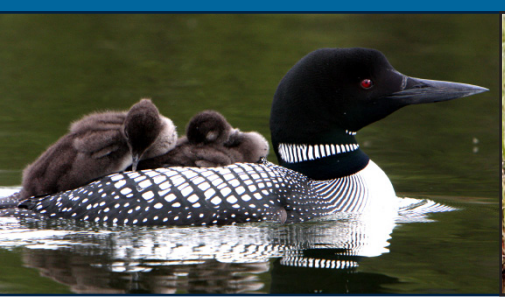
Adirondack Loons

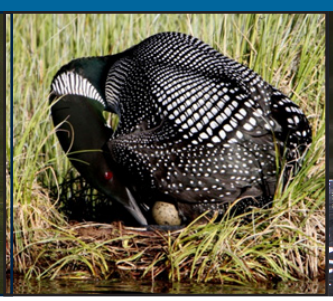
Sentinels of Mercury Pollution in New York's Aquatic Ecosystems

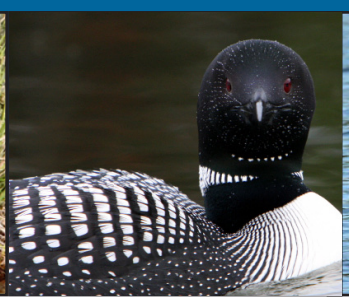
Each summer, the haunting call of the Common Loon (*Gavia immer*) resounds through New York's six-million-acre Adirondack Park as the birds raise their families on the Park's lakes and ponds. The loon, a mystical icon of northern waterways, is a beautiful, highly charismatic bird with the potential to serve as a sentinel for the hidden risk of contaminants in our local waters.

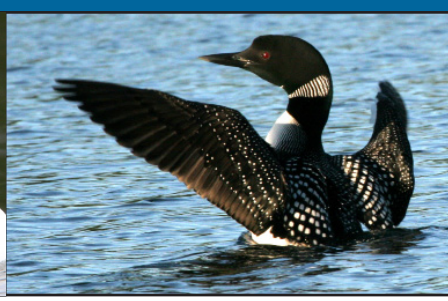
Mercury is an environmental pollutant released through a variety of industrial processes, such as coal burning, waste incineration, and metal production. Mercury emitted into the atmosphere can travel great distances on air currents before being deposited in aquatic systems. Once in waterways, this contaminant is taken up by fish, which make it a problem for all fish-eating species, such as loons and even people!

In this summary brochure, we showcase the results of a long-term study in the Adirondack Park to assess the effect of mercury contamination on wildlife and the entire aquatic ecosystem, using the Common Loon as an indicator species. We traced mercury contamination throughout the food web, from zooplankton to loons and found mercury levels in some Common Loons that increased their risk to reproductive harm.









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Mercury Studies in the Adirondack Park

In 2003 and 2004, researchers from Biodiversity Research Institute, the Wildlife Conservation Society, and their partners collected samples from 44 Adirondack lakes to test for mercury throughout the aquatic food web (from water to loons). Moving from organisms low on the food chain (e.g., zooplankton) to those high on the food chain (e.g., fish and loons), mercury concentrations increase dramatically (Figure 1).

Because loons are long-lived (20-30 year lifespan), territorial, and at the top of the aquatic food web, they are excellent sentinals of the health of freshwater habitats. Through our study, we have learned that this majestic bird has much to tell us about mercury in the Adirondack Park.

Understanding the Science: Biomagnification

Biomagnification is the increase of a contaminant as it moves up trophic levels. For example, fish (the prey) eat at a lower trophic level than loons (the predator). Think of biomagnification this way - if each fish has 5 units of mercury within its body and a loon eats five fish per day, that means that a loon then accumulates 25 units of mercury per day.

