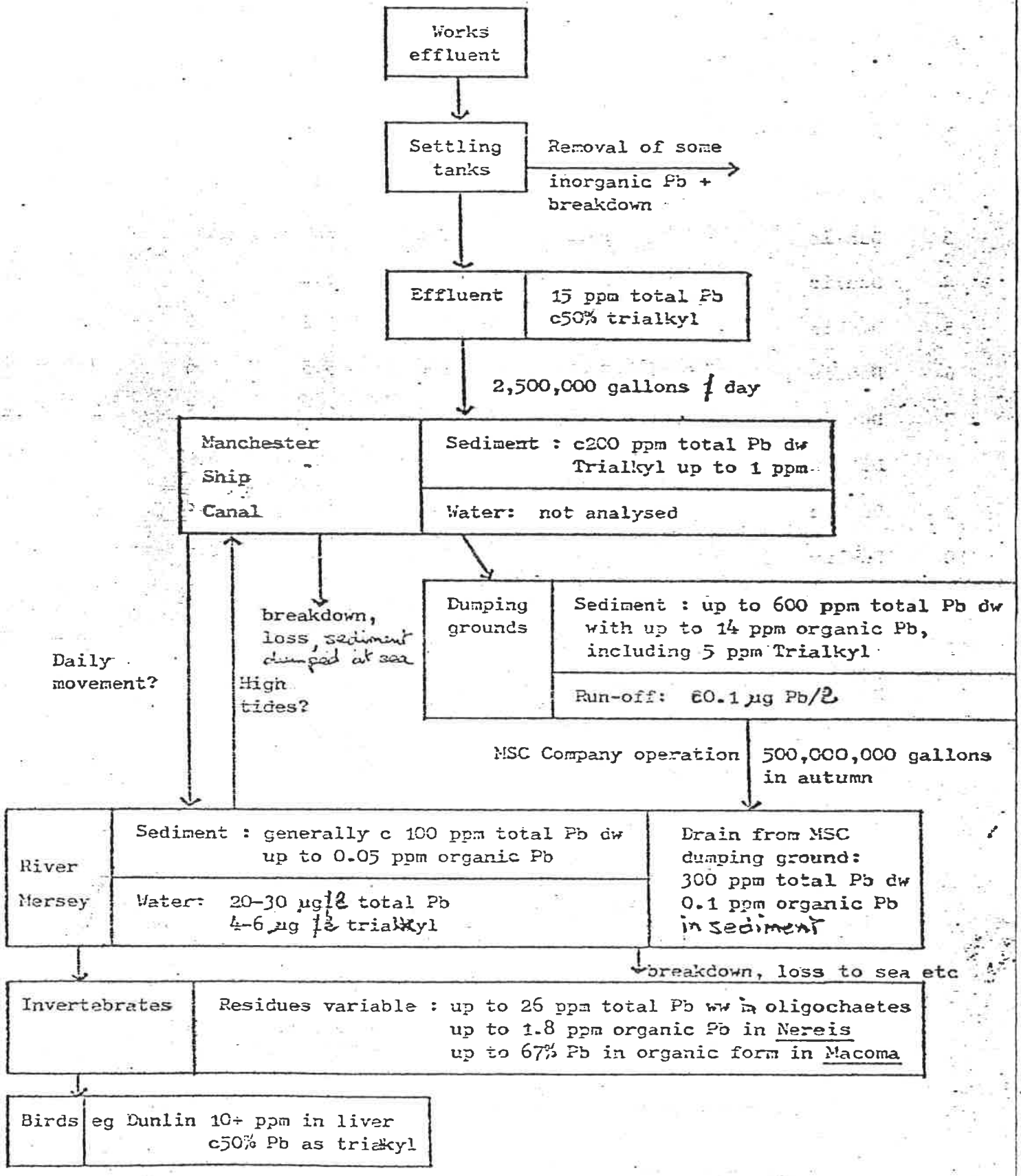
LEAD IN DUNLIN : MEAN AMOUNTS IN DEAD OR SICK BIRDS OR APPARENTLY HEALTH BIRDS (LIVE)

	No of Samples	Mean lead (total) in tissues, MG KG^{-1} (ppm) on wet weight basis				
		Liver	Kidney	Muscle	Brain	Bone
Dead	3	20.8	na	na	na	na
Sick	6	8.9	7.0	1.2	2.0	23.1
Live	4	4.5	9.4	0.9	1.8	15.6

na not analysed

Figure 1.

