DECABROMINATED DIPHENYL ETHER IN PTARMIGANS AND SPARROWS IN NORWAY.

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Introduction

Brominated flame retardants are used in a wide range of products to reduce flammability, and thus to decrease human and economical loss due to fire. Because of the bioaccumulation, long-range transport and documentation of potential toxic effects Penta- and Octa-technical brominated diphenylethers (BDE) mixtures are banned in the EU since August 2004[1]. Currently, one of the main chemicals used as BFRs is decabrominated diphenyl ether (deca-BDE). Most of the studies related to BFRs and other halogenated organic compounds have been conducted on species from aquatic or marine ecosystems. It has been shown that concentrations of many organochlorines (OCs) such as PCBs and organochlorines pesticides have decreased in marine environment as a result of bans in the 1970s and early 1980s. Relatively little is known about deca-BDE in birds from terrestrial ecosystems. Only a few study reports hepatic concentrations of these compounds in birds.

Material and methods

Concentrations of deca-BDE were analyzed in the liver samples of terrestrial birds: willow (*Lagopus lagopus*) and rock ptarmigans (*L. mutus*) and house sparrows (*Passer domesticus*). Sampling was conducted at Dovrefjell, in the vicinity of Lillehammer (Gausdal), at Hardangervidda (Vesletunga) and close to the most southern region of ptarmigan distribution in Norway - Rosskreppfjorden in Sirdal. House sparrows were collected on 18 islands located in an archipelago off the coast of Helgeland in northern Norway (Figure 1). Samples preparation and chemical analyses were done in the Laboratory of Environmental Toxicology at the Norwegian School of Veterinary Science. The method for deca-BDE determination includes liquid extraction, clean up with sulphuric acid and GC-MS analysis. The concentrations of deca-BDE were determinable in at least 50% of samples, and these results were subjected to further statistical analysis. In the case where a few results were below the method's limit of detection ($LOD_{deca\text{-}BDE}$ = 0.025 ng/g ww), the concentration was set to half the LOD.

Results and discussion

Hepatic concentrations of deca-BDE in willow and rock ptarmigans are presented in Figure 2. The highest concentrations were found in willow ptarmigans from Dovrefjell. Concentrations in livers of house sparrow from Helgeland were in the range from 4.46 to 1710 ng/g l.w. In general, reports related to concentrations of deca-BDE in bird liver samples are scarce. In liver of aquatic and terrestrial predatory birds of Belgium deca-BDE concentrations range from non-detectable (most of the results) levels up to 85 ng/g lw in kestrel, *Falco tinnunculus*[2]. However recently extremely high levels of deca-BDE were found in liver of common kestrels (2870 ± 1040 ng/g lw) and also other terrestrial birds in China[3]. More often than in liver, BFRs were analyzed in birds eggs. For example peregrine falcon (*Falco peregrinus*) egg studies reported deca-BDE levels ranging

Figure 1. Map showing the sample location.

from 3.8 to 250 ng/g lw in South Greenland population[4] and <20 to 430 ng/g in Swedish birds[5]. In bird of prey eggs in Norway, the levels were in range of <LOD up to 80 ng/g lw in peregrine falcon[6]. It has been suggested that organisms using terrestrial food chains may have greater exposure to deca-BDE[3]. It was found that deca-BDE tends to partition to the particle phase of atmosphere and subsequently accumulates on the surface such as tree bark by direct deposition of the particle[7]. Similarly, deposition of deca-BDE on leafs and other parts of the plants could be a source of contamination for herbivorous birds. Lower levels of deca-BDE in ptarmigans then in sparrows probably reflect lower exposure to this compound. Willow and rock ptarmigans are species endemic to their regions and inhabit remote areas, not adjacent to highly urbanized and more polluted areas. Thus, they are not exposed to higher concentration of BFRs during any period of their life. In contrary, house sparrows were collected on islands that are generally sparsely populated by humans, and on some of the islands sparrows are living in close association with human settlements inside and around cattle farms. Hence the potential of

exposure from human-related PBDE sources is accentuated. Additionally sparrows have high basal metabolic rate which results in high food ingestion and consequently higher probability of contamination via food.

