Botulism in Lake Erie Workshop Proceedings

Co-Sponsored by

New York Sea Grant
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Bob Wellington with sturgeon (Erie, PA)

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Botulism in Lake Erie Workshop Proceedings:

Introduction
Introduction – Workshop Objectives

Responding to fish and bird die-offs along the shores of Lake Erie from 1999-2001, the staffs of New York, Pennsylvania and Ohio Sea Grant wanted to understand the extent of the die-offs, gather scientific information and explore the ecological impacts of these botulism outbreaks. In order to achieve these goals, the Sea Grant programs realized a need to create a functioning network of involved agencies and individuals and organize a workshop that would get this diverse binational group working together.

Working from the success of the first conference on avian botulism that was held in 2001, New York, Pennsylvania and Ohio Sea Grant worked together to co-sponsor a workshop that was designed to develop a research agenda to deal with this ecological problem. On February 28, 2002, a workshop on Botulism in Lake Erie was held in Buffalo, New York. That workshop brought together 100 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 develop a research agenda for future efforts.

The original conference, held on January 24-25, 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. Organizers wanted to determine the extent of the avian botulism problem based on geography and environmental conditions that existed during the outbreaks. 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.

Botulism in Lake Erie

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.

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.

The following illustration shows the cycle for Type C Botulism:
Introduction – 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:


Introduction –  
Synopsis of Research Questions/Issues from 2001 Botulism Workshop

Research Questions:

- What role do round gobies (*Neogobius melanostomus*) play in botulism outbreaks?
- What role do *Dreissenid* mussels play in botulism outbreaks?
- Do lower lake levels have something to do with outbreaks? Any connections?
- Do weather or limnological conditions play a role in botulism outbreaks?
- What unique climatic and hydrological conditions are present before/or during outbreaks?
- What role does water clarity and resulting fish movements/feeding areas play in outbreaks?
- What role does *Microcystis* or other toxic algae play in botulism outbreaks?
- What other environmental stressors may be involved in botulism outbreaks?

Other Pertinent Questions:

- During outbreaks - are fish/waterfowl safe to eat?
- During non-outbreak periods, are there concerns about eating fish/waterfowl?
- What is the human health threat of handling, eating contaminated fish/waterfowl?

Desired Outcomes/Needs:

- Test for spores/toxin in *Dreissenid* mussels and other possible vectors.
- Test healthy fish/birds for botulism toxin during outbreaks.
- Test for toxins in area around dead fish/birds for botulism spores/toxin.
- Test mudpuppies and other benthic organisms for botulism spores/toxin.
- Improve/expand fish pathology capabilities and develop standardized analysis protocol.
- Develop a model to predict potential for outbreaks using various environmental factors.
- Develop a cohesive database: fish, bird die-offs, limnological data.
- Standardize methods of reporting mortality/episodes.
- Standardized method for fish/waterfowl collection, disposal.
- Standardized public outreach information (education).
- Establish “fast response” team to collect data during outbreak periods.
- Need agency (Health Canada, US Federal Agencies, State Health Departments) assistance in developing coordinated advisories/information for other agencies to distribute to the public.

Public needs information on:

- Unified message on the botulism issue.
- Proper cooking techniques for fish.
- Does freezing impact toxins?
- Proper handling of birds found during outbreaks.
- Proper carcass disposal.
Introduction – Contacts

For additional information on the botulism outbreaks in Lake Erie, the NY/OH/PA Sea Grant co-sponsored workshop, or on follow-up activities, please contact:

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