Lead in the environment of the River Mersey : movement and residues



APPENDIX 7

RO NW England
ARO Merseyside
RO West Midlands
England HQ
Mr Park, GBHQ
Miss Ross, GBHQ
Chief Scientist
Chief Advisory Officer, GBHQ
Dr Langslow
Dr Batten, GBHQ
Dr Smith, Liverpool Polytechnic
Mr Stowe, RSPB
1. A A Bell, ITE 2. Dr D. Osborn
M C French, ITE
Mr Cockbain
Dr Jefferies

RIVER MERSEY : DEATHS OF BIRDS, AUTUMN 1979

The involvement of CST in this incident is summarised below. The first I heard of the incident was on 12 October when Mr Rob Cockbain, a local ornithologist contacted Dr Langslow and related what had happened. Dr Langslow and I made several telephone calls to Liverpool Polytechnic, University Veterinary Field Station on the Wirral, Lasswade, MAFF etc. The incident appeared to be severe, and analysis for pollutants was needed. I was told indirectly that MAFF were doing some analyses, but by 16 October I had still been unable to find out precisely who in MAFF was conducting the investigation and which analyses were being done. I therefore arranged for some waders, which had been found dead by staff of Liverpool Polytechnic, to be sent to Monks Wood (ITE) for analysis. Under the contract that we have with ITE on 'Birds of prey and pollutants', some money is set aside for examination of seabirds should a wreck such as this occur. The birds arrived on 17 October and were examined immediately. Carcases of three Dunlin and two Redshank (out of a total of 10 waders) were in reasonable condition, and livers from these birds were analysed for various pollutants. Analytical results were ready by 19 October and can be summarised as follows. Residues of organochlorine insecticides and polychlorinated biphenyls were not physiologically significant. Mercury was present, but not in significant amounts. Cadmium was not detected. Copper levels were high in one bird which was especially emaciated. Lead levels were, however, unusually high (Appendix 1).

It was not possible to state categorically that lead killed the waders since (a) the nature of the lead was not known (organic bound lead is more toxic than inorganic lead) and (b) data are not available on amounts of lead in Dunlin and Redshank tissues which are indicative of death by lead poisoning (see conclusions).

Realising the possible implication of these residues to human health, the NW Region was contacted on 19 October for information about which body to notify. Accordingly the Emergency Planning Officer for Merseyside was contacted that day.

On the following Monday (22 October) it was decided to obtain some more birds for analysis. The objectives were to try to confirm the high levels of lead, to determine the levels in other tissues, and to ascertain how much was in the organic form. RSPB staff had collected sick or moribund birds during the weekend. These were dying and represented a source of fresh material. Livers from six Dunlin were analysed for total lead (Appendix 2). Levels were rather lower than those found previously, although three exceeded 10 ppm, and the other three contained >5 ppm. Lead levels in other organs and tissues are also shown in Appendix 2. Attempts failed to extract detectable amounts of organic lead from the kidneys of these Dunlin, and the analysts concluded therefore that lead was in the inorganic state. The limit of detection was 0·5 ppm.

Conclusions

What then is the significance of these lead residues? Are these levels unusual? Do they suggest that the birds died from lead poisoning? Information on lead levels in tissues of maritime and estuarine birds is discussed in Appendix 3. It appears that a liver level of >3 ppm lead is unusual; the livers of all 11 birds analysed exceeded this level, including one which was 10 times as high.

Unfortunately a discussion of the significance of lead residues has to be based on what is known about wildfowl poisoned by lead shot (Appendix 4). For wildfowl, a level >10 ppm wet weight is taken to suggest that the bird died from lead poisoning; livers from 6 out of 9 Dunlin and the liver from one of the two Redshank exceeded 10 ppm lead. For wildfowl, a level of >5 ppm is taken to indicate recent acute exposure to lead and active lead intoxication; the remaining four livers from the waders were in the range 6-10 ppm.

It is worth recording that the Veterinary Investigation Centre (MAFF) has analysed two avian samples from the Mersey incident for lead, using a less refined technique. They reported: Wigeon (bulked sample of livers from 2 birds), 40 ppm lead wet weight; Redshank (livers of 4 birds), 30 ppm.

So far no evidence has been made public to implicate any other factor as the principal cause of this incident.

A S COOKE
Chief Scientist Team
Huntingdon

29 October 1979

APPENDIX 1

Lead levels in Dunlin and Redshank supplied by Liverpool Polytechnic

Species	Lead in liver (ppm wet weight)
Dunlin	18.5
Dunlin	31.0
Dunlin	12.8
Redshank	7.5
Redshank	20.2

All birds were dead when collected.

