POLYBROMINATED DIPHENYL ETHER RESIDUES IN CORMORANT (PHALOCROCORAX CARBO L.) LIVERS FROM ENGLAND, UK

by Colin R. Allchin, Steven Morris, Moira Bennett, Robin J. Law and Ian Russell

CEFAS
The Centre for Environment, Fisheries & Aquaculture Science

Introduction

Polybrominated diphenyl ethers (PBDEs) are widely used as additive flame retardants in polymeric materials [1]. These compounds are stable and persistent, and have become ubiquitous environmental contaminants [2,3,4,5]. As they are hydrophobic and lipophilic, most congeners are also bioaccumulative. A pilot survey in 1995–1996 demonstrated their presence downstream of sites of manufacture and use [6], and we are now studying PBDEs as a congener basis in sediments, fish, shellfish and in cormorants and marine mammals as top predators.

A cormorant (Phalocrocorax carbo L.)

Methods and Materials

The cormorants were shot under licence during studies of the impact of pisciverous birds on freshwater fisheries. Homogenised liver samples were Soxhlet extracted with a 1:1 mixture of *n*-hexane and acetone, and the extracts cleaned up and fractionated using alumina and silica column chromatography. The extracts were then treated with concentrated sulphuric acid prior to analysis of BDEs using GC-NICIMS and monitoring the bromide ions at m/z 79 and 81. Storage of standard solutions and extracts was in amber glassware and precautions were taken to reduce exposure to light during sample manipulation. Due to an increase in commercially available individual BDEs, the Burnham laboratory is now using a mixture of 14 authentic reference standards as opposed to formulations.

Results and Discussion

The analytical methodology yielded clean chromatograms with good peak separation of the target analytes (see Figure 1). A comparison of the BDE congener standard mixture is given in Figure 2. In some sample extracts, additional bromine responses were apparent which we were unable to identify.

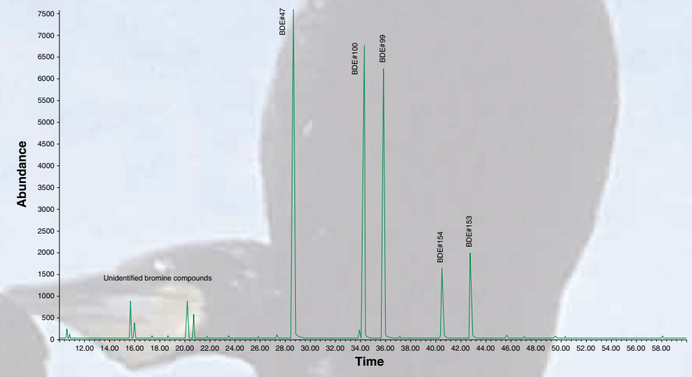

Figure 1. Typical selected ion chromatogram of a cormorant liver extract.

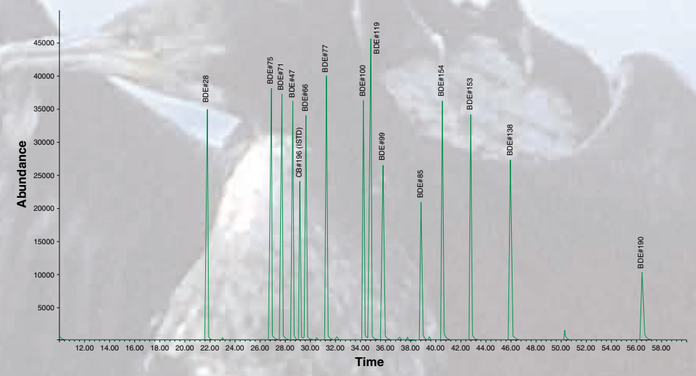

Figure 2. Selected ion chromatogram of the 14 BDE congener standard.

Table 1 presents the mean and range (in parenthesis) of BDE concentations in both male and female cormorants. Values were found to be < 20 µg kg^{-1}. The most abundant congener was BDE47 in all samples but one. The predominance of BDE47 was in common with other studies of these compounds in biota.