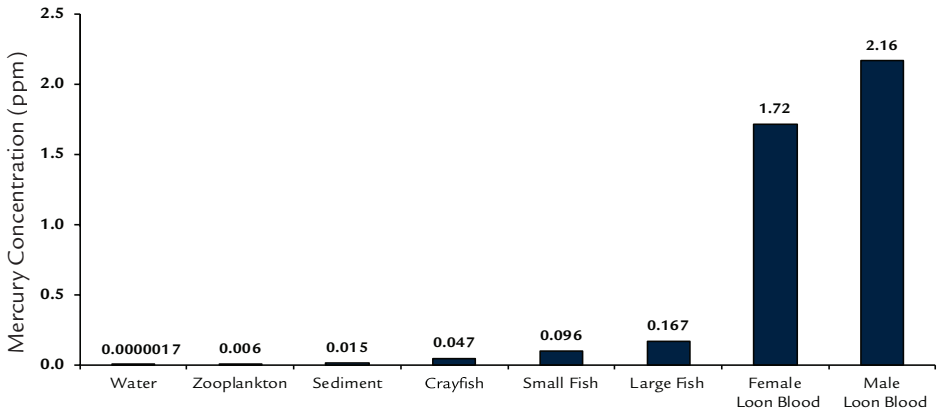


Figure 1. Biomagnification in the Adirondack food web. Samples collected from the different parts of the food web show that loon blood mercury concentrations are 10 times higher than their fish prey. Numbers above bars indicate average total mercury values.

The Effect of Mercury on Common Loons

Mercury can affect a loon throughout its life cycle, leading to a variety of problems including:

- Lethargic behavior
- Failure to defend territories
- Failure to incubate eggs
- Reduced hatching rates
- Failure to care for chicks
- Overall lowered reproductive success

Through detailed research, scientists have determined that different concentrations of mercury in the blood relate to reproductive success risk categories ranging from low to extra high risk (summarized in Table 1). Mercury is always expressed as a concentration - the amount of the toxin within a given volume (or part-per-million, ppm).

We can use these risk categories to better understand how mercury affects loons in the Adirondack Park. Risk categories allow us to visualize in which lakes loons experience high mercury contamination (Figure 2), summarize what proportion of the loon population is in each risk category (Figure 3), calculate the decrease in reproductive success of loons in high risk categories (Figure 4), and model long term impacts to the loon population (Figure 5).

Table 1. Mercury risk categories for Common Loon reproductive success.

Risk Group	Adult Loon Blood Mercury
Low	< 1 ppm
Low-Moderate	1 - 2 ppm
Moderate-High	2 - 3 ppm
High	3 - 4 ppm
Extra High	> 4 ppm

Spatial Distribution of Loon Mercury in the Adirondack Park

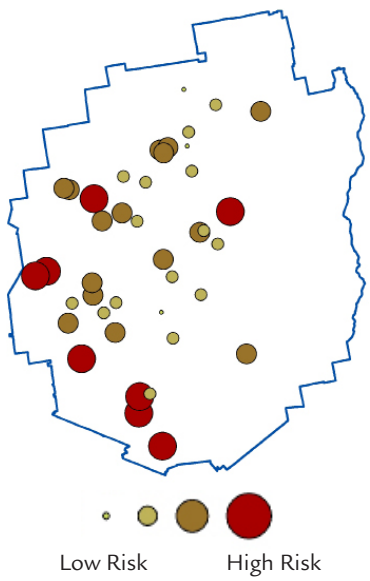


Figure 2. The "male loon units" in this figure are an indicator of average mercury levels within each lake or pond. In general, loon mercury levels are higher in the southwest portion of the Park.

To learn how we calculate "loon units" and to find the loon mercury level in a lake near you, see our complete report (details on back page).

Major Research Questions and Findings

Question: What Proportion of Adirondack Loons are at Risk to Mercury?

Between 1999 and 2007, biologists captured the notoriously hard-to-catch adult loons on their home lakes, placed bands on their legs and collected samples of their blood and feathers. These samples were taken back to the lab and analyzed for mercury content, allowing us to assess whether mercury levels in the Adirondack Park are of concern for loons.

Findings: Researchers sampled 101 male loons and found that more than half had blood mercury concentrations above the threshold for moderate risk (Figure 3).

Information about the "night-lighting" technique used to capture adult loons, along with data results for female loons can be found in our full report; see info on back page to obtain a copy.

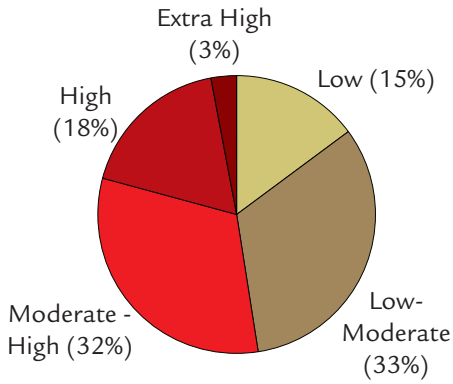
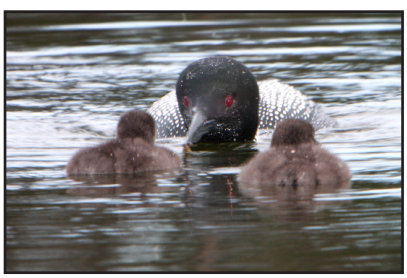


Figure 3. Proportion of male Common Loons at risk of reproductive impairment.

