Institute of Terrestrial Ecology

No. 201

WILDLIFE AND POLLUTION: 1993/94 Annual Report

Natural Environment Research Council

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No. 201

WILDLIFE AND POLLUTION: 1993/94 Annual Report

I NEWTON, A ASHER, L DALE, P FREESTONE, MC FRENCH, H MALCOLM, D OSBORN, J WRIGHT, C WYATT & I WYLLIE

INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENTAL RESEARCH COUNCIL)
JNCC PROJECT 018 (Contract F71-12-153)
ITE PROJECT T08054c5

Annual report to Joint Nature Conservation Committee

Monks Wood Experimental Station
Abbots Ripton
Huntingdon
Cambs
PE17 2LS

August 1994

JOINT NATURE CONSERVATION COMMITTEE

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JNCC/NERC CONTRACT HF3/08/01
JNCC PROJECT 018 (Contract F71-12-153)
ITE PROJECT T08054c5

Annual report to the Joint Nature Conservation Committee

WILDLIFE AND POLLUTION

I Newton, A Asher, L Dale, P Freestone, M C French,
H Malcolm, D Osborn, J Wright, C Wyatt & I Wyllie

Monks Wood
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CONTENTS

1 PREFACE AND SUMMARY

1.1 Introduction

The Wildlife and Pollution contract covers a long-term monitoring programme to examine the levels of pollutants in some wildlife in Britain. The programme was started 30 years ago, when there were serious concerns over the effects of organochlorine insecticides and organomercury fungicides on several birds and mammals. This early work demonstrated the effects of the organochlorines, and eventually contributed to the ban on their use in this country. The programme has measured levels of these compounds in predatory and fish-eating birds since then. Investigations have also been made into the levels of polychlorinated biphenyls (PCBs), following their identification as pollutants in 1966. Mercury levels have also been tracked. In addition, the contract supports a wildlife incident investigation service, which can examine the causes of unexpected mortality incidents (that are not obviously related to oil pollution or to farm chemicals). In recent years, investigations have been made into the effects of the newest generation of rodenticides on barn owls.

This annual report is an interim summary of results. Every 3 years these annual results are gathered together into a more substantial report in which they are integrated with previous findings. In addition, results are periodically published in the scientific literature. Key papers are listed in this report under each sub-project summary.

The Wildlife and Pollution contract was the subject of scientific assessment within JNCC's rolling programme of peer review in autumn 1993.

Each subproject within the Wildlife and Pollution contract is summarised below. Each is dependent on the provision of material from amateur naturalists and other interested parties, and it is not always possible to obtain desired material for analysis.

1.2 Organochlorines and mercury in predatory birds

The main objective of this work was to analyse the bodies of predatory and fish-eating birds, supplied by members of the public, in order to continue the monitoring of organochlorine and mercury residues in livers. This enables us to keep a watch on the effects of previous hard-won withdrawals of permitted uses of some of these chemicals, and to examine geographical variation in residues. For 1993, the livers from 263 birds were analysed, including those from 59 kestrels, 120 sparrowhawks, 19 herons, 10 kingfishers, 3 great-crested grebes and 52 of various other species. These birds came from various localities in England, Scotland and Wales. Over the whole monitoring period (1963-93), the overall data for most species have revealed significant long-term downward trends in residues. This decline may be levelling off for DDE (the main metabolite of DDT), and HEOD, Mercury (Hg) residues showed non-significant declines between 1991 and 1992. Five significant changes in geometric mean levels between 1992 and 1993 were noted; two decreases (HEOD in herons and great-crested grebes) and three increases (in PCBs in sparrowhawks, and mercury in sparrowhawks, kestrels and merlins). It is impossible to say whether these differences reflected real year-to-year changes in exposure.

1.3 Organochlorines and mercury in peregrine eggs

Eggs from 21 peregrine clutches were analysed in 1993, from various parts of England, Scotland and Wales. The organochlorine levels in British peregrines continue to decline, but occasional high PCB levels appear.

1.4 Organochlorines and mercury in merlin eggs

Eggs from 60 merlin clutches were analysed in 1993, from various parts England, Scotland and Wales. The results confirm that the merlin remains the most contaminated of the British raptors. Mercury in eggs from the Northern Isles continues to be at high levels.

1.5 Organochlorines and mercury in golden eagle eggs

Eggs from 22 clutches from Scotland were analysed. These confirm the low levels of contamination in eggs from inland districts found in recent years. Eggs obtained from coastal areas tended to have thinner egg shells and higher burdens of pollutants.

1.6 Organochlorines and mercury in gannet eggs

Only three eggs were analysed in 1993, all from St Kilda. Residue levels were low and within the range of previous ones from this colony.

1.7 Rodenticide residues in Barn Owls

The aims of this study were to find (i) to what extent barn owls in Britain are contaminated with certain rodenticide residues, and (ii) whether such residues are likely to cause significant mortality. As barn owl numbers are thought to have declined this century, it is important to assess any role that secondary poisoning from rodenticides might have on the British population. The second-generation anticoagulant rodenticides (currently difenacoum, bromadiolone, brodifacoum, flocoumafen) are likely to pose the greatest threat. These are rapidly replacing Warfarin and are both more toxic and more persistent. Thirty-nine birds were examined in 1993. The residues of one or more rodenticides were found in the livers of 14 (36%), and eight birds had levels which are probably close to lethal.

1.8 Incident investigations during 1993-94

Two wildlife incidents were investigated during the reporting year, the first involving wildfowl from Essex and the second seabirds from the North Sea. Throughout this section HCH refers to gamma-hexachlorocyclohexane (lindane).

1.9 Numbers of birds required for organochlorine and mercury analyses

Carcass residue data from 1992 are analysed in an attempt to find whether the number of analyses could be reduced without affecting significantly the geometric mean residue levels recorded.

1.10 Papers from the contract published during the year:

NEWTON, I., WYLLIE, I. & ASHER, A. 1993. Long-term trends in organochlorines and mercury residues in some predatory birds in Britain. Environ. Pollut. 76: 143-51.

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Annual report to the Joint Nature Conservation Committee

WILDLIFE AND POLLUTION

Part 2 Organochlorines and mercury in predatory birds, 1993

I Newton, A Asher, L Dale, P Freestone, M C French,
J Wright, C Wyatt & I Wyllie

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2 ORGANOCHLORINES AND MERCURY IN PREDATORY BIRDS, 1992

2.1 Introduction

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 and metal residues in livers. The chemicals of interest included DDE (from the insecticide DDT), HEOD (from the insecticides aldrin and dieldrin), PCBs (polychlorinated biphenyls from industrial products) and Hg (mercury from agricultural and industrial sources). Throughout this section the levels of organochlorines are given as ppm in wet weight and of mercury as ppm in dry weight.

The main species involved included the sparrowhawk and kestrel, representing the terrestrial environment, and the fish-eating heron, kingfisher and great-crested grebe, representing the aquatic environment. The findings from various other species received during the year are also included. Earlier results from the programme were summarised by Newton *et al* (1993), and in previous reports in this series.

2.2 Results

During the past year, the livers from 263 birds were analysed, including those from 59 kestrels, 120 sparrowhawks, 19 herons, 10 kingfishers, 3 great-crested grebes and 52 others. These totals included some birds which had died in earlier years, but which were analysed in 1993. The results for each chemical from the main species for 1993 specimens only are given in Table 1, and the geometric mean levels in Table 2.

The birds received in 1993 contained many with surprisingly high levels of contaminants, well above the usual levels for their species. Such birds included a kestrel from Orkney with 67 ppm PCB and others from the same place with 7 and 8 ppm mercury; a sparrowhawk from Bedfordshire with 24 ppm DDE; 14 sparrowhawks with more than 20 ppm PCB (including birds with 99, 110 and 110 ppm from Greater London, Cheshire and Hertfordshire); two sparrowhawks with 16 and 25 ppm mercury from Dumfries and Cheshire; two peregrines with 93 and 120 ppm PCB from Dyfed and Co Antrim; four herons with 22, 27, 31 and 41 ppm mercury from Sussex, Northants and Highland (2); a bittern with 19 ppm mercury from Essex; and two Kingfishers with 41 and 140 ppm PCB from Greater London and Essex. On the other hand, this was the first year since the start of the scheme in 1963 that a sparrowhawk (from Greater London) was found with no detectable DDE.

Six significant differences in geometric mean values were found between the 1993 and 1992 results, out of 24 comparisons (Table 3). These involved decreases in HEOD levels in herons and great-crested grebes, an increase in PCB levels in sparrowhawks, and increases in mercury levels in kestrels, sparrowhawks and merlins. It is impossible to say whether these differences reflected real changes in exposure. In general, PCBs seem to be emerging as increasingly important contaminants.

2.3 Reference

NEWTON, I., WYLLIE, I. & ASHER, A. 1993. Long-term trends in organochlorine and mercury residues in some predatory birds in Britain. Environ. Pollut. 79: 143-51.

