Environmental Parameters Associated with Outbreaks of Botulism in Eastern Lake Erie

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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

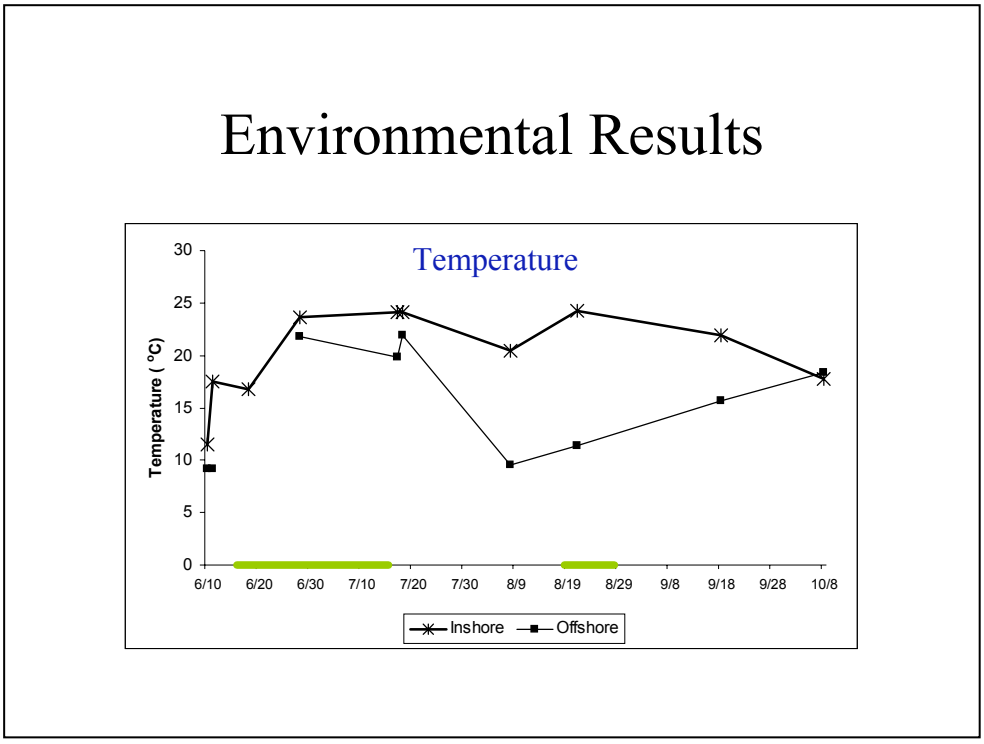
Van Buren Bay

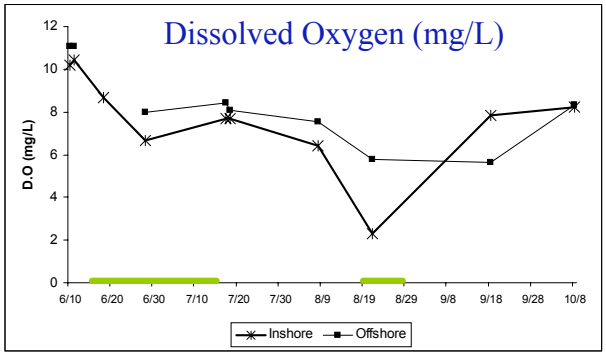
Physico-Chemical Parameters:

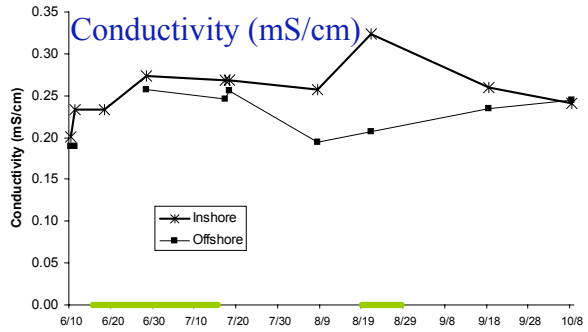
- 0.5 m above sediment.
- Multiparameter Meter YSI 556:
  - Temperature
  - Dissolved Oxygen
  - Conductivity
  - Salinity
  - Total Dissolved Solids
  - pH
  - Redox Potential

