**Polychlorinated biphenyls (PCBs) and Polybrominated diphenylethers (PBDEs) in current and historical samples of avian eggs and fish from nesting sites in Buzzards Bay, MA, USA**

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**Introduction**

Well-documented effects of contaminants such as PCBs and chlorinated pesticides have resulted in US regulations limiting their distribution in the environment. More recently, polybrominated diphenyl ethers (PBDEs) have been added to the list of contaminants of emerging concern. PBDEs are of a larger class of contaminants called brominated flame retardants that are used to reduce the intensity and spread of fire in household and commercial products such as televisions, computers, and electronic equipment. PBDEs are similar to PCBs in chemical and physical properties, and similarly persistent in the environment. Like PCBs, PBDEs can bioaccumulate in humans and wildlife. However unlike PCBs, PBDE levels have been increasing in avian populations breeding in the US. Migratory avian species are exposed to a wide variety of contaminants through diet or breeding grounds, and also through their over-wintering habitats. Avian eggs are useful for environmental monitoring because metabolically-transformed contamination has the potential to cause serious effects in sensitive early life stages.

This project represents collaborative efforts by various partners. Massachusetts Division of Fisheries and Wildlife collected Common Tern eggs from Ram Island in Buzzards Bay, MA, in spring of 1994-96, 1998-2005, and additional eggs were available through Canadian Wildlife Service archives (1972). In 2006, fish were collected from tern colonies by Massachusetts Division of Fisheries and Wildlife. Chemical analyses were developed and conducted by the U.S. EPA, Atlantic Ecology Division, Narragansett, RI.

Here we present the concentrations of PCBs and PBDEs in eggs of migratory bird species with summer breeding habitats near or at a PCB Superfund site. Common Terns (Sterna hirundo) feed on small fish within 20 km of the breeding colonies. Roseate Terns feed mostly sand lance (Ammodramus americanus) to their chicks and Common Tern chicks enjoy a greater diversity of fish species. Fish species collected from tern colonies (butterfish, Atlantic herring, sand lance, mackerel, blueline, soup and flounder) were analyzed for PCBs and PBDEs. The terns share major breeding colonies in Buzzards Bay, MA, and have similar but distinctive feeding preferences, which may affect their exposure to contaminants.

**Chemical Analysis**

Homogenized eggs were extracted using acetonitrile and pentane. PCBs were analyzed on a Gas Chromatograph (Agilent 6890) equipped with an electron capture detector. PBDEs were analyzed on a GC-MS in negative chemical ionization mode. The mean concentration of PCBs is the sum of 18 PCB congeners and that of PBDEs is the sum of 7 congeners. Archived egg extracts stored at -4°C were analyzed for PBDEs in 2007. Fish were analyzed in 2008 for PCBs and PBDEs. PBDE Congener 209 was analyzed in fish and not in tern eggs.

**Results**

**Concentrations of PCBs and PBDEs (ng/g wet) in fish from tern colonies at NBH - 2006**

**Recent trends**

- **PBDEs peaked & declined**
- **PCBs declined**

**Both PCBs and PBDEs declined**

**Conclusions**

- **Recent trends, 1997-2005**
  - Total PCBs in recently collected tern eggs (2005) declined to 12% of 1972 levels.
  - In contrast to PCBs, total PBDEs have increased during this same period to 3079% of 1972 levels.

**Recent trends, 1994-2005**

- **Total PCB and PBDE egg concentrations for recently collected samples of tern eggs were not significantly different:**
  - **between species**
  - among nesting colonies
  - Bluefish had the highest PCB contribution, followed by flounder. No correlation was observed between lipid percent and total contamination levels.
  - **PBDE**
  - **congener 47** provided the largest contribution to the total PBDEs in tern eggs.
  - **PBDE concentrations were lower in fish species**.
  - **PBDE 47** was the most dominant in tern eggs, whereas **PBDE 209** was most dominant in fish species.
  - **Tern eggs will be reanalyzed for PBDE 209.**

**Study System**

**Breeding site: one source of contamination**

**Wintering site(s): other sources of contaminations?**

Banding recoveries have shown that both Roseate and Common terms from the three study sites migrate to spend the winter on the north and east coasts of South America. During this period, most birds of both species feed in coastal waters far from sources of industrial contamination, but many Common Terns winter in the outer parts of the Rio Plata estuary where they may be exposed to contaminants from industrial areas in Argentina and Uruguay.