Table 1. **Levels of organochlorines (ppm in wet weight) and mercury (ppm in dry weight) in the livers of predatory birds analysed between April 1993 and March 1994.**
ND=None detected

Spec. no.	Date found	County	Age	Sex	DDE	HEOD	PCB	Hg
Kestrel (*Falco tinnunculus*)								
11164	Jun 90	Highland	A	F	0.06	0.34	2.30	1.10
11177	Aug 90	Highland	A	M	0.72	0.16	8.60	6.20
11178	Nov 90	Highland	J	M	0.09	0.17	1.10	1.20
11165	Jan 91	Highland	A	M	0.26	0.24	6.30	2.60
11377	Dec 91	Strathclyde	J	M	0.15	0.23	4.11	3.69
11226	Apr 92	Cheshire	J	M	0.16	0.18	2.30	0.57
11139	Dec 92	Gwent	J	F	0.05	0.08	1.40	3.90
11011	Jan 93	Wilts	J	F	0.21	0.20	3.00	0.86
11013	Jan 93	Leics	A	F	0.05	0.09	1.14	0.72
11014	Jan 93	Orkney	J	M	0.20	0.44	1.01	6.87
11015	Jan 93	Lincs	J	M	0.24	0.69	2.09	0.90
11028	Jan 93	Cambs	A	M	0.05	0.14	0.16	1.07
11029	Jan 93	Cambs	J	F	0.07	0.11	1.11	0.17
11031	Jan 93	Dorset	J	F	2.21	0.72	4.03	0.79
11045	Feb 93	Lothian	J	F	0.20	0.14	0.96	2.87
11048	Feb 93	Norfolk	J	F	0.10	0.13	1.55	0.49
11049	Feb 93	Sussex	J	M	0.09	0.08	0.54	0.32
11050	Feb 93	Sussex	J	F	0.39	0.15	3.74	1.17
11052	Feb 93	Strathclyde	J	M	0.55	0.15	4.41	0.95
11076	Feb 93	Orkney	J	F	4.18	0.10	66.58	8.49
11086	Mar 93	Cambs	J	M	2.20	0.20	6.70	4.90
11088	Mar 93	Strathclyde	J	M	0.07	0.08	2.50	0.60
11094	Mar 93	Lincs	J	F	0.22	0.21	1.70	0.30
11114	Mar 93	Powys	J	F	0.27	0.24	3.90	6.10
11115	Mar 93	Powys	A	F	0.34	0.17	9.70	5.80
11134	Mar 93	S. Humberside	A	M	0.27	0.12	11.00	0.45
11197	Mar 93	Herts	J	F	0.12	0.25	3.40	0.80
11155	May 93	Cambs	A	M	0.33	0.55	1.80	0.74
11195	Jun 93	Northants	A	M	0.11	0.12	3.40	0.45
11229	Jun 93	Greater London	A	M	0.13	0.15	6.50	0.43
11420	Jun 93	D & G	J	M	0.01	0.08	0.19	0.65
11228	Jul 93	Suffolk	J	F	0.03	0.61	0.47	0.50
11242	Aug 93	Lincs	J	F	0.71	0.45	2.30	2.10
11248	Aug 93	Cambs	J	M	0.13	0.72	2.57	1.02
11250	Aug 93	Devon	J	M	0.04	0.17	2.15	0.82
11262	Aug 93	Surrey	J	F	3.95	0.28	5.35	1.92
11274	Aug 93	Hampshire	J	M	0.09	0.14	1.31	0.40

Spec. no.	Date found	County	Age	Sex	DDE	HEOD	PCB	Hg
Kestrel (*Falco tinnunculus*) cont.								
11288	Aug 93	IOW	J	M	4.46	0.84	4.83	1.18
11331	Aug 93	Highland	A	M	0.18	0.93	7.40	2.40
11276	Sep 93	Cambs	J	M	0.04	0.14	14.60	0.42
11304	Sep 93	Tayside	A	M	0.44	0.19	12.92	4.02
11393	Sep 93	Highland	J	F	0.04	0.18	0.55	0.63
11311	Oct 93	Leics	.	.	9.74	2.18	10.12	1.57
11324	Oct 93	Norfolk	J	M	0.02	0.11	0.32	0.31
11325	Oct 93	Essex	J	F	1.60	0.27	3.00	0.68
11334	Oct 93	Essex	J	F	0.09	0.57	0.43	0.77
11339	Oct 93	Strathclyde	J	F	0.27	0.29	1.30	2.00
11340	Oct 93	Kent	J	M	0.11	0.09	0.36	1.10
11341	Oct 93	Lincs	A	F	0.12	0.21	0.39	0.29
11351	Oct 93	Northants	J	M	0.12	0.53	1.20	2.70
11363	Oct 93	Sussex	J	F	0.08	0.27	1.27	2.75
11358	Nov 93	Kent	J	F	1.40	0.27	3.50	1.20
11360	Nov 93	Dyfed	J	F	0.20	0.19	4.12	4.34
11361	Nov 93	Strathclyde	J	F	0.05	0.52	6.36	0.89
11388	Nov 93	Cambs	A	M	0.16	0.43	1.40	0.18
11400	Nov 93	Northants	A	F	0.36	0.17	6.57	1.22
11405	Dec 93	Highland	A	F	0.04	0.07	0.98	0.26
11406	Dec 93	Strathclyde	J	F	0.13	0.05	2.38	1.90
11416	Dec 93	Clwyd	J	F	0.05	0.06	1.77	1.21
Sparrowhawk (*Accipiter nisus*)								
11169	Aug 90	Highland	J	F	0.69	0.17	5.49	2.61
11173	Aug 90	Highland	J	F	1.70	0.17	4.70	2.70
11176	Aug 90	Highland	J	M	2.30	0.25	5.00	2.90
11172	Oct 90	Highland	J	M	0.17	0.04	2.21	4.35
11168	Aug 91	Highland	J	F	0.10	0.03	3.37	1.28
11174	Aug 91	Highland	J	M	0.10	0.05	0.12	ND
11167	Oct 91	Highland	J	F	0.07	0.04	0.43	0.73
11265	Mar 92	Oxford	J	F	2.20	0.16	69.00	6.70
11078	Jul 92	Highland	A	M	1.00	0.08	3.80	3.20
11079	Jul 92	Highland	J	F	0.25	0.05	1.10	2.80
11133	Jul 92	Norfolk	J	F	1.30	0.05	1.50	1.00
11224	Jul 92	Bedfordshire	A	F	3.45	0.64	9.57	2.54
11144	Sep 92	Kent	J	F	6.30	0.36	11.00	0.88
11171	Sep 92	Highland	J	M	0.16	0.09	0.97	2.34
11170	Oct 92	Highland	A	M	1.51	1.10	4.85	0.81
11175	Oct 92	Highland	J	F	2.10	0.22	4.80	2.70
11193	Oct 92	Worcs	J	F	6.60	0.46	7.80	4.30

Spec. no.	Date found	County	Age	Sex	DDE	HEOD	PCB	Hg
Sparrowhawk (*Accipiter nisus*) cont.								
11037	Nov 92	Worcs	A	M	3.90	0.16	13.00	3.10
11166	Nov 92	Highland	J	F	0.15	0.04	2.51	0.70
11038	Dec 92	Warwicks	J	M	5.80	0.22	14.00	2.00
11329	Dec 92	Highland	J	F	0.26	0.03	0.09	2.00
11024	Jan 93	Essex	A	M	3.07	0.37	22.23	2.28
11025	Jan 93	Bucks	A	F	1.21	0.07	3.72	1.03
11030	Jan 93	Strathclyde	A	M	0.01	0.02	0.11	2.02
11032	Jan 93	Suffolk	J	F	7.80	0.36	8.00	2.20
11035	Jan 93	Norfolk	A	F	2.20	0.16	4.20	2.10
11039	Jan 93	Warwicks	J	M	0.57	0.05	5.10	0.80
11041	Feb 93	Cambs	A	F	3.10	0.30	55.00	3.80
11044	Feb 93	Sussex	A	F	1.70	0.12	5.50	1.60
11047	Feb 93	Devon	J	F	0.51	0.05	0.91	1.50
11051	Feb 93	Derbyshire	J	M	0.73	0.07	3.40	1.40
11053	Feb 93	Kent	J	F	19.00	0.62	13.00	2.40
11058	Feb 93	Hampshire	A	M	0.42	0.02	0.76	1.50
11059	Feb 93	Devon	A	M	0.57	0.07	2.30	2.10
11064	Feb 93	Humberside	J	M	0.61	0.06	2.10	0.96
11069	Feb 93	Cambs	A	F	1.80	0.16	18.00	3.00
11070	Feb 93	Cambs	J	M	0.66	0.05	0.99	1.60
11071	Feb 93	Kent	A	F	8.30	0.74	50.00	3.40
11072	Feb 93	Central	J	M	0.33	0.04	1.70	1.60
11073	Feb 93	Lincs	J	F	3.30	1.10	3.80	2.50
11074	Feb 93	Cambs	J	M	1.20	0.05	0.89	2.70
11081	Feb 93	Northants	A	M	7.20	0.38	26.00	1.60
11085	Mar 93	D & G	J	F	4.60	0.60	3.10	16.00
11090	Mar 93	Yorks	A	M	0.74	1.20	6.30	1.90
11093	Mar 93	Norfolk	A	F	0.98	0.16	8.50	1.90
11097	Mar 93	Devon	A	M	6.20	0.68	36.00	4.80
11103	Mar 93	Cheshire	J	M	0.51	0.26	3.20	2.30
11109	Mar 93	Greater London	A	F	ND	0.64	99.00	1.30
11110	Mar 93	Surrey	J	M	0.64	0.09	4.80	1.30
11112	Mar 93	Bucks	J	M	5.40	0.27	16.00	5.60
11113	Mar 93	Hampshire	A	M	0.99	0.15	5.60	3.30
11119	Mar 93	Greater London	J	F	6.70	5.00	49.00	5.90
11122	Mar 93	Cambs	J	F	9.70	2.40	88.00	8.00
11124	Mar 93	Powys	A	M	0.40	0.14	2.30	2.90
11190	Mar 93	Lancs	A	M	1.70	0.28	5.50	5.10
11194	Mar 93	Worcs	A	F	8.40	0.38	3.80	2.90
11125	Apr 93	Shropshire	A	F	7.40	2.40	40.00	6.90
11127	Apr 93	Lincs	A	M	3.40	0.47	2.00	3.60
11129	Apr 93	Cheshire	J	M	9.40	3.60	110.00	25.00
11141	Apr 93	Herts	A	F	11.00	2.10	110.00	4.70

