# Botulism in Lake Erie
# Workshop Proceedings

*Co-Sponsored by*

New York Sea Grant
Ohio Sea Grant
Pennsylvania Sea Grant




April 3, 2003
Buffalo, New York

Proceedings by Helen M. Domske, November 2003

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Canadian Cooperative Wildlife Health Centre, University of Guelph
National Wildlife Health Center, USGS
Cornell University, Aquatic Animal Health Program

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November 2003

## Introduction – Workshop Objectives

In response to fish and bird die-offs along the shores of Lake Erie in 2002, the extension staff of New York, Pennsylvania and Ohio Sea Grant wanted to continue their efforts to deal with botulism outbreaks that have occurred since 1999. To understand the extent of the die-offs, gather scientific information and explore the ecological impacts of these botulism outbreaks the Sea Grant programs agreed to once again organize a workshop that would get a binational group of agency representatives, researchers and stakeholders together.

Building upon the success of the first two conferences on botulism that were held in 2001 and 2002, New York, Pennsylvania and Ohio Sea Grant worked together to co-sponsor a third workshop. On April 3, 2003, the third workshop on Botulism in Lake Erie was held in Buffalo, New York, to provide updates on die-offs and an overview of current research efforts. The workshop brought together 70 researchers, fishery and wildlife biologists, resource managers, and agency representatives. The goal of the workshop was to share information from the American and Canadian shores and to hear presentations from researchers working on the botulism issue.

The first conference was held in January 2001, was co-sponsored by New York and Pennsylvania Sea Grant, and was held in Erie, Pennsylvania. That workshop focused on avian botulism, since at that time most mortalities were occurring in fish-eating birds like loons and mergansers. Although organizers realized that the first conference was premature from a data standpoint, they wanted to create a functioning network of scientists who would collaborate on research issues and respond to future outbreaks. On February 28, 2002, a workshop on Botulism in Lake Erie was held in Buffalo, New York. Ohio Sea Grant joined the effort for the workshop that involved 100 participants. The goal of the workshop was to share information on outbreaks and to develop a research agenda. Copies of the proceedings from both conferences can be found at: www.nyseagrant.org/botulism/

To demonstrate a research commitment to this important environmental issue, New York Sea Grant made botulism a focus area for their 2003 call for funded research proposals. As a special focus area, botulism research was assigned a high level of support and a number of research proposals were received by the New York Sea Grant Institute. We expect that the funded projects will help to answer some of the questions related to the botulism outbreaks of the past four years.

## Lake Erie Botulism List-Serve

Realizing the importance of quick notification and advanced networking opportunities, the Sea Grant programs developed an electronic list-serve related to botulism outbreaks around Lake Erie. The e-mail listing, under the supervision of Eric Obert, sends out reports on die-offs and observations, as well as answers question ns and provides information. Members of the e-mail group include researchers, fishery and wildlife biologists, resource managers, agency representatives and concerned stakeholders. If you wish to join the list-serve, please send a message to eco1@mail.psu.edu and Eric Obert will add your name to this list.

## Botulism in Lake Erie - Overview

Botulism, a disease caused by *Clostridium botulinum,* has been recognized as a major cause of mortality in migratory birds since the early 1900s. Although type C botulism has caused the die-off of thousands of waterfowl (especially ducks) across the western United States, type E has been mainly restricted to fish-eating birds in the Great Lakes. Other outbreaks of type E have sporadically occurred in Alaska, Florida, and California, with periodic outbreaks occurring in Lake Michigan and Lake Huron over a twenty-year period beginning in 1964. During 1999 and 2000, a large die-off of waterfowl occurred in Lake Erie and type E botulism was isolated in these outbreaks. In 2001, a large die-off of benthic fishes like sheepshead occurred along the shores, followed in the fall by another die-off of fish-eating birds. Die-offs continued in 2002, with mortalities seen in benthic fishes and thousands of mudpuppies, cryptic aquatic amphibians. Bird die-offs during the 2002 fall migration were also quite large, with estimates of 17,000 dead birds in the New York waters of the lake.

The bacterium is classified into seven types (A-G) by using characteristics of the neurotoxins that are produced. The toxins produced by *C. botulinum* are among the most potent biological poisons, warranting human health and safety concerns. These neurotoxins bind to the receptors on nerve endings, impacting neuromuscular function, which results in the paralytic effect on birds. Impacted waterfowl typically show signs of weakness, dizziness, inability to fly, muscular paralysis, and respiratory impairment. Often, the inner eyelid or nictitating membrane becomes paralyzed, impairing the bird's normal vision.

Although type C and type E avian botulism outbreaks occurred in the Great Lakes in the past, there are some significant differences between the two types. Type C botulism primarily impacts dabbling ducks and bottom-feeding waterfowl, although shorebirds may also fall victim to this type of botulism. In type C botulism, the bacterium, *C. botulinum,* does not produce toxin unless it is infected by a specific "phage" or virus. This relationship with a phage is not known to exist with type E. Type E botulism typically impacts fish-eating birds like loons and grebes. Several species of gulls that are common in the Great Lakes region have been impacted by type C and type E botulism. While live fish can carry spores of type E botulism, it is not known whether they can carry the toxin itself or become sick and die from the toxin. Type E toxin has been found in carcasses of several species of Great Lakes fish, including round gobies, and researchers are studying the role this invader may play, if any, in recent outbreaks of the disease in Lake Erie.

Spores of both type C and type E botulism are naturally found in anaerobic habitats such as soils and aquatic sediments, and can also be found in the intestinal tracts of live, healthy animals. The spores can remain in the ecosystem for extended periods of time, even years, and are quite resistant to temperature extremes and drying. In the absence of oxygen, with a suitable nutrient source, and under favorable temperatures and pH, spores can germinate and vegetative growth of bacterial cells can occur (Brand, *et. al* 1988).

Botulism toxin is only produced during vegetative growth, not when the bacterium is in its spore stage. Decaying animal and insect carcasses provide favorable conditions for botulism

toxin production since the decay process uses up oxygen and creates anaerobic conditions (Friend, *et al.* 1996).

It has long been known that type C botulism is perpetuated through a carcass-maggot cycle. Researchers have now determined that type E botulism can also be spread through this cycle. Birds and fish that have died from botulism decay and become hosts for maggots. The maggots may contain the botulism toxin and if fed upon by birds, the cycle is continued.

## Human Health Considerations

Human botulism is typically caused by eating improperly canned or stored foods and normally involves type A or type B botulism toxin. There have been several fatalities during the 1960s in the Great Lakes basin attributed to type E toxin, but these were caused by eating improperly smoked or cooked fish that contained the toxin. Humans, dogs, and cats are generally considered resistant to type C avian botulism (Friend, *et al.* 1996).

The toxin found in food items will be killed by proper cooking of fish and waterfowl. When canning or smoking fish or waterfowl, methods should be used that incorporate sufficient heat to insure that any toxins will be killed off. Anglers and hunters should avoid harvesting any sick or dying fish or waterfowl, or those demonstrating unusual behavior, in areas where avian botulism has occurred. People should not handle dead birds or fish with bare hands. The use of gloves or an inverted plastic bag is recommended in order to avoid risks. If a diseased or dead bird is handled without gloves, hands should be thoroughly washed with hot soapy water or an anti-bacterial cleaner.

In case of a die-off, individuals are urged to contact local agencies responsible for fish and wildlife management to notify them of fish and bird mortalities. It is important to record the location, type of birds or fishes, and number of carcasses found. Stakeholders should follow agency recommendations in handling dead fish and wildlife. In certain areas, burying of the carcasses is allowed, in other areas incineration may be recommended. If birds are to be collected, they should be placed in heavy plastic bags to avoid the spread of botulism-containing maggots.

**References:**

Brand, Christopher J., Stephen M. Schmitt, Ruth M. Duncan and Thomas M. Cooley, *An Outbreak of Type E Botulism Among Common Loons (Gavia immer) in Michigan's Upper Peninsula*, Journal of Wildlife Diseases, 24(3), 1988, pp. 471-476.

Friend, Milton, Louis N. Locke and James J. Kennelly, National Wildlife Health Laboratory, Madison, Wisconsin. 1996.

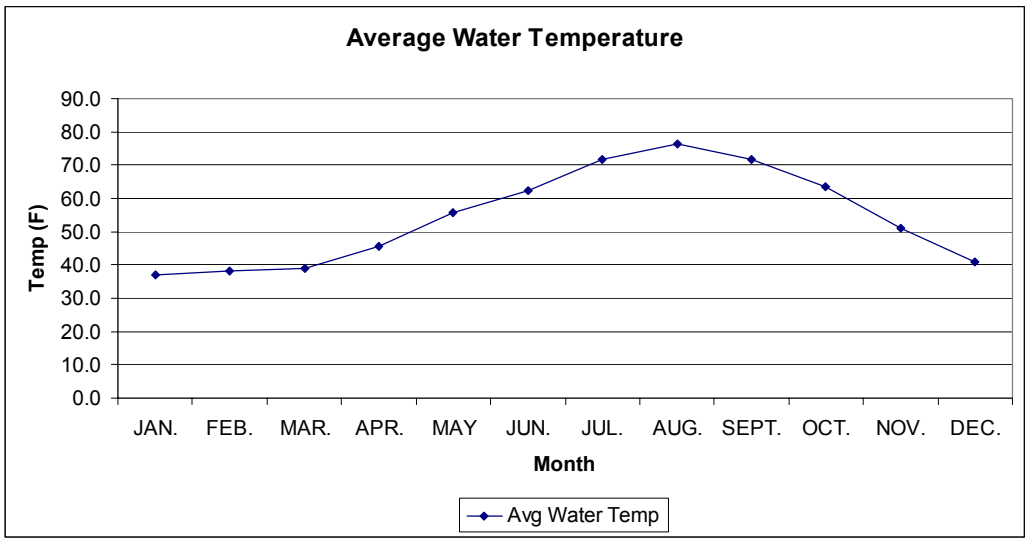
Avian Botulism Factsheet: http://www.nwhc.usgs.gov/facts/avian.html

## Pennsylvania Update

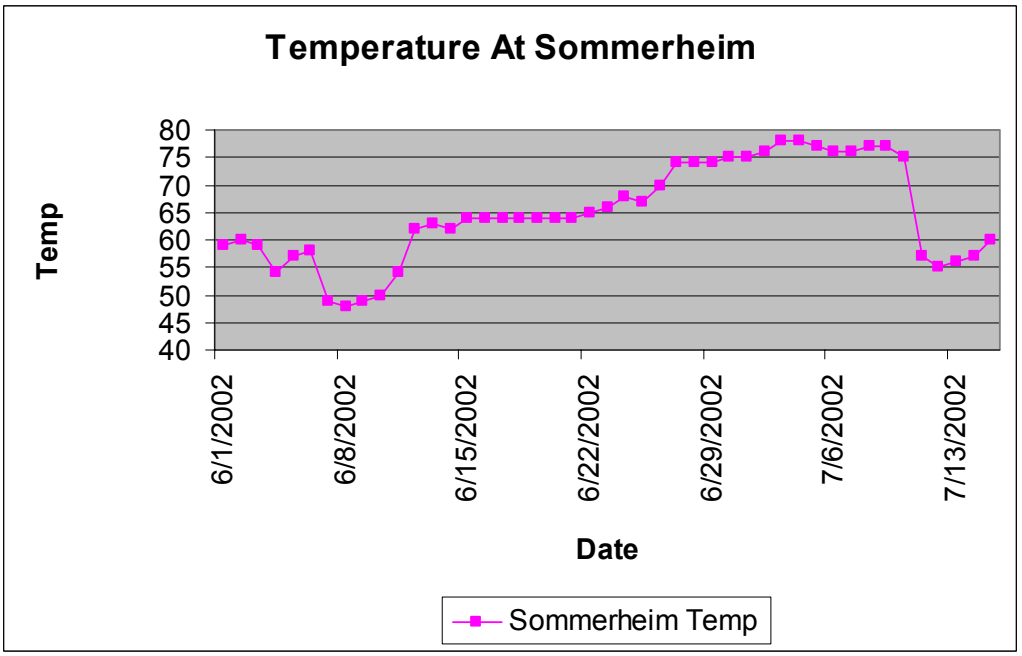
# Botulism in Lake Erie

Bob Wellington – Erie County Health Department
Mike Mumau – Presque Isle State Park

**Near shore water temperature @ Erie Waterworks Intake**




**July 11, 2002: Fish Die-off**



**Blue-green algae bloom, Horseshoe Pond, Presque Isle State Park**

**Collection Procedures & Data for Dead Fish Presque Isle State Park**

- Nearly 2000 fish collected on Presque Isle during summer 2002
- July 10 & 11 − 446 dead fish collected
- Collected regularly on Monday, Wednesday and Friday. Also early morning on weekends
- Collected by interns, placed in plastic bags, sealed and deposited in compacter
- Concentration found west of Beach 6

**Most Common Fish Species**

- Freshwater Drum
- Channel Catfish
- Small mouth Bass
- Common Carp
- Alewife
- Walleye
- White sucker
- Yellow Perch
- Bluegill

**Collection Procedures & Data for Dead Birds, Presque Isle State Park**

- Bird mortalities were reduced compared to 2001
- Ring-billed gulls, herring gulls − in the summer
- Loons − in the fall
- Cooperative agreement with Erie County Humane Society for disposal (incineration)
- Double bagged, then placed in freezer for temporary storage
- Park interns and maintenance staff work cooperatively

**New York Update**

# Waterbird Mortality in New York Waters of Lakes Erie and Ontario Resulting from Type E Botulism

Kenneth Roblee
NYS Department of Environmental Conservation
Bureau of Wildlife, Region 9

Botulism Observed in a Gull Colony

- The Bethlehem Steel gull colony near Buffalo contains approximately 10,000 pairs of nesting Ring-billed gulls.
- During a July 5, 2002 inspection of the colony, 946 dead gulls (adults and chicks) were counted.
- The following week approximately 3,000 dead gulls were observed.
- Type E botulism was diagnosed and mudpuppies were found in gull stomachs.

