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Organochlorine Residues in British Otters

C. F. Mason, T. C. Ford, and N. I. Last

Department of Biology, University of Essex, Wivenhoe Park, Colchester C04 3SQ, United Kingdom

Otters (Lutra lutra) have declined sharply in numbers in Britain and Europe and are now absent from many areas where they were widespread three decades ago (Macdonald 1983). An analysis of data from hunts suggested that the British decline began in the mid-fifties and Chanin and Jefferies (1978) attributed this to the introduction of dieldrin into agriculture. Of 31 otters examined for organochlorines between 1963 and 1973, 81% contained measurable quantities of dieldrin, with a mean concentration of 0.5 mg kg^{-1} wet weight liver (Jefferies et al. 1974). However, the detailed data on organochlorine levels, which may lend support to the link between dieldrin and the otter decline, has never been made available.

In Sweden, where otters have also declined sharply, PCB residues in otter tissues were generally higher than those known to cause reproductive impairment in experimentally dosed mink (Mustela vison), whereas samples of otters from neighbouring Norway, where the species is still locally common, had only low levels of PCB (Olsson et al. 1981). PCB was considered unimportant by Chanin and Jefferies (1978), though supportive evidence was not presented.

Dieldrin has been voluntarily withdrawn from agricultural use in Britain and some affected species, notably birds of prey (Newton and Haas 1984) have shown an increase in range. Nevertheless, dieldrin still appears to be used locally and, as watercourses form sinks for organochlorines of both agricultural and industrial origin, the otter may remain especially vulnerable. It is clearly of great importance, especially for the development of conservation programs, that the current organochlorine burden in otters be assessed. However, the otter is now rare in much of Britain, especially in areas where organochlorine usage is likely to be greatest, and is fully protected, so that tissues for analysis become available only rarely. We report here the organochlorine burdens of 23 otters obtained in Britain between December 1982 and March 1985. Sixteen specimens refer to the year 1984.

MATERIALS AND METHODS

Material was obtained by requests to individuals or organizations likely to receive dead otters. Thigh muscle was the preferred tissue for analysis, but sometimes only liver or kidney was supplied. All material was stored deep frozen prior to sample preparation.

Methods largely followed FAO (1983). Some 8-10 g of tissue was thinly sliced from the sample and weighed. The tissue was stirred in 10 mL acetone:hexane (35:10) and homogenized. The supernatant was decanted into a sintered glass funnel and the filtrate was collected into a separating funnel containing 20 mL NaCl/phosphate (11.7 g NaCl in 1 L 0.1 M orthophosphoric acid), while sediment was resuspended in two further 10 mL aliquots of hexane:diethyl ether (9:1) and decanted after 5 min. The separating funnel was shaken and the aqueous phase was decanted and re-extracted in hexane. The solvent phase extracts were evaporated at 70°C to dryness and the weight determined. The extract was re-dissolved in toluene and pesticides determined in a Perkin-Elmer Model F17 gas chromatograph, with a tritium electron-capture detector. The column had a length of 1.5 m and an inside diameter of 3.0 mm and was packed with QF1 and SF96 on acid-washed Chromosorb W (FAO 1983). The column temperature was 180°C, the injector temperature 225°C and the detector 250°C. Confirmations were made on Packard or Pye Unicam Series 204 gas chromatographs in other laboratories.

Residue levels are reported as mg kg^{-1} extracted fat. PCBs were determined against an Aroclor 1260 standard.

RESULTS AND DISCUSSION

The origins of the 23 otters are shown in Fig. 1. Twelve specimens resulted from road accidents, five animals died in fish traps (fyke nets) or lobster creels, while the remaining six were found dead from unknown causes.

Concentrations of organochlorines in tissues are given in Table 1. PCB was detected in 15 animals, five of which had concentrations exceeding 50 mg kg^{-1} fat, above which reproductive failure may occur (Olsson et al. 1981). Three of these animals (nos. 12, 13, 15, see Fig. 1) originated from East Anglia, which is downwind of several industrial areas of England and which now holds only a fragmentary population of otters. One animal (23) was from the edge of the species' current south-western range, the other (18) was from an area holding a good population of otters. Of the seven animals from Orkney, only one (3) contained detectable concentrations of PCBs.

Lindane was found in 18 otters, reflecting the widespread use of this compound in British agriculture, but concentrations were generally low. Dieldrin was found in 16 animals, with elevated

