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