**Lake Erie Botulism Mortality Surveys**
**100m Transect Survey Results**
**by NYSDEC 10/15/02 – 1/09/03**
**Table 1, Section 1**

| Species | Predicted Mortality | Upper Conf. | Lower Conf. |
|---|---|---|---|
| | | | |
| Common Loon | 2,042 | 3,447 | 637 |
| Horned Grebe | 273 | 482 | 64 |
| Red Necked Grebe | 36 | 84 | 0 |

**Lake Erie Botulism Mortality Surveys**
**100m Transect Survey Results**
**by NYSDEC 10/15/02 – 1/09/03**
**Table 1, Section 2**

| Species | Predicted Mortality | Upper Conf. | Lower Conf. |
|---|---|---|---|
| | | | |
| Wood Duck | 18 | 54 | 0 |
| Greater Scaup | 128 | 213 | 43 |
| Long-tailed Duck | 12,616 | 20,808 | 4,424 |
| Scoter | 18 | 54 | 0 |
| C. Merganser | 18 | 54 | 0 |
| R-b Merganser | 839 | 1,405 | 273 |
| Unidentified Merg. | 383 | 649 | 117 |
| Unidentified Duck | 36 | 108 | 0 |

**Lake Erie Botulism Mortality Surveys**
**100m Transect Survey Results**
**by NYSDEC 10/15/02 – 1/09/03**
**Table 1, Section 3**

| Species | Predicted Mortality | Upper Conf. | Lower Conf. |
|---|---|---|---|
| | | | |
| Bonaparte's Gull | 18 | 54 | 0 |
| Ring-billed Gull | 273 | 429 | 117 |
| Herring Gull | 474 | 767 | 181 |
| Gr. Black-bkd. Gull | 36 | 84 | 0 |
| Unidentified Gull | 91 | 203 | 0 |
| | | | |
| TOTAL BIRDS* | 17,301 | 27,566 | 7,036 |

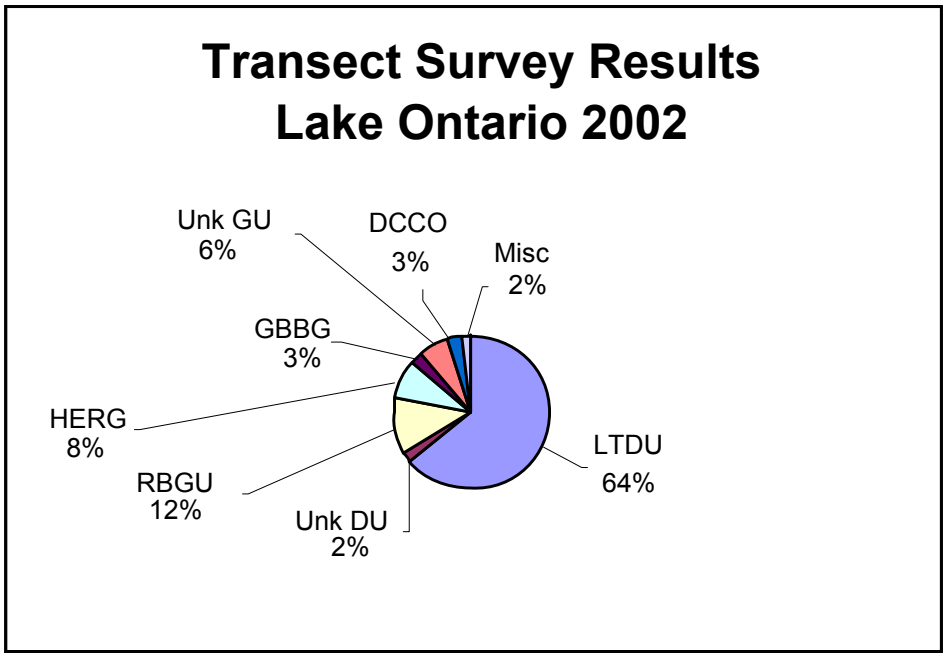
***** Total from Table 1, sections 1, 2 & 3

**Lake Erie Waterbird Mortality**
**New York Botulism Transect Survey Results**

| | 2000 | 2001 | 2002 |
|---|---|---|---|
| | | | |
| Common Loon | 583 | 1,149 | 2,042 |
| Horned Grebe | 109 | 0 | 273 |
| Long-tailed Duck | 0 | 310 | 12,616 |
| Red-breasted Merganser | 2,479 | 91 | 839 |
| Ring-billed Gull | 1,714 | 510 | 273 |
| TOTAL BIRDS | 5,415 | 2,862 | 17,301 |

**Lake Ontario Botulism Mortality Survey**
**100 M Transect Survey Results**
**NYSDEC 2002**

| Species | Predicted Mortality | Upper Limit 95% Confidence | Lower Limit 95% Confidence |
|---|---|---|---|
| Long-tailed Duck | 675 | 1,336 | 0 |
| Herring Gull | 80 | 83 | 0 |
| Ring-billed Gull | 129 | 251 | 7 |
| Greater Black-backed Gull | 32 | 76 | 0 |
| Double-crested Cormorant | 32 | 76 | 0 |
| Unknown Duck | 16 | 48 | 0 |
| Unknown Gull | 64 | 25 | 3 |
| Misc Unknown | 16 | 48 | 0 |
| TOTAL BIRDS | 1,046 | 1,924 | 168 |




**Niagara County Botulism Mortality Survey**
**100 M Transect Survey Results**
**NYS DEC 2002**

| Species | Predicted Mortality | Upper Limit 95% Confidence | Lower limit 95% Confidence |
|---|---|---|---|
| Long-tailed Duck | 700 | 1,169 | 231 |
| Unknown Duck | 17 | 50 | 0 |
| Ring-billed Gull | 100 | 201 | 0 |
| Herring Gull | 67 | 164 | 0 |
| Greater Black-backed Gull | 17 | 50 | 0 |
| Unknown Gull | 17 | 50 | 0 |
| Double-crested Cormorant | 17 | 50 | 0 |
| Misc. Unknown | 17 | 50 | 0 |
| TOTAL BIRDS | 950 | 1,565 | 335 |

**2002 in Summary**

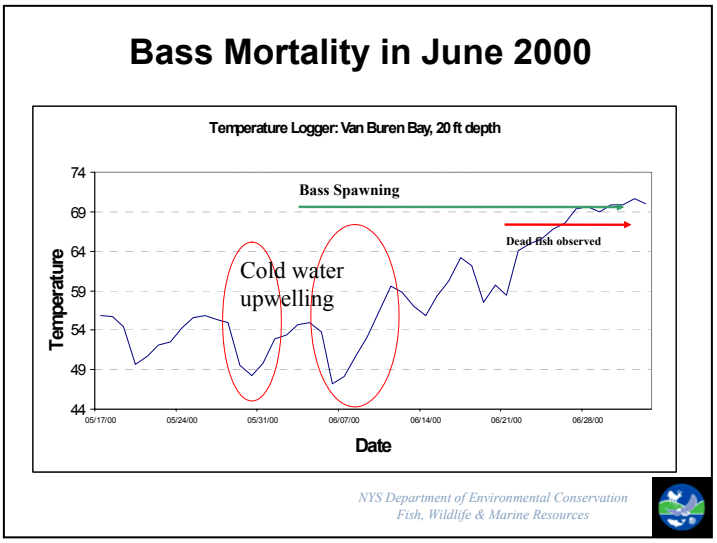
- Significant mortality observed at Bethlehem Steel gull colony.
- Loon, long-tailed duck and total bird mortality increased in Lake Erie.
- Botulism-caused mortality observed in gulls and long-tailed ducks in Lake Ontario.

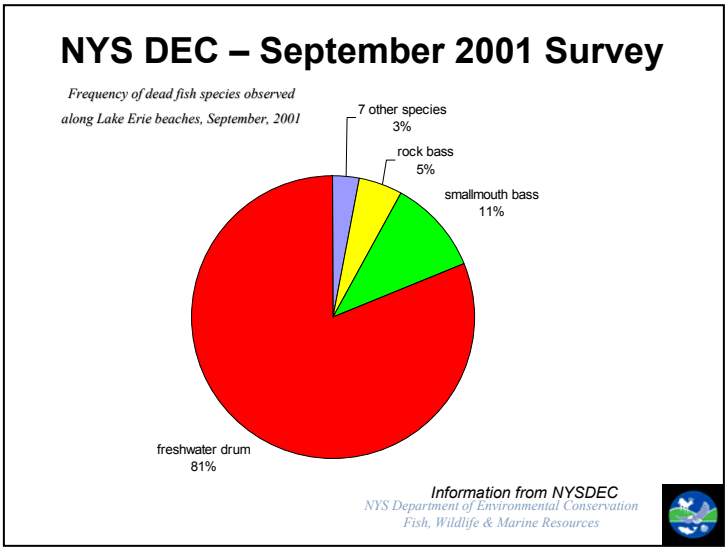
# Long-Term Assessments of Warmwater Fish Stocks and Characteristics of Fish Kill Events in NY's Portion of Lake Erie

Don Einhouse
NYS Department of Environmental Conservation
Lake Erie Fisheries Unit

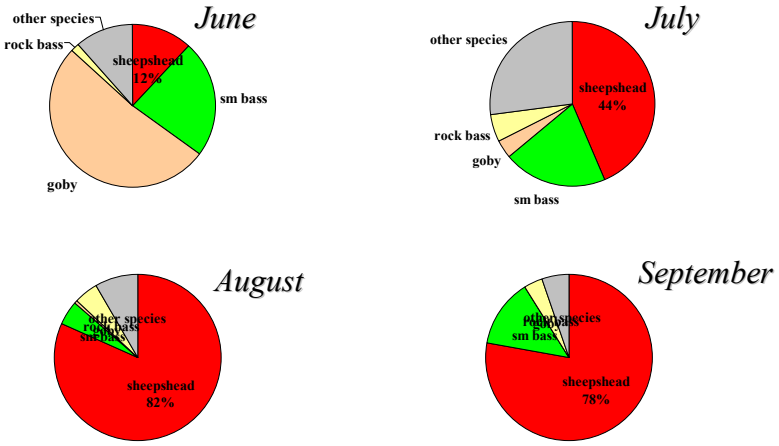
**Common fish kills observed in eastern Lake Erie through the years**

- March-April, Alewife & Gizzard Shad - temperature stress
- May-June Smelt - *Glugea* and spawning
- June-July Smallmouth Bass - spawning & upwellings?
- June-August Warmwater Fish - upwellings



## 2002 Fish Kills: Fish Species Composition

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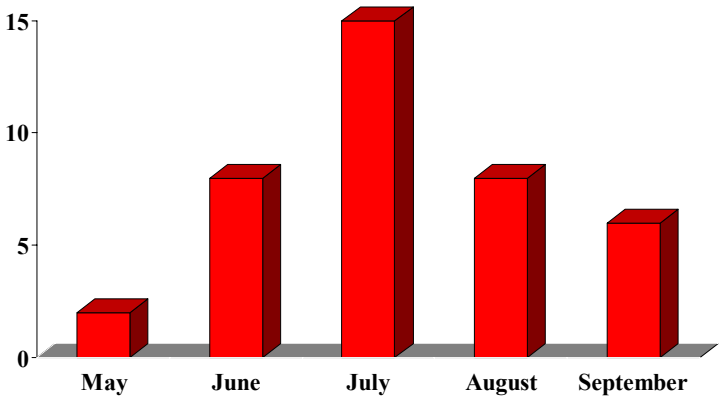
## Number of Fish Kill Investigations per Month, 2002

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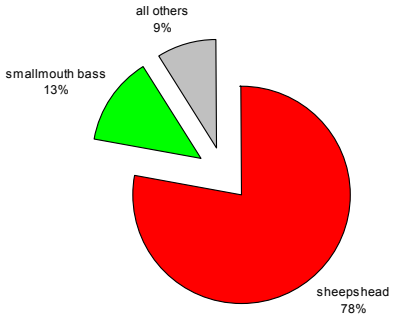
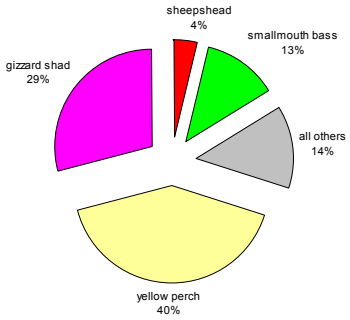
## September Fish Kills




## September Net Collections

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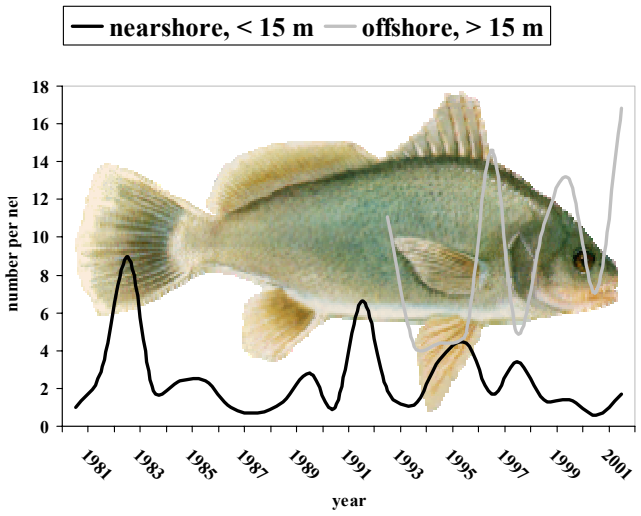
## Sheepshead Abundance

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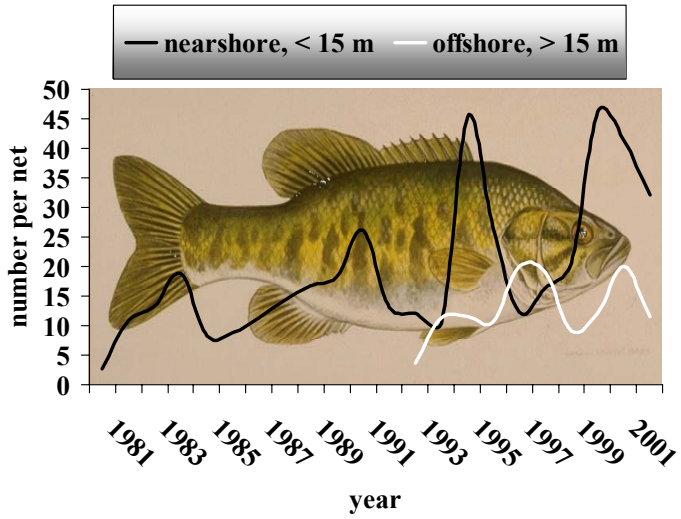
# Smallmouth Bass Abundance