APPENDIX 2

Lead levels in Dunlin supplied by RSPB (ppm wet weight)

Liver	Kidney	Brain	Muscle	Bone
10.8	6.0	2.9	1.4	20.9
7.0	5.8	1.9	1.0	40.0
6.0	5.5	1.1	0.6	24.3
10.6	8.3	2.1	1.5	22.0
7.5	7.8	1.5	0.9	10.8
11.2	8.6	2.6	1.8	20.7

All birds were alive when collected.

APPENDIX 3

Lead levels in the tissues of 'seabirds' in Britain

ITE holds a certain amount of unpublished information on lead levels. Waders that were netting casualties from the Wash in the early 1970s generally did not contain measurable amounts in their livers:

Redshank : $n = 4$, each < 0.02 ppm

Dunlin : $n = 16$, 15 had < 0.02 ppm
1 had 6.3 ppm

Knot : $n = 22$, each had < 0.02 ppm

so apart from a single Dunlin, lead levels were below the limit of measurement. The Wash, is however, a relatively non-polluted estuary. ITE also has data on residues in a large number of Guillemots (mainly using birds found dead). About 10% had lead levels >3 ppm.

Livers ($n > 100$) from many other species have been analysed, including Gulls, Terns, Auks, Gannets and Wildfowl. Only in the liver of one Mute Swan was a level of 3 ppm exceeded.

Dr P Evans (Durham University) has analysed waders collected from the Tees. Usually lead levels in the liver were <2 ppm wet weight. Information is more difficult to interpret since Dr Evans concentrated on analysis of the kidney and expressed concentrations as ppm dry weight. Dunlins were found to contain higher amounts in their kidneys (mean about 3 ppm wet weight (roughly converted from ppm dry weight) and for one sample a mean of about 10 ppm) than Redshanks (range up to 3-4 ppm wet weight). Dr Evans found that the kidney normally contained 2-3 the concentration (ppm dry weight) found in the liver (although this relationship does not hold for the present wet weight data presented in Appendix 2).

To conclude, a level in the liver exceeding 3 ppm can probably be regarded as being unusual.

APPENDIX 4 of 7

Liver lead levels indicative of death

Virtually the only information available appears to be that on levels in wildfowl poisoned by lead shot (eg USDI Fish and Wildlife Service Report 182 (1974); J Wildl. Mgmt. 42 299 (1978); Environ. Pollut. 18 187 (1979)). Lead concentrations found in wildfowl during incidents have been reported as follows:

Species	Lead in liver (ppm wet weight) Mean	Range	Authors (References given in above publications)
Canada goose	18	9-27	Adler, 1944
Canada goose	12	1-20	(Bagley et al, 1967
	22	12-53	(
Canada goose	26	12-44	Locke et al, 1967
Canada goose	21	10-45	Locke & Bagley, 1967
Whistling swan	28	18-37	(Chupp & Dalke, 1964
Mallard	12	12	(
Mute Swan		1-70	(Erne & Borge, 1969
Mallard		5-45	(
Canada Goose	about 30	>10	Szymczak & Adrian, 1978
Mute Swan	30-40	>15	Simpson et al, 1979

For comparison data for waders from the Mersey incident, autumn 1979:

Dunlin	21	13-31	(Liverpool Polytechnic
Redshank	14	8-20	(
Dunlin	9	6-11	RSPB

Based on the data available on wildfowl, levels must exceed 10 ppm for death by lead poisoning to be suspected. A level of >5 ppm has been suggested as being diagnostic of recent acute exposure to lead leading to active intoxication (USDI Fish and Wildlife Service Report 182).

Reference .....

APPENDIX 8

RO, N W England
ARO, Merseyside
RO, West Midlands
England HQ
Mr Park, GBHQ
Miss Ross, GBHQ
Chief Scientist
Chief Advisory Officer
Dr Langslow
Dr Jefferies
Dr Batten, GBHQ
Dr Osborn, ITE
Mr Cadbury, RSPB

Copies in ITE to:

Dr Dempster
Dr Bull
Mr Bell
Mr Freestone
Mr French

RIVER MERSEY: DEATHS OF BIRDS, AUTUMN 1979
REPORT ON MEETING HELD AT LIVERPOOL POLYTECHNIC, 6 NOVEMBER 1979

1. Background

On 1 November, I was contacted by Dr J Harradine of WAGBI who was trying to get together representatives from interested organisations for a discussion about this incident. The likely venue and date were Preston (using NW Water Authority facilities) on 6 November. One of the main reasons for holding a meeting was to obtain data on lead analysis from NWWA. On the morning of 5 November, I was told by NWWA that they had few results yet and they would not be attending. I understood from ITE and RSPB that the meeting had been postponed for a week. However, later in the day I was contacted by Dr Cadbury of RSPB who said that the meeting was rearranged again for the following day (6th) at Liverpool Polytechnic. It was most unclear who would be attending. I relayed this information to NW Region. I had decided to go to the Mersey area that day anyway with ITE staff to see the areas in which the birds were dying and to take samples if feasible. Therefore I attended the meeting as well. Everyone was surprised at the number of people who attended. Even NWWA sent 3 or 4 representatives.

I thought that circulating a summary of the meeting would be a useful way of keeping NCC staff informed of the situation. The important points are outlined below.

2. Details of dead birds

The first bird, a redshank, was found on 16 September. The peaks in numbers of casualties have coincided with high tides. Thus the incident has seemed to diminish on several occasions, only to flare up again at the next high tide. To date, about 1700 birds have been found on the north shore in the vicinity of Hale. Fewer birds (in the region of several hundred) have been discovered opposite on the south shore. Coverage on the south side has not been so complete, but it is believed that reports of more corpses on the north shore does really reflect a higher number being deposited there. Waders (especially Dunlin, and to a lesser extent Redshank and Curlew) have predominated. Gulls (particularly Black-headed) have been found in quite high numbers. Wildfowl (especially Teal and Pintail) have also been affected.

3. Examination and analysis

Sick birds are light in weight, are uncoordinated, are easily caught and suffer from loss of balance. They exhibit head-trembling and are often unable to hold their heads erect. Droppings are green. Post-mortem examination has revealed green-stained intestines. Gizzards are empty except for grit. Many of these symptoms are consistent with lead poisoning.

Bacteriological tests nave failed to disclose anything of significance. Tests for botulism have been negative. The only 'pollutant' found in unusual amounts is lead. Three establishments reported that they had analysed for lead. MAFF's Veterinary Investigation Centre reported the following:-

(1) Pooled sample of kidneys (not livers as I had been told previously) from 2 dead Wigeon: 40 ppm wet weight.

(2) Kidneys from 4 dead Redshank: 30 ppm.

(3) Livers from the 2 Wigeon and from 2 of the Redshank: 30 ppm, 20 ppm, 12 ppm, 15 ppm (the representative was unable to say which results related to which species).

The Veterinary Field Station of the University of Liverpool reported for the livers of dead birds:

Redshank: 36.5 ppm wet weight

Black-headed Gull: 13.2 ppm

Dunlin: pooled sample of 2 birds, 20.9 ppm.

With Dr Osborn of ITE, I reported on the analysis done at Monks Wood. Since writing the Report on the incident (dated 29 October), further analyses have been done on tissues of the sick birds collected by the RSPB. (See Appendix 1 attached) The aim was to determine how the lead was distributed amongst the organs and tissues of the Dunlin. The pattern (in terms of ppm dry weight) of similar levels in the liver and kidney with only slightly higher levels in the bone is indicative of recent acute exposure to lead contamination. Chronic exposure results in relatively much higher levels in bone.

When the data quoted in my Report of 29 October are also taken into account, the following statements can be made.

(1) Three laboratories have analysed lead in dead or sick birds. Liver levels were in the range 6.0 - 36.5 ppm wet weight (n = 18).

(2) These levels are unusually high.

(3) For Dunlin analysed at Monks Wood, birds found dead contained higher liver lead levels than birds which were sick when caught:

Dead: range 12.8 - 31.0 ppm (n = 3)
Sick: range 6.0 - 11.2 ppm (n = 6)

(4) Distribution of lead in the bodies of sick Dunlin indicates recent acute exposure.

(5) Lead levels of this magnitude in wildfowl which have ingested lead shot are taken as sufficient to suspect: death by lead poisoning ($\geq$10 ppm) or lead intoxication ($\geq$ 5 ppm).

(6) No other cause of this incident has yet been proposed.

Results on levels of organic lead in dead birds are still awaited from the laboratories of Associated Octel. North West Water Authority released some figures for levels of lead and other metals in sediments. These showed high, but not startlingly-high, levels in areas where the birds feed, but the survey was not very detailed.

4. Urgent Future Work

RSPB agreed to continue to coordinate collection of information on where and when birds die and what species are affected. Coverage of the south shore is to be improved. It is hoped that this may yield clues on the source of the problem.

