

# Polybrominated diphenylethers in biota from Bjørnøya (Bear Island)

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## INTRODUCTION

Bjørnøya (Bear Island, Norway) is situated about 500 km north off the Norwegian mainland halfway between Norway and Spitsbergen (74°N, 19°E). Previous studies have shown that land locked Arctic char (*Salvelinus alpinus*) from Lake Ellasjøen (21 m.a.s.l.) on Bjørnøya is contaminated with some of the highest concentrations of PCB found in freshwater fish from Arctic areas<sup>1</sup>. In Lake Øyangen, situated 5 km north of Lake Ellasjøen, levels are several orders of magnitude lower. Biota samples from different trophic levels were collected from the Lakes Ellasjøen and Øyangen and analysed for the content of polybrominated diphenylethers (PBDE). Samples from different seabird species were included in the study (including guano and intestinal content) to investigate the impact by the seabird colonies on the freshwater systems on Bjørnøya as well.

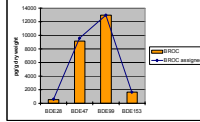
## MATERIAL AND METHODS

❖ **Sample type:** Two pooled zooplankton samples (Lake Øyangen: 10g, Lake Ellasjøen 12g); one pooled sample of chironomids (*Chironomidae* sp.) from Ellasjøen (ES) and of tadpole shrimps (*Lepidurus arcticus*) from Øyangen (Ø); 4 Arctic char (AC, *Salvelinus Alpinus*; Ø) and 6 Arctic char (separate fish; ES). Two pooled and two individual intestinal content samples, 3 muscle samples and 15 liver samples were collected from glaucous gull (GG, *Larus hyperboreus*; near ES). Intestinal content samples and muscle tissue were collected from kittiwake (K, *Rissa tridactyla*, 3; 3) and little auk (LA, *Alle alle*, 1; 3).

❖ **Sample preparation:** Homogenisation with Na<sub>2</sub>SO<sub>4</sub>, cold-column extraction, GPC, florisil column

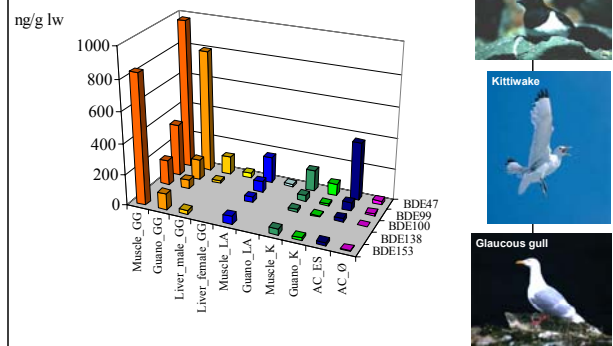
❖ **GC/LRMS-EI:** MD800, Finnigan, San Jose, CA); 30m DB5MS capillary column

(id: 0.25 mm, film thickness: 0.25 µm, J&W, Folsom, CA).

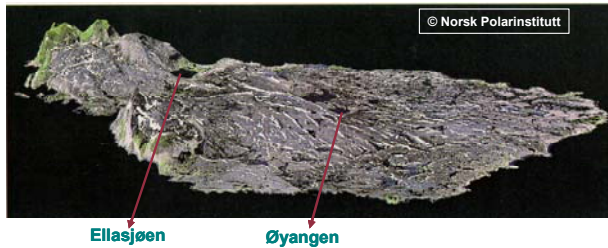


As standard reference material used sediment from the EU BROCC project – Biological Reference Materials for Organic Contaminants (analysed 03/2004).

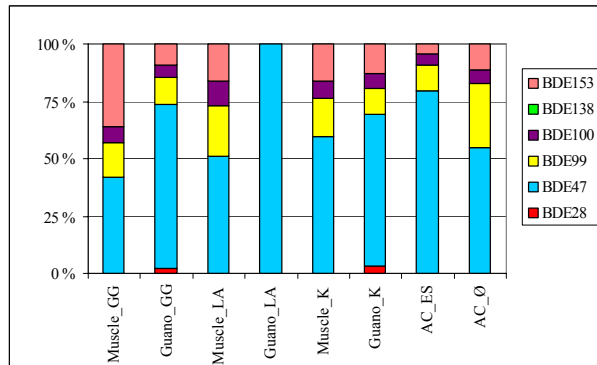
## RESULTS AND DISCUSSION



**Figure 2:** Average PBDE levels in biota from Bjørnøya in ng/g lw (GG: glaucous gull; LA: little auk; K: kittiwake; AC: Arctic char; ES: Ellasjøen; Ø: Øyangen)



**Figure 3:** Topographic map of Bjørnøya (Bear Island)



**Figure 4:** Relative distribution of average PBDE congeners in biota from Bjørnøya (GG: glaucous gull; LA: little auk; K: kittiwake; AC: Arctic char; ES: Ellasjøen; Ø: Øyangen)

**Table 1:** Estimation of seasonal input of sumPBDE to Lake Ellasjøen via guano deposition

	Glaucous gull	Kittiwake
sum PBDE ng/g lw	1108.1	119.1
sum PBDE µg/kg ww	22.1	4.6
Number of birds; spring, autumn	70	500
Number of birds; summer	70	2000
Residence at Lake Ellasjøen per day (h)	24	2.5
Amount guano per day (g)	262	80
Amount guano entering Lake Ellasjøen per day (g)	131	8
Number of birds per 24 h; spring, autumn	70	4800
Amount guano per day (kg); spring, autumn	9.2	38.4
Number of birds per 24 h; summer	70	19200
Amount guano per day (kg); summer	9.2	153.6
Length of season (d)		
	90	120
Total amount guano per season (kg)	825	11520
Total amount PBDE per season (mg)	18.2	52.6

## CONCLUSIONS

- ❖ The levels for all zooplankton, chironomids and tadpole shrimps collected at both locations were very low (from less than LOD to 7 ng/g lw).
- ❖ PBDE concentrations of Arctic char samples from Lake Øyangen often not exceeded the detection limits. Considerably higher PBDE levels were found for Arctic char from Lake Ellasjøen with up to 420 ng/g lw (in the same order of magnitude as levels reported from a densely populated area in Scandinavia, Lake Vättern, in southern Sweden<sup>3</sup>).
- ❖ Seabird guano must be considered as one of the major PBDE sources for the Lake Ellasjøen fresh water system.
- ❖ Guano of kittiwake contributes 2.5 fold more to the PBDE contamination to Lake Ellasjøen compared to glaucous gull because of the much higher number of individuals.

## REFERENCES

1. Skotvold T, Wartena EMM and Schlabach M. (1998) *Organohalogen Comp.* 39: 411.
2. Bustnes JO, Erikstad KE, Bakken, Mehlum, F, Skaare, JU. (2000) *Ecotox.* 9/ 3: 179.
3. Sellstrom U, Jansson B, Kierkegaard A, de Witt C. (1993) *Chemosphere.* 26(9):1703.
4. Evensen, A., Christensen GN, Skotvold T, Fjeld E, Schlabach M, et al.(2004) *The Science of the Total Environment* 318: 125.
5. Herzke D, Gabrielsen GW, Evensen A, Burkow IC. (2002) *Environmental Pollution.* 121: 293.

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