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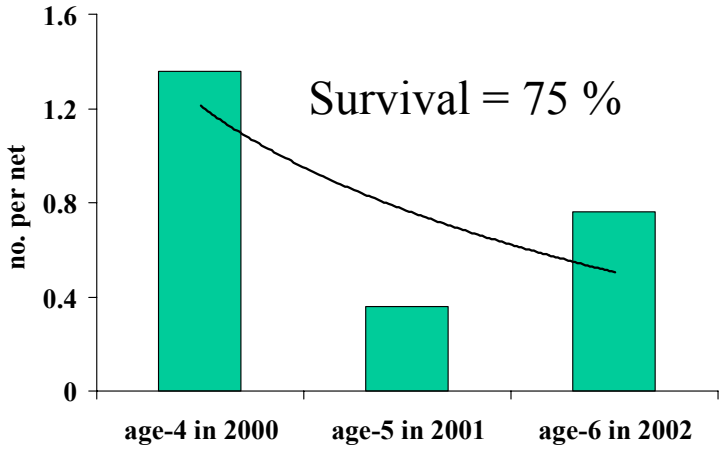
# 1996 Smallmouth Bass Year Class

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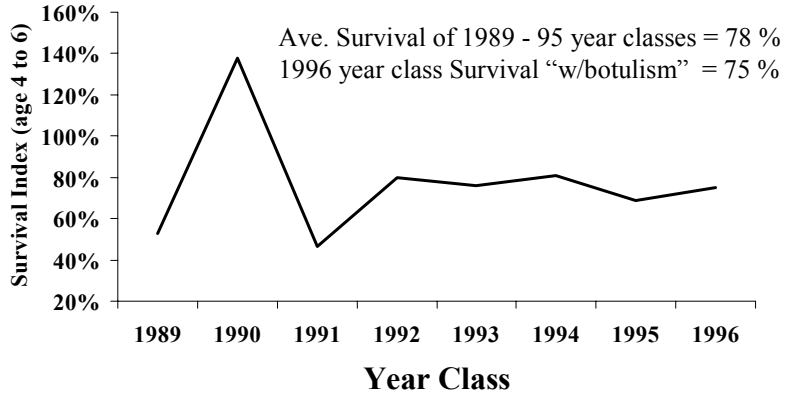
# Smallmouth Bass Survival




Ave. Survival of 1989 - 95 year classes = 78 %
1996 year class Survival "w/botulism" = 75 %

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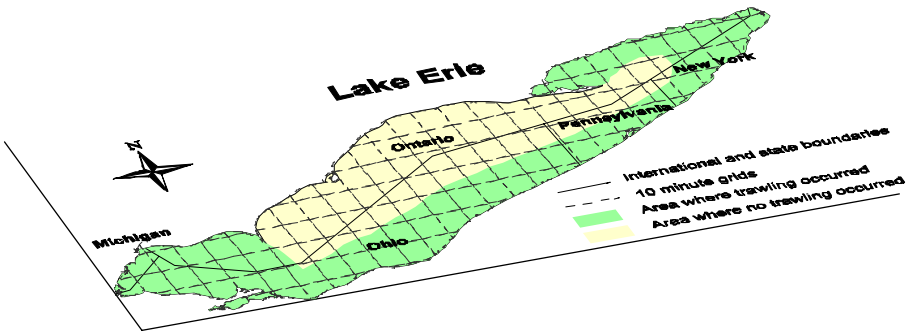


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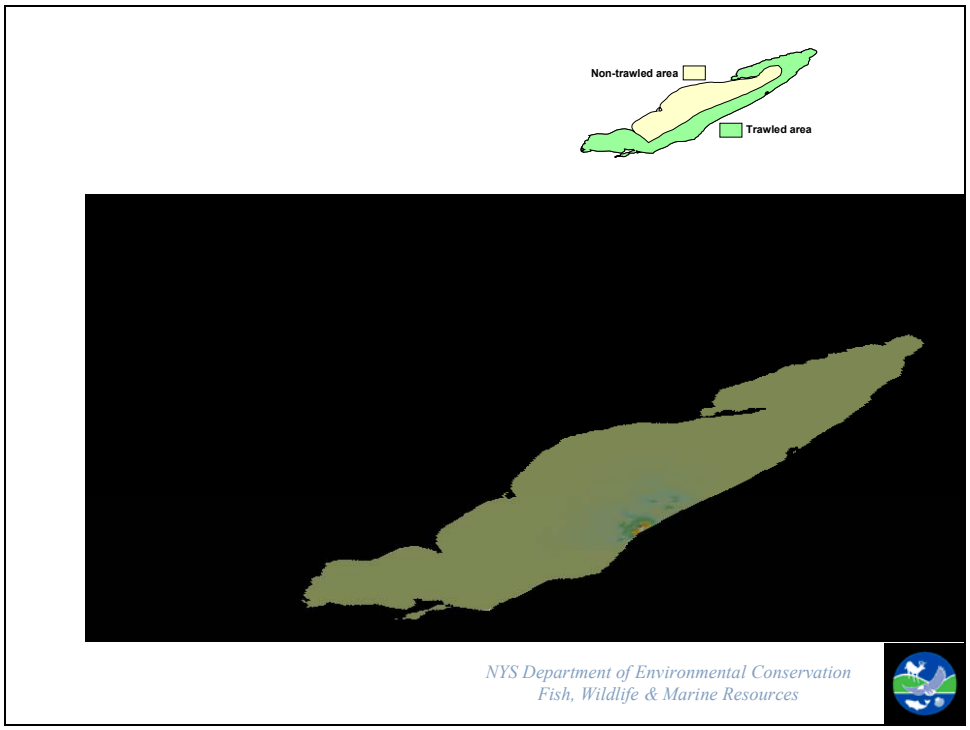
Non-trawled area
Trawled area
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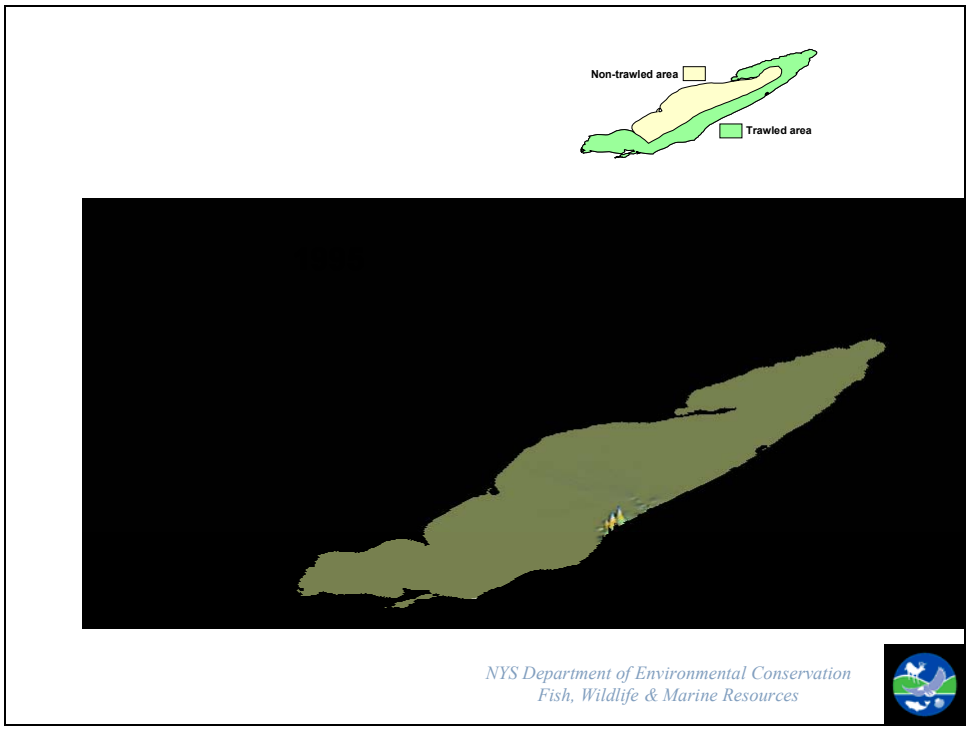
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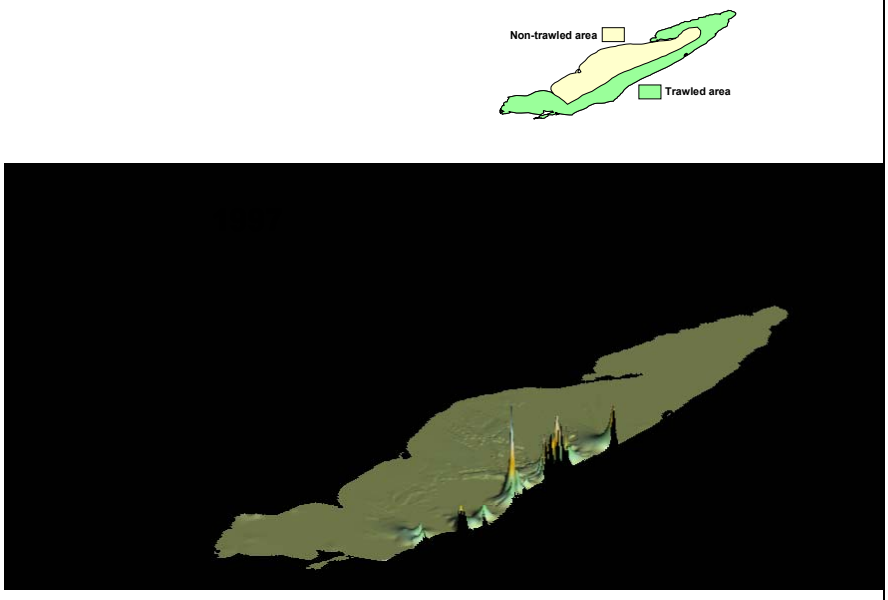


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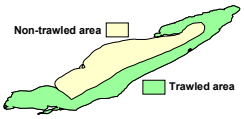


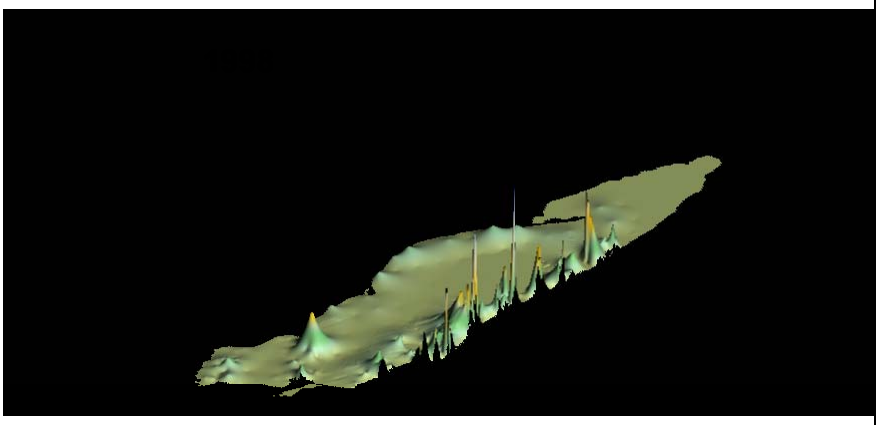

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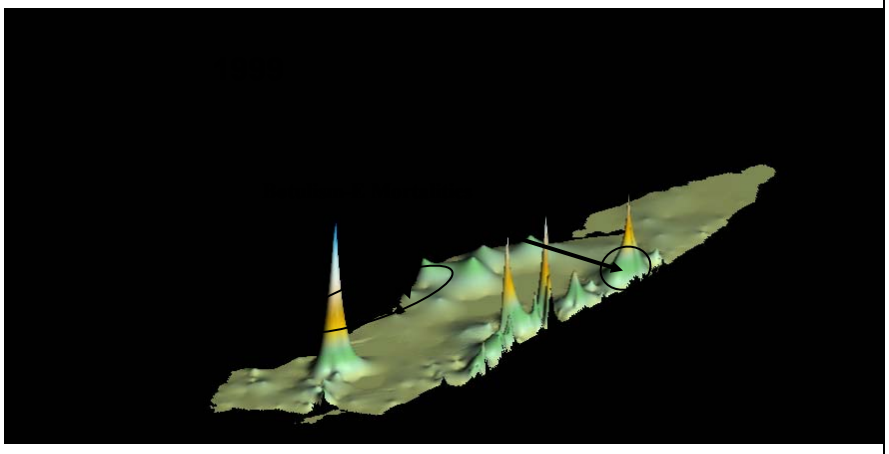

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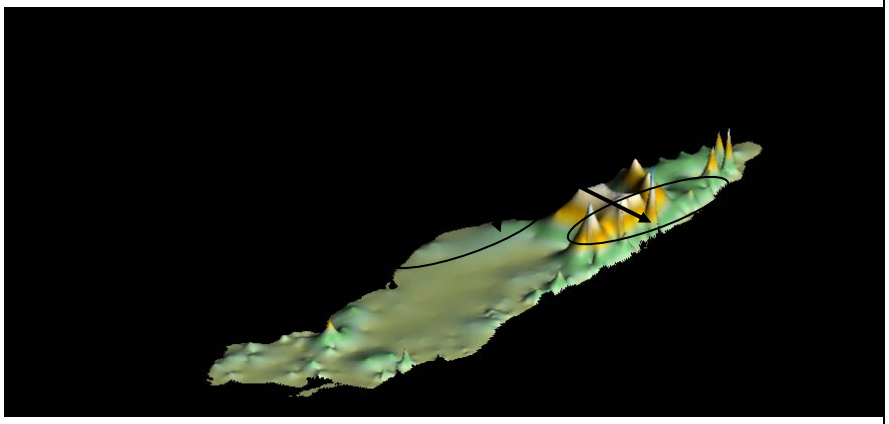


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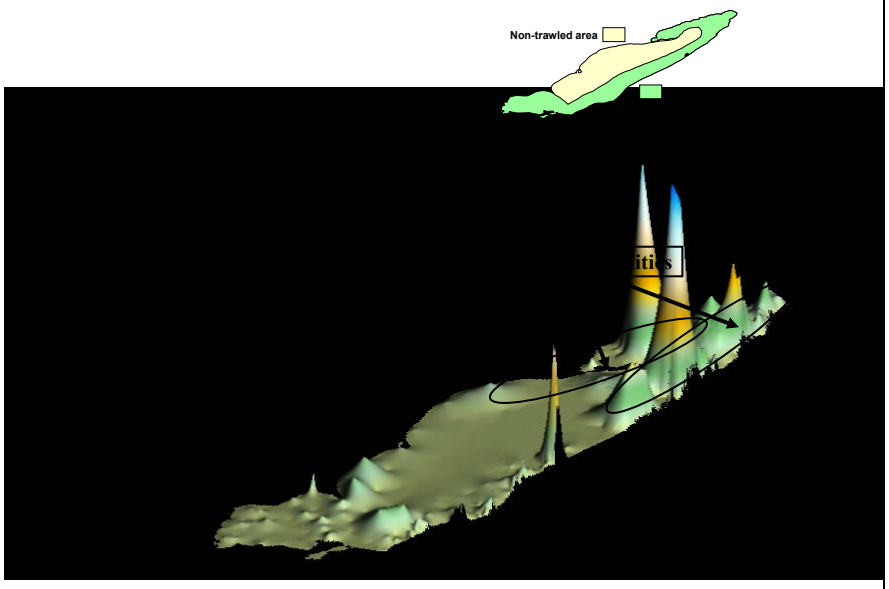


