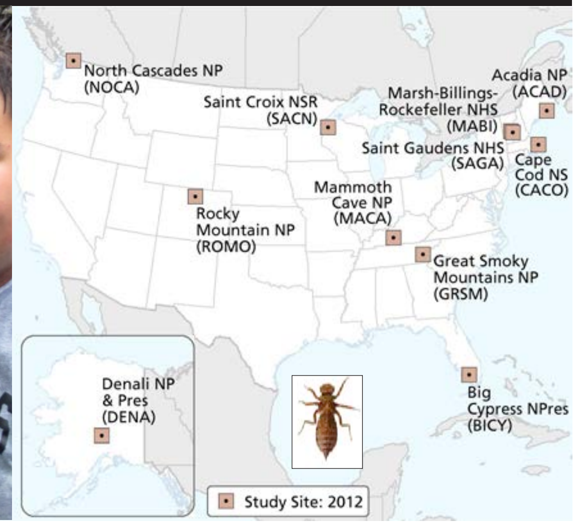
Six-legged Scouts:

Dragonfly larvae help scientists understand mercury in national parks



What is mercury and why are parks involved?

Mercury is a global pollutant that threatens resources the National Park Service (NPS) is charged with protecting. Concentrations of mercury in fish and other biota exceed human and wildlife health thresholds in many national parks across the United States. Efforts by resource managers to focus conservation work in areas of highest risk to humans, fish, and wildlife are hampered by significant variability in mercury concentrations from site to site—even among neighboring lakes, streams, or wetlands. Sampling dragonfly larvae is an easy and effective way for NPS managers to assess the risk of mercury contamination in aquatic ecosystems. In 2012, citizen scientists assisted with this undertaking in national parks.

Where does mercury come from?

You might think of mercury as a silvery, liquid metal in thermometers, or even in the solid form as fillings for cavities in your teeth. But most of the mercury that affects parks comes from a different source—burning fossil fuels like coal in power plants. Once burned, mercury travels long distances in the atmosphere as tiny particles and gases. It can even circle the globe. It settles to the ground by falling in rain and snow or landing as dust particles. Mercury then moves with the water downhill in to watersheds, ultimately ending up in streams, ponds, lakes, and wetlands.

How does mercury get into park ecosystems and wildlife?

Once in the water, mercury is transformed into a more toxic form, methylmercury, that can cross the cell wall in organisms. Methylmercury bioaccumulates (builds-up) in organisms faster than the organism's body can get rid of it. Larger animals higher on the food chain accumulate more mercury, a process called biomagnification. Biomagnification is why mercury in top-level predators like large fish, eagles, or even humans can have up to a million times more mercury than the lake or stream water in which they live or hunt. The toxic effects of mercury include impaired reproductive and neurological development.

What do dragonfly larvae have to do with mercury?

Before they become brightly-colored flying adults, dragonfly larvae (immature dragonflies) hatch from eggs and live underwater, in the same areas where mercury is converted into methylmercury. They molt and grow over the course of 1–4 or more years, all the time eating other aquatic insects, tadpoles, and small fish. They stay in the same stream or pond as they grow to maturity. These life-history characteristics are important because they link with two important influences on mercury risk: the landscape (where you live) and the food web (what you eat). This project tests how dragonfly larvae can serve as indicators of ecosystem health. Data provide the foundation for future studies to further characterize the risk and transfer of mercury around food webs.

