Monitoring Perfluorinated Compounds in Bald Eagles

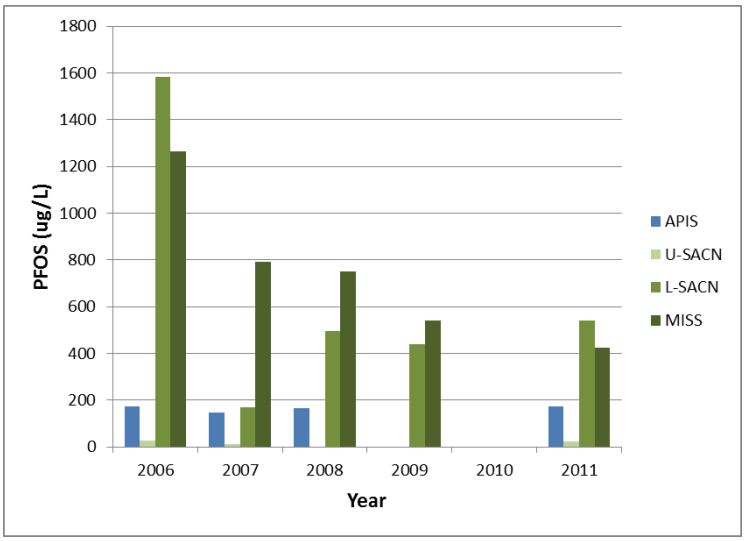
How and Why We're Monitoring

- Perfluorinated compounds (PFCs) are a group of chemicals with the unique property of repelling both water and oil. The number and variety of products that have PFCs in them is enormous, including drugs, anesthetics, pesticides, refrigerants, stain and water repellents, and polymers.
- Two PFCs are currently receiving a great deal of attention from scientists and regulators: perfluorooctane sulfonate (PFOS), best known for its use in treating fabrics for stain and water repellency, and perfluorooctanoic acid (PFOA) best known for its use in making non-stick surfaces for cookware and paper products. Both are found in fish and wildlife around the world. They are highly persistent, accumulate in higher trophic-level organisms, and there is growing evidence they are toxic to humans and wildlife.
- Between 2006 and 2011, the National Park Service measured concentrations of PFOS, PFOA, and 14 other PFCs in blood of bald eagle *(Haliaeetus leucocephalus)* nestlings at the Apostle Islands National Lakeshore (APIS), Mississippi National River and Recreation Area (MISS), and the upper and lower St. Croix National Scenic Riverway (U/L-SACN). Aerial surveys were also conducted each spring to assess the productivity of the eagle population in each park.

What We're Finding

We found that the **mean concentrations of PFOS in eaglet blood varied by park**, with the highest levels at L-SACN in 2006 and lowest at U-SACN in 2011 (Figure 1, left panel). Concentrations of PFOS in eaglets at L-SACN and MISS declined dramatically over this time period while levels remained relatively unchanged at APIS and U-SACN. The decline in PFOS in eaglets from the lower St Croix and Mississippi rivers coincides with the removal of PFOS from the market by its largest producer, 3M Corporation, in about 2002.

By contrast, **concentrations of PFOA were highest in eaglets at APIS. They increased through at least 2008 before declining in 2011** (Figure 1, right panel). PFOA trends in the other study areas were similar to those at APIS, though levels were much lower and appear to have peaked earlier. As with PFOS, the declines in PFOA are likely associated



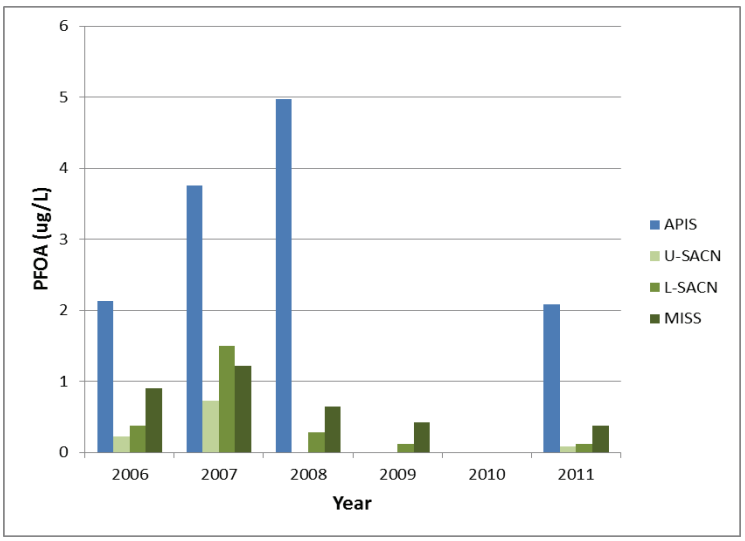


Figure 1. Geometric mean levels of PFOS (left) and PFOA (right), in bald eagle nestlings at four studies areas: Apostle Islands National Lakeshore (APIS), upper and lower St. Croix National Scenic Riverway (U/L-SACN), and the Mississippi National River and Recreation Area (MISS), 2006-2011.

with its purported removal from the market by both 3M and DuPont, the primary producers in North America.

To visualize the extent of contamination in aquatic systems, we mapped the highest concentrations found at each eagle nest across the four study areas (Figure 2). The Upper SACN had the lowest levels of both chemicals, while MISS had some of the highest levels. The Lower SACN had a few nests with high levels, and APIS had nests with consistently high concentrations of PFOA over the time period.

