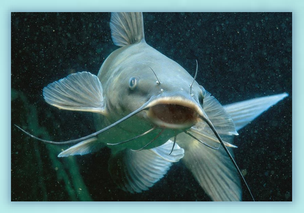
Flame retardant contamination in seafood and significance for conservation

Andrea Noziglia*, Robert Wildermuth**, and Leah Gerber*

**Arizona State University, **Western EcoSystems Technology*

Background Although seafood is marketed as a healthy protein option containing essential omega-3 fatty acids, mounting evidence shows serious health risks related to seafood consumption due to chemical contamination [1; 2; 3]. Additionally, overfishing and subsequent fishery collapse are global problems with grave ecological and socioeconomic consequences [4; 5; 6]. Initial research has shown a correlation between better fishery sustainability and lower mercury content [7]. If flame retardants follow this same trend, we could recommend choices that are both healthful and environmentally friendly. Data collection is the first step.



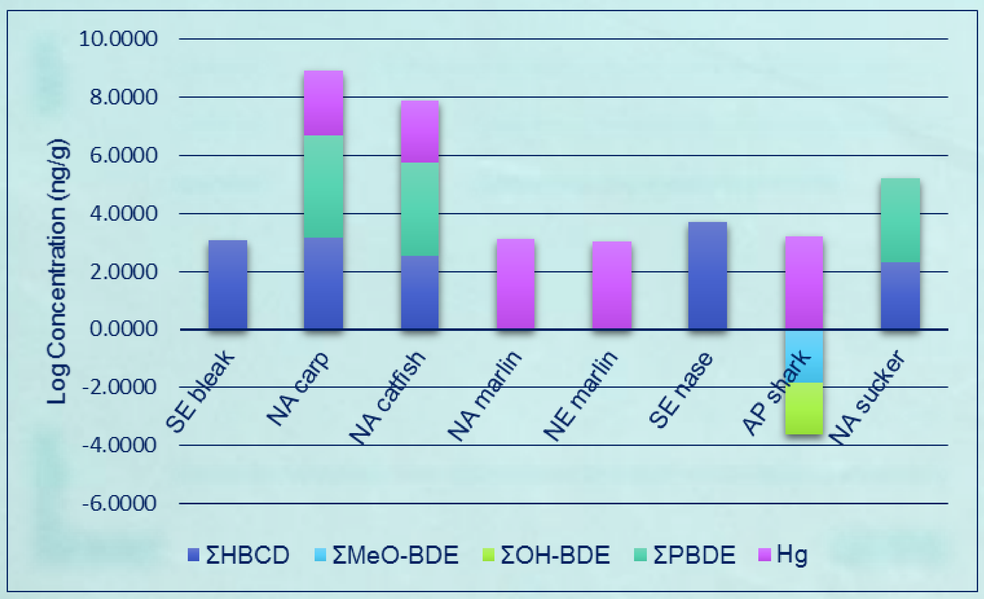


Figure 1. Most contaminated fish in the database (log scale)