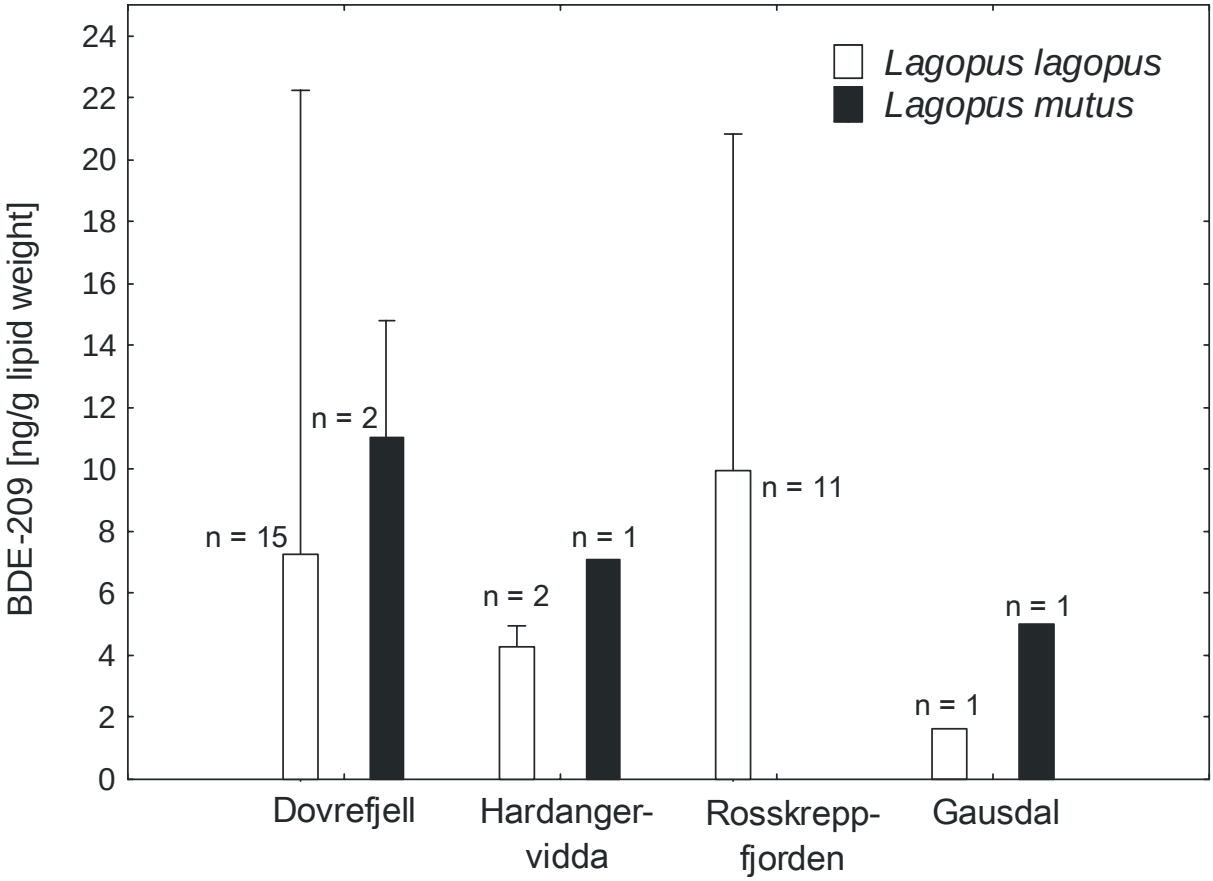

Figure 2. Mean (±SD) concentrations of deca-BDE in willow and rock ptarmigans in Norway.

As can be seen on Figure 2 there is a lack of spatial variation in deca-BDE concentrations between the region studied. However number of individuals from Hardangervidda and Gausdal was limited. On the other hand, high differences between the individuals can be seen, especially for house sparrow samples where concentrations varied in order of 2 magnitudes and more (data not shown). This may reflect the differences in foraging behavior. As mentioned above one group of the sparrows are living in close association with human settlements with farms, while an other group was associated with more sparsely populated areas without farms. The differences in diet between those two groups of sparrows may be responsible for high variation of the deca-BDE concentrations in house sparrows.

Our findings confirm the growing view that organisms in terrestrial food chain may be exposing to higher level of deca-BDE in comparison to marine organisms. It was found that this compound may accumulate not only in apex predator in terrestrial food chain but also in herbivorous birds. Large differences in deca-BDE levels among individual sparrows suggest varying exposure probably related to differences in foraging behavior.

Acknowledgements
The study was financially supported through the Norwegian Research Council's (NFR) 'FORURENS Programme' (Project 'BROMOBIRD' contract no. 171756/S30) at the Norwegian University of Science and Technology (NTNU).

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