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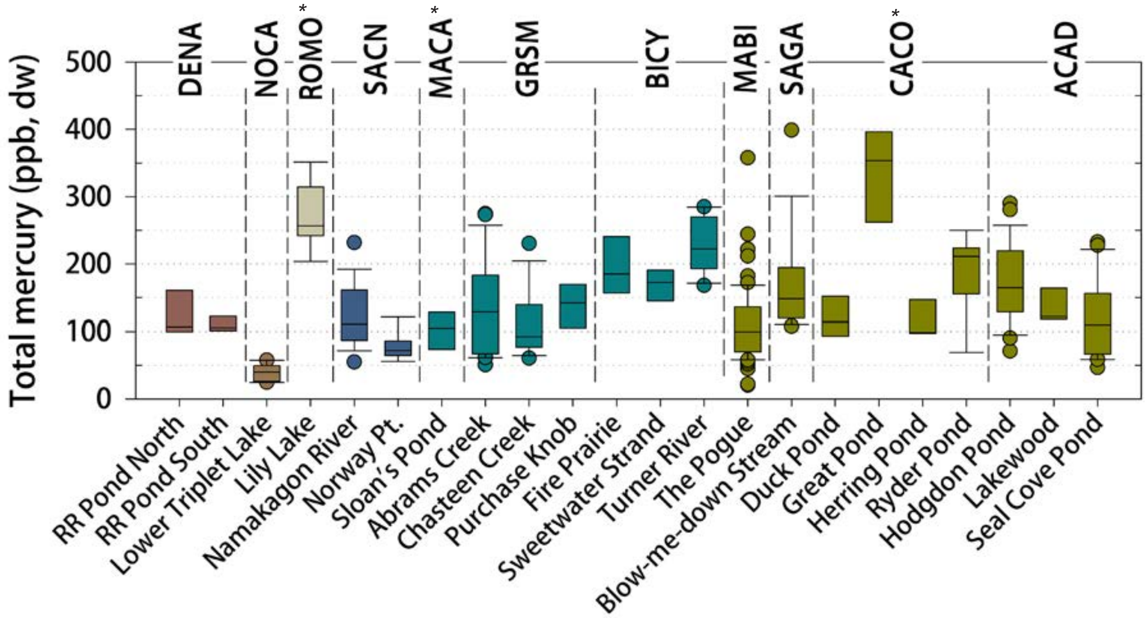
This graph is a box and whisker plot showing mercury in dragonfly larvae in parts per billion, dry weight (ppb, dw) for each site within the participating parks. The graph is ordered from west to east, reading left to right. The box is the middle 50% of the data, and the line across the box is the median. The whiskers are the highest and lowest 25% of the data. Dots beyond the whiskers are extreme values. When the median from one site overlaps a box from another site, sites are similar in mercury concentrations, and when they do not overlap, mercury concentrations differ among sites.



**One site at each ROMO, MACA, and CACO is not shown because samples were too small to produce reliable results. (See map for park codes.)*

What are we learning from dragonfly larvae?

- Across all parks combined, median mercury in dragonfly larvae was 125±77 parts per billion on a dry weight basis (ppb, dw). Median mercury was highest at CACO (Great Pond), ROMO (Lily Lake), and BICY (Turner River).
- This study is a new line of research, so we do not know if these values are cause for concern. Continued work in this arena will help inform concern thresholds.
- In general, eastern parks had greater mercury in dragonfly larvae than western parks. This makes sense because many eastern parks, particularly in the Northeast, are downwind of major coal-fired power plants.
- Park staff chose sites that had contrasting landscape features, like high and low elevation, different forest types, or varying abundance of nearby wetlands. We wanted to see if dragonfly larvae would highlight fine-scale differences in mercury among sites within a park—and they did. There were statistically significant differences among sites, even within a park.
- Some parks already had other data about mercury that supported our findings. At CACO, Great and Ryder Ponds have fish consumption advisories for mercury, and the dragonfly data show elevated concentrations as well. At ACAD, Hodgdon Pond had greater mercury concentrations in fish and invertebrates than adjacent Seal Cove Pond in an earlier study, and that pattern held for dragonflies.
- Four parks had repeated sampling (GRSM, MABI, SAGA, and ACAD); we will investigate changes through time in future studies.

How are citizen scientists involved?

In 2012, 11 national parks participated in this pilot study. More than 300 dragonfly larvae samples were collected from 25 sites by about 200 citizen scientists. Citizen scientists varied in each park, and included school groups, park volunteers, and interpretive program participants. These citizen scientists, along with park staff, helped collect, measure, and identify dragonfly larvae, all the while learning about mercury, biodiversity in parks, and aquatic ecosystems. Sampling was often incorporated into interpretive programs related to aquatic macroinvertebrates, like dragonfly larvae, because they are commonly used to monitor water quality in streams. Dragonfly larvae were then sent to the University of Maine and Dartmouth College for mercury analysis. We thank park staff and citizen scientists for contributing time to this collaborative research.

What's next?

This study is expanding in 2013, involving both the pilot parks and NPS units from other regions and ecosystem types. The effort will also extend to urban parks and foster biodiversity discovery activities and teachable moments. Dragonfly data can be found on the project website and citizen scientist groups are encouraged to use it! The pilot project was funded by the University of Maine.

For more information:

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Project website:
http://www.nature.nps.gov/air/Studies/air_toxics/dragonfly/index.cfm

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