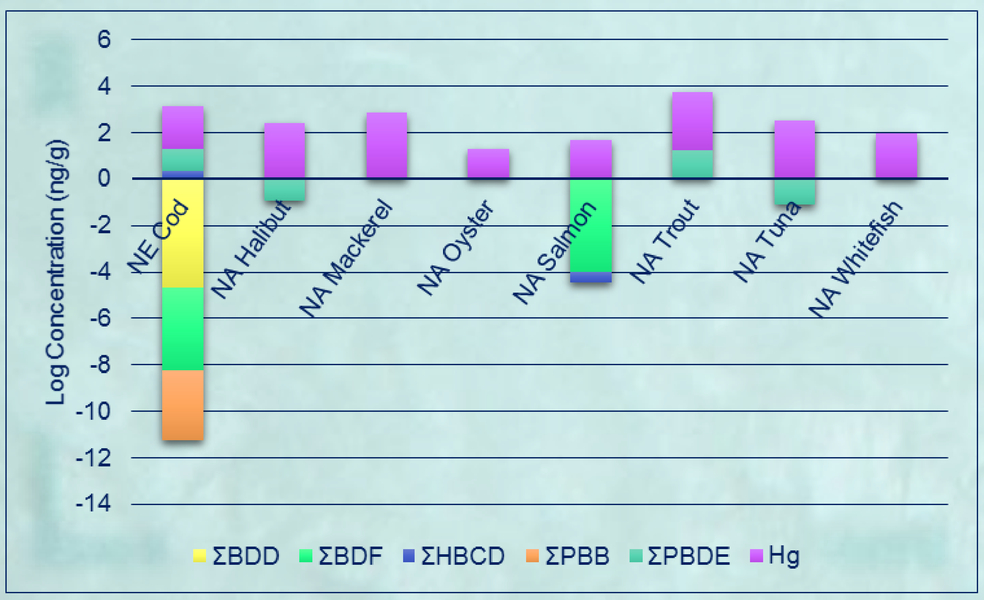


Figure 2. Most investigated fish in the database (log scale)

Methods We conducted a literature review and collected mean flame retardant concentrations found in fish and shellfish sampled in 2002 or later. Data were synthesized by finding the mean in three ways: an unweighted mean, a mean weighted by sample size, and a truncated weighted mean. Two-tailed, paired-sample Student's t tests guided our choice of which mean statistic most accurately represented the data.

Table 1. Pairwise comparisons between three mean statistics showing how many congeners were included in the dataset

Number of:	Included congeners	Significant p-values	Not analyzed	Total
BDD	19	1	0	20
BDF	10	0	0	10
BRP	4	0	0	4
HBCD	4	0	0	4
MeO-BDE	10	0	3	13
OH-BDE	7	0	5	12
PBB	12	1	0	13
PBDE	49	1	0	50
PCDE	6	0	0	6
Hg	1	0	0	1
Total	122	3	8	133

Results 280 sources (peer-reviewed, government) contributed to the database of 226 regional fish stocks (108 types of fish). Table 1 highlights the statistical analysis; we chose the weighted mean. Top predators frequently contained higher concentrations of both flame retardants and mercury.

Conclusions The current results represent the first step, data collection, in the analysis of the relationship between contamination and sustainability—the impact a fishery has on population size and ecological function. We hypothesize that flame retardant concentration is indirectly related to sustainability. Consumer desire for healthy seafood will aid conservation goals, while desire for sustainable seafood will benefit human health; the two objectives will be strengthened by previously uninvolved and unrelated stakeholders.

We are grateful for the contributions of A. Smith, S. Pratt, R. Karimi, T. P. Fitzgerald, T. Gancos Crawford, and S. Geren. These researchers added to the ongoing database and provided key input to our research questions. Acknowledgements to the generous support of the Lighthouse Foundation.

1. König, A. et al. 2005. Am. J. Prev. Med. 29:335-346. **2.** Domingo, J. L. 2007. Environ. Int. 33:993-998. **3.** Brunner, E. J., P. J. S. Jones, S. Friel, and M. Bartley. 2008. Int. J. Epidemiol. 38:93-100. **4.** Pauly, D. et al. 2002. Nature 418:689-695. **5.** Worm, B. et al. 2009. Science 325:578-585. **6.** Gaines, S. D. and C. Costello. 2013. Proc. Natl. Acad. Sci. 110:15859-15860. **7.** Gerber, L. R., R. Karimi, and T. P. Fitzgerald. 2012. Front. Ecol. Environ. 10:487-493. Image, top right corner: <http://www.geekayenterprises.com/Seafoodproducts.html>. Image, Background inset: <http://www.pinterest.com/muddawg63/natures-wonders/>. Image, bottom right: <http://ourlocality.org/dunbarshoreandharbour/#gsc.tab=0>.