Spec. no.	Date found	County	Age	Sex	DDE	HEOD	PCB	Hg
Sparrowhawk (*Accipiter nisus*) cont.								
11145	Apr 93	Warwicks	A	M	11.00	0.64	41.00	4.30
11149	Apr 93	Herts	J	F	1.07	0.16	3.82	1.99
11151	May 93	Dyfed	J	F	7.00	0.19	15.69	6.41
11153	May 93	Leics	J	M	0.48	0.11	6.28	1.45
11156	May 93	Grampian	J	M	15.47	0.43	32.75	7.22
11163	May 93	Tyne & Wear	J	M	0.23	0.12	3.30	1.41
11212	Jul 93	Strathclyde	A	F	0.75	0.11	5.80	0.52
11219	Jul 93	Gwent	A	F	2.20	0.28	4.60	1.80
11222	Jul 93	Strathclyde	A	F	4.20	0.78	3.40	5.40
11227	Jul 93	Oxfordshire	A	F	3.30	0.30	5.10	2.60
11236	Aug 93	Devon	J	M	0.13	0.05	0.21	1.60
11240	Aug 93	Northants	J	F	0.11	0.04	0.13	0.62
11243	Aug 93	Fife	J	M	0.14	0.08	0.16	0.89
11244	Aug 93	Greater London	J	M	0.15	0.05	0.42	0.42
11245	Aug 93	Bedfordshire	J	M	0.20	0.12	0.60	1.00
11247	Aug 93	Gwynedd	A	F	0.13	0.07	7.80	2.40
11249	Aug 93	Greater London	J	F	0.25	0.24	3.90	0.43
11251	Aug 93	Hampshire	J	M	0.19	0.12	0.39	1.40
11259	Aug 93	Hertfordshire	J	F	0.21	0.05	0.13	0.68
11261	Aug 93	D & G	J	F	1.20	0.09	2.30	5.40
11263	Aug 93	Powys	J	A	0.05	0.05	0.22	1.70
11264	Aug 93	Derbyshire	J	F	0.17	0.10	0.04	0.47
11266	Aug 93		A	F	8.50	2.50	78.00	4.40
11268	Aug 93	Hertfordshire	J	F	0.49	0.11	2.00	0.88
11269	Aug 93	Bedfordshire	J	F	0.17	0.08	1.70	0.74
11270	Aug 93	Oxfordshire	J	F	0.04	0.04	0.49	0.99
11271	Aug 93	D & G	J	M	0.06	0.03	0.54	3.90
11272	Aug 93	Strathclyde	J	M	1.60	0.36	9.10	2.00
11273	Aug 93	Hants	J	F	1.50	0.22	7.50	1.60
11277	Aug 93	Essex	J	F	0.89	0.14	2.00	0.52
11278	Aug 93	Greater London	J	M	1.70	0.30	17.00	0.81
11279	Aug 93	Devon	J	F	0.10	0.21	0.61	0.58
11280	Aug 93	W. Yorks	J	F	0.15	0.28	2.00	0.40
11281	Aug 93	Suffolk	J	F	1.80	0.09	0.80	0.36
11289	Aug 93	Yorks	J	M	0.18	0.31	0.72	0.62
11292	Aug 93	Dyfed	J	F	1.40	0.15	6.50	4.50
11293	Aug 93	Lincs	J	F	2.50	1.00	6.70	1.10
11296	Aug 93	Clwyd	J	M	0.19	0.11	1.40	3.40
11318	Aug 93	Lincs	J	F	0.29	0.12	1.30	0.74
11319	Aug 93	Gloucestershire	J	F	2.10	0.83	17.00	2.10
11320	Aug 93	Worcestershire	J	F	2.30	0.22	4.30	1.20
11323	Aug 93	Cambs	J	F	0.96	0.07	1.90	1.60

Spec. no.	Date found	County	Age	Sex	DDE	HEOD	PCB	Hg
Sparrowhawk (*Accipiter nisus*) cont.								
11328	Aug 93	Highland	J	F	0.21	0.04	1.10	5.70
11330	Aug 93	Highland	J	F	1.40	0.29	2.40	5.00
11287	Sep 93	Cambs	J	M	1.40	0.18	1.60	1.10
11294	Sep 93	Devon	J	M	0.15	0.13	0.63	0.63
11298	Sep 93	Strathclyde	J	M	3.80	0.13	14.00	4.40
11300	Sep 93	Lothian	J	F	0.12	0.08	1.70	0.69
11303	Sep 93	Suffolk	J	M	4.40	0.06	1.90	0.54
11305	Sep 93	Lincs	J	M	0.18	0.04	1.47	2.69
11308	Sep 93	Norfolk	J	M	3.30	0.35	2.40	3.10
11321	Sep 93	H & W	A	F	6.40	0.49	9.20	1.60
11338	Sep 93	Cumbria	J	F	0.51	0.06	0.60	1.20
11315	Oct 93	Orkney	A	F	0.25	0.03	0.39	2.40
11335	Oct 93	G. Manchester	J	M	0.13	0.05	0.95	0.38
11343	Oct 93	Oxford	J	M	0.35	0.05	2.30	2.50
11344	Oct 93	Powys	J	M	0.21	0.09	1.00	1.60
11354	Nov 93	Powys	A	F	4.70	0.49	5.30	3.90
11359	Nov 93	N. Yorks	J	M	0.42	0.06	2.20	0.63
11364	Nov 93	Bedfordshire	J	M	24.30	1.10	9.96	ND
Goshawk (*Accipiter gentilis*)								
11418	Dec 93	Merseyside	A	M	0.12	0.07	0.43	0.13
Peregrine falcon (*Falco peregrinus*)								
11092	Mar 93	Cleveland	A	F	1.20	0.05	12.00	3.10
11136	Apr 93	W. Glamorgan	A	M	0.78	0.32	14.00	2.90
11147	May 93	Dyfed	A	F	4.30	0.36	93.00	2.30
11421	May 93	D & G	J	.	0.20	0.03	0.52	0.72
11200	Jun 93	Co. Antrim	A	M	5.70	1.50	120.00	8.20
Merlin (*Falco columbarius*)								
11154	Nov 90	Sussex	A	F	0.64	0.24	2.20	1.90
11425	92	Grampian	J	.	0.09	0.02	0.20	0.33
11426	92	Grampian	J	.	1.08	0.03	1.00	0.50
11427	Jul 92	Tayside	J	.	0.27	0.05	0.68	0.53
11428	Jul 92	Tayside	J	M	0.12	0.05	0.41	0.41
11429	93	Tayside	J	.	0.08	0.03	0.17	0.41
11430	93	Tayside	J	.	0.07	0.03	0.10	0.42
11431	93	Tayside	J	.	0.08	0.04	0.21	0.43
11432	93	Grampian	J	M	1.24	0.09	1.55	0.85

Spec. no.	Date found	County	Age	Sex	DDE	HEOD	PCB	Hg
Merlin (*Falco columbarius*) cont.								
11433	93	Grampian	A	F	1.73	0.19	2.66	5.28
11061	Feb 93	Cleveland	J	M	0.86	0.70	21.35	0.45
11203	Jun 93	S. Yorks	J	F	0.18	0.08	0.86	0.45
11322	Aug 93	Gwynedd	J	M	0.22	0.13	1.70	4.20
Hobby (*Falco subbuteo*)								
11210	Jul 93	Essex	A	M	10.28	0.40	50.37	3.17
Golden Eagle (*Aquila chrysaëtos*)								
11158	Sep 92	Highland	.	F	0.06	0.02	5.03	0.17
11189	Jan 93	Skye	J	M	4.60	0.12	59.00	1.60
11376	Jun 93	Strathclyde	J	M	0.03	0.01	0.10	1.17
Buzzard (*Buteo buteo*)								
11378	Jan 92	Strathclyde	A	M	0.03	0.15	12.03	1.93
11009	Jan 93	Clwyd	A	M	0.002	0.01	ND	0.22
11010	Jan 93	W. Midlands	J	M	0.01	0.20	0.13	ND
11063	Feb 93	W. Glamorgan	A	M	0.02	0.08	0.07	0.51
11218	Jul 93	Dyfed	J	M	0.05	0.04	0.74	1.10
11362	Nov 93	Mid Glamorgan	A	M	ND	0.04	ND	0.39
11495	Nov 93	Avon	J	M	0.01	0.55	0.16	0.43
11444	Dec 93	Dyfed	J	M	0.01	0.02	0.39	1.06
11445	Dec 93	Dyfed	.	M	0.01	0.03	0.26	1.61
Marsh Harrier (*Circus aeruginosus*)								
11205	Jun 93	Lincs	A	F	0.86	0.15	5.21	0.02
11285	Sep 93	Norfolk	A	F	5.40	0.30	32.00	1.60
Hen Harrier (*Circus cyaneus*)								
11419	Aug 93	D & G	J	F	0.03	0.01	0.02	0.69
Long-eared Owl (*Asio otus*)								
11187	Jun 87	Highland	A	F	0.85	0.02	2.10	0.26
11181	Aug 92	Highland	J	F	0.08	0.01	0.66	0.08
11188	Dec 92	Highland	A	M	0.16	0.01	0.92	0.08
11198	Jan 93	Powys	A	F	0.17	0.02	2.80	0.33

