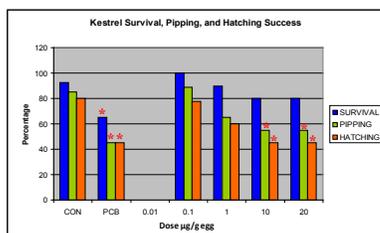


Toxicity of Polybrominated Diphenyl Ethers and Other Flame Retardants to Wildlife



The Challenge: Polybrominated diphenyl ether flame retardants (PBDEs) are contaminants that bioaccumulate and biomagnify in aquatic and terrestrial food webs. Unlike many contemporary pollutants, these flame retardants have increased in the environment over the past 30 years. Studies in Chesapeake and Delaware Bays have documented concentrations of nearly 1 µg/g wet weight of PBDEs in osprey eggs, and even greater levels in peregrine falcon eggs. Very little information is available on the toxicity thresholds of these compounds and new organophosphate flame retardants in wildlife.

The Science: We are determining the toxicity of PBDE flame retardants in various bird embryos (chicken, mallard, American kestrel, black-crowned night-heron and common tern) over a wide range of environmentally realistic doses. Measurements include embryonic survival, pipping and hatching success, and various biochemical, endocrinological, and immunological endpoints. In addition, studies also examined the toxicity of various organophosphate flame retardants in adult kestrels. The goal of these studies is to establish adverse-effect thresholds that can be used to interpret concentrations in free-ranging bird eggs collected from potentially polluted sites.



The Future: The penta-BDE formulation delayed hatching, and also decreased pipping and hatching success at 20 µg/g egg in kestrels, but had no effect on survival endpoints. Evidence of genotoxicity and oxidative stress was detected in kestrels and terns. Six congeners or co-eluting pairs of congeners were detected in treated eggs that were not found in the dosing solution suggesting metabolism in the developing embryo. Based on PBDE uptake rate in kestrel embryos, the lowest-observed-adverse-effect-level on pipping and hatching success was 1.8 µg total PBDE/g egg wet weight, which approaches concentrations detected in eggs of free-ranging birds. Studies with organophosphate flame retardants suggest that they are rapidly metabolized, and seemingly of minimal risk to predatory birds.

	Chicken	Mallard	Kestrel
Survival to 90%	-	-	-
Pipping	-	-	+
Hatching	-	-	+
Edema	-	-	-
Deformities	-	-	-
Bone Lengths	-	-	-
Histopathology	+	-	-
EROD Induction	+	-	-
Thyroid Effects	-	-	-