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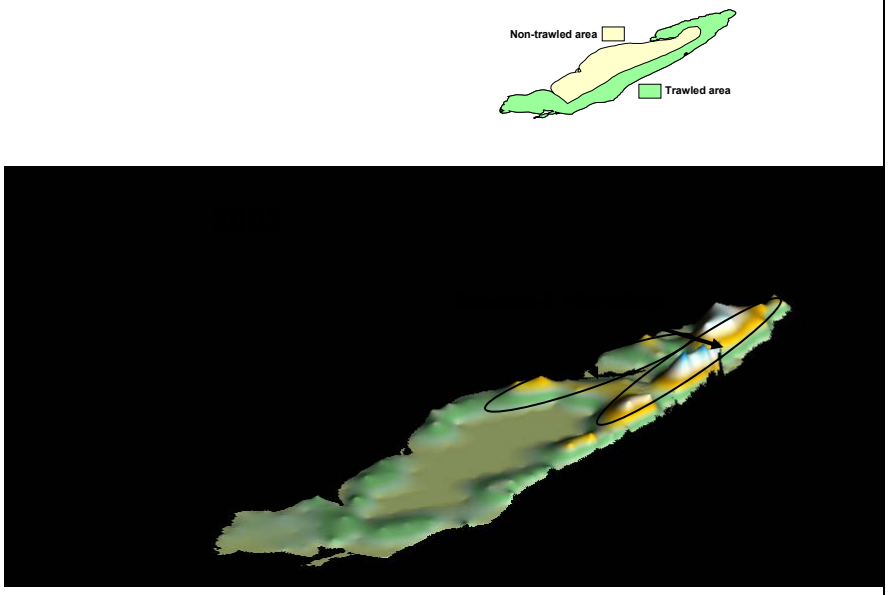


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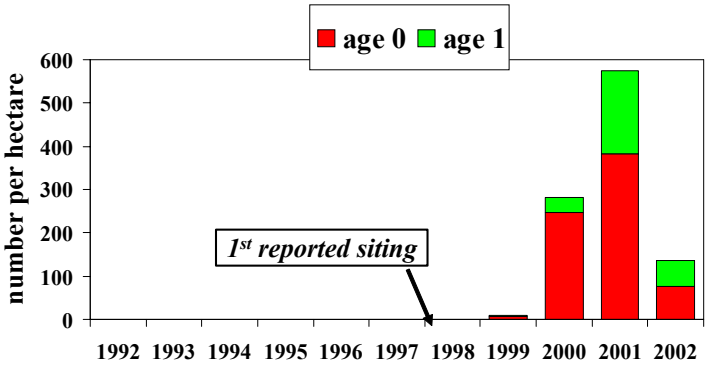
# Round Goby Abundance NY Waters of Lake Erie

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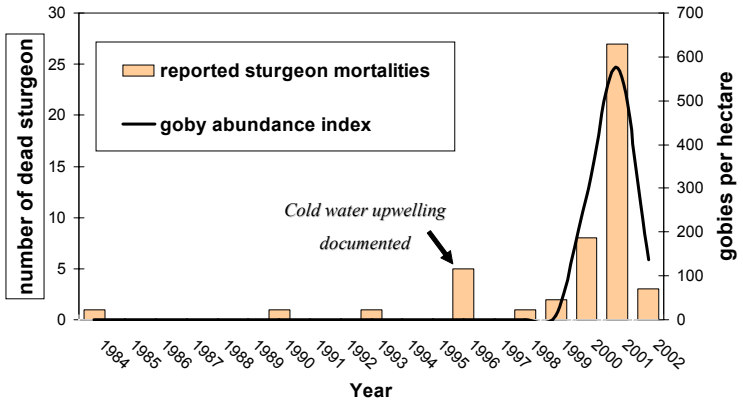
# Sturgeon Mortalities and Goby Abundance

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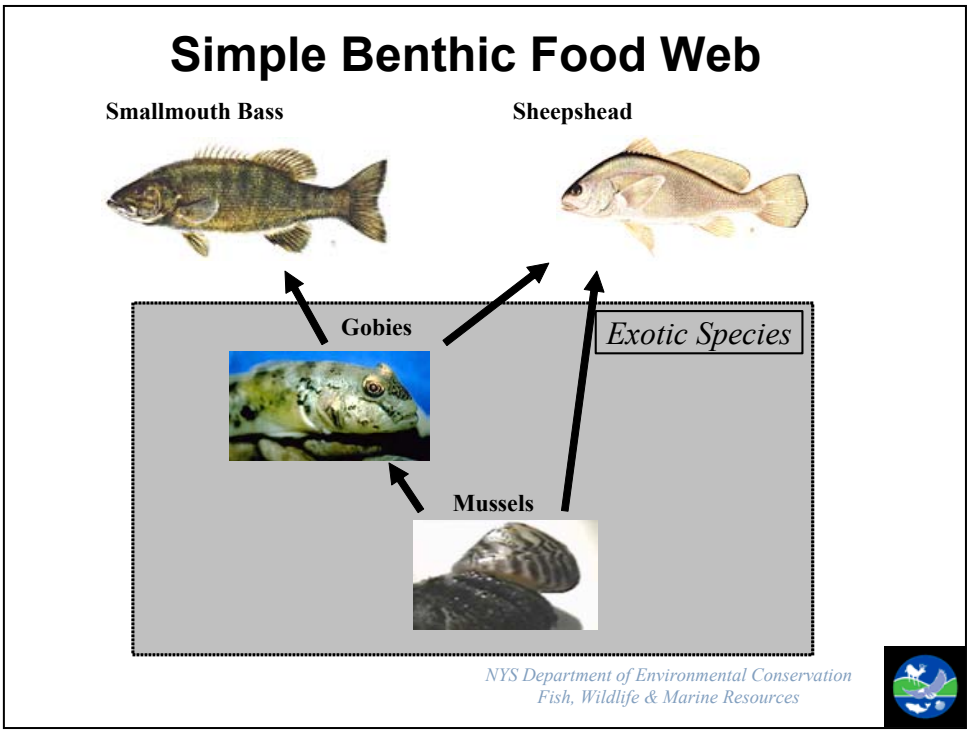
# Smallmouth Bass Diets from Annual September Sampling

| Year | Sample (n) | Percent of stomachs with selected prey | | | |
|---|---|---|---|---|---|
| | | crayfish | clupeids | smelt | goby |
| 1985 - 87 | 173 | 23.7 % | 9.8 % | 4.6 % | 0.0 % *Prior to Goby presence* |
| 1999 | 80 | 11.3 % | 15.0 % | 10.0 % | 42.5 % |
| 2000 | 170 | 4.1 % | 1.2 % | 2.4 % | 89.4 % |
| 2001 | 58 | 1.7 % | 1.7 % | 6.9 % | 58.6 % |
| 2002 | 22 | 13.6 % | 4.5 % | 0.0 % | 81.8 % |

*NYS Department of Environmental Conservation*
*Fish, Wildlife & Marine Resources*




**NYS DEC - Lake Erie Unit Research Partnerships**

- NYS DEC - Wildlife Pathology Unit
- Cornell University - Aquatic Animal Health Program
- SUNY Fredonia - Biology Department

**Questions?**

- Where is the anaerobic environment in eastern Lake Erie?
- Some benthic fish species are conspicuous by their absence in fish kills, ex. suckers, yellow perch?
- We have experienced abundant mussel densities for over a decade, but botulism only recently?

## Botulism in Fish and Wildlife in NYS Waters of Lake Erie

Ward Stone – Pathologist, NYS Department of Environmental Conservation
(Slide presentation – not available)

This presentation focused on the work being done by NYSDEC pathologist Ward Stone and his lab colleagues. He indicated that there were more than 7,000 submissions for botulism testing during the year. Type E botulism was diagnosed for the first time in 2002 and the toxin was found in sheepshead and smallmouth bass.

Regarding the birds that were examined, Stone indicated that the birds were not thin, and it appeared that these fish-eating birds looked like they drowned. He noted that round gobies and mudpuppies were found inside many of these birds. Some of the bird carcasses were scavenged by other mammals, which would seem to explain the opossum and 2 raccoons that were recovered and tested positive for botulism. He did mention that 1,100 loon carcasses were found over a small area, indicating the intensity of the die-off.

He also mentioned that shorebirds ate fly maggots and the larvae were in the gizzards which concentrated the toxin. Stone surmised that long-tailed ducks were eating quagga mussels and were probably picking up the type E toxin directly from the mussels.

Ward Stone discussed experiments that his lab worked on, including feeding pieces of loon livers that contained the type E toxin to round gobies. He stated that round gobies carry the toxin quite readily and are highly susceptible. Within 12 hours the gobies are usually dead, but can survive up to 24 hours.

Concerning the outbreak in Lake Ontario, Stone gave the following information on species impacted by type E: A ring-billed gull was collected at Fair Haven on July 16, 2002. A long-tail duck was found at Four Mile Creek, and a common goldeneye was collected at Fort Niagara on October 29th . A herring gull was collected at West Brighton, Pt. Breeze on November 4, 2002.

Stone also noted that his lab found 10 different types of botulism type E in specimens collected and also a variety of botulism types were found in the Lake Erie sediments.

**Found and Examined Type E Botulism Outbreak**

| 2000 | 2001 | 2002 | |
|---|---|---|---|
| 106 | 303 | 434 | Common Loon |
| 11 | 5 | 128 | Horned Grebe |
| 2 | 29 | 19 | Double-crested Cormorant |
| 1 | 44 | 4,877 | Long-tailed Duck |
| 424 | 16 | 627 | Red-breasted Merganser |
| 70 | 58 | 151 | Herring Gull |
| 427 | 160 | 856 | Ring-billed Gull |
| 33 | 22 | 22 | Great Black-backed Gull |
| 0 | 23 | 2 | Sanderling |
| 13 | 3 | 22 | Bonaparte's Gull |
| 1,100 | 706 | 7,202 | TOTAL |

**Canadian Update**

# Type E Botulism in Fish-eating Birds

# Ontario 2002

**Jeff Robinson**

**Canadian Wildlife Service**

**Ontario Region, London**

**G. Douglas Campbell and Ian K. Barker**

**Canadian Cooperative Wildlife Health Centre**

**Ontario Veterinary College**

**University of Guelph**

## What are we studying in Canada?

- Stomach examination of fish eating birds to determine food habits (ongoing, OMNR, Canadian Co-operative Wildlife Health Centre)
- Distribution of fish and bird mortality events (OMNR, CWS)
- Loon population analysis for Ontario breeding lakes (CWS)
- Experimental dosing of fish with Type E toxin to:
  - evaluate toxic dose
  - fish behavior relevant to consumption by fish-eating birds
  - tissue distribution

  (R.D. Moccia - University of Guelph & graduate student)


**2002 Type E Botulism Test Results**

| Case # | Date | Location | Species | Result | Stomach contents |
|---|---|---|---|---|---|
| W321.02 | 28 June | Mohawk Is. | Herring Gull | + | |
| W322.02 | " | " | RB Gull | - | |
| W338.02 | 9 July | Pt. Pelee NP | RB Gull | - | |
| W360.02 | 14 July | " | RB Gull | + | |
| W386.02 | 2 August | Mohawk Is. | Caspian Tern | - | |
| W387.02 | " | " | DC Cormorant | - | |
| W388.02 | " | " | RB Gull | NT | |
| W415.02 | 4 Sept. | Pt. Dover | RB Gull | - | |
| W449.02 | 31 August | Long Pt. | Sanderling | - | |
| W450.02 | " | " | DC Cormorant | - | unidentified fish bones |
| W451.02 | " | " | Golden Plover | + | |
| W503.02 | 15 October | Kincardine | Common Loon | - | unidentified fish bones |
| W504.02 | " | " | Red Necked Grebe | + | round goby |
| W515.02 | " | " | Common Loon | - | unidentified fish bones |
| W516.02 | " | " | Red Breasted Merganser | + | unidentified fish bones |
| W517.02 | " | " | Red Necked Grebe | - | empty |
| W518.02 | " | " | Pied Grebe | - | empty |
| W519.02 | " | " | RB Gull | - | unidentified fish bones, Physells spp.,zm |
| W520.02 | 30 October | Lincoln | Ruddy Duck | - | |
| W521.02 | 31 October | Burlington | Long Tailed Duck | - | empty |
| W550.02 | 9 November | Hoover Pt. | Common Loon | NT | unidentified fish bones, zm |
| W551.02 | " | " | Red Breasted Merganser | NT | |
| W552.02 | " | " | Horned Grebe | NT | |
| W553.02 | " | " | Long Tailed Duck | NT | |
| W554.02 | 9 November | Quarrie Rd. | Common Loon | NT | |
| W555.02 | " | " | Long Tailed Duck | NT | |
| W556.02 | 9 November | Long Beach | Common Loon | + | |
| W557.02 | " | " | Long Tailed Duck | - | |
| W561.02 | 9 November | Nickle Beach | Common Loon | NT | empty |
| W562.02 | " | " | Horned Grebe | NT | |
| W563.02 | " | " | Long Tailed Duck | NT | |
| W566.02 | 9 November | Long Pt. | Common Loon | + | |
| W579.02 | | John Pearce PP | RB Gull | NT | |
| W580.02 | | Pt. Bruce | RB Gull | NT | |
| W581.02 | | Pt. Burwell PP | RB Gull | NT | |
| W582.02 | | Pt. Stanley | RB Gull | NT | |