Spec. no.	Date found	County	Age	Sex	DDE	HEOD	PCB	Hg
Long-eared Owl (*Asio otus*) cont.								
11082	Feb 93	Staffs	A	F	0.01	0.09	0.26	0.11
11095	Mar 93	Cambs	A	F	0.26	0.03	0.85	0.55
11118	Mar 93	Caithness	A	F	0.17	0.02	0.74	1.90
11143	Apr 93	Orkney	A	F	0.16	0.05	10.75	0.44
11417	Dec 93	Norfolk	A	F	9.23	0.08	8.07	1.21
Short-eared Owl (*Asio flammeus*)								
11180	Nov 91	Skye	A	F	ND	0.02	2.60	0.72
11100	Mar 93	Strathclyde	.	F	0.65	0.09	2.30	3.60
Little Owl (*Athene noctua*)								
11202	Jun 93	Kent	J	M	47.52	0.33	27.55	2.43
11208	Jul 93	Staffs	A	F	1.10	0.07	5.90	ND
11209	Jul 93	Notts	J	F	0.07	0.03	1.70	0.42
11220	Jul 93	Cambs	J	M	5.70	0.35	1.60	0.55
11295	Sep 93	Derbyshire	J	F	0.11	0.03	0.72	0.23
Heron (*Ardea cinerea*)								
11395	Nov 92	Highland	J	M	1.31	0.12	6.06	26.82
11394	Dec 92	Highland	J	M	1.59	0.10	6.76	41.11
11123	Jan 93	Highland	J	M	1.60	0.05	6.40	13.00
11159	May 93	Gwent	J	F	0.36	0.26	5.21	16.58
11161	May 93	Greater London	J	F	0.23	0.21	2.86	5.36
11162	May 93	Borders	J	F	0.35	0.15	1.25	16.08
11206	Jun 93	Dyfed	J	M	0.60	3.20	4.42	6.32
11207	Jul 93	Dyfed	J	M	0.13	0.02	1.55	10.24
11223	Jul 93	Anglesey	J	M	0.04	0.04	0.31	7.56
11230	Jul 93	Herts	J	M	0.11	0.06	0.49	7.44
11231	Jul 93	Strathclyde	J	M	0.52	3.04	11.04	6.90
11238	Aug 93	Strathclyde	J	M	1.90	0.16	16.00	9.10
11241	Aug 93	Lincs	J	F	1.30	0.23	10.00	5.70
11254	Aug 93	Dyfed	J	M	0.19	0.05	1.72	2.40
11290	Aug 93	Dyfed	J	F	0.07	0.05	1.82	4.65
11291	Aug 93	Dyfed	J	M	0.08	0.02	1.85	4.55
11299	Sep 93	Northants	J	M	4.76	.012	27.75	31.25
11381	Nov 93	Kent	J	M	1.62	0.12	10.37	17.56
11397	Nov 93	E. Sussex	J	F	1.36	1.78	2.78	22.44

Spec. no.	Date found	County	Age	Sex	DDE	HEOD	PCB	Hg
Bittern (*Botaurus stellaris*)								
11046	Feb 93	Essex	A	F	0.09	0.04	0.54	19.24
Kingfisher (*Alcedo atthis*)								
11111	Mar 93	Essex	A	M	11.00	2.70	140.00	6.30
11216	Jul 93	Kent	J	F	1.38	0.25	2.66	2.35
11221	Jul 93	Kent	J	M	0.13	0.57	2.14	1.99
11235	Aug 93	Strathclyde	J	F	0.66	0.19	1.99	0.91
11237	Aug 93	Norfolk	J	F	0.16	0.14	1.27	5.30
11258	Aug 93	Yorks	J	M	0.12	0.69	2.90	1.95
11352	Oct 93	London	J	F	0.44	5.32	41.68	4.23
11407	Dec 93	Norfolk	A	F	0.26	0.38	0.48	2.83
11414	Dec 93	Bedfordshire	A	M	0.51	0.59	0.38	3.55
11434	Dec 93	Devon	J	M	0.29	0.22	4.09	1.76
Great-crested Grebe (*Podiceps cristatus*)								
11068	Feb 93	W. Sussex	A	M	0.09	0.03	0.83	7.08
11121	Mar 93	Bedfordshire	A	F	0.72	0.03	1.90	3.30
11148	Apr 93	Anglesey	A	M	0.29	0.04	2.50	5.80

Table 2. **Geometric mean levels of pollutants in various species in Table 1; for 1993 specimens only**

	HEOD	p-p'-DDE	PCBs	Hg
Kestrel				
Mean	0.22	0.20	2.21	1.03
N	52	52	52	52
Range within 1 SE	0.19-0.24	0.16-0.24	1.87-2.61	0.90-1.17
Sparrowhawk				
Mean	0.18	0.89	3.34	1.76
N	99	99	99	99
Range within 1 SE	0.16-0.20	0.75-1.06	2.82-3.95	1.60-1.95
Merlin				
Mean	0.09	0.20	0.90	0.83
N	8	8	8	8
Range within 1 SE	0.03-0.13	0.07-0.44	0.16-1.67	0.30-1.20
Heron				
Mean	0.15	0.41	3.26	8.95
N	17	17	17	17
Range within 1 SE	0.10-0.22	0.29-0.57	2.40-4.42	7.62-10.52
Kingfisher				
Mean	0.54	0.40	3.36	2.70
N	10	10	10	10
Range within 1 SE	0.37-0.78	0.25-0.63	1.88-6.00	2.25-3.25
Great-crested Grebe				
Mean	0.03	0.26	1.58	4.49
N	3	3	3	3
Range within 1 SE	0.031-0.035	0.14-0.49	1.13-2.20	3.13-6.44

Table 3. **Comparison of geometric mean residue levels (log values) from birds collected in 1992 and 1993; t-values are shown. Minus values indicate a decrease and plus values indicate an increase from 1992.**

	HEOD	p,p'-DDE	PCBs	Hg
Kestrel	$t_{99}=+2.62$	$t_{99}=-3.15$	$t_{99}=+3.90$	$t_{99}=+0.93$*
Sparrowhawk	$t_{221}=+0.86$	$t_{221}=-055$	$t_{221}=+2.43$*	$t_{200}=+2.02$***
Merlin	$t_{20}=-0.34$	$t_{20}=-0.88$	$t_{20}=-0.28$	$t_{20}=+0.13$*
Kingfisher	$t_{15}=+0.021$	$t_{15}=-1.25$	$t_{15}=+0.77$	$t_{15}=+0.89$
Heron	$t_{29}=-2.12$***	$t_{29}=+1.08$	$t_{29}=+1.77$	$t_{29}=+0.1$
Great-crested Grebe	$t_{6}=-0.96$**	$t_{6}=-0.96$	$t_{6}=-1.06$	$t_{6}=-2.06$

Notes: Zero values were taken as 0.001 for all residues.

* significance of difference $P<0.05$; ** $P<0.01$; *** $P<0.001$

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JNCC/NERC CONTRACT HF3/08/01
JNCC PROJECT 018 (Contract F71-12-153)
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Annual report to the Joint Nature Conservation Committee

WILDLIFE AND POLLUTION

Part 3 Organochlorines and mercury in peregrine eggs, 1993

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August 1994

3 ORGANOCHLORINES AND MERCURY IN PEREGRINE EGGS, 1993

3.1 Introduction

The findings from all peregrine eggs analysed between 1961 and 1986 were summarised in Newton *et al* (1989); those from eggs analysed in 1987-92 are given in previous reports in this series, and those from eggs analysed in 1993 are given in Table 4.

3.2 Results

Among the eggs from 21 clutches received in 1993, none of the contaminants were at high level, compared to previous years. This continues the trend of declining contamination in this species. The only figures of note were levels of 12, 12 and 77 ppm PCBs in eggs from Argyll, Strathclyde and Dyfed.

3.3 Reference

NEWTON, I., BOGAN, J.A. & HAAS, M.B. 1989. Organochlorines and mercury in British Peregrine eggs. Ibis 131; 355-376.

Table 4. **Residue levels (organochlorine ppm wet weight (in lipid); Mercury ppm dry weight) and shell indices for Peregrine eggs received in 1993.**
ND=none detected

Number	Year	County	SI	DDE	HEOD	PCB	Hg
SOUTHERN ENGLAND							
E6014	93	Avon	-	0.81 (12.00)	0.11 (1.70)	7.00 (10.00)	0.38
E6068	93	Devon	-	0.27 (3.59))	0.03 (0.43)	0.92 (12.08)	0.68
WALES							
E5679	93	Dyfed	1.65	4.20 (67.00)	0.44 (7.00)	77.00 (1200.0)	3.30
E5889	93	Powys	1.51	0.66 (21.00)	0.11 (3.60)	2.40 (78.00)	0.66
NORTHERN ENGLAND							
E5584	93	N Yorks	1.88	0.10 (2.41)	0.03 (0.75)	1.09 (25.96)	0.32
E5592	93	Cheshire	2.10	1.80 (29.00)	0.11 (1.80)	3.20 (52.00)	0.48
E5606	93	Lancashire	1.94	0.15 (2.90)	0.05 (0.90)	1.20 (22.00)	0.32
E5609	93	Lancashire	1.85	0.03 (0.71)	0.02 (0.50)	0.22 (5.00)	0.13
SOUTHERN SCOTLAND							
E5594	92	D & G	1.78	1.00 (29.00)	0.40 (1.80)	2.60 (24.00)	0.22
E5595	92	D & G	1.96	0.25 (9.30)	0.07 (0.36)	1.40 (22.00)	0.51
E5599	92	D & G	1.78	0.97 (12.00)	0.13 (1.20)	2.00 (24.00)	0.51
E5600	92	D & G	1.77	0.28 (3.50)	0.07 (0.89)	0.67 (8.30)	0.25
E5603	92	D & G	1.88	0.46 (12.00)	0.09 (2.20)	3.50 (90.00)	0.38
E5604	92	D & G	1.66	0.47 (11.00)	0.05 (1.20)	0.82 (20.00)	0.20
E5624	92	Strathclyde	1.53	3.40 (67.00)	0.24 (4.70)	1.40 (270.0)	1.60
E5631	92	D & G	2.06	0.40 (7.00)	0.08 (1.30)	1.30 (22.00)	0.69
E5966	93	D & G	-	0.42 (9.20)	0.06 (1.20)	1.10 (25.00)	0.68
E5969	93	D & G	-	0.20 (2.80)	0.05 (6.67)	1.30 (18.0)	0.49
E5996	93	Strathclyde	1.65	1.30 (22.00)	0.15 (2.40)	12.00 (190.0)	1.30
CENTRAL AND EASTERN HIGHLANDS							
E5565	92	Argyll	1.59	1.46 (26.52)	0.12 (2.09)	11.63 (210.58)	0.62
E6053	93	Grampian	-	0.28 (8.19)	0.01 (0.23)	0.24 (6.90)	0.20

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WILDLIFE AND POLLUTION

Part 4 Organochlorines and mercury in merlin eggs, 1993

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August 1994

4 ORGANOCHLORINES AND MERCURY IN MERLIN EGGS, 1993

4.1 Introduction

The findings from most previous analyses of merlin eggs were given in Newton & Haas (1988), those from 1987-1992 in previous reports in this series, while those from 1993 are summarised in Table 5. They involve eggs from 60 clutches, more than in previous years because of the increased attention being devoted to this species.

