

U.S. National Park Service – Great Lakes Inventory & Monitoring Network

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Introduction and Objectives

The U. S. National Park Service (NPS), Great Lakes Inventory and Monitoring Network is monitoring the spatial distribution and trends of two new and emerging contaminants:

- PFOS (perfluorooctanyl sulfonate), used in water and stain repellent coatings (e.g. Scotchgard), and
- PBDE (polybrominated diphenyl ether), used in flame retardants.

We are monitoring the occurrence of these chemicals in the blood serum of bald eagle nestlings at three national parks. This study is part of a larger effort by the Great Lakes I&M Network to monitor key indicators of ecosystem health across nine national parks in the upper Midwest.

This poster focuses on the occurrence and distribution of these two chemicals. They have come under increasing scrutiny by scientists and environmental regulators because they are persistent, bioaccumulate in the environment, and are known to be toxic to some organisms. Other contaminants being monitored by the NPS are PCBs, DDT, mercury, lead, and perfluorooctanoic acid (PFOA).

Study Area

In 2006 and 2007 the NPS joined with the Wisconsin Department of Natural Resources, Audubon Minnesota, and the U.S. Fish and Wildlife Service to sample blood from bald eagle nestlings at Apostle Islands National Lakeshore (APIS), St Croix National Scenic Riverway (SACN), and the Mississippi National River and Recreation Area (MISS) (Fig. 1).

Methods

Bald eagle nestlings were hand captured in the nest at five to eight weeks of age and brought to the ground (Fig. 2a & 2b) where they were measured, weighed, and banded (Fig. 3). We then extracted 11 ml of blood (Fig. 4) and three feathers from each nestling for contaminants analysis. Blood samples were centrifuged within eight hours and the serum was frozen for transport to the Wisconsin State Laboratory of Hygiene. The Lab used high performance liquid chromatography and mass spectrometry to determine concentrations of target contaminants.



Figure 2a. Six or seven week-old bald eagle nestling contemplating hand capture.



Figure 2b. Jim Spickler, Eco-ascension Research and Consulting, brings two bald eagle nestlings (red bags) down from a nest.



Figure 3. Bill Route measures eaglet flight feathers to estimate hatching date.



Figure 4. Drawing a blood sample from the brachial vein of a bald eagle nestling.



Figure 1. Area map showing location of three national parks where bald eagles are being used to monitor concentrations of persistent contaminants.

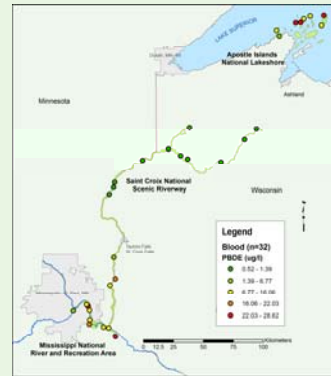


Figure 5. Distribution and quantity of PBDE in bald eagle blood.



Figure 7. The mixture of PBDE congeners in a common commercial flame retardant (a) compared to those found in bald eagle serum in this study (b).

We also found PFOS in all nestlings sampled (Fig. 8). Levels were highest at MISS followed by APIS and SACN. A *post hoc* analysis and grouping of the data shows three regions that vary as to the sources and transport pathways of PFOS into park ecosystems: 1) Lake Superior where the large lake-surface area collects PFOS through aerial deposition from regional and global sources, 2) the upper SACN where there are no known point sources and a low surface area for collecting PFOS from the air, hence provides a comparison to more polluted areas, and 3) the Greater Twin Cities area where the Mississippi and lower portions of the St. Croix rivers are affected by known point sources and gain additional loads from upstream sources (Figs. 9 & 10).

PFOS serum levels in bald eagle nestlings decreased significantly from 2006 to 2007 in the Greater Twin Cities area and the upper SACN (*t* test, *P* = .002), but did not differ significantly at the Lake Superior nests (*t* test, *P* = .79; Figs 9 & 10) (see note right of Fig. 9).

