(Re)Emerging POPs and Temporal Changes in Polar Bears From a "POP Hotspot" in the Canadian Arctic – Hudson Bay

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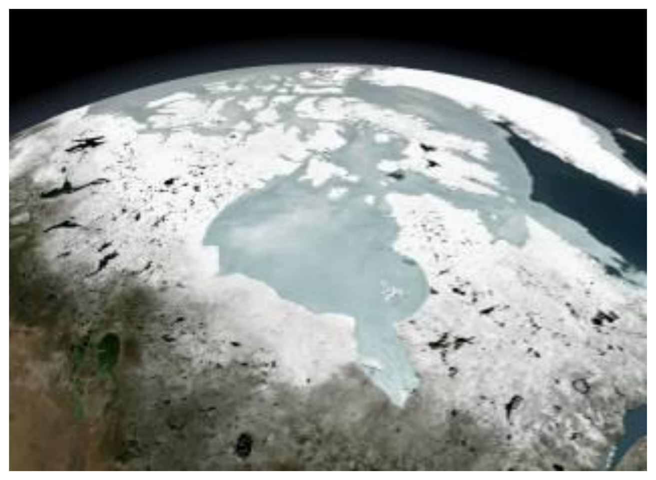
Photo: R. Dietz

Introduction

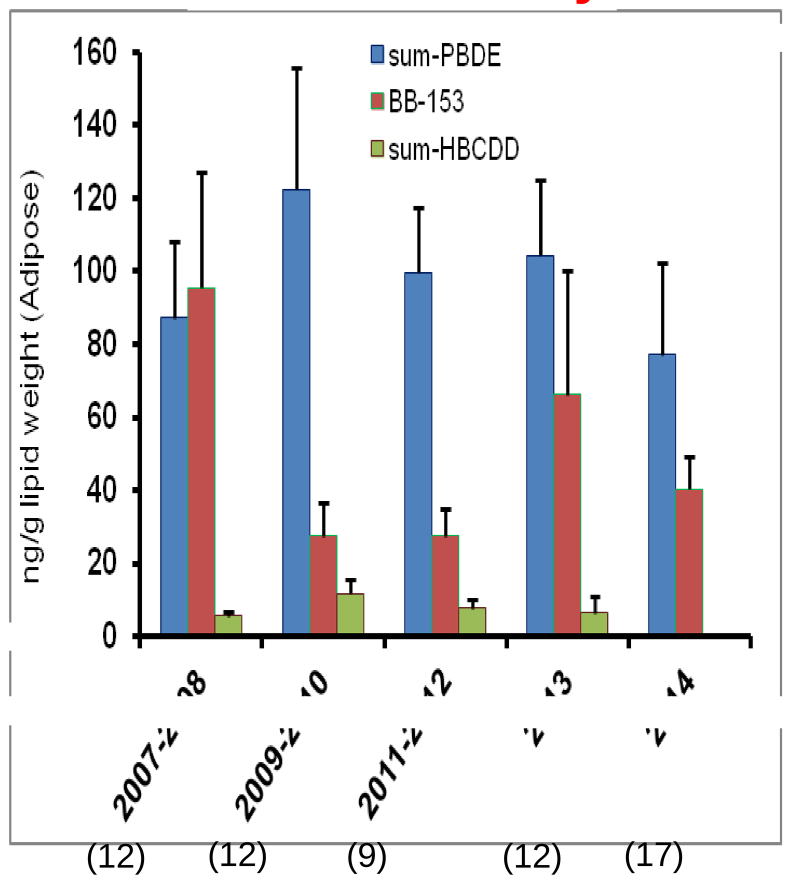
There is a growing array of chlorinated, brominated and fluorinated persistent organic pollutants (POPs) that have been shown to be transported to the (Canadian) Arctic and accumulate in biota and wildlife [*1,2*]. These recently emerged POPs include polybrominated diphenyl ethers (PBDEs) and other flame retardants (FRs) as well as perfluoroalkyl substances (PFASs) and their precursors. The polar bear (*Ursus maritimus*) is the apex predator of the arctic marine ecosystem and food web, and recently emerged POPs such as FRs and PFASs have been increasingly reported in the tissues of bears collected over the last decade from selected circumpolar subpopulations including Hudson Bay [*2-8*]. However, POPs of priority (e.g. SCCPs and other FRs; e.g. Stockholm Convention of POPs) are not well studied in bears. The increasing complexity of (known) POP exposure in polar bears poses an increase in health risks to polar bears, especially bears from Hudson Bay and East Greenland, which have been shown to be `hot spots` with respect to high and /or changing tissue levels of POPs, and/or greater temperature changes due to Arctic warming [*1,4,6,8*].