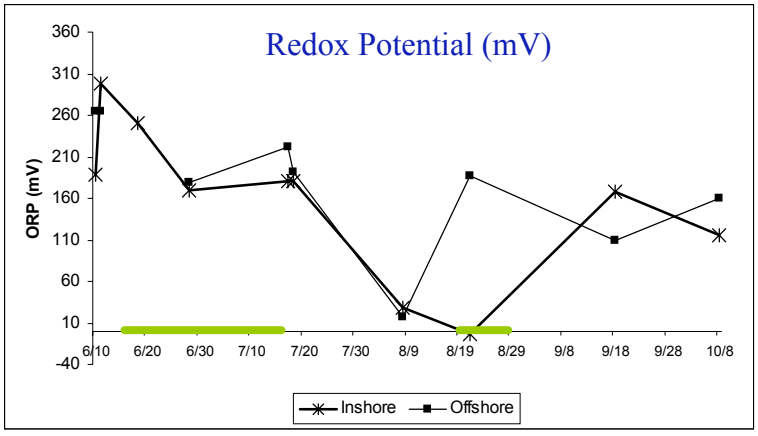
Water Samples:

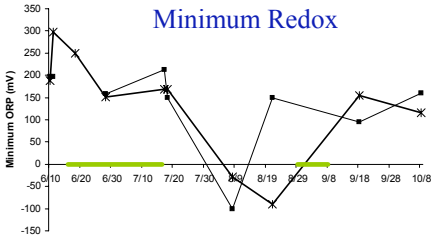
- 0.5 m above sediment
- Acrylic Alpha Bottle
- Parameters:
  - Nitrates
  - Phosphate
  - Chloride
  - Chlorophyll *a*

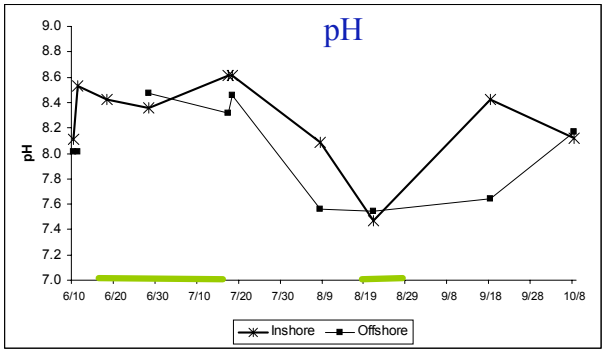


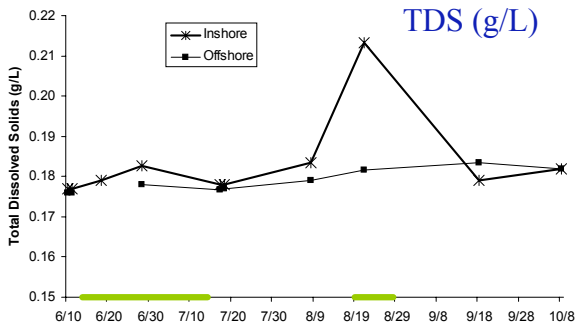

Dissolved Oxygen (mg/L)
D.O (mg/L)
12
10
8
6
4
2
0
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8
Inshore
Offshore

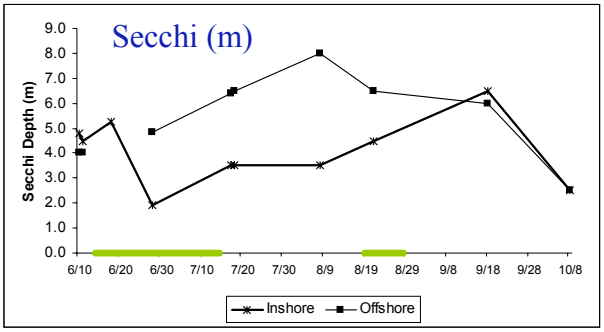

Conductivity (mS/cm)
Conductivity (mS/cm)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8
Inshore
Offshore

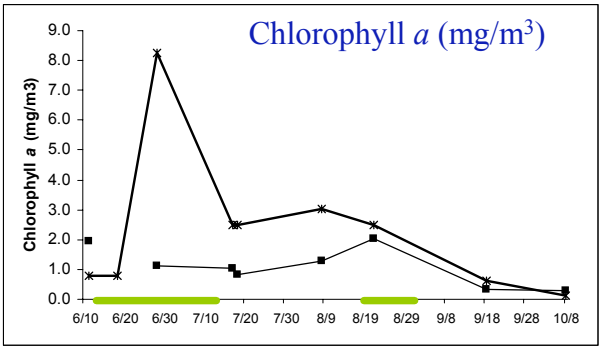

Redox Potential (mV)
ORP (mV)
360
310
260
210
160
110
60
10
-40
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8
Inshore
Offshore