4.2 Results

The results from these additional merlin clutches serve to confirm that the merlin continues to be the most contaminated of the British raptors, even though levels of DDE and HEOD are lower than in earlier years. Notable levels include the 16, 22, 34, 35 and 49 ppm PCBs in eggs from Yorkshire, Northumberland (2) and Durham (2), and the 11, 11 and 12 ppm mercury in eggs from Northumberland, Orkney and Shetland. On the other hand, for the first time since the start of the scheme in 1963, a merlin egg was found (from Northumberland) with no detectable DDE.

Despite repeated requests, we received no Merlin prey items in 1993, for analysis of mercury levels. Now that many Merlins are nesting in trees, on the edges of new conifer plantations, prey remains are hard to find. The recent increase in populations has also removed the urgency of the problem from the minds of many observers.

4.3 Reference

NEWTON, I. & HAAS, M.B. 1988. Pollutants in Merlin eggs and their effects on breeding. Brit. Birds 81: 258-269.

Table 5. **Residue levels (organochlorine ppm wet weight (in lipid); Mercury ppm dry weight) and shell indices for Merlin eggs received in 1993.**
ND = none detected

Number	Year	County	SI	DDE	HEOD	PCB	Hg
NORTHERN ENGLAND							
E5529	92	N'humberland	1.29	1.89 (32.56)	0.14 (2.47)	1.62 (27.94)	1.40
E5531	92	N'humberland	1.09	3.15 (40.04)	0.19 (2.36)	3.54 (45.03)	1.72
E5532	92	N'humberland	1.12	2.77 (41.57)	0.13 (1.90)	7.80 (117.23)	10.66
E5562	92	N'humberland	1.09	2.59 (65.87)	0.12 (3.16)	6.56 (166.56)	3.71
E5690	93	N Yorkshire	1.33	2.60 (34.00)	0.25 (3.30)	5.70 (76.00)	1.90
E5692	93	N Yorkshire	1.16	2.10 (29.00)	0.41 (5.60)	16.00 (220.0)	1.20
E5707	93	N Yorkshire	1.12	3.20 (62.00)	0.26 (5.00)	6.20 (120.0)	1.70
E5906	93	N'humberland	1.03	4.40 (77.00)	0.18 (3.10)	4.80 (84.00)	3.30
E5910	93	N'humberland	1.12	3.20 (50.00)	0.11 (1.80)	3.20 (50.00)	1.80
E5911	93	N'humberland	1.19	4.70 (43.00)	0.26 (2.40)	5.60 (51.00)	2.00
E5916	93	N'humberland	1.18	2.70 (49.00)	0.21 (3.80)	3.60 (67.00)	2.00
E5917	93	N'humberland	1.32	2.20 (30.00)	0.14 (1.90)	4.60 (63.00)	2.30
E5918	93	N'humberland	1.16	3.70 (50.00)	0.16 (2.20)	7.00 (93.00)	4.70
E5920	93	N'humberland	0.95	2.70 (72.00)	0.19 (5.20)	3.00 (80.00)	2.90
E5922	93	N'humberland	1.01	2.80 (74.00)	0.24 (6.30)	3.50 (91.00)	2.50
E5925	93	N'humberland	1.13	2.30 (39.00)	0.29 (6.30)	5.70 (97.00)	2.00
E5926	93	N'humberland	1.11	ND (ND)	0.40 (5.60)	22.00 (300.0)	2.70
E5928	93	N'humberland	1.22	2.00 (33.00)	0.08 (1.30)	3.70 (61.00)	3.50
E5929	93	N'humberland	1.18	2.70 (44.00)	0.18 (2.90)	3.00 (49.00)	3.70
E5930	93	Durham	1.22	4.50 (65.00)	0.19 (2.80)	4.50 (66.00)	2.10
E5931	93	Durham	1.06	2..80 (47.00)	0.18 (3.00)	2.80 (46.00)	1.70
E5933	93	Durham	1.15	5.20 (66.00)	0.44 (5.60)	34.0 0 (430.0)	3.50
E5936	93	Durham	1.04	4.60 (77.00)	0.35 (5.80)	49.0 (82.00)	1.60
E5967	93	Durham	1.19	2.40 (46.00)	0.20 (3.80)	5.10 (97.00)	1.90
E5939	93	Durham	1.14	7.00 (100.0)	0.59 (8.80)	3.50 (53.00)	1.70
E5940	93	Durham	1.16	2.20 (42.00)	0.36 (7.00)	3.70 (71.00)	2.10
E5943	93	Durham	1.28	4.80 (66.00)	0.44 (6.10)	3.50 (48.00)	2.00
E5946	93	Durham	1.07	5.60 (85.00)	0.57 (8.60)	6.90 (100.0)	3.80

Number	Year	County	SI	DDE	HEOD	PCB	Hg
NORTHERN ENGLAND cont.							
E5943	93	Durham	1.28	4.80 (66.00)	0.44 (6.10)	3.50 (48.00)	2.00
E5946	93	Durham	1.07	5.60 (85.00)	0.57 (8.60)	6.90 (100.0)	3.80
E5948	93	Durham	1.39	2.00 (30.00)	0.81 (12.00)	3.50 (54.00)	2.50
E5953	93	N'humberland	1.13	2.80 (70.00)	0.18 (3.60)	35.0 (71.00)	3.60
E6019	93	N'humberland		2.80 (45.00)	0.22 (1.70)	3.60 (57.00)	2.00
WALES							
E5873	93	Powys	1.36	0.74 (20.00)	0.14 (0.39)	2.20 (60.00)	1.30
GALLOWAY & SOUTHERN UPLANDS							
E5605	92	D & G	1.17	2.70 (45.00)	0.21 (3.50)	4.80 (82.00)	3.30
E5632	93	Strathclyde	1.20	2.50 (29.00)	0.09 (1.00)	3.60 (43.00)	3.30
E5693	93	Borders	1.23	2.40 (34.00)	0.15 (2.10)	3.30 (46.00)	2.10
E5697	93	Lothian	1.09	3.00 (54.00)	0.18 (3.20)	3.70 (65.00)	2.60
E5698	93	Lothian	1.12	2.70 (50.00)	0.19 (3.50)	4.50 (83.00)	4.90
E5701	93	Lothian	1.21	3.30 (43.00)	0.20 (2.60)	2.20 (28.00)	2.10
E5703	93	Lothian	1.24	3.10 (49.00)	0.19 (3.00)	5.10 (81.00)	2.30
E5708	93	Lothian	1.09	3.80 (65.00)	0.28 (4.80)	4.80 (82.00)	4.20
E5768	93	D & G	1.16	2.90 (47.00)	0.07 (1.20)	4.00 (66.00)	4.30
E5775	93	D & G	1.32	3.00 (43.00)	0.08 (1.20)	6.30 (91.00)	2.40
E5790	93	Strathclyde	1.20	3.50 (47.00)	0.09 (1.20)	3.50 (47.00)	3.50
E5819	93	D & G	1.32	2.00 (40.00)	0.08 (1.60)	1.70 (34.00)	4.20
E5864	93	Lothian	1.11	3.50 (49.00)	0.28 (4.00)	4.10 (58.00)	2.70
E5869	93	Borders	1.15	3.60 (57.00)	0.39 (6.10)	4.80 (77.00)	2.10
E5892	93	Strathclyde	1.12	4.40 (30.00)	0.28 (1.90)	1.00 (71.00)	3.50
E5894	93	Strathclyde	1.20	1.80 (23.00)	0.07 (0.97)	5.10 (64.00)	5.90
E5965	93	Borders	1.02	4.70 (75.00)	0.42 (6.70)	9.20 (150.00)	3.70

Number	Year	County	SI	DDE	HEOD	PCB	Hg
GALLOWAY & SOUTHERN UPLANDS cont.							
E5972	93	D & G	1.22	3.90 (50.00)	0.13 (1.60)	4.00 (51.00)	3.80
E5974	93	D & G	1.14	3.60 (61.00)	0.13 (2.20)	4.30 (73.00)	2.90
E5975	93	D & G	1.28	3.40 (48.00)	0.10 (1.40)	3.10 (44.00)	4.70
E5976	93	D & G	1.18	3.00 (66.00)	0.15 (3.40)	4.30 (95.00)	3.06
E5977	93	D & G	-	4.00 (70.00)	0..39 (6.90)	4.00 (71.00)	3.20
E5979	93	D & G	1.26	1.80 (26.00)	0.06 (0.85)	2.30 (33.00)	3.00
NORTHERN ISLES							
E5878	93	Shetland	1.27	1.60 (35.00)	0.06 (1.30)	3.80 (83.00)	12.00
E5879	93	Shetland	1.11	1.80 (33.00)	0.08 (1.50)	3.40 (63.00)	7.70
E5957	93	Orkney	-	0.71 (19.00)	0.04 (1.00)	1.40 (37.00)	11.00

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WILDLIFE AND POLLUTION

Part 5 Organochlorines and mercury in golden eagle eggs, 1993

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August 1994

5 ORGANOCHLORINES AND MERCURY IN GOLDEN EAGLE EGGS, 1993

5.1 Introduction

The findings from earlier analyses of golden eagle eggs to 1986 were given in Newton & Galbraith (1991), and those from 1987-92 in the previous reports in this series. The results for eggs from 22 clutches analysed in 1993 are summarised in Table 6.