## Beach Survey, North Shore, Lake Erie

## November 14, 2002

Long Point NWA

| | | |
|---|---|---|
| Common Loon | 720 | 30 per km of beach surveyed |
| Gull spp. | 254 | 10.6 |
| Red-breasted merganser | 43 | 1.8 |
| Scaup spp. | 7 | 0.3 |
| Long-tailed duck | 4 | 0.2 |
| White-winged scoter | 1 | |
| Horned Grebe | 1 | |
| carp | 100 | |
| Total | 830(34/km) | |

Points west of Long Point NWA

Port Burwell

| | |
|---|---|
| Bonaparte's Gull | 60 |
| Ring-billed Gull | 76 |
| Herring Gull | 11 |
| Herring or Ring-billed | 31 |
| Great Black-backed Gull | 1 |
| Common Loon | 11 |
| Horned Grebe | 1 |
| White-winged Scoter | 1 |
| Red-breasted Merg | 8 |
| Greater Scaup | 1 |
| Total | 201(50/km) |

Port Bruce

| | |
|---|---|
| Bonaparte's Gull | 26 |
| Herring or Ring-billed Gull | 35 |
| Great Black-backed Gull | 1 |
| Common Loon | 7 |
| Horned Grebe | 3 |
| Double-crested Cormorant | 2 |
| Red-breasted Merganser | 6 |
| scaup species | 1 |
| Total | 81(160/km) |

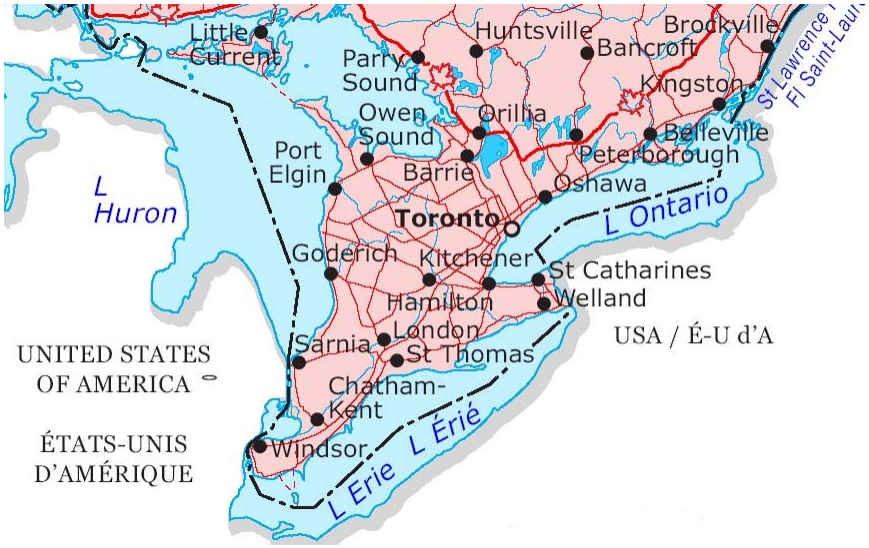
Port Stanley

| | |
|---|---|
| Bonaparte's Gull | 16 |
| Ring-billed Gull | 95 |
| Herring Gull | 15 |
| Common Loon | 3 |
| Red-breasted Merganser | 4 |
| Total | 133(50/km) |

Rondeau Provinical Park(October 25, 2002)

| | |
|---|---|
| Common Loon | 82 |
| Red-breasted Merganser | 40 |
| Gull spp | 4 |
| Total | 126(13/km) |

Round gobies now are found as far north as Severn Sound in Georgian Bay, and the North Channel of Lake Huron



**Gizzard contents analysis from 2002 botulism events (confirmed and suspected)**

| | Common Loon Erie Nov 9 | Common Loon Huron Oct 15 | LT Duck Erie Oct 30 | LT Duck Nov 9 |
|---|---|---|---|---|
| Empty | 17 | - | 1 | 1 |
| Fish(no ID) | 25 | 6 | 5 | - |
| Perch(white and yellow) | 5 | - | - | - |
| Goby | 1 | - | - | - |
| Shad | 1 | - | - | - |
| Shiner | 2 | - | - | - |
| Zebra Mussels | 2 | 1 | 18 | 3 |
| Other items | 5 | - | 1 | - |

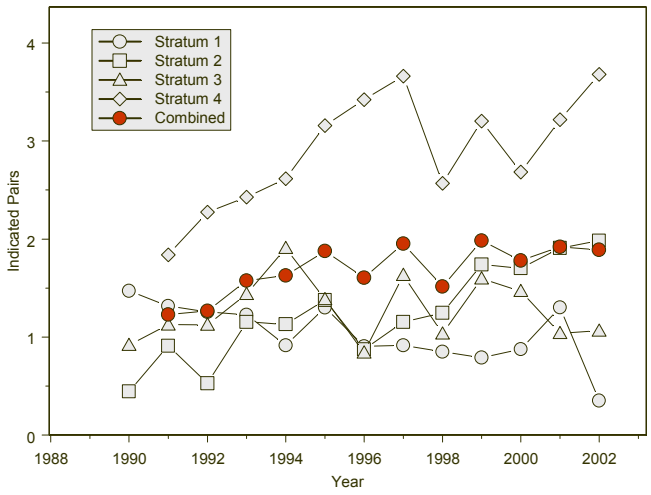
Breeding loon numbers in Stratum 4 (north-central Ontario) ~doubled 1991-2002

Table 6: Estimated number of indicated pairs and standard error

## Common Loon

| Year | --Stratum 1-- | | --Stratum 2-- | | --Stratum 3-- | | --Stratum 4-- | | -----Total----- | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1990 | 4856 | 1166 | 2346 | 636 | 4424 | 978 | | | | |
| 1991 | 3458 | 929 | 4278 | 1030 | 5407 | 1476 | 18979 | 3890 | 32122 | 4386 |
| 1992 | 3192 | 813 | 2304 | 512 | 5407 | 1745 | 23511 | 4124 | 34414 | 4580 |
| 1993 | 3746 | 962 | 5520 | 1303 | 7374 | 1964 | 25846 | 5746 | 42485 | 6285 |
| 1994 | 2882 | 763 | 5013 | 1156 | 10815 | 2788 | 28239 | 5568 | 46948 | 6379 |
| 1995 | 3458 | 1544 | 6323 | 1712 | 7692 | 1998 | 24786 | 7002 | 42258 | 7637 |
| 1996 | 1773 | 657 | 2484 | 697 | 5838 | 1590 | 29929 | 6229 | 40024 | 6499 |
| 1997 | 3192 | 1100 | 5493 | 1003 | 14010 | 2890 | 39038 | 9200 | 61733 | 9758 |
| 1998 | 2660 | 786 | 5332 | 1203 | 8173 | 1423 | 28194 | 5585 | 44358 | 5940 |
| 1999 | 1419 | 452 | 7097 | 1394 | 9807 | 1857 | 28194 | 5654 | 46517 | 6129 |
| 2000 | 2305 | 731 | 5962 | 1510 | 11208 | 3062 | 24724 | 4970 | 44199 | 6074 |
| 2001 | 5047 | 1618 | 7593 | 1688 | 8406 | 1822 | 37303 | 6688 | 58349 | 7316 |
| 2002 | 1820 | 499 | 8517 | 1547 | 7005 | 1483 | 40339 | 7401 | 57680 | 7722 |

Figure 1 Indicated Pairs for Common Loon



# Environmental Parameters Associated with Outbreaks of Botulism in Eastern Lake Erie

Alicia Perez-Fuentetaja,
Theodore Lee, Mark Clapsadl
Biology Department, SUNY Fredonia

**Outline:**

- Overall view of two-year project
- Goals
- First field season
- Methods
- Field results
- Future work

**Project:** "*Botulism Type E in Lake Erie: Ecology and Lower Food Web Transfer*"

- Funding:
  - 2002-2003 US Fish and Wildlife Service
  - 2003-2004 US EPA/GLNPO
- Research team:
  - SUNY-Fredonia / Biology Department
  - NYDEC / Dunkirk Office (B. Culligan, D. Einhouse)

**Project Goals:**

(1) To identify environmental conditions in Lake Erie associated with the presence of *Clostridium botulinum* type E.

(2) To determine whether benthic food items (mussels, and other benthic organisms) contain the botulism bacterium in their tissues, becoming a food web link between sediment and fish.

**Hypotheses to be tested:**

Assumption: There are pockets of anaerobic conditions in the benthic ecosystem of Lake Erie's Eastern basin.

Hypothesis: Anaerobic sites provide habitat for *C. botulinum* type E, which multiply and infect (or are carried by) organisms that inhabit the lake sediment.

Assumption: Outbreaks of botulism are discrete events.

Hypothesis: There must be a set of environmental conditions necessary for the lysis of the *C. botulinum* type E bacteria and the release of the toxin.

# 2002 Season Stations


# Lake Sites

Dunkirk Harbor

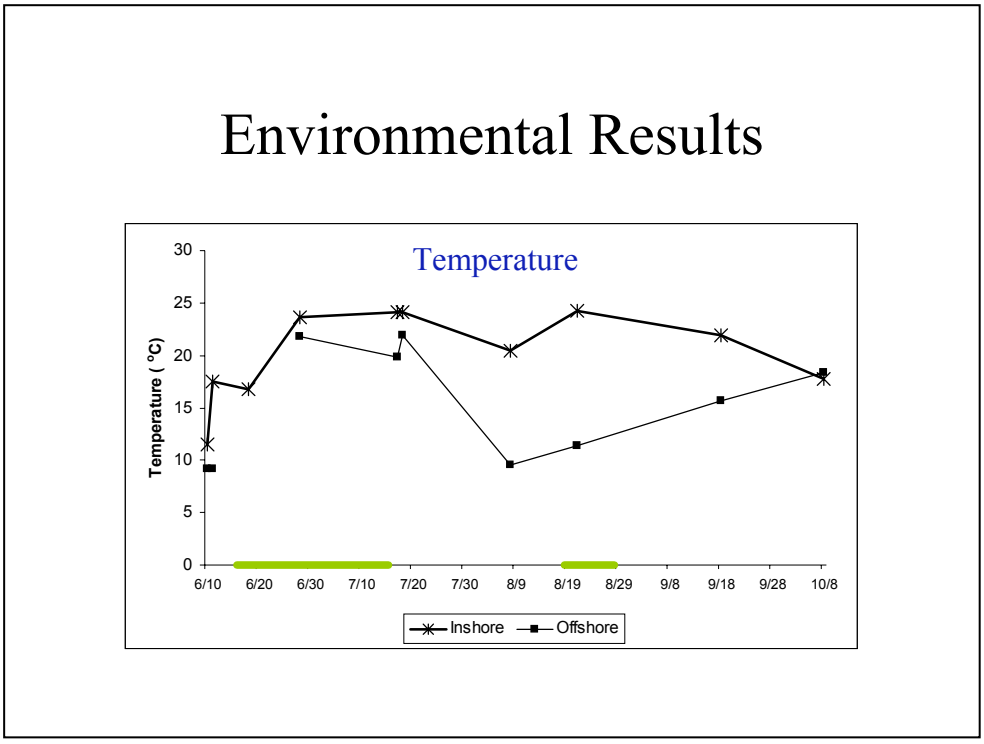
Van Buren Bay

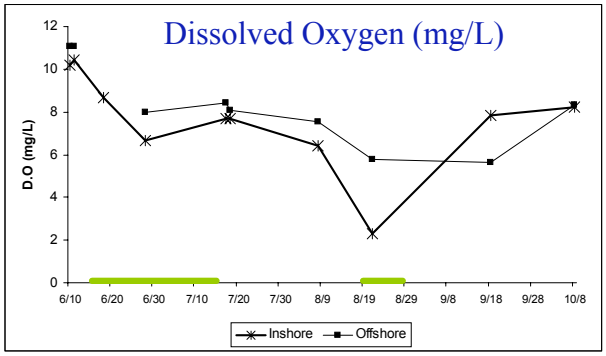
**Physico-Chemical Parameters:**

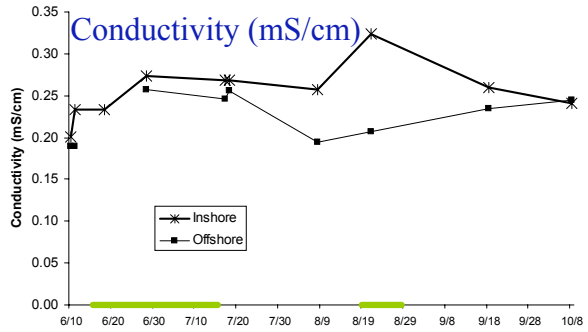
- 0.5 m above sediment.
- Multiparameter Meter YSI 556:
  - Temperature
  - Dissolved Oxygen
  - Conductivity
  - Salinity
  - Total Dissolved Solids
  - pH
  - Redox Potential

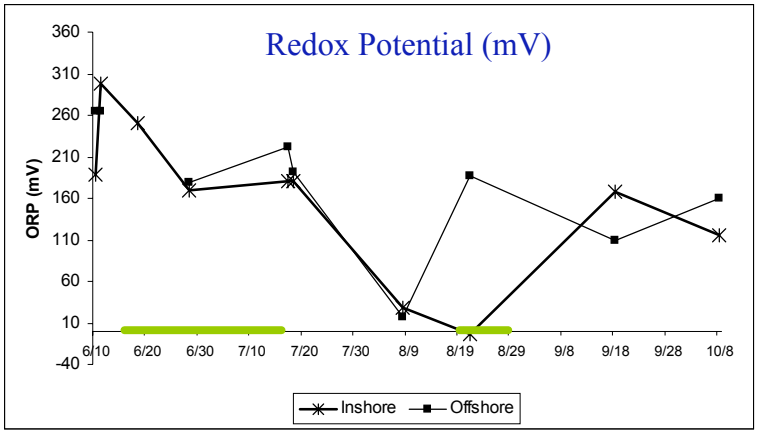
**Water Samples:**

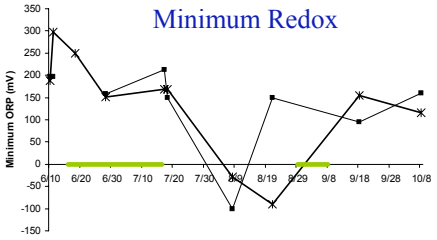
- 0.5 m above sediment
- Acrylic Alpha Bottle
- Parameters:
  - Nitrates
  - Phosphate
  - Chloride
  - Chlorophyll *a*