Study Objective:

We presently report on temporal trends of emerged/emerging POPs, and targeted and newer substances of regulatory priority, in the tissues of polar bears harvested from Western and Southern Hudson Bay subpopulations.



Results



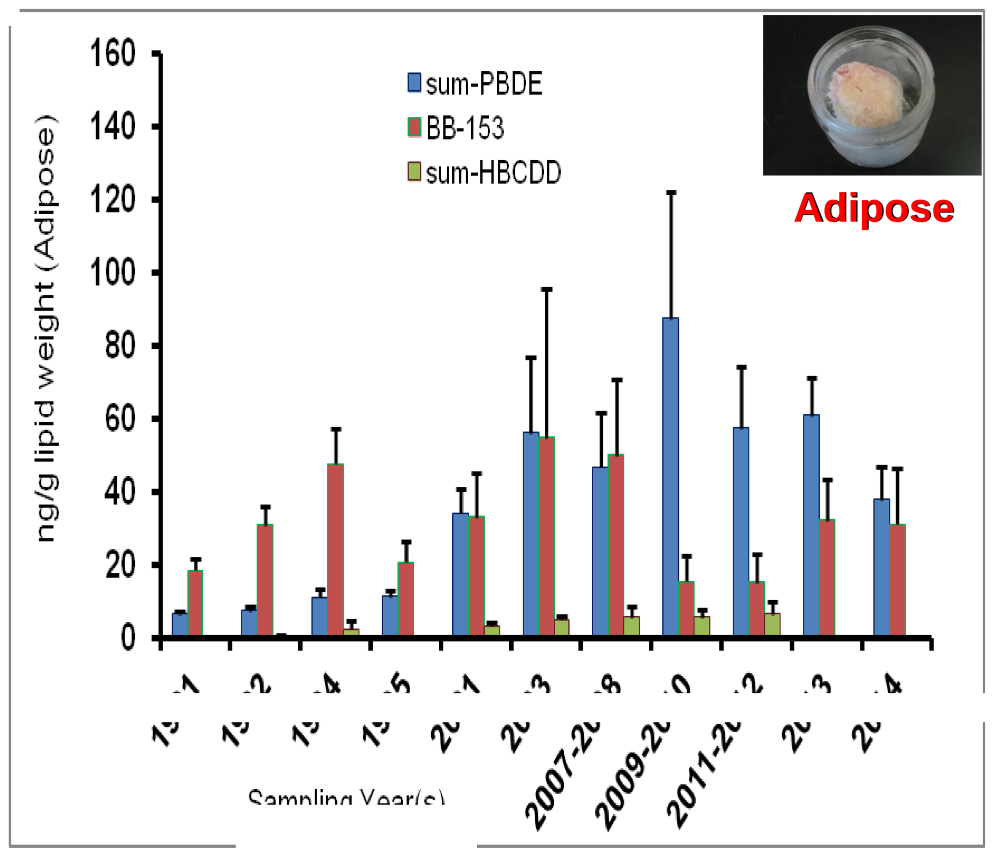


Figure 1. Temporal trends of mean concentrations of brominated FRs. 1991-2007 [*6,8*]); 2008 – 2014 (R. Letcher, unpublished). Error bars are SDs. Data not corrected for sex, age or diet.