Table 1. Mean concentrations (µg kg^{-1} wet weight) and ranges of BDE congeners in cormorant livers.

	BDE#47	BDE#100	BDE#99	BDE#154	BDE#153
96/97 Females (n=5)	8.6 (4.31 – 16.61)	5.0 (1.58 – 12.48)	5.1 (1.99 – 8.99)	1.5 (0.38 – 1.89)	1.1 (0.38 – 1.89)
99/00 Females (n= 8)	5.6 (1.1 – 20.7)	4.5 (0.8 – 13.54)	2.1 (<0.2 – 3.66)	1.3 (0.2 – 4.36)	1.4 (0.2 – 5.51)
96/97 Males (n=15)	15.1 (1.69 – 66.16)	7.2 (0.45 – 29.99)	3.1 (0.49 – 14.57)	2.4 (0.14 – 8.46)	3.0 (0.18 – 13.78)
99/00 Males (n=19)	12.1 (1.8 – 76.06)	6.5 (0.6 – 38.22)	2.8 (0.19 – 11.62)	2.0 (<0.2 – 9.37)	1.1 (<0.2 - 5.17)

The congener profiles determined in cormorant livers are also shown in Figure 3. Profiles were dominated by congeners BDE47, 99, 100, 153 and 154. Other congeners were below limits of detection.

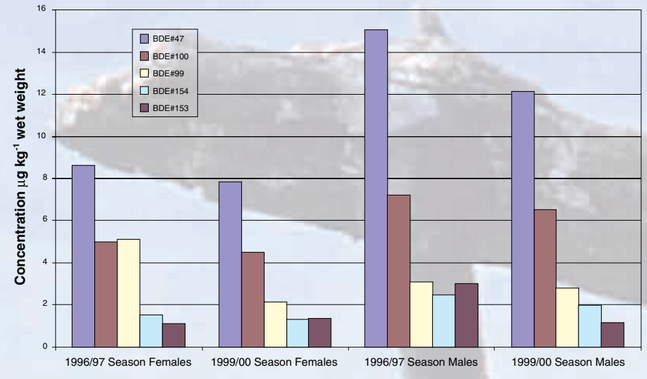

Figure 3. Profile of concentrations of BDE47, 99, 100, 153 and 154 in cormorant livers (µg kg^{-1} wet weight).

BDE47 may be either more biologically available, preferentially accumulated, or the 2,2',4,4'-configuration may be the most environmentally stable. BDE data was normalised to BDE47 (Figure 4).

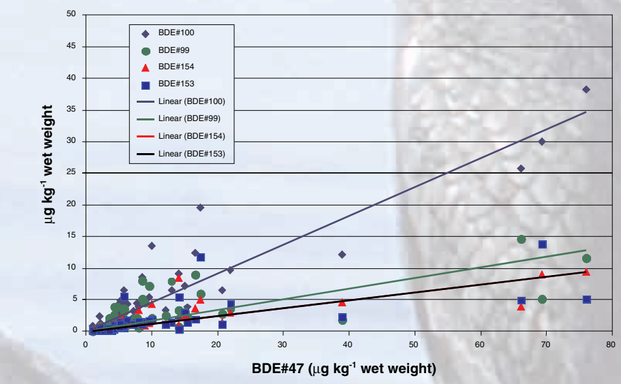

Figure 4. The relative distribution of BDE congeners in cormorant livers normalised to BDE47.

There is a paucity of scientific data detailing BDE concentrations in cormorant tissue. The only comparative data that exists is that reported by de Boer[7]. A total concentration of 28,000 µg kg^{-1} was measured in a cormorant's liver from the Rhine delta. This was considerably higher than the concentrations reported here.

Acknowledgements

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The Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Burnham Laboratory, Remembrance Avenue, Burnham on Crouch, Essex CM0 8HA, UK. http://www.cefas.co.uk