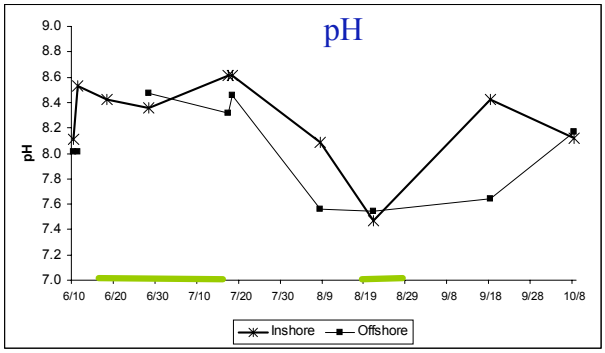


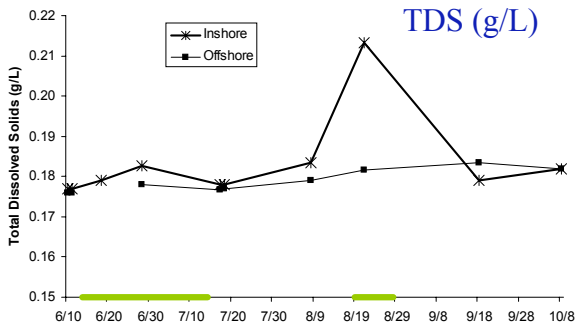

Dissolved Oxygen (mg/L)
D.O (mg/L)
12
10
8
6
4
2
0
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8
Inshore
Offshore

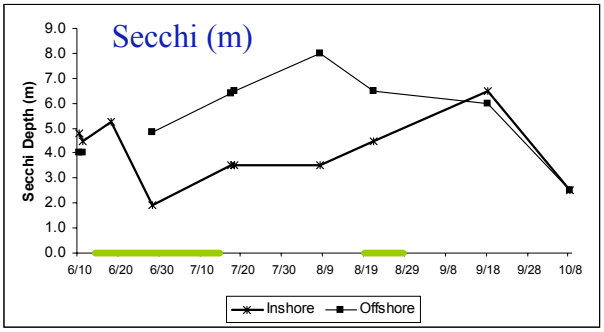

Conductivity (mS/cm)
Conductivity (mS/cm)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8
Inshore
Offshore

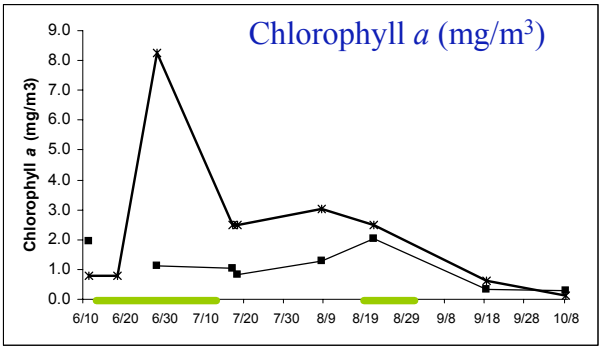

Redox Potential (mV)
ORP (mV)
360
310
260
210
160
110
60
10
-40
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8
Inshore
Offshore

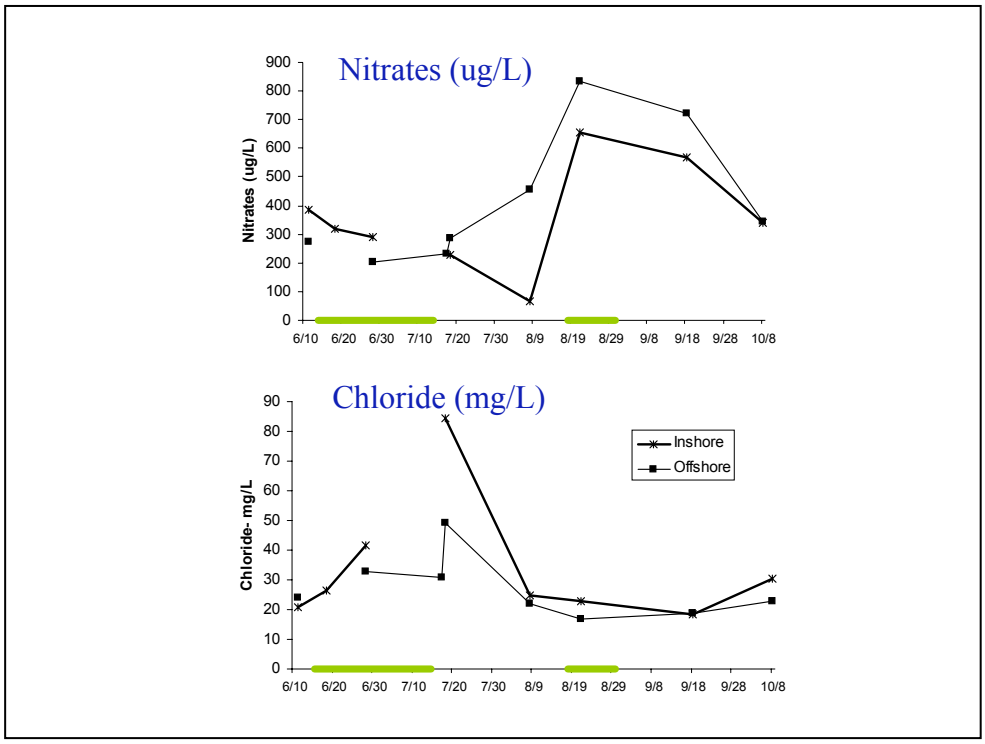

Minimum Redox
Minimum ORP (mV)
350
300
250
200
150
100
50
0
-50
-100
-150
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8


pH
9.0
8.8
8.6
8.4
8.2
8.0
7.8
7.6
7.4
7.2
7.0
pH
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8
Inshore
Offshore


TDS (g/L)
Inshore
Offshore
Total Dissolved Solids (g/L)
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8


Secchi (m)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Secchi Depth (m)
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8
Inshore
Offshore


Chlorophyll a (mg/m3)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Chlorophyll a (mg/m3)
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8

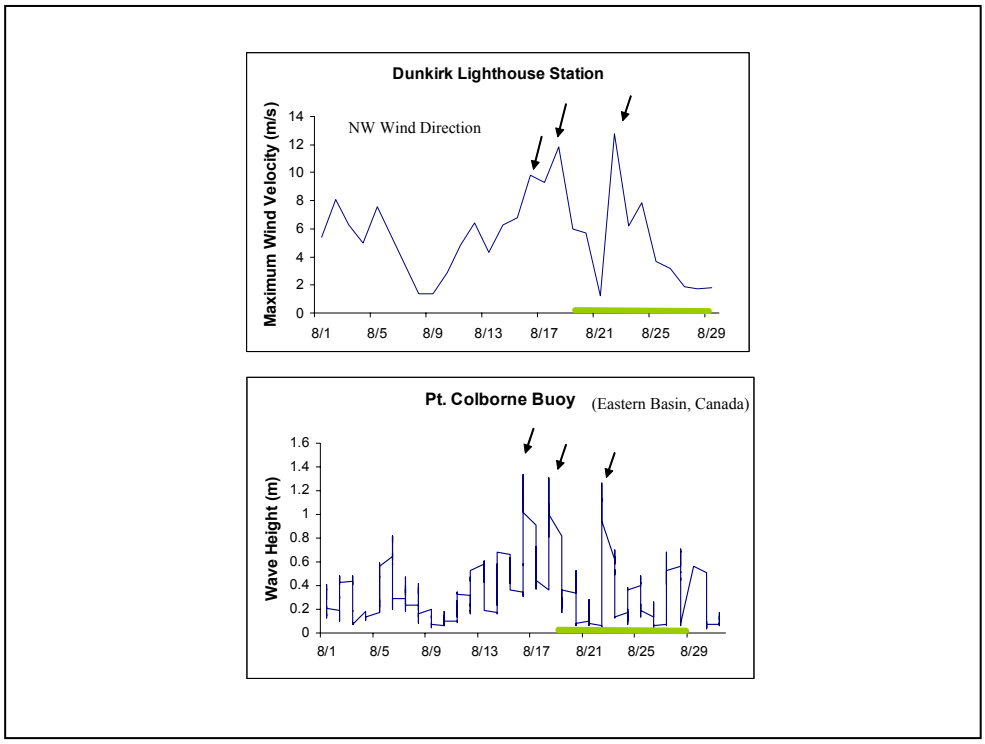



**In Summary:**

- One large algal bloom in June was correlated with decreased visibility and fish mortalities.
- Temperature increased and Dissolved Oxygen and pH decreased during the two outbreak events (June/July, August).
- Redox levels experienced a marked decrease from mid to late August, associated with an increase in Total Dissolved Solids and nitrates, and an outbreak of fish and bird mortalities.

**Data Being Processed:**

- Weather events during the season 2002 that may explain mixing of the water column and changes in Lake Erie conditions.




**Data Being Processed:**

- Analysis of tissue from benthic organisms, including quagga mussels, dipteran larvae, nematoda, amphipoda and mayfly larvae, as well as pseudofeces, to detect the toxin from *C. botulinum* type E using PCR.

**Season 2003:**

- Additional sampling sites along the coast.
- Monitoring of physico-chemical parameters following depth profiles.
- Li-cor light penetration measurements, including photosynthetically active radiation (PAR).

**Acknowledgements:**

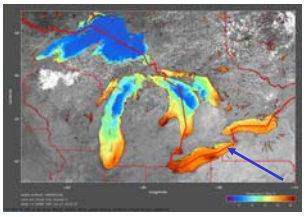
- Captain and crew of the R/V Argo (DEC).
- Dean NSSPS, SUNY-Fredonia.
- William Culligan and Donald Einhouse, NYSDEC.
- Dr. Pamela Marshall, SUNY-Fredonia.
- Students Jessica Wuerstle and Daniel Sek.

# Prevalence of Botulism in Fish in the Lower Great Lakes

- Investigators: Paul Bowser, Cornell University
  Rod Getchell, Cornell University
- Collaborators: Bill Culligan, NYSDEC Dunkirk
  Don Einhouse, NYSDEC Dunkirk
  Web Pearsall, NYSDEC Avon
  Ward Stone, NYSDEC Delmar
  James & Fina Casey, Cornell University
  Claudia Sutton, Cornell University

# Type E Botulism: Why are we studying it?

- Type E Botulism outbreaks have killed thousands of waterfowl on Lake Erie in each of the last 4 years.
- Fish kills have been associated with many of these events.
- The public hazard from these outbreaks needs to be clarified -- Are apparently healthy fish safe to eat, while sick fish are not safe to consume?



# How are we conducting the research?

- NYSDEC fisheries personnel are collecting healthy, sick, and fresh dead fish from Lakes Erie and Ontario.
- At Cornell, fish are necropsied and tissues are tested for various pathogens, including *Clostridium botulinum* Type E.
- Tissues are frozen for later molecular analysis.

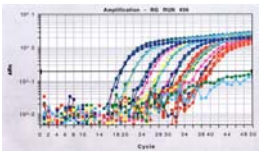
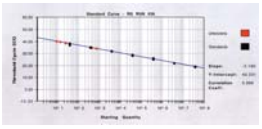
# How are we conducting the research?

- Fish intestinal contents, liver, and blood are processed to concentrate their DNA.
- This multi-step procedure provides purified DNA that can be assayed for the presence of the *C. botulinum* Type E toxin gene.

# How are we conducting the research?

- Standard PCR amplification of a 139 base pair fragment of the light chain of the botulism toxin gene demonstrates the presence or absence of *C. botulinum* Type E.
- But, quantitative (real-time) PCR will provide actual numbers of *C. botulinum* Type E when compared to a series of standards.
- The sequences of the primers and probe used in the QPCR assay are as follows:
  AATATTGTTTCTGTAAAAGGCATAAG
  GAAATCAATATGTATCGAAATAAATA
  ATGGTGAGTTATTTTTTGTGGCTTCCG
  AGAATAGTTATAATGATGATAATATA
  AATACTCCTAAAGAAATTGACGATAC
  AGTAACTT



# What are the results we have found so far?

- We have measured significant numbers of *C. botulinum* Type E in dead and dying fresh water drum during three die-offs in July of 2001 near Dunkirk and Barcelona Harbor on Lake Erie.
- We also measured detectable levels of *C. botulinum* Type E in one apparently healthy five fish pool of smallmouth bass from Dunkirk, NY.





# 2002 Fish Collection Totals

| | Lake Erie | Lake Ontario |
|---|---|---|
| Spring | 265 | 8 |
| Summer | 176 | 71 |
| Fall | 186 | 30 |

| | |
|---|---|
| Smallmouth Bass | 286 |
| Freshwater Drum | 208 |
| Round Goby | 148 |
| Yellow Perch | 24 |
| Alewife | 20 |
| Brown Bullhead | 11 |
| Other species | 41 |

# Preliminary 2001-2002 *C. botulinum* Type E QPCR Results

| Species | Sample Location | Collection Date/s | Quantity/Gram |
|---|---|---|---|
| FWDrum | Dunkirk, NY | July 11, 2002 | 19,800/g IC |
| FWDrum | Dunkirk, NY | July 18&30, 2002 | 21,700/g IC |
| FWDrum | Barcelona, NY | July 26, 2002 | 23,100/g IC |
| SMBass | Dunkirk, NY | August 21, 2002 | 15,200/g IC |
| Sturgeon | Door County, WI | Summer, 2002 | 17,400/g SC |

| Species | Sample Location | Collection Date/s | Quantity/Gram |
|---|---|---|---|
| FWDrum | Dunkirk, NY | August 17, 2001 | 3,000/g K,L,S |

IC = Intestinal contents; SC = Stomach contents included two goby-like fish; K,L,S = Combined kidney, liver, and spleen

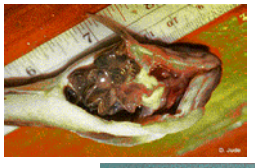
# Preliminary 2001 Avian *C. botulinum* Type E QPCR Results

| Species | Sample Location | Quantity/Gram |
|---|---|---|
| Common Loon | Lake Erie | 148,000/g ACC |
| Common Loon | Lake Erie | 40,700/g ACC |
| Common Loon | Lake Erie | 36,200/g SC |
| Coot | Lake Erie | 340/g ACC |
| Long Tail Duck | Lake Erie | 40,800/g GC |

ACC = Alimentary canal contents; SC = Stomach contents;
GC = Gizzard contents.

# Where do we go from here?

- We will make a greater effort to collect fish during botulism outbreaks, particularly round gobies and freshwater drum.
- We will also collect sediment and quagga mussels from outbreak areas to further analyze the food chain path that Type E Botulism is following.



