Monitoring Persistent Contaminants in Bald Eagles

Importance

Human-made contaminants released into water, air, or on land often end up in aquatic systems. Bald eagles are high on the aquatic food web and serve as good indicators of the distribution and levels of these contaminants in the environment. The National Park Service Great Lakes Inventory and Monitoring Network is currently monitoring six contaminants in bald eagle nestlings. Each of these contaminants is known or hypothesized to adversely impact wildlife and humans. This Resource Brief presents efforts to monitor DDE (a metabolite of the pesticide DDT) and PCBs – both banned in North America in the 1970s - and mercury – one of the most pervasive contaminants in the upper Midwest.

Current Levels

Eaglets raised near Lake Superior (including the Apostle Islands National Lakeshore) had higher concentrations of DDE than eaglets from either the Mississippi National River and Recreation Area or the St. Croix National Scenic Riverway with the upper portions of the St. Croix Riverway (above St. Croix Falls, WI) being lowest (Table 1).

We found PCBs were significantly higher in eaglets raised along the Mississippi NRRA and lower St. Croix NSR, moderately high on Lake Superior, and low in eaglets from the upper St. Croix NSR.

The patterns of distribution for mercury differed from those we observed for DDE and PCBs. Mercury was highest in eaglets from the upper St. Croix NSR and lowest from those sampled on the Mississippi NRRA and Lake Superior. The cold, deep, and relatively unproductive water of Lake Superior likely retards the breakdown of historically high levels of DDE and PCBs while aerial deposition from global sources on this large surface area continue to add to this burden.

Mercury is deposited on the landscape from regional and global sources. This elemental form of mercury is turned in to the highly toxic methyl mercury - which is >95% of what we measure in eaglets - by anaerobic bacteria that occur in wetlands. Hence waterbodies with high proportions of their water coming from wetlands tend to have greater availability of methyl mercury.

Trends

Bald eagle nestlings have been used as a sentinel species to monitor environmental contaminants on the Great Lakes for over 20 years. The Wisconsin Department of Natural Resources (WDNR) monitored contaminants in eaglets along the south shore of Lake Superior, including the Apostle Islands, from 1989 through 2002. The NPS picked up this effort in 2006 for areas it manages.

Combining data from both agencies reveals that levels of DDE, PCBs, and mercury in eagle nestlings have declined at annual rates of 3% for DDE, 4.3% for PCBs, and 2.4% for mercury (see Figure 1 on back). Similar long-term data are not available for the St. Croix NSR and Mississippi NRRA.

Table 1. Geometric mean levels of three contaminants found in bald eagle nestlings from Lake Superior (including the Apostle Islands National Lakeshore), the Mississippi National River and Recreation Area, and the St. Croix National Scenic Riverway, 2006-2008. Different letters (a, b, c) indicate significant differences between sites (P <0.05).

	Estimated Geometric Mean		
Region (n)	DDE (ppb)	PCBs (ppb)	Mercury (ppm)
Lake Superior (29)	16.2 a	55.46 b	3.88 b c
Mississippi River (51)	9.03 b	88.06 a	3.13 c
Lower St. Croix River (14)	6.73 b	79.71 a b	4.54 b
Upper St. Croix River (19)	2.60 c	2.66 c	6.81 a