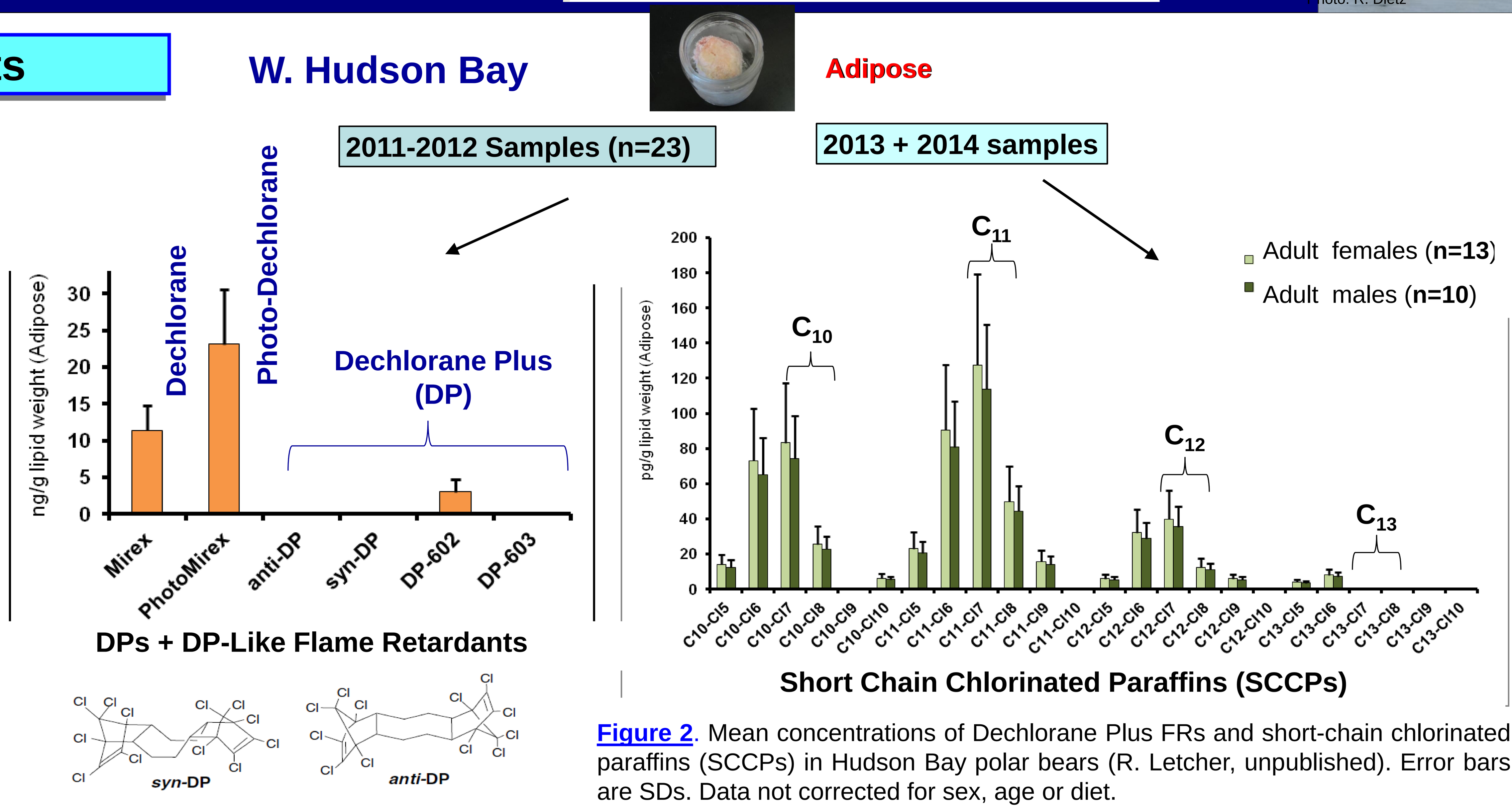


Figure 2. Mean concentrations of Dechlorane Plus FRs and short-chain chlorinated paraffins (SCCPs) in Hudson Bay polar bears (R. Letcher, unpublished). Error bars are SDs. Data not corrected for sex, age or diet.