5.2 Results

Recent analyses serve to confirm the low levels of contamination found in recent years in eagle eggs from inland districts (Table 6). All results were well within the range of previous values. Some coastal eggs were also obtained in 1993, and one (from Islay) contained a relatively high level of PCB, at 29 ppm.

No Sea Eagle eggs were obtained in 1993.

5.3 Reference

NEWTON, I. & GALBRAITH, A.E. 1991. Organochlorines and mercury in the eggs of Golden Eagles *Aquila chrysaetos* from Scotland. Ibis 133: 115-120.

Table 6. **Residue levels (organochlorine ppm wet weight (in lipid); Mercury ppm dry weight) and shell indices for Golden Eagle eggs received in 1993.**
ND=None detected

Number	Year	County	SI	DDE		HEOD		PCB		Hg
NORTHERN ENGLAND										
E5634	93	Cumbria	2.68	0.11	(2.74)	0.02	(0.48)	0.48	(11.74)	0.32
WESTERN SCOTLAND - INLAND										
E5545	92	Strathclyde	3.36	0.09	(2.37)	0.06	(1.66)	0.45	(11.63)	ND
E5546	92	Strathclyde	3.66	0.03	(1.03)	0.04	(1.18)	0.20	(6.40)	ND
E5633	92	D & G	3.01	0.13	(3.10)	0.09	(2.00)	0.52	(12.00)	ND
E5905	93	Central	2.69	0.11	(1.70)	0.06	(0.90)	2.00	(30.00)	0.24
E6003	93	Strathclyde	3.22	0.06	(1.30)	0.14	(3.00)	0.98	(22.00)	0.26
E6004	93	Strathclyde	3.26	0.11	(1.80)	0.18	(3.00)	2.20	(38.00)	1.20
EASTERN SCOTLAND - INLAND										
E5798	93	-	-	0.01	(0.16)	0.04	(1.40)	0.01	(0.28)	ND
E5954	93	Grampian	3.20	0.01	(0.21)	0.01	(0.33)	0.08	(1.79)	0.09
E5956	93	Grampian	2.72	0.01	(0.21)	0.01	(0.23)	0.03	(0.62)	ND
EASTERN SCOTLAND - COASTAL										
E5874	93	Isle of May	3.05	0.01	(0.21)	0.05	(0.76)	0.12	(21.00)	ND
E5875	93	Isle of May	3.29	0.01	(0.11)	0.03	(0.54)	0.03	(0.49)	ND
E5876	93	Isle of May	3.96	0.02	(0.20)	0.06	(0.72)	1.30	(16.00)	ND
WESTERN ISLES										
E5897	92	Islay	2.63	3.40	(97.0)	0.08	(2.20)	29.00	(830.0)	1.90
E5898	92	Islay	3.51	0.08	(1.90)	0.08	(1.80)	1.80	(41.00)	0.33
E5900	92	-	2.88	0.05	(1.60)	0.02	(0.65)	0.62	(18.00)	0.33
E5901	92	Mull	2.94	0.03	(0.32)	0.06	(0.80)	1.40	(18.00)	0.06
E5902	92	Mull	3.03	0.06	(1.10)	0.03	(0.52)	0.36	(6.90)	ND
E5583	93	Lewis	3.03	0.23	(5.82)	0.09	(2.17)	5.74	(143.06)	3.55
E5754	93	Lewis	3.07	0.38	(8.30)	0.07	(1.60)	2.50	(55.00)	0.74
E5755	93	Lewis	2.84	1.20	(2.30)	0.04	(0.76)	8.20	(170.0)	0.77
E5756	93	Lewis	3.38	0.11	(51.0)	0.02	(0.94)	0.70	(31.00)	0.43

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WILDLIFE AND POLLUTION

Part 6 Organochlorines and mercury in gannet eggs, 1993

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6 ORGANOCHLORINES AND MERCURY IN GANNET EGGS, 1993

6.1 Introduction

The findings from all gannet eggs collected during the period 1971-87 were summarised in Newton et al (1989), while those from 1988-92 were given in previous reports in this series. The findings for eggs from St Kilda in 1993 are given in Table 7. Ten eggs were collected, but seven broke in transit, leaving only three for analysis.

6.2 Results

The levels of all contaminants were low, and well within the range found in other recent eggs from this colony.

6.3 Reference

NEWTON, I., HAAS, M.B. & FREESTONE, P. 1990. Trends in organochlorine and mercury levels in gannet eggs. Environ. Pollut. 63: 1-12.

Table 7. **Residues of organochlorines (ppm wet weight) and mercury (ppm dry weight) in three Gannet eggs (Sula bassana) received in 1993.** ND=None detected.

	Shell-index	pp'-DDE	HEOD	PCBs	Hg
ST. KILDA	2.92	0.10	0.08	1.30	2.50
	3.08	0.06	0.06	1.80	2.70
	3.17	0.08	0.06	1.50	2.20
Mean*	3.06	0.08	0.07	1.52	2.45
SD	0.13	0.11	0.07	0.07	0.04
Range within 1SE	2.98-3.13	0.07-0.09	0.06-0.07	1.38-1.67	2.32-2.61

*Mean: Arithmetic for shell-index; geometric otherwise

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WILDLIFE AND POLLUTION

Part 7 Rodenticides in barn owls

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7 RODENTICIDES IN BARN OWLS

7.1 Introduction

The aim of this work was to screen barn owl carcasses for residues of 'second generation' rodenticides. The carcasses were supplied by members of the public, and included birds which had died from various causes, mainly accidents. The chemicals of interest included difenacoum, bromadiolone, brodifacoum and flocoumafen. The findings from all barn owls analysed in previous years were given in Newton *et al* (1990) and in previous reports in this series, while those from 39 birds examined in 1993 are given in Table 8.

7.2 Results

Residues were detected in 14 (36%) of the 39 birds examined, a slightly higher percentage than in the last three years. Brodifacoum was detected in six birds, difenacoum in six, bromadiolone in three and flocoumafen in two. In three birds more than one chemical was detected. Six birds contained brodifacoum at levels (0.12-1.00 ppm) which could have been lethal or close to lethal, as did one bird with bromadiolone (0.25 ppm) and one with flocoumafen (0.47 ppm). However, physical symptoms of rodenticide poisoning (haemorrhages) were seen in only one of these birds (with 0.47 ppm brodifacoum), and the rest were classed on post-mortem as victims of starvation (five birds) or road accidents (eight). The appearance of flocoumafen in only one individual is in keeping with the more recent introduction of this chemical.

As a group, these owls provided further evidence for the growing contamination of the barn owl population with these chemicals, and of the growing number with residues that could have been lethal.

7.3 Reference

NEWTON, I., WYLLIE, I. & FREESTONE, P. 1990. Rodenticides in British Barn Owls. Environ. Pollut. 68: 101-117.

Table 8. **Levels of rodenticides (pm in wet weight) in the livers of Barn Owls (*Tyto alba*) received in 1993.**

ND=none detected; J=juvenile in first year; A=adult other than first year; M=male; F=female; brod=brodifacoum; difen=difenacoum; brom=bromadialone; floc=flocoumafen

Spec. No.	Date	County	Age	Sex	brod.	difen.	brom.	floc.
11179	Jan 91	Highland	J	M	ND	ND	ND	ND
11232	Dec 91	Shropshire	A	F	ND	0.05	ND	ND
11283	92	Anglesey	A	F	0.396	ND	ND	ND
11116	Aug 92	Powys	J	F	ND	ND	ND	ND
11282	Aug 92	Gwynedd	J	M	ND	ND	ND	ND
11054	Nov 92	Norfolk	J	F	ND	ND	0.251	ND
11056	Dec 92	Shropsire	J	F	ND	ND	ND	ND
11019	Jan 93	Norfolk	J	M	ND	ND	ND	ND
11020	Jan 93	Devon	J	M	ND	ND	0.078	ND
11023	Jan 93	Gwynedd	J	F	ND	0.075	ND	ND
11026	Jan 93	Norfolk	J	M	ND	ND	ND	ND
11027	Jan 93	Grampian	A	F	ND	ND	ND	ND
11034	Jan 93	Wilts	A	M	ND	ND	ND	ND
11036	Jan 93	Wilts	J	F	ND	ND	0.067	ND
11098	Jan 93	Wilts	J	F	ND	ND	1.000	ND
11055	Feb 93	Midlothian	J	M	ND	ND	ND	ND
11057	Feb 93	Shropshire	J	F	ND	ND	ND	ND
11060	Feb 93	Yorks	J	F	ND	ND	ND	ND
11062	Feb 93	Wilts	A	F	0.470	ND	ND	ND
11067	Feb 93	Notts	A	M	ND	ND	ND	ND
11105	Feb 93	Clwyd	J	F	ND	ND	ND	ND
11130	Feb 93	Cornwall	J	F	ND	0.040	0.574	ND
11091	Mar 93	Somerset	J	M	ND	ND	ND	ND
11096	Mar 93	Norfolk	J	M	ND	ND	0.140	ND
11104	Mar 93	Anglesey	J	M	ND	0.032	0.556	ND

Spec. No.	Date	County	Age	Sex	brod.	difen.	brom.	floc.
11108	Mar 93	Suffolk	J	F	ND	ND	0.124	ND
11120	Mar 93	Norfolk	A	M	ND	ND	ND	ND
11128	Mar 93	Lincs	J	M	ND	ND	ND	ND
11138	Apr 93	Leics	J	M	ND	ND	ND	ND
11140	Apr 93	Strathclyde	J	M	ND	ND	ND	ND
11157	May 93	Yorks	A	M	0.037	0.055	ND	ND
11214	June 93	Carmarthen	A	F	ND	ND	ND	ND
11233	July 93	Shropshire	A	M	ND	ND	ND	ND
11297	July 93	Sussex	J	F	ND	ND	ND	ND
11253	Aug 93	Hants	J	M	ND	ND	ND	ND
11306	Sept 93	D & G	A	F	ND	ND	ND	ND
11307	Sept 93	Herefordshire	J	M	ND	ND	ND	ND
11309	Sept 93	Yorks	J	M	ND	ND	ND	ND
11314	Sept 93	Lothian	J	M	ND	ND	ND	ND
11317	Oct 93	Lincs	J	M	ND	0.018	ND	ND

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WILDLIFE AND POLLUTION

Part 8 Incidents investigated during 1993-94

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8 INCIDENTS INVESTIGATED DURING 1992-93

8.1 Introduction

Two wildlife incidents were investigated during the reporting year, the first involving wildfowl from Essex and the second seabirds from the North Sea. Throughout this section HCH refers to gamma-hexachlorocyclohexane (lindane).