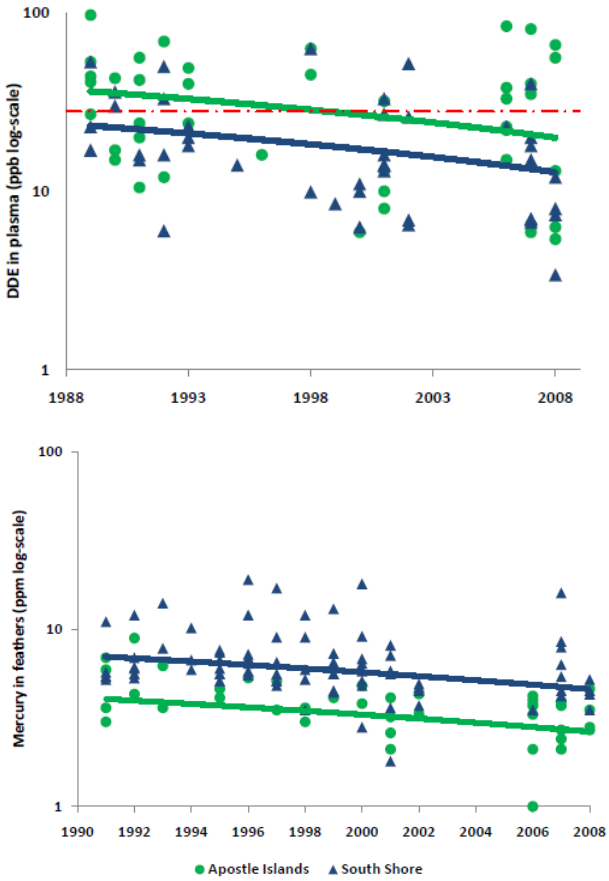

Figure1. Levels of DDE (top left) and PCBs (top right) in plasma and mercury (bottom left) in feathers collected from bald eagle nestlings along Lake Superior, 1989-2008. Data are from the WDNR (1989-2002) and the NPS (2006-2008). Data points show levels for individual nestlings; trend lines are from best-fit models using eagle territory, year, and study area (*P* <0.02). The dotted red lines on DDE and PCB charts show published threshold levels for healthy bald eagle populations of 28 ppb and 190 ppb respectively. Threshold values do not exist for mercury.

The trends (slope of the lines) are not significantly different between the south shore of Lake Superior and the Apostle Islands for any of the contaminants, but mean levels are significantly different between these areas for DDE and mercury (two trend lines).

On a population level the average concentrations of DDE and PCBs are currently below threshold values established for healthy bald eagle populations (Figure 1). For DDE it took 28 years from when DDT was banned in 1972 for levels to drop below the threshold. Moreover, >50% of the nestlings sampled on the Apostle Islands from 2006 to 2008 are still above threshold values. Similar thresholds do not yet exist for mercury in bald eagle feathers.

The bald eagle population on the Apostle Islands began increasing in 1983 when the first nestling was fledged in more than 15 years (Figure 2). This increase closely coincides with the bans on DDE and PCBs.

Management Implications

- All three contaminants show significant yet slow declines, although levels of DDE at some nests consistently exceed threshold values on the Apostle Islands and mercury in the upper St. Croix River needs further evaluation.
- Air deposition is the primary source of all three contaminants; PCBs are linked to human land use; elemental mercury is linked to human sources with wetlands contributing to the production of methyl mercury, the most toxic form.
- A more detailed summary of these data is available on-line, a paper has been submitted for publication (in-review), and a technical report will be available by fall of 2010.
- With financial support from the Great Lakes Restoration Initiative, in 2010 we will be evaluating additional contaminants for monitoring

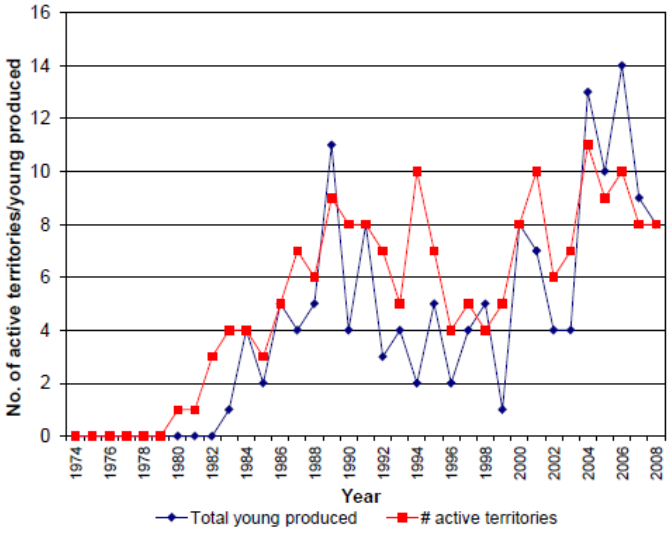

Figure 2. Number of active eagle territories and number of young produced at Apostle Islands National Lakeshore, 1974-2008.