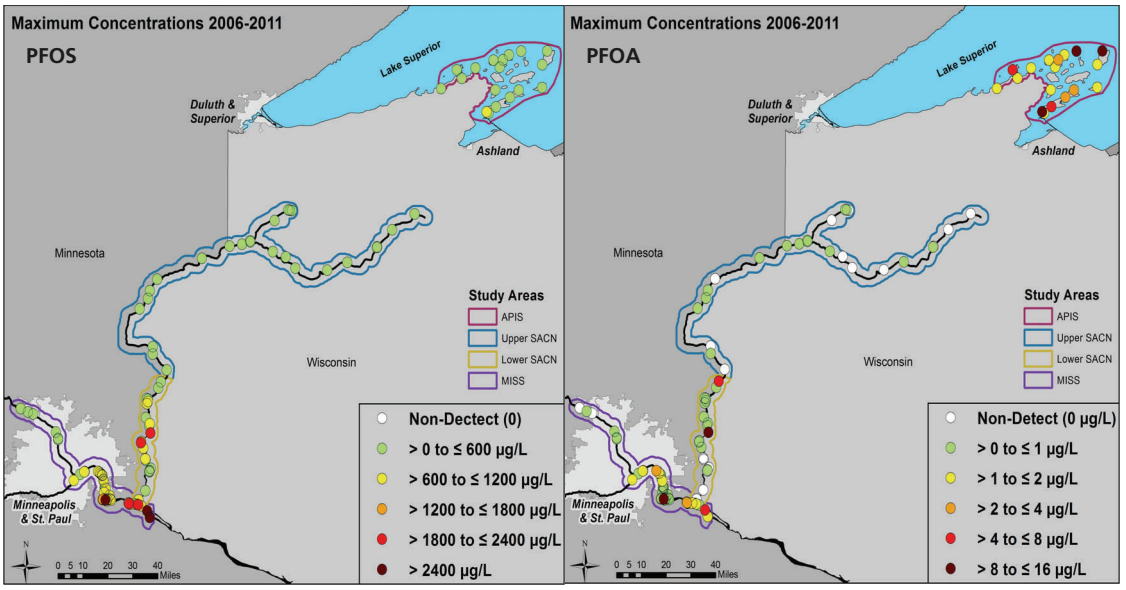


Figure 2. Maximum concentrations of PFOS (left) and PFOA (right) in bald eagle nestlings at four studies areas: Apostle Islands National Lakeshore (APIS), upper and lower St. Croix National Scenic Riverway (U/L-SACN), and the Mississippi National River and Recreation Area (MISS), 2006-2011.

High levels of PFOS and PFOA in the reach of Mississippi River below South St. Paul were not surprising, as this is where 3M manufactured and disposed of PFCs from about 1950 through at least 2000. The high levels at scattered nests below St. Croix Falls on Lower SACN and the consistently high levels of PFOA at APIS are not as easily explained. However, the overall pattern of contaminant distribution in eagle nestlings is likely due to differences in the source of the chemical and differences in each chemical's properties (e.g., bioaccumulation rates, volatility, ability to bind to sediments, solubility in water, and persistence).

On average we found the productivity of the bald eagle population in each park to be healthy and generally increasing. Productivity was highest at MISS and L-SACN. Differences in productivity are believed to be associated with the availability of prey, and we found no relationship between eagle productivity and concentrations of PFOS or PFOA. However, we have not evaluated any non-lethal effects that could be caused by these contaminants such as disruption of the endocrine system.

Management Implications

Animal studies have shown that the fetus and infant are sensitive life stages to PFC exposures. Humans are exposed to PFCs at all stages of life, including in the womb, during infancy, and during puberty. These human-made chemicals have contaminated some municipal water supplies near Minneapolis/St. Paul, and PFOS has triggered fish consumption advisories for sections of the Mississippi River (1 meal per week to 1 per month, depending on species of fish, for women who are planning to get pregnant and for children). State and federal regulators are using the results of our work to better understand how widely PFCs have contaminated the Mississippi River ecosystem and to evaluate the contamination trends in fish and wildlife.

The U.S. Environmental Protection Agency (EPA) has published rules to limit, but not entirely stop, future manufacture and importation of several PFC chemicals, including PFOS. Additionally, the EPA and eight major PFOA producers have agreed to eliminate PFOA emissions by 2015. This program is non-binding and does not include other American and international producers. Together, the EPA rules and self-imposed reductions will likely result in continued declines in both PFOS and PFOA, but they are expected to remain in the environment for many years due to the slow breakdown of discarded products and the persistence of residual waste in the environment (PFOA is estimated to have a half-life of 92 years in the atmosphere).

We found some of the highest PFOS concentrations in bald eagle nestlings in 2011—nine years after this chemical was phased out. Our monitoring will continue to track trends in these chemicals to determine how quickly they are removed from the environment and whether certain areas would benefit from remediation.

Links to Additional Information

Minnesota Department of Health fish consumption advisories
www.health.state.mn.us/divs/eh/fish/eating/sitespecific.html

EPA Action Plans
www.epa.gov/oppt/existingchemicals/pubs/actionplans/pfcs.html