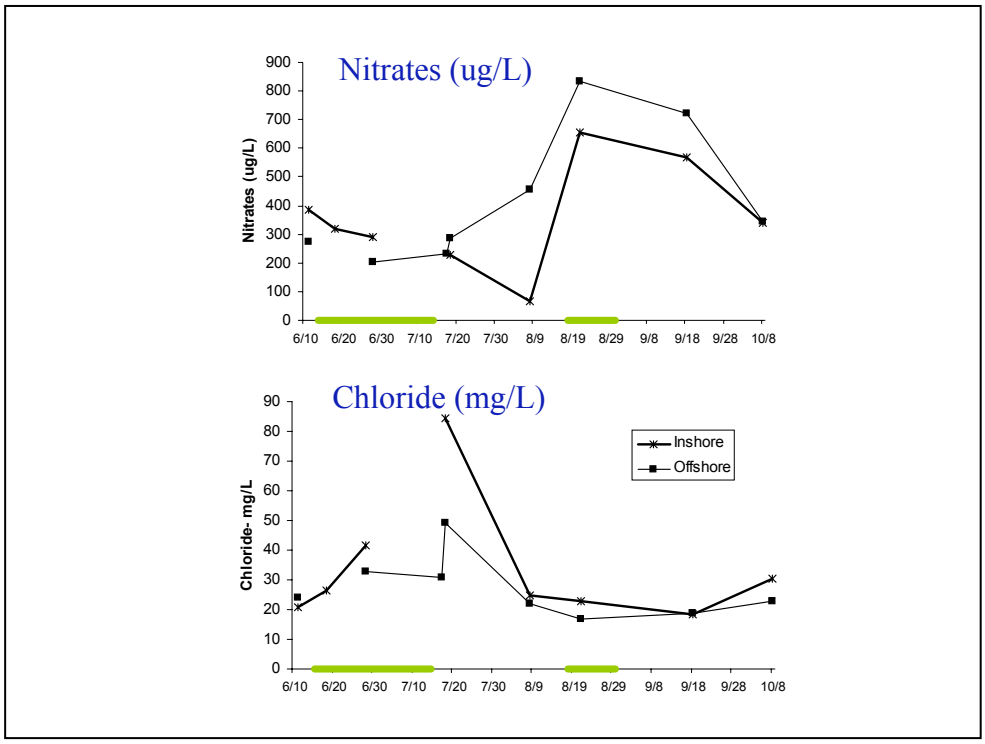

Minimum Redox
Minimum ORP (mV)
350
300
250
200
150
100
50
0
-50
-100
-150
6/10 6/20 6/30 7/10 7/20 7/30 8/9 8/19 8/29 9/8 9/18 9/28 10/8


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

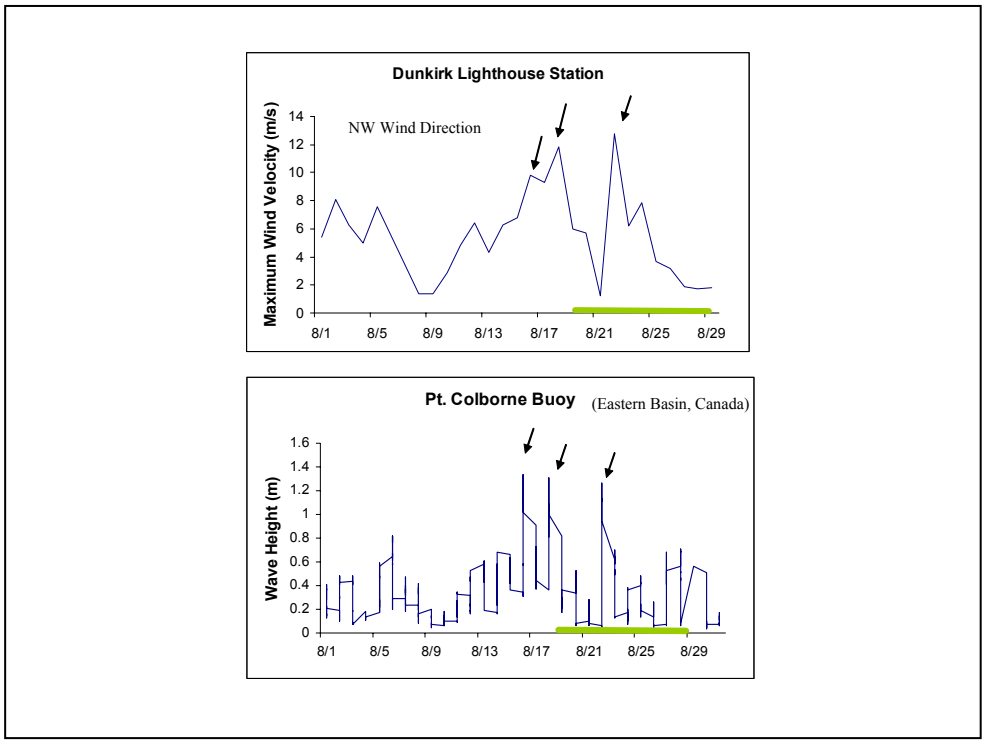


In Summary:

- 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:

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