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Synthesis of U.S. Geological Survey Science for the Chesapeake Bay Ecosystem and Implications for Environmental Management

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Cover. Clockwise from upper left: [1] satellite image of Chesapeake Bay, [2] collection of sediment samples using the USGS hoverprobe, [3] storm event at the Conowingo Dam, and [4] osprey landing in nest. All photographs courtesy of USGS.
Inside Cover. The Minnie T. Phillips was built in Baltimore, Maryland in 1873. At 100 feet and 137 tons, she was primarily engaged in the coasting trade to the Bahamas. Photograph from Chesapeake Bay Schooners by Snediker and Jensen, 1992.

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Chapter 9: Contaminant Exposure and Impacts on Waterbirds and Selected Wildlife

By Barnett A. Rattner

The impact of selected contaminants on waterbirds and wildlife in the Chesapeake Bay ecosystem has been addressed with USGS studies and use of ecotoxicological information for wildlife that has been extracted from the Contaminant Exposure and Effects—Terrestrial Vertebrates (CEE-TV) database (Rattner and others, 2005). Currently, the CEE-TV database contains 839 data records (representing about 9,500 individuals) for the Chesapeake Bay region, with sample-collection dates ranging from 1966 to 2005. Contaminant exposure and effects data are available for 109 species of terrestrial vertebrates, with the majority of records from birds (79 percent) and mammals (12 percent). Exposure and effects data are available on 92 unique contaminants, with most information focused on legacy organochlorine contaminants (including DDT, chlordane, endrin, dieldrin, and polychlorinated biphenyls, or PCBs) and heavy metals (including lead, mercury, cadmium, and chromium).

Concentrations of *p,p*'-DDE (a metabolite of DDT that caused eggshell thinning and decimated populations of fish-eating birds) and other organochlorine pesticides and metabolites have declined since they were banned in the 1970s, whereas PCB values in eggs seem to have remained unchanged (fig. 9.1). One recent USGS study of ospreys documented their reproduction in the most highly polluted parts of the Bay (Rattner and others, 2004). In 2000 and 2001, a "sample egg" was collected from many osprey nests in or near the CBP "toxic regions of concern" (Baltimore Harbor, Anacostia River, Elizabeth River), and the fate of eggs remaining in each nest was monitored. Concentrations of organochlorine pesticides, total PCBs, and arylhydrocarbon receptor-active PCB congeners were often greater in sample eggs from regions of concern compared to the reference area (South, West, and Rhode Rivers). Productivity of ospreys in or near Baltimore Harbor and the Anacostia River was marginal (observed success less than 1 fledgling/active nest) for sustaining local populations. In addition, tumors in bullhead catfish have been found in these very same regions (Pickney, Harshberger, May, and Reichert 2004; Pickney, Harshberger, May, and Melancon, 2004). Overall, management actions in the 1970s and 1980s restricting the use of chlorinated compounds and some metals have had several results for wildlife. Decreased use of chlorinated pesticides contributed to improved conditions and population recovery of many fish-eating birds. Populations of many species, including the bald eagle, have rebounded to numbers observed before the advent and use of organochlorine pesticides. However, concentrations of other contaminants such as PCBs in wildlife appear unchanged and remain a concern.

Several emerging contaminants are being detected in Chesapeake Bay wildlife, but the associated threat to wildlife is not known at this time. Environmental concentrations of polybrominated diphenyl ether (PBDE) flame retardants (commonly used in polymers, textiles, and electronics) are increasing; on a global basis, some of the highest levels in bird eggs have been found in ospreys nesting in the Chesapeake (Hale and others, 2004). Since little is known about the toxicity thresholds of PBDEs in wildlife, it is difficult to predict the hazards they pose to biota in the Bay. USGS studies have been initiated to determine potential embryo-toxicity of these flame retardants using wild bird eggs. Other compounds of contemporary interest include alkylphenol, ethoxylate, and perfluorinated surfactants, pharmaceuticals, and personal care products. Finally, rising mercury concentrations in the environment and widespread fish consumption advisories are of national concern (U.S. Geological Survey, 2006). Although fish consumption advisories due to mercury contamination are widespread, adverse effects have not been documented in wildlife associated with the estuary. Data from the CEE-TV database show that mercury concentrations in bird eggs, and in livers and kidneys of terrestrial vertebrates collected in the Chesapeake estuary, are generally well below known adverse effect levels.

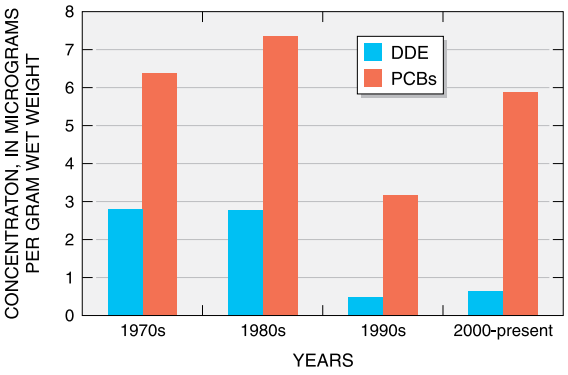

Figure 9.1. Changes in DDE and PCB concentrations in the Bay ecosystem from the 1970s to present day. Concentrations of DDT and its breakdown products have declined since their ban in the 1970s, but PCB concentrations remained unchanged. The populations of many fish-eating birds, such as the bald eagle, have rebounded with the decline in DDT and DDE. However, other contaminants that are slow to break down remain a threat to wildlife.

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Osprey nest atop channel marker in the Tred Avon River in Easton, Maryland. Photograph by Jane Hawkey, IAN Image Library (www.ian.umces.edu/imagelibrary/).