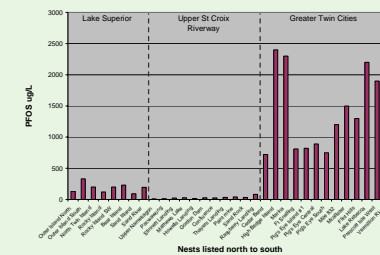


Figure 9. PFOS concentrations in bald eagle nestlings, 2006.

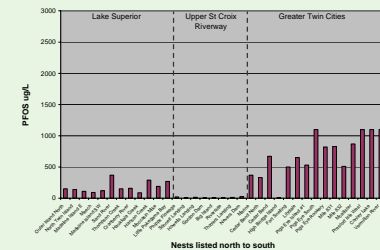


Figure 10. PFOS concentrations in bald eagle nestlings, 2007.

Results

Blood and feather samples from 66 nestlings (32 in 2006, 34 in 2007) were analyzed for PBDE and PFOS. All 2006 samples contained PBDEs (Fig. 5) and concentrations were higher at APIS and MISS than the upper SACN (Figs. 5 & 6). Note that nests in Figure 6 are listed in a downstream order and that PBDEs begin to spike on the lower SACN. (Results for 2007 samples for PBDE are not yet available.)

We found that the proportion of various congeners in eagle blood was similar to that found in common commercial flame retardants (Fig. 7a & b), which attests to the resistance of this chemical to being broken down in the environment.

Sample sizes are low, but our data (n=8), and data from Dykstra et al. (2005) (n=5), suggest that PBDEs have doubled in Lake Superior over the last five years (Fig. 8). This increasing trend in PBDEs has been found in several studies across the world (e.g. Ikonomu (2002). Our samples from 2007 and additional sampling in 2008 will either support or refute the increasing trend in eagles on Lake Superior.

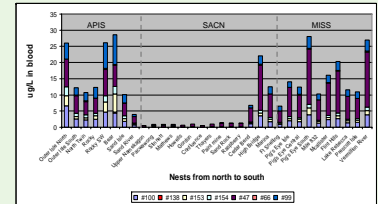


Figure 6. Concentrations of Total PBDE (bars show each congener) in bald eagle blood at three national parks in 2006.

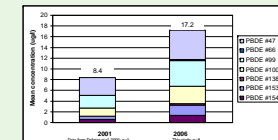


Figure 8. Doubling of PBDEs in bald eagle blood; 2001 to 2005.

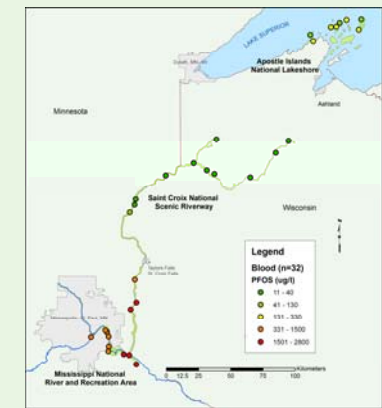


Figure 8. PFOS concentrations in bald eagle nestling blood, 2006.

Future efforts

We will continue sampling bald eagle nestlings at APIS, MISS, and the lower portion of SACN in 2008 to determine whether the trends we've observed continue. In 2008 we will also begin sampling fish and macro invertebrates to monitor these and other contaminants at the other six national parks in the western Great Lakes region. All nine parks will be monitored for targeted contaminants on a two to three-year rotation.

Acknowledgments

This monitoring program is funded by the National Park Service's Vital Signs monitoring program. We received cooperation and assistance from several county, state, federal, and non-governmental organizations. Jim Spickler, Giacomo Renzullo, and Craig Thompson safely climbed nest trees and successfully capture nestlings; Dan McGuinness and John Stravers provided boat operations on the Mississippi River and Glenn Miller on Lake Superior; Frank Stone captured our efforts on video for prosperity.

Literature cited

Dykstra, C.R., M.W. Meyer, P.W. Rasmussen, and D.K. Wamke. 2005. Contaminant concentrations and reproductive rate of Lake Superior Bald Eagles, 1989-2001. *J. Great Lakes Res.* 31:227-235.
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