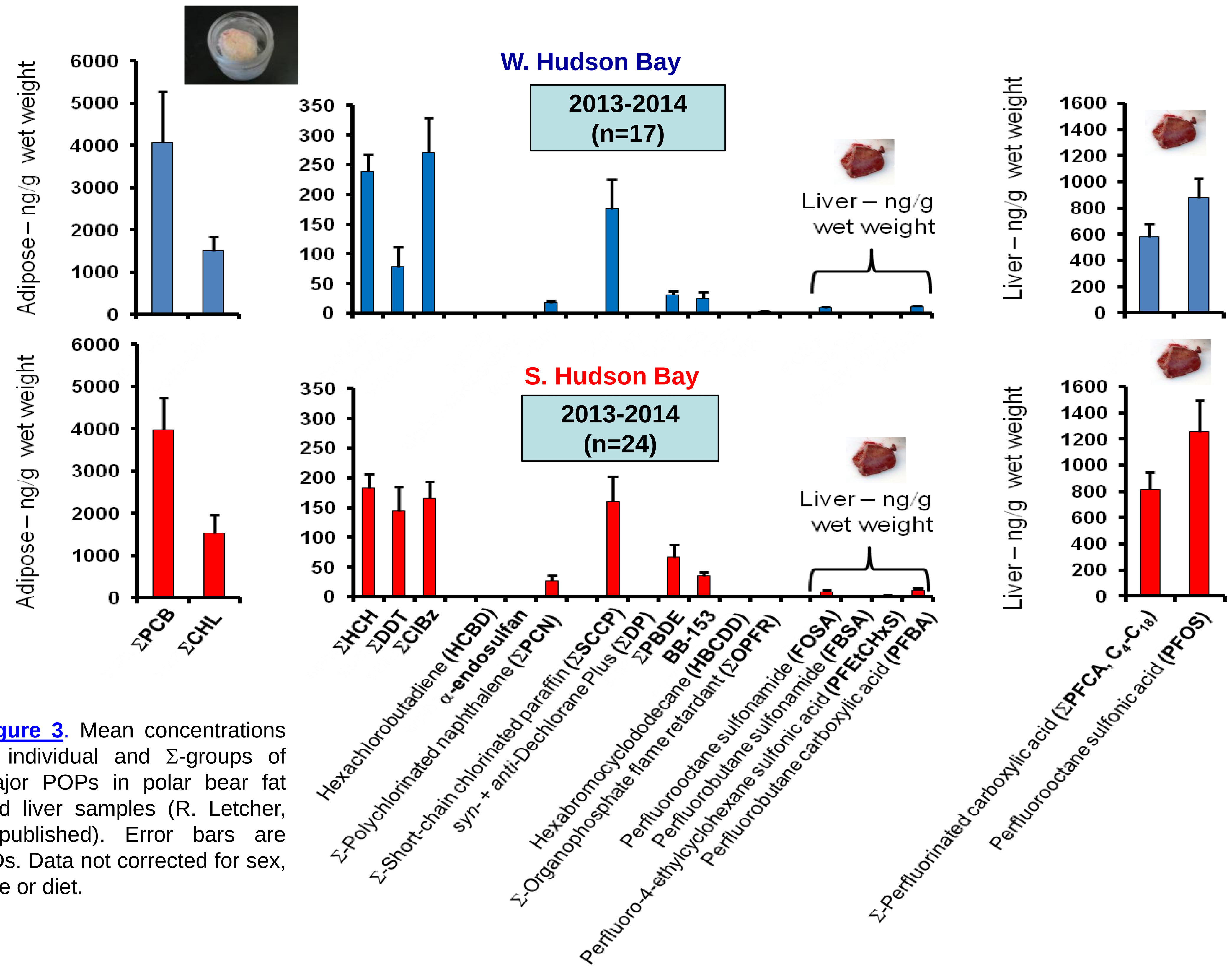


Figure 3. Mean concentrations of individual and Σ-groups of major POPs in polar bear fat and liver samples (R. Letcher, unpublished). Error bars are SDs. Data not corrected for sex, age or diet.

Conclusions

- 14 PBDE congeners (e.g., BDE-47, -99, -100, -138, -153, 183); DecaBDE consistently not detected; ΣPBDEs showing a decreasing trends starting in the late 2000s (well after Penta- and Octa-BDE phase-out and addition to Annex A of the Stockholm Convention on POPs in 2009 (Fig. 1)
- 18 other non-PBDE BFRs (e.g., BTBPE, DBDPE, 1,2-dibromo-4-(1,2-dibromoethyl)-cyclohexane (TBECHs)), consistently not detected / very low detection frequency since 2007; α-HBCDD dominant FR next to PBDEs; appears to be decreasing recently in Hudson Bay bears (Fig. 1)
- ΣPFCAs and PFOS not apparent over 2007-2014; new PFASs and precursors detected, e.g. perfluoroethylcyclohexane sulfonate (PFEtCHxS), perfluorobutane carboxylic acid and sulfonate and their sulfonamide percursors (See separate Letcher et al. and Boisvert et al. posters at NCP meeting)
- *Syn*- and *anti*-DP FRs not detectable, but DP-602 and DP-603 were measureable (Fig. 2)
- Organophosphate FRs (OPFRs) (e.g. tris(2-chloroisopropyl)phosphate (TCIPP) and tris(2-butoxyethyl)phosphate (TBOEP)) at low levels and comparable to HBCDD (Fig. 3)
- ΣSCCPs very low at < 500 pg/g lw; Cl_6 and Cl_7 of C_{10}, C_{11} and C_{12} SCCPs dominant; no difference between males and females (Fig. 2)
- α-endosulfan but not β-endosulfan, endosulfan sulfate and hexachlorobutadiene (HCBD) not detected at all (Fig. 3).
- There is an increasing complexity of new POPs (e.g. SCCPs; Fig. 3)) in Hudson Bay polar bears, and retrospectively may have been an exposure issue for some time. Such new POPs should be of concern for circumpolar subpopulations of bears.

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Acknowledgements

Photo: R. Letcher

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