Question: Does Mercury Impact Loon Reproduction in the Adirondack Park?

Using the unique bands placed on each bird, teams of researchers identified loons as they returned to the Park each year from 1999-2007. To keep track of how many chicks survived each season, researchers observed the birds as they nested and raised chicks.

Findings: Successful loons generally raise 1 to 2 chicks per year. Loons in moderate-high mercury risk groups produce significantly fewer chicks each year than those in low risk groups (Figure 4). Although a small difference, when multiplied over many years and many pairs, this could cause problems for the Adirondack loon population.



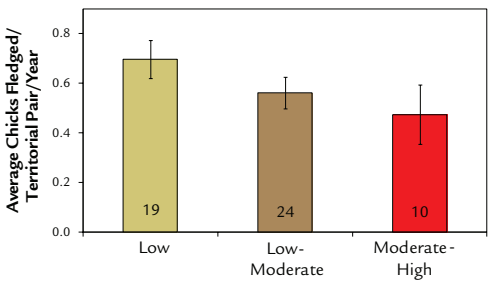


Figure 4. The average number of chicks produced per loon pair in mercury risk groups. The numbers within the bars are the number of pairs observed. There is a statistically significant difference between the low and moderate-high risk groups.

Question: What Impact Could Mercury Exposure Have on the Adirondack Loon Population?

We used a population modeling technique to predict what impact mercury could have on the loon population over a 50 year time period. We compared different risk scenarios, which varied from no mercury risk (hypothetical scenario where no loons have high mercury values) to complete mercury risk (hypothetical scenario where all loons have high mercury values).

Findings: A hypothetical loon population with complete mercury risk will not increase over the next 50 years, while a population with no mercury risk would increase substantially over the next 50 years (Figure 5). The Adirondack loon population is likely somewhere between the no mercury and complete mercury risk groups, indicating that the population will likely increase, but at a lower rate depending on how many birds are exposed to mercury.

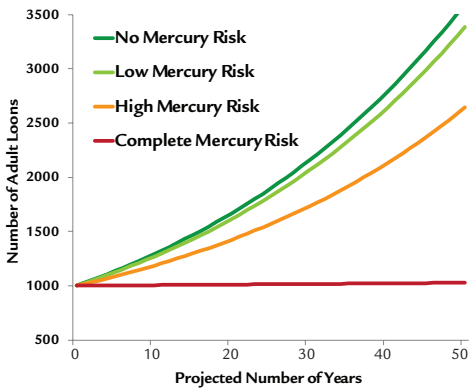
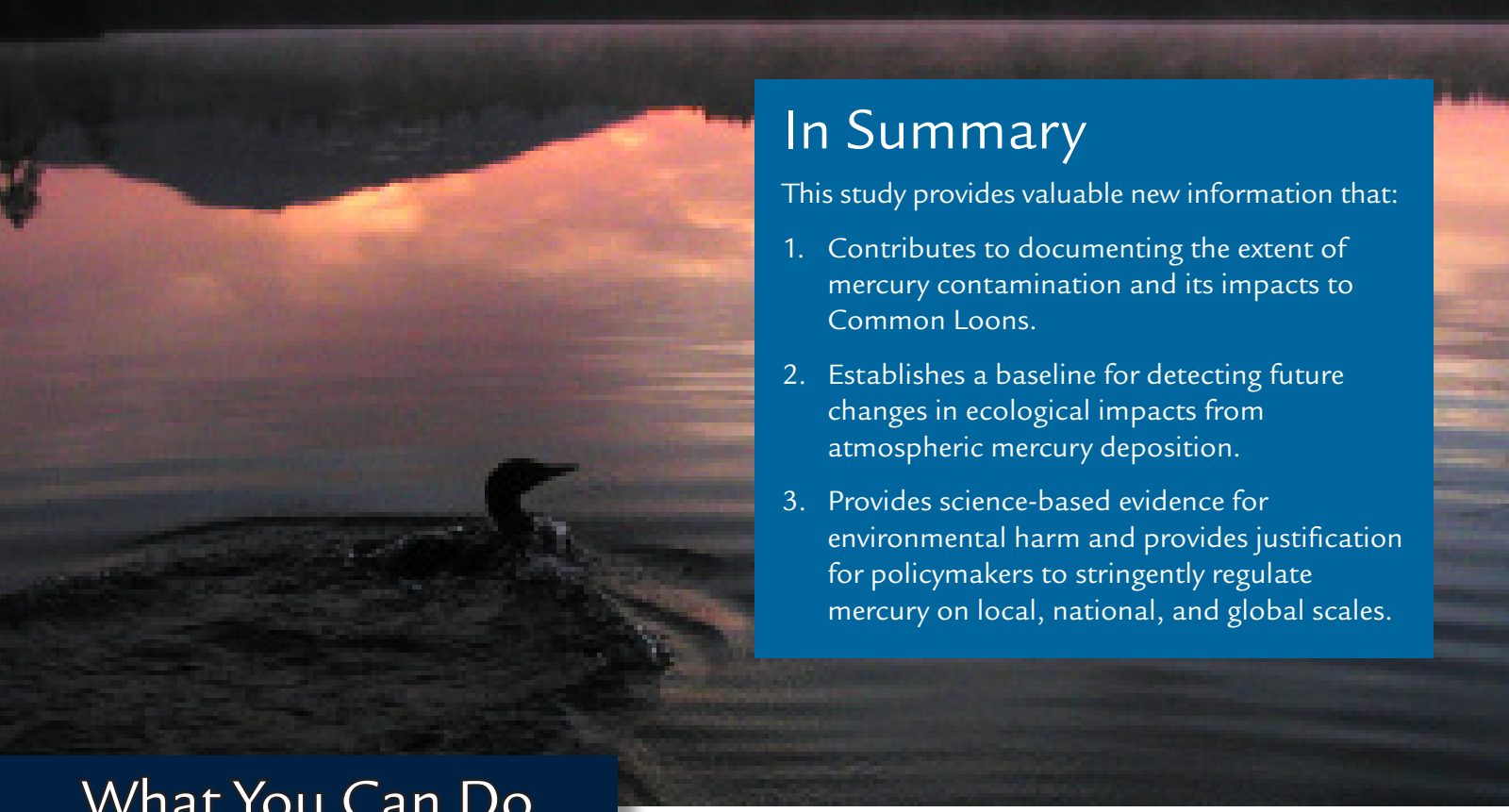