# Comparative Toxicity of Type E Botulinum Toxin in Several Lake Erie Fish Species

R.D. Moccia, A.Yule, I.K. Barker and J. Austin
University of Guelph and Health Canada
Sponsored by Environment Canada

**THE PARADOX:**

- How to explain the 'Fish' pathway of toxin ingestion in species like loons and mergansers which feed nearly exclusively on 'live' fish.
- Lack of apparent correlation between fish botulism epizootics and avian mortality patterns.

**THE QUESTIONS:**

- Are 'living' fish a reasonable transport mechanism by which BoNT (*Clostridium botulinum neurotoxin*) moves from point of origin to the bird?
- Is it plausible that live, but moribund, fish are selective prey species?
- Can 'live' fish harbour bird-lethal doses of BoNT?
- Do fish display a varying 'tolerance' to BoNT related to phylogeny, natural life history or primary feeding habitat? eg. benthic versus pelagic species
- Is there a potential human health hazard to people who consume BoNT laden fish?

**Setting Out to Answer One Very Small Piece of the Botulism Ecology Puzzle**

**RESEARCH OBJECTIVES:**

1. Develop fish botulism exposure model ("FBEM")
2. Test comparative sensitivity and temporal aspects of clinical intoxication for several candidate fish species
3. Develop Dose-Response Model
4. Determine Toxin titres in BoNT Mortalities

"FBEM"  Trout, goby, mudpuppy, perch …

**GENERAL APPROACH:**

- Produce and encapsulate BoNT-E at known Dosages (eg. 400 MLD)
- Intubate test fish
- Map the temporal aspects and clinical progression of intoxication
- Assay mortalities for BoNT titres
- Calculate expected toxin transport to bird

**TOXIN PRODUCTION METHODS:**

**Method used to prepare the BoNT**

- *C. botulinum* type E strain
- grown in tryptone-peptone-glucose yeast extract broth at 25˚C
- atmosphere of 10% H2, 80% N2, 10% CO2 for 4 days
- harvested by centrifuge
- concentration of type E neurotoxin assayed by mouse bioassay
- toxicity neutralized by monospecific type E antiserum: therefore, toxic effect was only due to type E neurotoxin (no other toxins in preparation)

**CAPSULE PREPARATION:**

- starch filler (60mg) was added to each gelatin capsule
- 100 ul of culture supernatant (containing 400MLD) was quickly added to gelatin capsule
- filled capsules immediately frozen

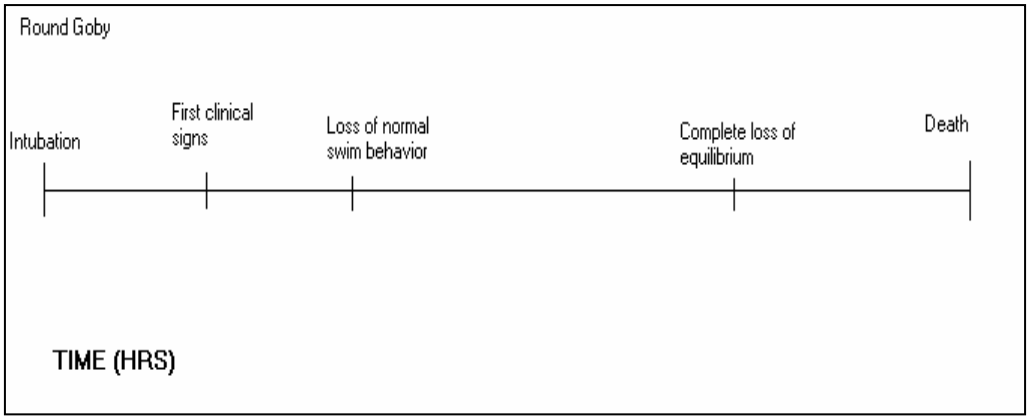
**CONTROLS:**

- possible effects of starch filler on toxicity was checked
- gelatin phosphate and buffer and starch filler mix had no effect

**PRELIMINARY MORBIDITY SIGNS IN RAINBOW TROUT (400MLD)**

| TIME | COMMENT |
|---|---|
| 0 | - fish intubated |
| x | - time of capsule degeneration and toxin release |
| xx | - normal behavior |
| y | - restless, agitated, increased swimming behavior |
| yy | - first equilibrium loss (loss gradually increases), postural changes, righting ability gradually lost, progressive immobility |
| yyy or | - sporadic swimming (fish upside down and on side), no fin coordination righting ability, irregular 'breaching' behavior noted |
| z | - complete loss of any motor function |
| zz | - loss of respiratory reflex/death |

**Once Temporal Response Pattern Has Been Establish for the Various Species, Their Sensitivities and Onset of Clinical Signs Can Be Compared.**




**PRELIMINARY RESULTS-IMPLICATIONS TO BIRD PREDATORS:**

1. LOSS OF EQUILIBRIUM: In a natural setting, fish showing equilibrium loss could represent "easy" prey for live-fish eating birds. Thus, such birds could be targeting intoxicated fish due to their abnormal behavior.

2. BREACHING BEHAVIOR: In a natural setting, fish showing breaching behavior would present an “easy” target for predators and maximize BoNT ingestion.

**Alternate Species**

**Once the “FBEM” is established in the rainbow trout the following species will be tested:**

- Round Goby
- Mudpuppy
- Yellow Perch
- Walleye
- others

**EARLY THOUGHTS:**

- Prolonged moribund state with high BoNT exposure
- Progressive clinical stages with respiratory reflex lost late in sequence
- Behavioural response may ‘target’ predators
- Live fish may be significant vector for toxin
- No idea yet of inter-species sensitivity

# Type E Botulism in the Great Lakes
# Conference Overview

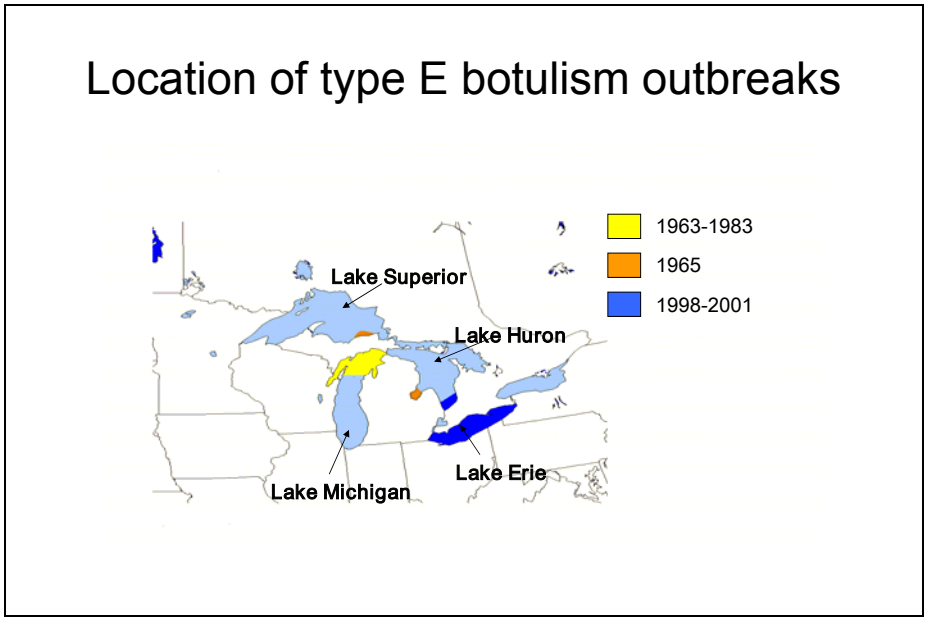
Grace McLaughlin
USGS National Wildlife Health Center

*Clostridium botulinum* type E

- Spores found primarily in cold water environments (Great Lakes, Baltic Sea)
- Toxin production NOT dependent on a bacteriophage
- Primarily afflicts fish and fish-eating birds
- Causes disease in humans

**Type E botulism outbreaks in the Great Lakes**

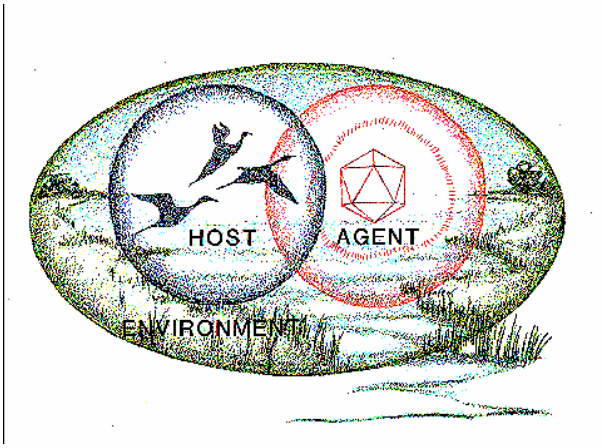
| Year | Lake | Number | Species |
|---|---|---|---|
| 1963-1964 | Michigan | >12,000 | Gulls, Loons |
| 1976-1983 | Michigan, Huron | >1800 | Gulls, Loons |
| 1998-2002 | Huron, Michigan | ~2500 | Mergansers, Gulls, Loons |
| 1999-2001 | Erie | >25,000 | Mergansers, Gulls, Loons |
| 2002 | Erie | >25,000 | Long-tail ducks, Gulls, Loons, Mergansers, Cormorants |




**Locations of other type E outbreaks in birds**

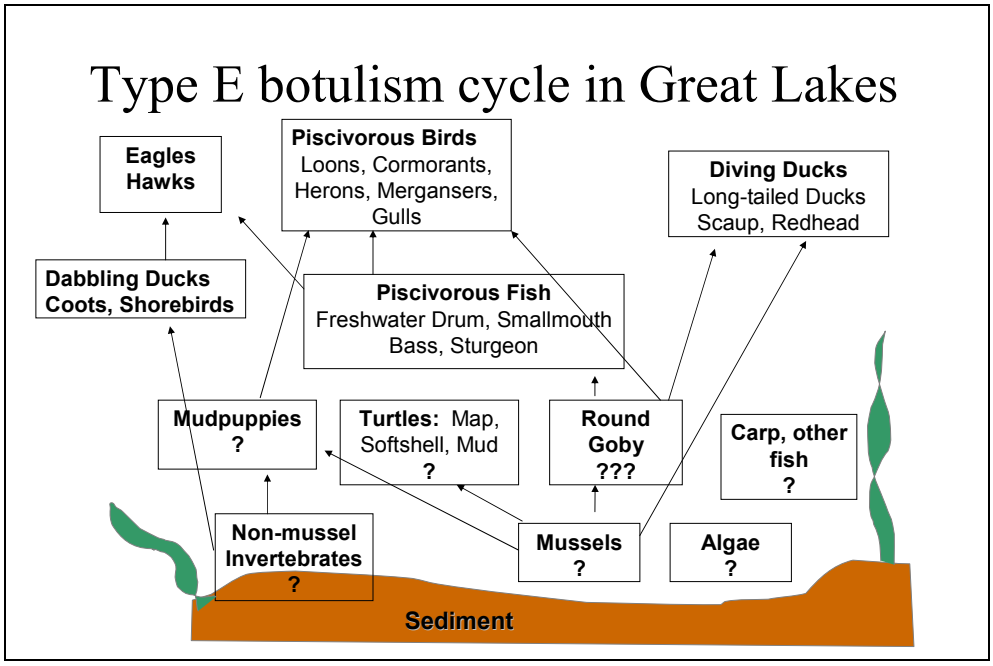
- Canche Estuary, France 1996 − 5-10,000 gulls
- Salton Sea (California) - isolated cases − pelicans, cormorants
- Alaska - isolated cases

**Epizootiology of Avian Botulism**




**Factors involved in avian botulism outbreaks**

- Toxigenic bacteria
- Appropriate environmental conditions
- Proper substrate
- Availability of toxin to birds




**Research Needs**

- Spatiotemporal distribution of type E spores and cells in Great Lake sediments and fish
- Sources of cells and toxin for fish and birds
- Environmental correlates
- Population effects in birds
- Non-avian mortality

**Pennsylvania Update 2002**
*Bob Wellington and Mike Mumau*

- March, May – dead alewives, turtles
- June – dead gobies & mudpuppies − less algae than in past years
- July – rapid temperature drop 75˚ ⟶ 50˚F in 2 days
- Monitored water temperature − 70˚-80˚F in July-September, 50˚F November
- Invertebrate mortality
- Several invasive species
  - Alewives, gobies
  - Algae (*Cladophora*? If so, long ago.)
  - Invertebrates (mussels, amphipods)
- Blue-green algae blooms
- ~2000 fish collected ~10 species
  - July 10-11 = 446 (22.3% of total)
- Fewer dead birds than 2001
- Gulls in Summer
- Loons in Fall
- Invertebrates – could be substrate for significant toxin production.

**New York Update 2002**
*Don Einhouse*

- Fish mortalities – effects on trends, abundance
  - March-April: alewives, gizzard shad − temperature stress
  - May-June: smelt – spawning, *Glugea*
  - June-July: smallmouth bass – spawning? upwelling?
  - June-August: warmwater species., upwelling
- June 50% gobies
- July 44% sheepshead
  - Also thousands of mudpuppies
- September mortality: 81% sheepshead
  - Only 4% net (live) samples, yellow perch 40%
  - Why don't yellow perch and gizzard shad die?
- Smallmouth bass survival has not changed with Botulism E
- Forage fish composition
- Gobies
  - 1994 – Cleveland
  - 1995 inconclusive numbers
  - 1996 moving East and West in Central basin, into West
  - 1997 into eastern basin
  - 1999 well into NY waters, but low numbers
  - 2000 declining in western basin, including East
  - 2001 huge number in eastern basin
  - 2002 declining in abundance

**Sturgeon Mortality**

- Rare to find on beach pre-2000
  - 5 in 1996 - upwelling
- >25 in 2001
  - Corresponded with high goby numbers
- Fewer in 2002
  - also fewer gobies in trawls

**Changes in Food Web**

- Shift to gobies post 1998
- Sheepshead eat mussels

**Questions:**

- Where is anaerobic environment?
  - In anything that dies. Pockets in substrate.
- Benthic fish species absent from kills – why?
  - Different susceptibility?
- Role of mussels?
- How to determine botulism E mortality?

