Monitoring Of Decabromodiphenylether In The Environment: A 10-Year Study Monitoring Birds, Sewage Sludge and Sediments

Heather A Leslie[1], Jacob de Boer[1], Pim E G Leonards[1], Colin R Allchin[2], P. Bersuder[2], Klaus Rothenbacher[3]

[1]RIVO
[2]CEFAS
[3]Bsef

Introduction

With regard to the occurrence of decabromodiphenylether (DBDE) in the environment and the emissions reduction measures taken by the bromine industry through product stewardship programmes, there is a need for monitoring levels and time trends of DBDE in the environment. A recent time trend study in guillemot eggs suggests that while chemicals brought on the market may quickly appear in environmental samples, reductive measures taken by industry may lead to relatively rapid decreases in concentrations measured in biota in time [1].

A 10-year monitoring study has therefore been initiated in April 2005 to monitor the DBDE concentrations in eggs of predatory birds (sparrowhawks, glaucous gulls), sewage sludge and surface sediment. The sampling locations are spread over seven different European countries. This will be a collaborative study coordinated by the Netherlands Institute of Fisheries Research (RIVO) in cooperation with the Centre for Environment, Fisheries and Aquaculture Science, CEFAS (UK) and with contributions from the Centre for Ecology and Hydrology, CEH (UK) and the Norwegian Polar Institute.

Methods

DBDE concentrations will be measured in time in the various environmental matrices with the purpose of determining time trends. Efforts have been made to keep the number of samples as high as logistically possible in order to maintain a reasonable amount of statistical power to detect changes in DBDE over the study period (Table 1). For each case, a yearly and biennial (every two years) sampling frequency was considered. The analysis assumes no year-to-year variability other than a linear trend in the change in DBDE concentrations.

Some earlier DBDE data is also available for several matrices and locations, including sparrowhawks from the UK and some of the sewage sludge and many of the sediment sites. This will provide additional information for determining temporal trends. A significant number of the samples will also be analyzed for lower BDE congeners (BDE 28, 47, 99, 100, 153, 154, 183) within the same programme.

Table 1. Examples of Power Analysis - Avian sampling (annual) and sewage sludge and sediment sampling (biennial). Assuming 100% field variation for birds; 40% field for sludge and sediments. Power calculated for hypothetical 10%, 20% and 30 % decrease in DBDE during programme.

	Birds' Eggs			Sewage Sludge and Sediment		
Number of samples	10%	20%	30%	10%	20%	30%
1	0.060	0.103	0.167	0.073	0.149	0.222
2	0.074	0.150	0.320	0.123	0.299	0.599
3	0.098	0.240	0.452	0.141	0.477	0.813
4	0.102	0.284	0.439	0.214	0.624	0.921
5	0.128	0.336	0.667	0.226	0.729	0.966
6	0.137	0.409	0.731	0.289	0.788	0.990
8	0.172	0.513	0.837	0.399	0.902	0.999

10	0.207	0.587	0.927	0.454	0.963	1.000
12	0.241	0.704	0.947	0.499	0.980	1.000
24	0.398	0.940	0.998	0.804	1.000	1.000

a) Birds' eggs. Eggs of two species will be collected annually (12 eggs per species, per year). Sparrowhawk eggs (*Accipiter nisus*) will be sampled in the UK by the CEH at Monks Wood annually, in each breeding season from the same area, although same site cannot be guaranteed because breeding territories are dynamic and so may shift in location and size. So as not to adversely affect the population, which has been threatened in the past in the UK, only failed eggs will be collected.

Glaucous gulls *(Larus hyperboreus)* are coastal birds, which scavenge for carrion, shellfish, birds' eggs and scraps. The colony to be sampled inhabits the "top cliff" area of Bear Island or Bjørnøya in northern Norway. It consists of 50-60 nests and has been present there at least since the 1960's. The feeding ecology of these gulls is very important to the concentrations of environmental contaminants measured, making it crucial to return to the exact same site for each sampling [2]. Birds eggs, such as guillemot *Uria* spp., are eaten mainly by the top cliff colony, as opposed to a second colony near sea level, which mainly feeds on fish. Because fish eating birds are unlikely to accumulate DBDE, the higher colony is the preferred choice for DBDE monitoring.

b) Sewage Sludge. A selection of sampling sites (n=12) for biennial sewage sludge sampling was made on the basis of results of the DIFFCHEM and LOES studies in which DBDE was measured in sewage sludge from sewage treatment plants (STPs) in the UK and the Netherlands and information from the Dutch water management institute, RIZA. A range of wastewater types are represented in the STP selection: regular household and drainage wastewater as well as those with input from industrial users of DBDE (*e.g.* textile industry areas). The proposed sites are located in the UK (5 STPs), Ireland (1 STP) and in the Netherlands (6 STPs), including some that have been subject to earlier flame retardant studies (HBCD and TBBP-A) in 2003, and a couple of sites at which DBDE has been measured in the LOES project [3]. Three 1-week composite samples will be analysed per site in each sampling year.

c) Sediment. Ten sediment sampling sites were selected, and are located in the UK (5), Ireland (1), France (1), Germany (2) and at the Belgium-Netherlands border (1). Top layer sediment samples will be taken biennially with a mini Van Veen sampler or box core. Four composite sediment samples per location will analysed for DBDE. In the past, DBDE has been measured in sediments from the majority of the proposed sites, and data are available for one or two earlier points in time (1995, 2000).

Results and Discussion

a) Reporting. Results will be reported after each sampling round. A full interim report will be provided after 6 years and a final report at the end of the project (after 10 years).

b) Other initiatives. In a complementary initiative, a pilot study is currently being carried out by Lancaster University to investigate the feasibility of reliably measuring time trends of DBDE in air.

Acknowledgements. This study has been commissioned by the Bromine Science and Environment Forum (BSEF). Centre for Ecology and Hydrology, CEH (UK) and the Norwegian Polar Institute are acknowledged for contributions of bird egg sampling.

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