Figure 5. Predicted loon population growth under different mercury risk scenarios.



In Summary

This study provides valuable new information that:

1. Contributes to documenting the extent of mercury contamination and its impacts to Common Loons.
2. Establishes a baseline for detecting future changes in ecological impacts from atmospheric mercury deposition.
3. Provides science-based evidence for environmental harm and provides justification for policymakers to stringently regulate mercury on local, national, and global scales.

What You Can Do

Mercury pollution is a problem that must be regulated at national and global levels. In December 2011, the U.S. Environmental Protection Agency finalized the Mercury and Air Toxics Standards rule which, for the first time, regulates how much mercury can be released into the environment by coal-fired power plants. Although human health and safety will greatly benefit from this rule, our study shows that it will also greatly help the ecological health of the Adirondack Park and its wild inhabitants.

Loons also face stressors from other human activities, as well as mercury pollution. Recreational disturbance, shoreline degradation, habitat alteration, water level fluctuation, fishing line entanglement, and lead poisoning from fishing tackle ingestion are all problems for loons in the Adirondack Park. Educating yourself about these dangers is the first step to helping loons in your area.

To download the complete report or to learn more about the threats facing loons, visit our websites.

Acknowledgements

This study and report were conducted with financial and in-kind support from the New York State Energy Research and Development Authority, the Wildlife Conservation Society, The Wild Center/Natural History Museum of the Adirondacks, NYS Department of Environmental Conservation, and Audubon International, as part of NYSERDA's Environmental Monitoring, Evaluation, and Protection Program Project #7608. We are also grateful to the Freed Foundation, Nordlys Foundation, John and Evelyn Trevor Charitable Foundation, and numerous other organizations and private donors for their generous support and in-kind assistance with this project.

www.briloon.org/adkloon ~ www.wcsadirondacks.org ~ www.nyserda.org

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General audience, non-technical report

Schoch and Jackson. 2012. Adirondack Loons – Sentinels of Mercury Pollution in New York's Aquatic Ecosystems. BRI Report 2011-29, Biodiversity Research Institute, Gorham, Maine.

Full technical report

Schoch, Jackson, Duron, Evers, Glennon, Driscoll, Yu, and Simonin. 2011. Long-term monitoring and assessment of mercury based on integrated sampling efforts using the common loon, prey fish, water, and sediment. BRI Report 2011-28 to the New York State Energy Research and Development Authority for NYSERDA EMEP Project #7608.