**NY Avian Mortality**

*Ken Roblee*

- >3000 Gulls in June & July
  - Concurrent with mudpuppy mortality
- October-December estimated >17,000 birds
  - >12,600 long-tailed ducks
  - >2000 loons
  - >1000 mergansers

**NY Pathological Investigations**

*Ward Stone*

- 7000+ submissions for botulism in 2003
- First diagnosis of type E - 2000
- Food habits: gobies, mudpuppies
- Sheepshead, bass
  - Moribund fish
- Feeding experiments
  - Gobies – gull liver
- Toxin identified in gizzard contents
  - Gulls in summer – mudpuppies
  - Mergansers – mudpuppies, gobies
  - Shorebirds - fly larvae from carcasses
  - Long-tailed ducks – mussels, gobies
- Few puddle ducks
- Scaup undetermined cause of death

**New York Mortality – bird pickup numbers**

| | 2000 | 2001 | 2002 | Totals |
|---|---|---|---|---|
| Totals | 1100 | 706 | 7202 | 9008 |
| Long-tailed ducks | 1 | 44 | 4877 | 4913 |
| Gulls | 543 | 228 | >1030 | >1800 |
| Red-breasted Merganser | 424 | 16 | 627 | 1067 |
| Loons | 106 | 303 | 434 | 843 |

Birds still being collected from 2002-2003
Estimates of dead birds much higher

**Food Habits**

- Gobies:
  - Loons: 56-61%
  - Horned grebe: 54%
  - Long-tailed Ducks: 60% of 169
- Mudpupppies
  - Gulls – 17-82%
  - Mergansers: 20-40%

**Feeding Experiments – New York**

- Feeding livers – assuming problem is botulism toxin, some negative samples used also
- Gobies, Centrarchids, fatheads susceptible
- Yellow Perch and Painted Turtles show some resistance
  - Yellow Perch impaired up to 1 week
  - Altered swimming ability
  - Change in activity patterns

**Botulism Type E Genetics**

- 10 different type E strains
  - Fish, sediments

- How do these compare to?
  - Other years
  - Huron
  - Michigan
  - Superior
  - Mediterranean, Baltic
  - France
  - Alaska

**Canadian Update**
*Jeff Robinson*

- Mortality distribution
- Food habits
- Loon population data
- Experimental dosing
- Loons
    - Believe Stratum 4 breeders
    - Population 19,000 to 40,000 breeding pairs
- Several Lake Erie events
    - June, July, August: gulls, terns, cormorants
    - September: gulls, cormorants
    - October: gulls
    - Late October & November: Common Loons, Long-tailed Ducks, Red-breasted Mergansers
- Lake Huron - October
    - Grebes, mergansers, Common Loons
    - Goderich and Port Elgin
- Ontario (not confirmed)

**Environmental Parameters Associated with Outbreaks of Botulism in Lake Erie**
*Alicia Perez-Fuentetaja, Ted Lee, Mark Clapsadl*

Identify environmental conditions in Lake Erie associated with presence of *Clostridium botulinum* type E.
Are there areas of low oxygen where the bacteria are found?
10m inshore, 20m offshore depths.
Triplicate samples
Physico-chemical parameters 0.5 m above sediment.

- Algal bloom at time of June-July outbreak
- Oxygen, Redox, pH drop in August
    - Rocke, Samuel – JWM
- Weather event in August
    - strong winds, wave action – mixing
- Sample processing in progress

**Botulism: Atypical Pathogenesis in Other Species**
*Dr. Robert H. Whitlock, New Bolton Center, University of Pennsylvania*

- Cattle
    - Grains – oat and rye silage
    - 1 Cat carcass killed 431 of 441 cows
    - Feeding in avian botulism site

- Horses
  - Ravens as vectors from carcasses
  - Wounds – castration,
    - drainage contaminated feed
  - 1979 racetrack – 30 horses died
- Diagnosis, vaccine, treatment

**Botulism in Fish**
*Getchell, Bowser, et al.*

- Rule outs – bacteria, viruses, weather (750)
- For Botulism E – quantitative PCR
  - Process intestinal contents, liver, etc.
  - Looking for light chain E toxin gene (not toxin)
- Found in sheepshead from July 2001 dieoff
  - Kd, Lv, Sp pool; 3K genome equivalents
- 15-23K genome equivalents GIT contents
  - Only found in very few fish
- 200 – 148K in bird samples
- What about in healthy fish? No vegetative cells

**Fish Susceptibility to Botulism E**
*Moccia et al.*

- Fish Botulism Exposure Model
  - Standardize methods
- Temporal aspects, Sensitivity
  - Trout, goby, perch, walleye, mudpuppy
- Dose-response model
- Toxin titers
  - Tissue distribution
- Methods
  - Dosages to intubate fish
  - Temporal pattern, tissue distribution
  - Calculate up-web transport
- Temporal Observations
  - Restless, agitated, inc. swimming
  - Disequilibrium, altered posture, righting response lost
  - Lethargy interspersed with swimming, lack of coordination
  - Head up/tail down posture, breaching
  - Loss of motor function except respiration
  - Respiratory failure
- Prolonged course
- Altered behavior - increased predation risk?
- Tissue distribution?
- Persistence of toxin?

# Agenda – Lake Erie Botulism Conference
# Thursday, April 3, 2003
# Holiday Inn, Amherst, New York

**9:00 - Welcoming Remarks:**
NYS Assemblyman, Richard Smith

**Botulism Overview/Introduction:**
Helen Domske, NY Sea Grant, Great Lakes Program – University at Buffalo

**Pennsylvania Update:**
Eric Obert, PA Sea Grant; Mike Mumau, Assistant Park Manager, Presque Isle State Park, Department of Conservation and Natural Resources, Bureau of State Parks; Bob Wellington, Erie County Department of Health

**New York Update:**
Waterfowl Mortalities - Ken Roblee, Senior Wildlife Biologist, NYSDEC
Fish Mortalities Relative to Recent Fish Population Trends - Don Einhouse, Senior Fisheries Biologist, NYSDEC

**Botulism in Fish and Wildlife in NYS Waters of Lake Erie**
Ward Stone, NYSDEC Pathologist

**Ohio Update:**
Frank Lichtkoppler, Ohio Sea Grant

***12:00 - Lunch***

**Canadian Update:**
Jeff Robinson, Canadian Wildlife Service, Dr. Ian Barker, CCWHC – Univ. at Guelph

***Research Presentations:***

Environmental Parameters Associated with Outbreaks of Botulism in Lake Erie
Dr. Alicia Pérez-Fuentetaja, Biology Department, SUNY-Fredonia

Botulism: Atypical Pathogenesis in Other Species
Dr. Robert H. Whitlock, New Bolton Center, University of Pennsylvania

***Afternoon Break***

Prevalence of Botulism in Fish in the Lower Great Lakes
Dr. Paul Bowser, Aquatic Animal Health Program, Cornell University

Comparative Toxicity of Type E Botulinum to Several Lake Erie Fish Species
Dr. Rich Moccia, University of Guelph

***Wrap-Up:***
Next Steps – Conclusions,
Dr. Grace McLaughlin, National Wildlife Health Center, USGS

**4:30 - Adjourn**

## Botulism In Lake Erie Workshop - Evaluation
## Thursday, April 3, 2003 Buffalo, New York

Please help us to evaluate the educational program by responding to the following statements.
We ask that you complete this evaluation in its entirety.

**69 participants**
**43 responses**
**62% return rate**

**KEY**
**1 = Strongly Disagree**
**2 = Disagree**
**3 = Neither Disagree nor Agree**
**4 = Agree**
**5 = Strongly Agree**

| **Please circle your response.** | **Strongly Disagree** | | | | **Strongly Agree** | **N** | **MEAN** | **+/_** |
|---|---|---|---|---|---|---|---|---|
| 1) The workshop achieved its goal of sharing information. | 1 | 2 | 3 | 4 | 5 | **43** | **4.58** | **.58** |
| 2) The workshop achieved its goal of providing networking opportunities. | 1 | 2 | 3 | 4 | 5 | **43** | **4.30** | **.67** |
| 3) The botulism overview was worthwhile. | 1 | 2 | 3 | 4 | 5 | **42** | **4.29** | **.77** |
| 4) The state & Canadian updates were worthwhile. | 1 | 2 | 3 | 4 | 5 | **43** | **4.51** | **.59** |
| 5) The research presentations were worthwhile. | 1 | 2 | 3 | 4 | 5 | **43** | **4.47** | **.70** |
| 6) The wrap-up was worthwhile. | 1 | 2 | 3 | 4 | 5 | **32** | **3.97** | **1.18** |
| **The educational materials and content of the workshop:** | | | | | | | | |
| 7) Helped me better understand the issues surrounding botulism in Lake Erie. | 1 | 2 | 3 | 4 | 5 | **43** | **4.30** | **.60** |
| 8) Provided information relevant to my work. | 1 | 2 | 3 | 4 | 5 | **43** | **4.19** | **.70** |
| 9) Were well organized. | 1 | 2 | 3 | 4 | 5 | **43** | **4.33** | **.57** |
| 10) Were easy to understand. | 1 | 2 | 3 | 4 | 5 | **43** | **4.33** | **.64** |
| 11) Presented information that will help me. | 1 | 2 | 3 | 4 | 5 | **43** | **4.35** | **.57** |

| **Please circle your response.**<br>**The educational materials and content of the workshop:** | **Strongly Disagree** | | | | **Strongly Agree** | **N** | **MEAN** | **+/_** |
|---|---|---|---|---|---|---|---|---|
| 12) Will be of great use to me. | 1 | 2 | 3 | 4 | 5 | **43** | **3.95** | **.75** |
| 13) I gained new knowledge from this workshop. | 1 | 2 | 3 | 4 | 5 | **43** | **4.49** | **.59** |
| 14) I plan to share the information learned at this workshop with others. | 1 | 2 | 3 | 4 | 5 | **43** | **4.23** | **.81** |
| 15) I plan to take some action as a result of the information I learned at this workshop. | 1 | 2 | 3 | 4 | 5 | **42** | **3.74** | **1.06** |

**Please circle or fill in your response.**

16) I attended a previous botulism workshop in Erie, PA in 2001 or Buffalo, NY in 2002. **N=43** **YES 56%** **NO 44%**

17) I shared the information I learned at previous botulism workshop(s) with others. **N=29** **YES 86%** **NO 14%** **14 not applicable**

Who did you share the information with? _____23 respondents_____

18) I took action as a result of what I learned at previous botulism workshop(s). **N=30** **YES 60%** **NO 40%** **13 not applicable**

What action did you take? _____16 respondents_____

19) Would you be interested in attending a workshop on this topic next year? **N=43** **YES 100%** **NO 0%**

20) What could we do to improve this workshop?

20 respondents

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**Thank you for completing this questionnaire.**
**Please return your completed evaluation to Frank Lichtkoppler before you leave or mail it to:**
**Ohio Sea Grant**
**99 East Erie Street,**
**Painesville, Ohio 44077**

**Evaluation Comments - Botulism in Lake Erie Workshop – April 3, 2003 - Buffalo, NY**

**Question 17. I shared the information I learned at previous botulism workshop(s) with others.**

**Who did you share the information with? 23 participants responded**

- Other extension staff, researchers, stakeholders
- Sport fishermen, media, agency staff
- Co-workers
- Co-workers, public, sportsmen
- Other researchers, grad students
- Staff members at DEC
- Co-workers
- Students, natural resources administrators and biologists, research collaborators
- Northeast loon work group
- Colleagues, community members
- Intra-agency, anglers
- Co-workers
- Co-workers
- Did get proceedings from website – have shared with students
- General public, sport fishermen
- Mortality Info/species impacts
- Co-workers and sportsman
- Media, public, agency staff, researchers
- Public Mostly
- Other biologists, researchers and public
- Other colleagues
- Various sport angling groups and legislators
- Anglers and others contacting DEC for information

**Question 18. I took action as a result of what I learned at previous botulism workshop(s).**

**What action did you take? 16 participants responded**

- Initiated research program
- Informed staff of the potential of wound botulism
- Initiated a research project
- Developed research project revised surveillance
- Started water bird mortality surveys on Lake Ontario
- Research project
- Response to public inquiries, presentations to clients groups, media interviews, articles for agency newsletter
- Have given out posters from Sea Grant and or talked with public
- Started genotyping loons – may not have had not connected to this group
- Several magazines articles, newspaper articles written
- Media, public, agency staff, researchers

- Collection of specimens, support of research
- Assisting in ongoing Sea Grant Research
- Various sport angling groups and legislators
- Collaboration
- Use information to guide my own actions regarding sportfishing activities in Lake Erie

**Question 20. What could we do to improve this workshop? 20 participants responded**

- Not sure. Format worked well, speakers were effective and well-regarded. I'd suggest: action items, format for next year, identify research needs.
- As the proceedings are prepared, it may be a good idea to put Grace McLaughlin's wrap up presentation up on the web first
- Great graphics Don Einhouse – Great. Some positive news, not gloom and doom! Good food, fish next year? Mudpuppy pie for desert!! Next year should have more results, relevant studies all appear to be just underway with no real results, Cornell, Ward Stone, University of Guleph. All appear to be on right tract. Look forward to their results.
- (Cold room) Otherwise great day!!!
- More time for informal interactions. I didn't know a lot of the "players" (only by name) and would have wanted more time to meet and talk with them.
- Perhaps less time on summaries with bird counts, and more presentations on research.
- Perhaps a short session where the group can pose suggestions on what to do next. Make a list of priorities. Dr. McLaughlin's recap at the end was unnecessary – repetitive of what we just saw in the previous presenters.
- A little more time to network. Heat.
- A little more systematic observations required in "status reports". More info correlating limnology with biological events. We have too few "lake" people.
- Today's workshop was excellent – improved over last year due to research presentations. Thanks for a great job.
- Obviously a warm room! I appreciate this opportunity – wish I could have come for pizza on Wednesday night – more networking time would have been nice – perhaps also more info about funding opportunities and who is funded to do what.
- Standardize presentation display machinery.
- Just some heat…
- Hold workshop in September/October to develop/refine research questions. Circulate status reports before workshop (or post them) and spend more time on research findings and development of joint proposals. We didn't need to hear about cows and horses in such detail.
- Review what possible links this issue may impact/have on the food chain. Health concerns. Would like copies of power-point slides for each presentation.
- Continue to vary the content. Economic impacts?
- Presenters and podium block the view of the attendees.
- Handouts prior to meeting
- Encourage other states/provinces to invest as much effort as New York has in studying botulism. The amount of federal participation in Great Lakes botulism efforts appears to be very low, which is true, is a real shame. Please continue to engage Canadians in workshop participation.

# Botulism in Lake Erie Attendees/Contact List
# April 3, 2003

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