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Survey for Levels of Bioaccumulative Chemicals in Wildlife Prey and Tissues and Wildlife Deformities within Lake Ontario and its Tributaries and the St. Lawrence River

US Army Corps of Engineers®
Buffalo District
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This project will involve completing a survey along the Lake Ontario shoreline, in selected tributaries of Lake Ontario, and in the St. Lawrence River for bioaccumulative chemicals in wildlife prey and tissues and for wildlife deformities. The primary objective of the project is to determine the extent to which bioaccumulative chemicals in wildlife prey and wildlife deformities are lake-wide versus Area of Concern (AOC)-specific issues. The resulting data will be used to help determine the status of Beneficial Use Impairment (BUI) #5—Bird or Animal Deformities or Reproductive Problems—in four AOCs: Niagara River,

Surveys for Bioaccumulative Chemicals and Deformities

✔ **Addresses GLRI Focus Areas**

✔ **Supports BUI Delisting at 3 AOCs**

✔ **Addresses LaMP Goals and Objectives**

Eighteenmile Creek, Rochester Embayment, and St. Lawrence River at Massena AOC, New York. Also, the resulting data will be useful to support Great Lakes Restoration Initiative (GLRI) goals and Lake Ontario Lake Management Plan (LaMP) goals.

Project Overview and Background

Overview of Great Lakes Contamination and the Link to Bird and Animal Abnormalities

Wildlife of Lake Ontario and the other Great Lakes are exposed to many bioaccumulative organic chemicals, including polychlorinated biphenyls (PCBs), dioxins/furans, and chlorinated pesticides. The bioaccumulative nature of these chemicals and long food webs in the Great Lakes result in significant contamination in fish and high exposure potential to these chemicals in people and wildlife that eat fish from these sources. Significant impacts on wildlife that consume Great Lakes fish have been well-documented. Well-known examples include the steep decline of bald eagle reproduction from the nearshore regions of the Great Lakes due to eggshell thinning caused by DDT; loss of mink populations from reproductive failure caused by PCBs; and cross-bill syndrome and other effects in a variety of fish-eating colonial nesting bird populations due to exposure to dioxins/furans and dioxin-like compounds (Swackhamer 2005).

Support of Great Lakes Restoration Initiative

This project will facilitate progress toward the goals of two Great Lakes Focus Areas: Toxic Substances and AOCs and Monitoring and Evaluation. The implementation of this project will facilitate progress towards the goals of these GLRI Focus Areas by collecting data on a sentinel wildlife species, the mink, which is a direct link to assessing the overall health of the Lake Ontario ecosystem.

GLRI Focus Areas

Long-term Goals of the Toxic Substances and AOCs Focus Area

✔ Significantly reduce exposure to toxic substances from historically contaminated sources through source reduction or other methods

✔ Reduce levels of toxic chemicals to the point that all restrictions on the consumption of Great Lakes fish can be lifted

✔ Protect the health and integrity of wildlife habitat from adverse chemical and biological effects associated with the presence of toxic substances in the Great Lake Basin

Long-term Goals of the Monitoring and Evaluation Focus Area

✔ A cooperative monitoring and observing system that provides a comprehensive assessment of the Great Lakes ecosystem

✔ Achievement of priority Lake Ontario LaMP goals and objectives through implementation of critical projects and programs

Support for Beneficial Use Impairment Delisting

The survey findings will be highly relevant to delisting criteria for BUI #5—Bird or Animal Deformities or Reproduction Problems—for four AOCs: the Rochester Embayment, Eighteenmile Creek, the Niagara River, and St. Lawrence River at Massena AOC, New York. For these AOCs, the delisting criteria for BUI #5 refers to expected levels of wildlife deformities or reproductive problems and/or levels of chemicals in wildlife prey. This project will provide data on the typical levels of these parameters in Lake Ontario and its tributaries for comparison with levels in the AOCs, which are needed to determine if the delisting criteria have been attained.