ITE (funded at least partially by NCC) will analyse tissues from affected and from shot wildfowl and waders. This will allow comparison of levels in shot and affected birds, will show how levels change in time, will determine whether levels in wildfowl are high enough to suspect acute lead poisoning etc. We are also liaising with the Institute of Environmental Virology, who will examine Dunlin and a Pintail for viruses. Although lead pollution seems the most likely explanation of this incident, it is important to continue to explore other possibilities. Analysis of mud samples is also being considered.

L.U.V.F.S. will examine rats which are suspected of dying after eating dead birds on the shoreline.

I asked the vets present whether it was possible to treat the sick birds. Apparently there has been some success. A Heron has been treated with EDTA (an antidote for lead poisoning) and has appeared to recover. There are, however, practical problems involved in the treatment of birds as small as Dunlin.

Arnold Cooke.

DR A S COOKE
Chief Scientist Team
Huntingdon

12 November 1979

APPENDIX I

Lead levels in Dunlin collected alive but sick from the River Mersey (by RSPB)

(This Appendix is an extended version of the previous Appendix 2)

	ppm wet weight				
Bird No.	Liver	Kidney	Bone	Brain	Muscle
1	10.8	6.0	20.9	2.9	1.4
2	7.0	5.8	40.0	1.9	1.0
3	6.0	5.5	24.3	1.1	0.6
4	10.6	8.3	22.0	2.1	1.5
5	7.5	7.8	20.7	1.5	0.9
6	11.2	8.6	10.8	2.6	1.8

	ppm dry weight		
1	39	24	51
2	25	23	96
3	21	22	56
4	38	33	61
5	27	31	53
6	40	34	33
Mean	32	28	58

Prepared by RSPB from

APPENDIX 9

Mersey Incident Casualty Total at 18th January, 1980

The following table related to casualties mainly on the north side of the estuary. Figures supplied largely by R. Cockbain et al.

		Dead	Live		
Wildfowl	Teal	39	13		
	Mallard	24	6		
	Pintail	22	15		
	Shelduck	12	3		
	Mute Swan	2			
				99	36
Waders	Dunlin	910	213		
	Redshank	86	74		
	Curlew	41	28		
	Grey Plover	5			
	Knot	5			
	Little Stint	5			
	Green Sandpiper	4			
	Lapwing	2			
	Ruff	1	1		
	Goldon Plover	1			
				1060	316
Gulls	Black-headed Gull	320	8		
	Herring Gull	23	3		
	Common Gull	14	1		
	Lesser Black-backed Gull	4			
	Great Black-backed Gull	1			
	Unidentified Gull	14			
				376	12
Others	Moorhen		1		
	Carrion Crow	1			
	Heron	1			
	Starling	5			
	Unidentified birds	28			
				35	1
		Total		1570	365

Additional casualties recorded elsewhere

Source	Species	Dead	Live
F.D.W.C/WAGBI	inc. Curlew, Knot Durlin, Teal and gulls	? 500	?
MAFF Liverpool	Wigeon	2	
	Redshank	2	
	Heron		1
Fishermen at Rockferry	Waders and Gulls	25-30	
		c, 500	

Overall total of birds affected: 1,570 dead, 365 live, and c.500 others = 2,435

Other species		
	Flounders	4
	Brown Rat	12
	Hedgehog	1
	Rabbit	1
	Eel	1

Note that overall total includes live birds, some of which may subsequently have been recovered dead.

RSPCA, NWWA and AOC may have collected casualties not included in these totals.

Principal foods of major wader and wildfowl casualties

Winter Feeding (Saltmarsh/Estuary)

Wigeon	Coastal areas - chiefly algae. Sea water/brackish areas - chiefly stems and leaves of grass, pond weed and algae.
Shelduck	Chiefly snails (*Hydrobia ulvae*).
Teal	Mainly seeds of aquatic plants (Sedges, pond weeds, samphire) also algae and snails.
Mallard	Mainly seeds (samphire - *Salicornia*, orache - *Atriplex* and seablite - *Suaeda*) and some snails (*Hydrobia*) and crustaceans.
Pintail	Mainly snails (*Hydrobia ulvae*) and also seeds (samphire and seablite).
Dunlin	Mainly snails (*Hydrobia ulvae*) and Nereids and crustacea (*Talitrus*).
Redshank	Mainly snails (*Hydrobia ulvae*) and Nereids and crustacea (*Carcinus*).
Curlew	Mainly crustaceans (*Carcinus*), Nereids and molluscs (*Cardium*).