8.2 Essex wildfowl poisoning incident

During November 1993 approximately 100 brent geese (*Branta bernicla)* carcasses were found along the Gore saltings, Essex. The carcasses of two juvenile mute swans (*Cygnus olor)* were found in an adjacent area. Livers and kidneys from these birds were analysed for organochlorine insecticides and PCBs, and scanned for the presence of heavy metals.

The residues of organochlorine insecticides and PCBs were very low, in most birds below the limit of analytical detection. Heavy metals were not present at levels thought to exert toxic effects. Lead was not the cause of death in this incident, unlike earlier incidents in this area.

The Central Science Laboratory (MAFF) also analysed tissues from some birds, and suggested that the geese had been poisoned by the organophosphate insecticide, triazophos. Triazophos is sprayed onto cereals, vegetables and fruit to control insects, and may be applied to soil prior to planting to control cutworms. Triazophos residues were not detected in the swan tissues.

8.3 North Sea Wreck 1994

During February 1994 there was a large seabird mortality incident on the East coast of Britain. Initially dead birds were washed ashore in Shetland, but within a few weeks the problem was reported along the whole length of the East coast. The RSPB estimated that the total number of mortalities was 75 000, with 50 000 of birds found in Shetland alone. Most of the affected birds were guillemots (*Uria aalge)*, although other fish-eating birds such as razorbills (*Alca torda*), shags (*Phalacrocorax aristotelis)* and little auks (*Alle alle)* were also affected.

Carcasses were received at ITE Monks Wood from several sites along the UK coastline for post mortem examination. This revealed that the birds were starved, and many had begun to metabolise protein as well as fat reserves. No gross abnormalities were present. Some of the birds had successfully moulted, indicating a recent natural demand on protein reserves. Samples of liver and fat (where present) were analysed for organochlorine compounds including pesticides and PCBs, and also for heavy metals (copper, zinc, cadmium, and mercury).

The findings from 39 guillemots and 4 shags are listed in tables 9 to 11. The birds were classified according to the area of the coastline on which they were found. On post mortem it was found that birds sent by a Norfolk wildlife rescue unit (The Seal and Wildlife Hospital, Bacton) were of a different internal appearance from birds from other areas. These birds had discoloured livers, with enlarged gall bladders containing dark green bile. The cause is under investigation.

Organochlorine Insecticides. The geometric mean levels of the organochlorine insecticides were low, and were unlikely to have contributed to the mortality of the birds. The organochlorine insecticide residues did not vary in guillemots from different coastal locations. There were no differences in residue levels between guillemots and shags, with the exception of HEOD which was 5-10 times greater in shags than in guillemots. The residue levels were similar to those found in auks from previous seabird mortality incidents, including the Braer oil spill in 1993 (Freestone et al 1993; NERC 1983).

PCBs. The mean total PCB levels were similar in guillemots from different locations, although they were slightly higher in birds from Norfolk and Kent. The mean total PCB levels in shags were similar to those found in guillemots. The levels of PCBs were similar to those from previous incidents (Freestone et al 1993). Despite continued debate on the toxicological significance of PCB residues, the levels found in these birds were below those currently believed to affect either breeding success or survival of auks (Harris & Osborn, 1981).

The PCB congener distribution pattern was the same in guillemots from different locations. Congener 138 was the most abundant followed by 153 > 118 > 180 > 128. Additional congeners were detected at lower levels. The congener pattern in guillemots from Arbroath was slightly different, in that 153 was the major congener followed by 138. 153 was also the major congener in the shags. The congener pattern was much the same as that found in birds killed by the Braer oil spill (Freestone et al 993). Shags from the Braer also had 153 as the dominant congener, compared to 138 found in Braer guillemots. The dataset is not yet large enough to judge whether this is a consistent species difference.

Metals. The levels of copper, zinc, cadmium and mercury measured in these birds were similar to those reported in auks in previous studies (NERC, 1983; Osborn et al 1979;) and are not considered to have contributed to the mortality. Copper and zinc are essential elements, the tissue concentrations of which should be controlled by normal homeostatic mechanisms. However, previous studies have shown that the levels of these elements in the tissues may sometimes be high enough to exert toxic effects. Increased concentrations of these elements have also been found following exposure to organic chemicals such as PCBs (Osborn & Harris, unpublished), or alkyl lead compounds (Osborn & Young 1985). Cadmium and mercury can be regarded as a contaminants, as they have no biological function, but their presence in seabirds is not necessarily the result of human activity. Cadmium from natural sources has been previously reported in seabirds at levels causing kidney lesions in pelagic seabirds (Nicholson & Osborn 1983). The concentrations of cadmium measured in the 1994 seabirds were below the liver cadmium concentration known to be high enough to predict kidney lesions. The ICP-MS scans did not demonstrate the presence of any additional elements which may have contributed to the mortality.

It can be concluded that the residues detected in these birds were present at levels which were unlikely to have contributed to the mortalities. The cause of death was almost certainly starvation.

8.4 References

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Table 9: Mean levels of organochlorine compounds (mg/kg wet weight) in livers of guillemots and shags from the North Sea Wreck in 1994. Data are expressed as geometric means and range within 1 SE. nd = not detected. Zer values (nd) were taken as 0.001 for all residues. PCB-MAT is the total PCB expressed using only the peaks corresponding to those found in Arochlor 1254. PCB-TOT is the total PCB expressed using all the peaks found in the GC trace in the region in which PCB congeners normally occur.

Area	Species	Numbers	HCB	HCH	DDE	HEOD	TDE	DDT	PCB-MAT	PCB-TOT
Shetland	guillemot	12	0.10 0.09 - 0.11	nd	0.95 0.83 - 1.09	0.01 0.01 - 0.02	0.03 0.02 - 0.06	nd	3.76 3.23 - 4.38	5.16 4.50 - 5.92
Orkney	guillemot	6	0.08 0.06 - 0.09	nd	0.77 0.60 - 0.98	0.02 0.02 - 0.03	0.01 0.01 - - 0.02	nd	3.67 2.84 - 4.75	5.06 4.16 - 6.16
Arbroath	guillemot	2	0.09 0.08 - 0.09	nd	0.63 0.42 - 0.94	0.02 0.01 - 0.03	nd	nd	3.48 2.02 - 5.98	3.98 2.50 - 6.35
Lothian	guillemot	5	0.12 0.10 - 0.13	nd	0.84 0.69 - 1.02	0.01 nd - 0.02	nd nd - 0.01	nd	4.25 3.34 - 5.41	5.18 4.00 - 6.72
Northumberland	guillemot	3	0.08 0.08 - 0.09	nd	0.58 0.43 - 0.79	0.04 0.03 - 0.06	0.01 nd - 0.02	nd	3.39 2.62 - 4.39	4.59 3.10 - 6.80
Norfolk	guillemot	5	0.06 0.04 - 0.08	nd	0.56 0.36 - 0.88	0.02 0.02 - 0.02	0.01 nd - 0.02	nd	3.30 1.72 - 6.37	3.75 1.92 - 7.31
Kent	guillemot	1	0.10	nd	1.45	0.11	0.06	nd	13.98	15.49
Aberdeen	guillemot	5	0.03 0.02 - 0.05	nd	0.46 0.27 - 0.77	0.04 0.03-0.05	0.01 nd - 0.01	nd	3.07 2.00 - 4.71	3.90 2.59 - 5.88
Arbroath	shag	1	0.09	nd	1.38	0.30	0.01	nd	7.68	10.69
Northumberland	shag	3	0.09 0.08 - 0.10	nd	0.81 0.63 - 1.02	0.25 0.17 - 0.35	nd	nd	5.91 5.36 - 8.78	7.61 5.36 - 10.80

Table10a: Mean PCB congener levels (mg/kg wet weight) in the livers of guillemots and shags killed in the North Sea Wreck in 1994. Data are expressed as geometric means and range within 1 SE. nd = not detected. Zero values (nd) were taken as 0.001 for all residues.