Support for Lake Ontario LaMP

The LaMP presents ecosystem goals for Lake Ontario based on indicators selected to provide a good characterization of the ecosystem; one group of these indicators, critical pollutant indicators, would be addressed by this survey. This survey will collect data on levels of critical pollutants in prey of piscivorous (fish-eating) wildlife in selected nearshore areas of Lake Ontario and will generate data that can be used to determine if mink reproduction differs between

Bird and Animal Deformities BUI Delisting Criteria Addressed by this Project

Rochester Embayment AOC
- Mink are present and are reproducing, or levels of PCBs, dioxin/furans, mirex, and mercury measured in the tissue of resident prey are below those known to be associated with mink reproductive failure

Eighteenmile Creek AOC
- No reports of wildlife population deformities or reproductive problems from wildlife officials above expected natural background levels

Niagara River AOC
- Rates of deformities and reproductive problems within the AOC do not exceed rates at non-AOC control sites

St. Lawrence River at Massena AOC
- Incidence rates, if present, of deformities or other reproductive problems in sentinel species do not exceed background levels of inland control populations

inland and lakeshore habitats. These data will support the LaMP objective that the health and reproductive success of piscivorous wildlife should not be impaired by contaminants present in the aquatic food web.

Project Specifics

This project will complete a survey of the following:

Task 1. Levels of bioaccumulative chemicals in aquatic prey of mink, including fish, crayfish, and/or frogs.

Task 2. Levels of bioaccumulative chemicals in mink tissues and mink jaw lesions.

Task 3. Video surveillance of mink for evidence of reproduction.

Sampling locations for this project will include the Eighteenmile Creek AOC, Rochester Embayment AOC, Niagara River AOC, other tributaries to Western Lake Ontario (WLO), the WLO shoreline, Eastern Lake Ontario Shoreline, St. Lawrence River at Massena AOC, New York, and an inland reference site near Massena, New York (see Table 1). These locations were selected so that conditions within the Eighteenmile Creek,

Niagara River, Rochester Embayment, and Massena AOCs can be compared with conditions typical for nearby non-AOC reference sites. Such comparisons will help determine if elevated levels of bioaccumulative chemicals in wildlife prey and wildlife deformities or reproductive problems are lake-wide or AOC-specific issues. These comparisons are relevant to determining the status of BUI #5—Bird or Animal Deformities or Reproductive Problems—in the AOCs named above.

Specific methodologies for Tasks 1 through 3 are summarized below.

Task 1. Chemicals in Fish, Crayfish, and Frogs

Mink prey on fish, crayfish, and frogs (EPA 1993). Fish and crayfish will be collected from five sites along the Lake Ontario shoreline, two reference tributaries to WLO, the Rochester AOC, Niagara River AOC, the St. Lawrence River at Massena

AOC, New York, and an inland reference site near Massena, New York, and analyzed for PCBs, dioxins/furans, and chlorinated pesticides (see Table 1 for sampling locations). Five medium-sized fish and five crayfish will be harvested from each sampling location. Five frogs per location will be harvested during creek-side or shoreline surveys if adequate numbers of fish and crayfish are not available. All collected specimens will be frozen and sent to an analytical laboratory to determine whole-body levels of bioaccumulative chemicals.

Task 2. Mink Liver Analysis and Jaw Lesion Evaluation

The mink is a sentinel species commonly found along water edges and in wetlands. Since it is a predator atop the aquatic food chain, it is highly susceptible to bioaccumulative pollutants in prey (Haynes et al. 2007). Symptoms of bioaccumulative chemicals in mink include lesions on the liver and along the jaw line. Individuals captured and pelted by trappers will be used for this study. Mink livers will be removed and stored for chemical analysis of PCBs, dioxins/furans, and chlorinated pesticides. Mink jaws will be removed and stored for examination for lesions as per Haynes et al. (2007). Up to 35 liver and 35 jaw samples will be collected, five liver and five jaw samples from each of seven areas: Eighteenmile Creek; Niagara River, WLO tributaries, WLO shoreline; Eastern

Lake Ontario Shoreline; St. Lawrence River at Massena AOC, New York, and an inland reference site near Massena, New York.

Task 3. Mink Reproduction Study

Weatherproof video surveillance equipment will be used to examine trends in mink relative abundance and population structure within the Eighteenmile Creek AOC, Niagara River AOC, other tributaries to WLO, along the WLO shoreline, along the Eastern Lake Ontario Shoreline, within the St. Lawrence River at Massena AOC, and at a reference site near Massena, New York (see Table 1 for sampling locations). Differences among areas (if any) will be evaluated in light of the prey chemical data from these areas to determine if differences in mink abundance and population structure may be the result of differences in chemical exposure.

Four video stations will be employed at each study site. Video surveillance stations will be set up May 15 and will continue monitoring until November 15, which covers the post-breeding period, a time when mink families would likely travel together. All video surveillance stations will be visited once per week. The video data will be analyzed for mink presence, with special attention paid to the number of mink observed at a given time, as multiple individuals recorded during the post-breeding season are indicative of family units and mink reproduction.