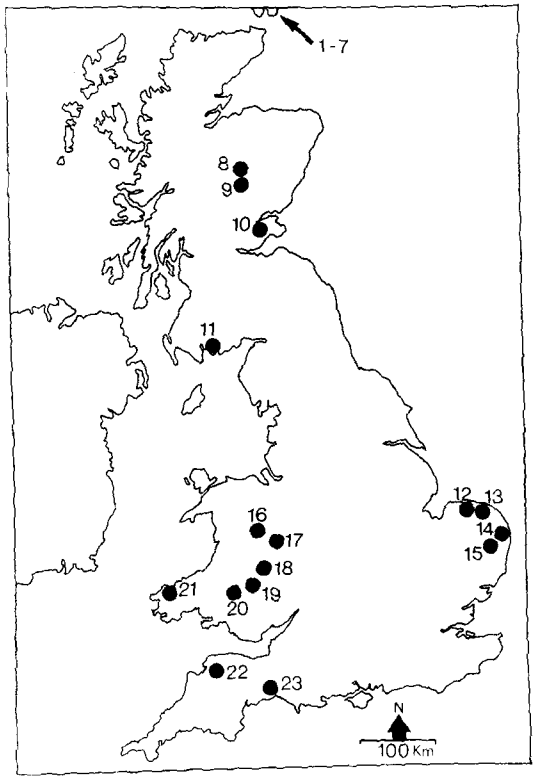

Fig. 1. Origins in Britain of otters analyzed for organochlorines

concentrations from eastern Scotland (10), eastern England (13, 15), Wales (17) and south-west England (22). The Scottish site was known to have received dieldrin in past years from an industrial source upstream, while otter 22 came from an area where several sources of dieldrin have recently been discovered, including a leaking chemical dump.

DDT and its derivatives were found in 21 otters and levels were elevated (> 50 mg kg^{-1} fat) in three, but it is considered that these concentrations are unlikely to have had any measurable effects on otters.

It is interesting to note that the embryo recovered from otter 10 contained measurable quantities of lindane, dieldrin and DDE, only PCB being found in the mother, but not in the embryo.

A sample of only 23 otters from Great Britain is a small one, but samples of rare and protected mammals will necessarily always be small. Nevertheless, the results clearly show that residues of organochlorines in otters are still widespread and that elevated levels in some regions should give cause for concern. Dieldrin

Table 1. Concentrations (mg kg^{-1} fat) of organochlorines in tissues of British otters

Specimen	Sex	Tissue	PCB	Lindane	Dieldrin	DDE	DDD	DDT
1	M	liver	-	0.4	0.3	-	-	-
2	F	liver	-	0.5	tr	-	-	tr
3	F	liver	20.5	0.1	0.1	-	tr	-
4	F	liver	-	0.2	0.2	0.3	-	-
5	F	liver	-	0.2	0.1	tr	tr	-
6	F	kidney	-	0.3	-	tr	-	1.8
7	M	liver	-	0.9	-	-	-	-
		muscle	-	0.3	-	tr	-	1.8
8	F	liver	-	6.0	tr	59.0	-	32.9
9	M	liver	tr	4.0	tr	3.5	tr	3.1
10	F	liver	6.0	11.5	66.4	115.7	-	83.1
		embryo	-	13.6	3.3	28.5	-	-
11	F	muscle	6.9	-	-	-	-	-
12	F	muscle	52.0	2.2	3.3	1.6	16.3	-
13	F	muscle	300.0	19.0	29.0	85.0	-	-
		liver	232.0	8.3	59.0	100.0	-	-
14	M	muscle	3.6	-	3.6	-	tr	9.2
		liver	14.2	-	7.9	tr	-	5.9
15	M	muscle	79.6	-	24.4	37.0	-	-
		liver	147.3	-	27.8	43.1	-	-
16	M	muscle	3.0	3.5	-	12.0	-	-
		liver	2.8	2.0	-	6.3	-	-
17	M	muscle	-	tr	3.7	10.8	4.0	4.4
		liver	4.4	tr	14.7	32.1	22.0	9.1
18	M	muscle	112.5	-	-	-	4.0	6.7
19	M	muscle	-	0.5	2.3	13.2	2.3	23.4
20	M	muscle	31.0	2.5	-	4.4	-	-
		liver	8.6	-	5.7	5.7	-	-
21	F	muscle	19.0	-	-	7.1	-	-
22	F	muscle	25.0	8.9	18.7	3.1	3.1	4.9
23	M	muscle	109.0	5.2	6.5	4.0	-	-

- = not detected, tr = trace

has been subject to a voluntary ban in agriculture since 1975, but high levels in some otters suggest that this insecticide, or aldrin, which converts to dieldrin in the environment, is still being used on a local scale.

Otters eat about 1 kg of food each day, most of which consists of fish. They may therefore be especially vulnerable to bio-accumulating pollutants. For example, in Dorset, southern England, from two rivers where otters' numbers have dwindled without apparently reproducing, mean concentrations of PCBs in samples of eels (Anguilla anguilla) were 1.4 and 5.2 mg kg^{-1} fat. Daily intakes of PCB by otters on food of such apparently low levels of contamination could be sufficient to eventually curtail the reproductive life of females, calculated from dietary intakes of PCB and reproductive effects on experimental mink given by Jensen et al. (1977).

Captive bred stock are currently being released in England to supplement endangered otter populations and such programs are expensive to carry out. Otters have large home ranges, often greater than 30 km river. As a basis for success and based on the data presented above it would seem essential to fully assess pollutant loads in prey species throughout the potential range of otters before captive-bred animals are released. Before the first release of captive otters, in East Anglia, only five fish were analyzed for pollutants (Jefferies et al. 1983), clearly an inadequate number considering the potential risk.

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