Area	Species	Numbers	8	18	28	31	52	77	101	118
Shetland	guillemot	12	nd	nd	nd	0.02 0.02 - 0.02	0.01 0.01 - 0.02	nd	nd	0.17 0.15 - 0.20
Orkney	guillemot	6	nd	nd	nd	0.01 0.01 - 0.02	0.02 0.01 - 0.04	nd	nd nd - 0.01	0.18 0.13 - 0.23
Arbroath	guillemot	2	nd	nd	nd	0.03 0.03 - 0.04	0.01 nd - 0.03	0.03 0.03 - 0.03	nd	0.18 0.12 - 0.27
Lothian	guillemot	5	nd	nd	nd	0.02 0.02 - 0.02	0.03 0.01 - 0.06	nd	nd	0.22 0.18 - 0.25
Northumberland	guillemot	3	nd	nd	nd	0.02 0.01 - 0.02	0.05 0.04 - 0.07	nd	nd nd - 0.01	0.15 0.12 - 0.19
Norfolk	guillemot	5	bd	nd	nd	0.02 0.01 - 0.02	nd	nd nd - 0.01	nd	0.15 0.08 - 0.29
Kent	guillemot	1	nd	nd	nd	0.04	0.11	nd	nd	0.64
Aberdeen	guillemot	5	nd	nd	nd	nd	nd	nd	nd	0.13 0.09 - 0.19
Arbroath	shag	1	nd	nd	nd	0.04	nd	nd	nd	0.49
Northumberland	shag	3	nd	nd	nd	0.03 0.03 - 0.04	nd	nd	nd	0.31 0.23 - 0.43

Table10b: Mean PCB congener levels (mg/kg wet weight) in the livers of guillemots and shags killed in the North Sea Wreck in 1994. Data are expressed as geometric means and range within 1 SE. nd = not detected. Zero valures (nd) were taken as 0.001 for all residues.

Area	Species	Numbers	126	128	138	149	153	169	170	180
Shetland	guillemot	12	nd	0.04 0.04 - 0.05	0.60 0.49 - 0.74	nd	0.42 0.34 - 0.51	nd	0.03 0.02 - 0.03	0.06 0.05 - 0.07
Orkney	guillemot	6	nd	0.05 0.04 - 0.06	0.74 0.56 - 0.98	nd nd - 0.01	0.42 0.31 - 0.56	nd	0.03 0.02 - 0.04	0.02 0.01 - 0.04
Arbroath	guillemot	2	nd nd - 0.01	0.06 0.05 - 0.08	0.26 0.17 - 0.40	0.02 0.02 - 0.02	0.44 0.32 - 0.63	nd nd - 0.01	0.04 0.02 - 0.08	0.08 0.05 - 0.12
Lothian	guillemot	5	nd	0.08 0.05 - 0.11	0.97 0.76- 1.24	nd nd - 0.01	0.60 0.51 - 0.70	nd nd - 0.01	0.04 0.03 - 0.05	0.10 0.09 - 0.12
Northumberland	guillemot	3	nd nd - 0.01	0.07 0.06 - 0.08	0.70 0.49 - 0.99	nd nd - 0.01	0.45 0.30 - 0.66	nd	0.03 0.02 - 0.03	0.07 0.05 - 0.09
Norfolk	guillemot	5	nd nd - 0.01	0.06 0.05 - 0.09	0.63 0.32 - 1.24	0.02 nd - 0.05	0.33 0.16 - 0.67	nd	0.04 0.02 - 0.07	0.02 0.01 - 0.04
Kent	guillemot	1	0.01	0.20	3.78	0.01	2.64	0.01	0.10	0.22
Aberdeen	guillemot	5	nd	0.05 0.03 - 0.08	0.63 0.41 - 0.96	nd	0.33 0.22 - 0.51	nd	0.03 0.02 - 0.04	0.04 0.03 - 0.06
Arbroath	shag	1	0.02	0.16	1.47	0.03	2.10	0.01	0.13	nd
Northumberland	shag	3	nd	0.10 0.07 - 0.14	0.93 0.64 - 1.35	0.01 nd - 0.02	1.27 0.84 - 1.91	0.101 nd - 0.01	0.08 0.05 - 0.13	0.29 0.17 - 0.49

Table 11: Mean metal levels (mg/kg dry weight) in the livers of guillemots and shags killed in the North Sea Wreck in 1994. Data are expressed as geometric means and range within 1 SE.

Area	Species	Numbers	Cu	Zn	Cd	Hg
Shetland	guillemot	12	38.77 35.76 - 42.03	120.97 110.69 - 132.19	4.51 3.89 - 5.21	2.34 2.10 - 2.62
Orkney	guillemot	6	42.39 36.48 - 49.26	109.49 103.73 - 115.57	5.90 4.86 - 7.15	2.81 2.50 - 3.16
Arbroath	guillemot	2	34.01 30.49 - 37.94	100.92 86.63 - 117.58	3.09 2.04 - 4.69	3.24 1.92 - 5.46
Lothian	guillemot	5	44.70 39.52 - 50.56	133.14 123.94 - 143.01	2.61 2.21 - 3.08	3.20 3.06 - 3.36
Northumberland	guillemot	3	40.25 35.28 - 45.92	100.82 91.21 - 111.44	4.14 3.02 - 5.67	2.36 2.16-2.58
Norfolk	guillemot	5	41.28 35.49 - 48.01	124.35 114.61 - 134.91	3.01 2.46 - 3.69	2.83 2.52 - 3.19
Kent	guillemot	1	38.30	111.72	3.62	5.61
Aberdeen	guillemot	5	29.67 25.06 - 31.13	116.86 107.28 - 127.29	3.40 2.52 - 4.56	2.24 1.81-2.76
Arbroath	shag	1	60.93	206.97	1.32	3.53
Northumberland	shag	3	49.11 46.17 - 52.25	235.66 180.29 - 308.04	3.76 3.07 - 4.60	5.15 2.97 - 8.93

INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENT RESEARCH COUNCIL)

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Annual report to the Joint Nature Conservation Committee

WILDLIFE AND POLLUTION

Part 9 Numbers of birds required for organochlorine and mercury analyses

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August 1994

9 Numbers of birds required for organochlorine and mercury analyses

9.1 Introduction

In the early years of the monitoring scheme, when wild populations were much depleted, it was hard to get specimens for study, and every carcass received was analysed. As the years passed, and populations recovered, increasingly large numbers of birds were sent in. In recent years, it has become usual to receive more than 100 Sparrowhawks and more than 50 Kestrels per year, but numbers of other species have remained low. This upward trend in specimens analysed led the last review group , mindful of the costs of analysis, to ask to what extent the numbers of analyses could be reduced without significantly affecting the mean residue levels recorded.

9.2 Procedure

This question was examined using the 1992 birds. After calculating geometric mean residue levels for the whole sample of each species, one bird was removed at random from the sample, and the geometric mean was recalculated. Then another bird was removed and the mean calculated again, and so on until the sample was reduced to one individual. By inspecting the resulting array of mean values, it was possible to check for each species, how many individuals were needed to consistently give geometric means within one or two standard errors of the means based on the whole samples (Table 12). It should be noted, however, that the number of specimens needed to give a mean which is not significantly different from the overall mean depends on the number in the overall sample (which influences the standard error). Also, because of the skewed distribution of residues, the higher the geometric mean, the greater in proportion to this mean was the standard error. In the samples in Table 12, results at only one standard error away from the geometric mean differed from this mean by an amount equivalent to 8-57% of the mean, depending on species and chemical.

9.3 Results

Whether at one or two standard errors, the minimum number of required individuals differed between species and between chemicals. In the year concerned, random samples of 70 or more Sparrowhawks and 38 or more Kestrels would have given mean residue levels within one standard error of the mean based on the whole sample. For Heron only 12 individuals were obtained in 1992, and the removal of only one bird at random from this sample usually altered the mean HEOD level significantly. To give mean values within two standard errors of the mean for the whole sample, at least 40 Sparrowhawks would have been needed, at least 20 Kestrels and at least five Herons.

9.4 Discussion

These values might well have differed in other years, when the numbers of specimens and range of residue levels differed. Nonetheless, the findings implied that samples of at least Sparrowhawks might be reduced without serious effects on the annual overall geometric mean. However, reducing the numbers of birds analysed has other

consequences. In particular, it diminishes our ability to examine regional variation and regional trends in residue levels (as opposed to overall national trends). It also risks upsetting the people who send us birds. The numbers of carcasses sent in would probably decline rapidly, when it became apparent that we were using only a proportion of them. Most senders show great interest in the findings, and even with analytical delays of a few months, they frequently write or phone to ask about results. These hidden costs in analysing only a proportion of the birds received must clearly be balanced against the benefits of any financial savings. Finally, it should be noted that the current contract from the JNCC allows for a total of only 120 organochlorine analyses, regardless of species. The remaining analyses for 1992 were funded by ITE, which is also seeking to cut costs.

Table 12

Numbers of randomly chosen birds needed to give a geometric mean residue levels within 1SE and 2SE of the geometric mean residue levels of the whole sample. Based on data for 1992.

		Total number analysed	Numbers of birds required for: HEOD	DDE	PCB	Hg
Sparrowhawk	1SE	110	70	70	38	35*
	2SE	110	5	40	32	3*
Kestrel	1SE	47	38	26	14	12
	2SE	47	20	7	13	3
Heron	1SE	12	>12	7	7	8
	2SE	12	1	1	2	5

* Mercury for Sparrowhawks is based on only 89 birds.

Mean residue levels of organochlorines (ppm wet weight) and mercury (ppm dry weight) in the whole sample.

	HEOD	DDE	PCB	Hg
Sparrowhawk				
Mean	0.16	0.99	0.65	1.12
Range within 1SE	0.14 - 0.18	0.83 - 1.18	0.34 - 1.02	0.94 - 1.33
Kestrel				
Mean	0.13	0.08	0.86	0.80
Range within 1SE	0.12 - 0.16	0.06 - 0.10	0.73 - 1.02	0.66 - 0.98
Heron				
Mean	0.06	0.16	1.13	6.77
Range within 1SE	0.05 - 0.06	0.09 - 0.27	0.80 - 1.60	5.27 - 8.69

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