TABLE 1. PROPOSED SAMPLING APPROACH AND LOCATIONS FOR EACH STUDY PARAMETER

Parameter	Sampling Locations[1]					
	Rochester Embayment AOC	Eighteenmile Creek AOC	Niagara River AOC	Additional Lake Ontario Tributaries	Lake Ontario Shoreline	St. Lawrence River at Massena AOC, NY
Bioaccumulative chemicals in mink prey	Sampling proposed at two sites, one along the lakeshore and one inland.	Sampling not required; Recent data are available from the TTM project being conducted by the USACE.	Sampling proposed at two sites along the river, one upstream at Buckhorn Island State Park and one within the Niagara Gorge.	Sampling proposed at Oak OrchardCreek and Twelve Mile Creek.	Sampling proposed at shoreline sites near the mouths of Oak Orchard Creek, Twelve Mile Creek, and the Genesee River and two sites in Eastern Lake Ontario.	Sampling proposed at two sites, one within the AOC and one at a nearby inland reference area.
Bioaccumulative chemicals in mink liver and mink jaw lesions	Sampling not required; Rochester AOC data are available from Haynes et al. (August 2007).	Sampling proposed if mink can be acquired from local trappers.	Sampling proposed if mink can be acquired from local trappers.	Sampling proposed if mink can be acquired from local trappers.	Sampling proposed if mink can be acquired from local trappers.	Sampling proposed within the AOC and at a nearby inland reference site if mink can be acquired from local trappers.
Video surveillance of mink	Sampling not required; Rochester AOC data are available from Haynes et al. (August 2007).	Sampling proposed at two sites along the creek, one upstream and one downstream of Burt Dam.	Sampling proposed at two sites along the river, one upstream at Buckhorn Island State Park and one within the Niagara Gorge.	Sampling proposed at Twelve Mile Creek and Oak Orchard Creek.	Sampling proposed near the mouths of Twelve Mile Creek and Oak Orchard Creek, and two sites in Eastern Lake Ontario.	Sampling proposed at two sites, one within the AOC and one at a nearby inland reference area.

Key: TTM = TrophicTrace Model   USACE = United States Army Corps of Engineers
Note: 1 = Suggested sampling locations are for costing purposes. Other tributaries or shoreline locations may be found to be more suitable.

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Project Goals

- Collect data to determine whether BUI #5—Bird or Mammal Deformities or Reproduction Problems—delisting criteria have been met

- Facilitate progress toward the long-term goals of the GLRI Focus Areas of Toxic Substances and AOCs and Monitoring and Evaluation

- Address ecosystem indicators of the LaMP

The mink is a sentinel species that is highly susceptible to bioaccumulative contaminants in prey, making it an ideal target species for analysis of bioaccumulative chemicals and their effects.

Project Objectives

- Sample for and determine levels of bioaccumulative chemicals in aquatic prey of mink

- Analyze livers and jaws of mink to determine levels of bioaccumulative chemicals and the potential presence of jaw lesions

- Monitor for mink presence using video surveillance

Project Outcomes

- Data to indicate whether bioaccumulative chemicals are at levels known to be associated with mink reproductive failure
- Data to indicate whether levels of bioaccumulative chemicals in prey are lake-wide or AOC-specific

- Data to indicate whether levels of bioaccumulative chemicals and rates of deformities exceed non-AOC sites

- Data to identify trends in mink relative abundance and population structure within the Eighteenmile Creek AOC, Niagara River AOC, WLO tributaries, along the WLO shoreline, along the Eastern Lake Ontario shoreline, within the St. Lawrence River at Massena AOC, and at an inland reference area near Massena, New York

Preliminary Total Cost Estimate

The estimated cost for this project is $730,816. Cost estimates per task are $229,576, $89,740, and $411,500 for Tasks 1, 2, and 3, respectively.

Project Collaborators

Eighteenmile Creek Remedial Action Plan (RAP) Coordinator and Rochester Embayment RAP Coordinator.

Sources

Haynes, James M., Sara T. Wellman, and James J. Pagano. 2007. RAP Progress in the Rochester Embayment of Lake Ontario: Population Monitoring, Trophic Relationships, and Levels of Bioaccumulative Chemicals of Concern in Mink, a Sentinel Species. Prepared for The New York Great Lakes Protection Fund.

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