

PS/SS: Brominated dioxins in San Francisco Bay sport fish

Estimated Cost: \$20,000-34,500
Oversight Group: Emerging Contaminants Work Group
Proposed by: Susan Klosterhaus, SFEI

Background

Polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are persistent, bioaccumulative, and toxic chemicals that are ubiquitous contaminants worldwide. Their brominated analogues, polybrominated dibenzo-*p*-dioxins and dibenzofurans (PBDD/DFs), have similar physico-chemical properties and are known to exhibit similar or greater toxicity than PCDD/DFs (e.g. Olsman 2007; Birnbaum et al 2003). PBDD/DFs are present as impurities in brominated flame retardant (BFR) mixtures and can be formed during the combustion of BFR-containing products and other fuels containing bromine additives such as gasoline. PBDD/DFs can also be formed during the photolysis of PBDEs (Watanabe and Tatsukawa 1987) and can be transferred from BFR-containing consumer products to house dust (Takigami et al 2008). Data for PBDD/DF concentrations in the environment are scarce, though studies have detected them in air, sediment, bivalves, fish and cormorant eggs (Li et al. 2007; Terauchi et al 2009; Malmvarn et al. 2005; Ashizuka et al 2008; Watanabe 2004). PBDD/DFs have also been detected in human milk and adipose tissue (Colles et al 2008; Choi et al. 2003). According to an expert dioxin panel (van den Berg et al. 2006), unlike PCDD/DFs, PBDD/DFs have not been assigned dioxin toxic equivalency factors (TEFs) because of the lack of toxicity and environmental fate data. Though their toxic potential has been known since the 1970s, only recently has there been a growing concern over PCDD/DF exposure, largely due to the production and ubiquitous use of brominated flame retardants (BFRs) in new and in-use consumer products. Environmental concentrations of PBDD/DFs appear to be significantly lower than PCDD/DFs and dioxin-like PCBs; however, the expert panel recommended that a more thorough exposure analysis for humans is needed and that among all compounds proposed for development of World Health Organization (WHO) TEFs, PBDD/DFs should be given high priority.

Applicable RMP Management Questions (MQ) and Study Objectives

MQ1. Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?

- A: Which chemicals have the potential to impact humans and aquatic life and should be monitored?
- B: What potential for impacts on humans and aquatic life exists due to contaminants in the Estuary ecosystem?

MQ2. What are the concentrations and masses of contaminants in the Estuary and its segments?

- A: Do pollutant spatial patterns and long-term trends indicate particular regions of concern?

The objectives of this study are to determine whether PBDD/DFs are present in the San Francisco Estuary foodweb and to determine their TEQ concentrations relative to PCDD/DFs

and dioxin-like PCBs (MQ1A, B). This study could also provide a preliminary assessment of whether there are particular areas of concern within the Estuary if samples from throughout the estuary are analyzed (MQ2A).

Relationship of the Study to the ECWG Priority Question

The Emerging Contaminant workgroup is focused on answering the question: “What emerging contaminants have the greatest potential to adversely impact beneficial uses in the Bay?” Correlations with PBDEs in air (Hayakawa et al 2004), sediment (Terauchi et al 2009), and house dust (Takigami et al 2008) suggest that PBDD/DFs may have the potential to adversely impact San Francisco Bay wildlife since PBDE concentrations in Bay wildlife are among the highest in the world. Other potential sources of PBDD/DFs to the Bay include atmospheric transport from e-waste/recycling regions (i.e. Asia), activities associated with autos shredder facilities and bromine-containing consumer product manufacturing, and vehicle exhaust. Together with the analysis of PCDD/DFs in the RMP Dioxin Strategy, analysis of PBDDs/Fs in aquatic biota will provide a more thorough assessment of dioxin TEQ concentrations in San Francisco Bay.

Approach

Monitoring of PCDD/DFs in Bay sport fish and other matrices as part of the RMP Dioxin Strategy provides an opportunity to concurrently assess the potential impact of PBDD/DFs. For QA/QC purposes, co-extraction and analysis of PBDD/DFs and PCDD/DFs in the same sample and at the same time point is ideal for chemical class comparisons. As part of the RMP Dioxin Strategy, twenty samples of white croaker and shiner surfperch collected from popular Bay Area fishing areas in 2009 will be analyzed for PCDD/DFs. To assess the risk of dioxin exposure to fish-eating wildlife, including people, a sub-set of these could also be analyzed for PBDD/DFs. PBDD/DFs could also be analyzed in cormorant eggs collected in 2009, though funding for PCDD/DFs analysis in these samples has not been allocated. Alternatively, a sub-set of sport fish samples could be analyzed for PCDD/DFs, PBDD/DFs, dioxin-like (coplanar) PCBs, and polychlorinated naphthalenes (PCNs) to obtain an estimate of the relative contribution of dioxin-like chemicals in the Bay foodweb. However, funding for the analysis of dioxin-like PCBs and PCNs has not been allocated.

AXYS Analytical will be analyzing the PCDD/DFs in the samples for the RMP dioxin strategy and could also analyze PBDD/DFs in these same samples for an additional \$900/sample. AXYS requires a 10 sample minimum. A proposed budget is presented below which provides the estimated costs for various analytical scenarios.

Proposed Budget

Task	Estimated Cost
White croaker PBDD/DF and PCDD/DF analysis - 10 samples total, various sites depending on availability - Funding for PCDD/DF analysis from RMP Dioxin Strategy	\$9,000
Cormorant egg PBDD/DF and PCDD/DF analysis - 10 samples total; 3 samples x 3 sites + 1 additional to meet 10 minimum - PCDD/DFs \$700/sample; PBDD/DFs \$900/sample - <u>No</u> funding for PCDD/DF analysis from RMP Dioxin Strategy	\$16,000
White croaker PBDD/DF, PCDD/DF, coplanar PCB, PCN analysis - 10 samples total, various sites depending on availability - Funding for PCDD/DF analysis from RMP Dioxin Strategy - PBDD/DFs \$900/sample; coplanar PCBs \$650/sample*, PCNs \$800/sample*	\$23,500
Project Management	\$2,000
Data Management	\$3,000
Data Analysis and Reporting	\$5,000
Shipping, miscellaneous expenses	\$1,000
Total for white croaker PBDD/DF and PCDD/DF analysis only	\$20,000
Total for cormorant egg PBDD/DF and PCDD/DF analysis only	\$27,000
Total for white croaker PBDD/DF, PCDD/DF, coplanar PCB, PCN analysis only	\$34,500

*Estimated costs; waiting for quote from AXYS

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