PROJECT UPDATE

August 2005

New York State Energy Research and Development Authority

Environmental Monitoring, Evaluation, and Protection Program

Long-Term Monitoring and Assessment of Mercury Using the Common Loon, Prey Fish, Water, and Sediment

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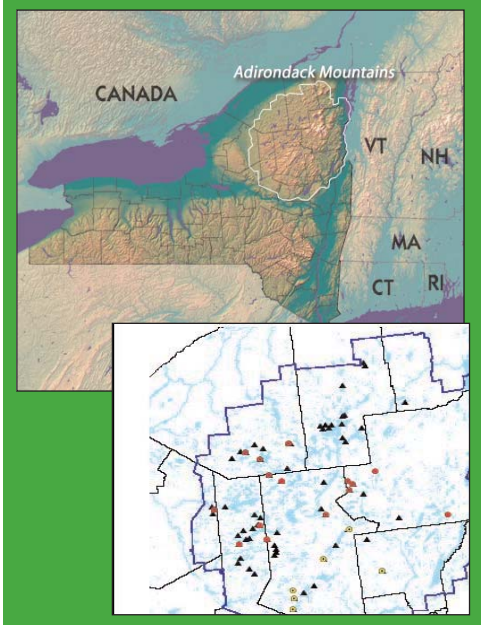
Project Location



Contact Information

For more information on this project see:
www.adkscience.org/loons/
and
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Keywords

- Bioaccumulation
- Biomagnification
- Common loon (*Gavia immer*)
- Methylmercury (MeHg)
- Wildlife criterion value (U.S. EPA)

PROJECT FOCUS

This collaborative project aims to assess mercury (Hg) exposure and risk in aquatic ecosystems in the Adirondack Park of New York State (NYS) by using the common loon (Gavia immer) as an indicator species. Involved in this effort are the Wildlife Conservation Society, BioDiversity Research Institute, and the NYS Department of Environmental Conservation, partners of the Adirondack Cooperative Loon Program. The objectives of the study are threefold:

- Developing a mercury "exposure profile" by evaluating abiotic (sediment; water column) and biotic (prey fish; crayfish; zooplankton; loon blood, feathers, and eggs) Hg levels in the aquatic environment.
- Developing a mercury "hazard profile," using the loon as indicator species, by determining the reproductive success and survival of loons and evaluating these parameters in relation to the blood mercury levels of the birds.
- Assessing mercury risk in Adirondack aquatic ecosystems by developing a "wildlife criterion value," using a U.S. Environmental Protection Agency formula that provides a water column mercury value that is protective of wildlife at the population level.

ACLP volunteers monitor loons on an Adirondack lake
Photograph by: Nina Schoch

CONTEXT

Mercury cycles in the environment as a result of both natural and human activities. The major sources of anthropogenic emissions are the combustion of mercury-containing fuels or materials, such as coal, in the production of electricity and industrial processes. Analyses of lake sediment cores show that the current rate of mercury deposition in the Northeast is 2–5 times greater than historical levels (before ~60 years ago), an increase that is attributed to deposition resulting from these emissions. Studies comparing mercury concentrations in fish with rates of atmospheric deposition have found that anthropogenic sources account for a major contribution to aquatic system mercury levels. As it accumulates in the organisms exposed to it (bioaccumulation), mercury poses a danger to organisms higher up in the food chain (biomagnification), even at low exposures. In aquatic ecosystems, methylmercury (MeHg), the toxic form of elemental mercury, accumulates in fish muscle tissue, posing a threat to fish-eating species, including humans.

In aquatic ecosystems across the Northeast, MeHg is currently at levels that pose a risk to human and ecological health. The level of risk varies considerably according to MeHg availability, which is affected by lake hydrology, biogeochemistry, habitat, topography, and proximity to airborne sources. The loon, which breeds on bodies of water throughout New York's Adirondack Park, is a fish-eating predator at the top of the food chain that may be detrimentally affected by mercury and other toxins that bioaccumulate and biomagnify through the environment. Risk assessments have shown that the loon is a suitable indicator of the toxicity of aquatic mercury.

METHODOLOGY

This four-year project expands on loon mercury exposure and reproductive success data collected previously in the Adirondack Park (1998–2000) by the U.S. Fish and Wildlife Service and BioDiversity Research Institute. Abiotic and biotic samples are being collected on ~40–50 lakes inhabited by loons within the Adirondack Park over a four-year period (2003–2006). During the 2003-2004 field season, loons were captured and sampled on 44 lakes.

PROJECT UPDATE

August 2005

Banding loons is a common way of monitoring their behavior
Photograph by: J. Ozard, NYS DEC

Project Status

- Initiated 2003
- Project ongoing

New York Energy Smart℠
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Since 1975, the New York State Energy Research and Development Authority (NYSERDA) has developed and implemented innovative products and processes to enhance the State's energy efficiency, economic growth, and environmental protection. One of NYSERDA's key efforts, the Environmental Monitoring, Evaluation, and Protection (EMEP) Program, supports energy-related environmental research. The EMEP Program is funded by a System Benefits Charge (SBC) collected by the State's investor-owned utilities. NYSERDA administers the SBC program under an agreement with the Public Service Commission.

2003-2004 Sampling

Category	Lakes Sampled
Fish	42
Water	44
Zooplankton	43
Crayfish	26
Sediment	32
Loon blood and feathers	44
Nonviable loon eggs	18

Data from these lakes will be coordinated with other water-quality research to enable analysis of water chemistry in relation to the sampled mercury levels. Long-term monitoring of mercury contamination and reproductive success of Adirondack loons will be evaluated through analysis of mercury in the abiotic and biotic samples that were collected from loon territories. This information will serve as an indicator of the broader risk mercury poses to environmental quality in northern NYS.

Specifically, the research will involve chemical analysis of loon blood samples to determine short-term mercury accumulation and of loon feathers to indicate long-term mercury accumulation in the birds. Using available data, the project team will develop a mercury exposure profile and assess the risk that mercury deposition poses to Adirondack ecosystems through the development of a wildlife criterion value. Common loon blood and egg mercury levels will be used as the primary indicators for assessing ecological health risks. A population model will be developed to determine if the Adirondack loon population is being negatively impacted by mercury contamination of the aquatic ecosystem.

RECENT FINDINGS

Previous results have indicated that 17% of the loons sampled in the Adirondacks were estimated to be at risk for harmful effects from mercury contamination. Additional results from sampling in 2003-2004, and future sampling in 2005-2006 will augment the database that is being developed.

NYS DEC biologist releasing an immature banded loon on an Adirondack lake
Photograph by: Nina Schoch

PROJECT IMPLICATIONS

This project's determination of levels of abiotic and biotic mercury exposure will contribute to the assessment of the risks posed by mercury pollution to human and ecological health in NYS and the Northeast. Results will be coordinated with related projects, with the aim of improving assessment of the impacts of mercury exposure on loons. Findings should prove useful in broader evaluations of the impact of mercury toxicity and the extent of mercury distribution in northeastern aquatic ecosystems in relation to deposition. The evaluation of mercury levels in prey fish will also aid in identifying Adirondack lakes that should be evaluated for fish consumption advisories to prevent human exposure to mercury.

Currently, although pollution prevention programs exist to remove mercury from the environment and products, mercury emissions from coal-burning power plants are not regulated. A federal rule to reduce mercury emissions is scheduled to be phased in over the next two decades. The findings of this and related projects on mercury should benefit the evaluation of the geographically specific effects of deposition on ecosystems and its risks for human health, as well as the selection of an optimal regulatory regime for mercury.