The Economic Impact of Tourism in the Lake Erie Region of Ohio

Total Tourism Impact
Lake Region

<table>
<thead>
<tr>
<th>Sales</th>
<th>$12.9 billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxes</td>
<td>$1.7 billion</td>
</tr>
<tr>
<td>Employment</td>
<td>$3.3 billion</td>
</tr>
</tbody>
</table>

Other economic factors to consider:

- Cost of removing toxins from drinking water
- Cost to communities with drinking water advisory
- Charter captain and marina industry
- Jobs and revenue brought into state because of agriculture
Setting the Stage for Lake Erie HABs
Great Lakes Watershed Land Use

10%

Percent Land Use

Erie

1st

Least

1st

Urban

Agriculture

Grassland

Forest

Wetlands
Microcystis at Stone Lab (8/10/10)
Microcystis near Marblehead

October 9\textsuperscript{th}, 2011

Photo: Richard Kraus, United States Geological Survey
Just Western Basin Problem?

September 24th, 2013

http://coastwatch.glerl.noaa.gov/gallery/jpg/a1.13267.1852.LakeErie.143.250m.jpg
Just a Lake Erie Problem?

October 9, 2011
State, Country, and Global Problem
Great Lakes Water Quality Agreement (Annex IV) calling for 40% reduction in phosphorous loading
What Might Phosphorus Reduction Do?

Lake Erie Severity Index with 40% P reduction

Dr. Rick Stumpf --- NOAA National Centers for Coastal Ocean Science
HAB Research Initiative has ......

- Provided new answers and practical guidance about producing safe drinking.

- Started to fill critical knowledge gaps about the risks that algal toxins present for human health.

- Identified how blooms behave and how to address nutrient runoff into aquatic ecosystems.

- Driven information sharing and priority setting between universities and agencies, positioning Ohio to better prevent and manage future crises.

>$3mil spent, ~$3mil ongoing, and more to come....
Truly Collaborative
2016 report on 2015 efforts

2017 report on 2015 & 16 efforts
Nutrient Sources Today

- Maumee and Sandusky Rivers largest Phosphorous loaders
  - 87% of Phosphorous from nonpoint sources
  - Agri. is dominant land use in these watersheds (>70%)

- Between 2002 and 2013, 70-90% of Phosphorous loads occurred during highest 20% of flows
  - i.e., most loading occurred during ~10 storm events/year (Baker et al., 2014)
70-90% of Loading 20% of Time

Source: Drs. Laura Johnson, Heidelberg University
Nutrient Sources Today

- >75% reduction in Phosphorous from WWTPs; contribute <9% of Phosphorous today
- CSOs: Long Term Control Plans in place (i.e., by 2020, 40 of 62 communities will have addressed)
  - 2013, CSOs in Maumee contributed <1% of Phosphorous
- In Maumee, septic systems contribute ~4% Phosphorous
  - Recent state regulations will continue to reduce
- Scott’s Miracle-Gro removed Phosphorous from lawn care products
  - 95% market followed Scott’s lead
- Internal loading of Phosphorous ~3-7% of total load
Understanding Agricultural Nutrient Loss

- 70s to mid-1990s, Phosphoous applied at 10-40 lbs. P$_2$O$_5$ above crop removal rates, resulting in accumulation
- Since the mid-1990s, *Phosphorous being applied*:
  - at ~5 lbs P$_2$O$_5$ below crop removal rates (Mullen 2013)
  - on average, 5.5 lbs P$_2$O$_5$ above removal rates while 58% of fields have Phosphorous applied at or below crop removal rates (NRCS 2016)
- NRCS (2016) found that 42% of acres accounted for 78% of Phosphorous runoff and 80% of sediment loss
We are Directionally Correct

- Avoiding frozen (fall/winter) **application** of fertilizer and manure (SB1)
- No fertilizer when rain is in **forecast** and **saturated** soils (SB1)
- 4R Nutrient Program (SB 150):
  - Right fertilizer source (i.e., manure)  
  - Right rate (i.e., amount)
  - Right time (i.e., rain/frozen ground)  
  - Right place (i.e., needed)
- Eliminate **broadcast application** and **incorporate** fertilizer (i.e., subsurface placement; band/inject)
- **Soil testing** of all fields to prevent application of too much Phosphorous
  - Do not apply Phosphorous above agronomic need (Tri-state Reco.)
- **Drainage water management:**
  - Disconnect hydrologic pathways; drain tiles vs. wetlands & blind inlets
  - Good portion of Phosphorous leaving fields is going through tiles
What Other Levers Can We Turn?

• **Lawn Care** Recommendations:
  - Follow Scott’s lead…..all lawn care fertilizer sellers and lawn care applicators meet the zero P goal

• Reduce **property runoff** (e.g., rain barrels, terraces, porous surfaces, etc.)

• **Sewage Treatment Plant** Recommendations:

**Immediate Needs:**
- Arm water treatment plants with tools, technology, and training to remove toxins
- Reduce load of P into Lake Erie by 40%

• **Water management**
• **Soil testing (<30ppm)**
“New” White Paper

• “Summary of Findings and Strategies to Move Toward a 40% Phosphorus Reduction”

• Numerous relevant sections:
  - “Introduction and Goal”
  - “Background and History ”
  - “Nutrient Sources Today”
  - “Understanding Agricultural Nutrient Loss”
  - “Identifying Effective BMPs”
  - “Understanding Farmer Decisions”
  - “Information Gaps and Research Needs ”

Summary of Findings and Strategies to Move Toward a 40% Phosphorus Reduction

A White Paper¹

By
Kristen Fussell, Gail Hesse, Laura Johnson, Kevin King, Greg LaBarge, Jay Martin, Jeffrey Reutter, Robyn Wilson, and Christopher Winslow

25 September 2017

http://go.osu.edu/habswhitepaper
Any Questions?

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FWMC of 0.23 mg/L TP

2011 - TP (MTA)
- Detroit River, 3075, 44%
- Maumee River, 3007, 44%
- Other Tribs, 847, 12%

2012 - TP (MTA)
- Detroit River, 1828, 37%
- Maumee River, 2411, 48%
- Other Tribs, 761, 15%

2013 - TP (MTA)
- Detroit River, 1796, 40%
- Maumee River, 2287, 50%
- Other Tribs, 459, 10%

Average -TP (MTA)
- Detroit River, 2233, 41%
- Maumee River, 2568, 47%
- Other Tribs, 689, 12%

Average Flow (cms)
- Detroit River, 4999, 95%
- Maumee River, 195, 4%

Average Flow-Weighted TP Conc.
- Maumee River, 0.42
- Detroit River, 0.014
- Other, 0.27
Track Blooms From the Source

- Monitoring tributaries for nutrients that cause algal blooms
- Early warning systems for bloom activity
- Understanding blooms better for smarter management
The Bottom Line:

• Event warnings (x2)
  - GLOS
• Rock and Honey Creeks
• Fingerprinting
• Vertical movement
• Shifts between toxic and non-toxic blooms
• Central Basin blooms
• Multi-Model collaboration
• The winter piece
Produce Safe Drinking Water
The Bottom Line:

- Distribution system (fate of toxins)
- Biofilters and potassium permanganate
- Bioremediation (toxin eating and phages)
- PAC and algaeicide; type and dose
- ELISA vs. LC-MS
- Ozone vs. UV
- Enzyme pathway for treatment
- Point-of-use reverse osmosis
Protect Public Health

Identifying pathways of exposure to harmful toxins

Detecting algal toxins in tissue samples

Detecting algal toxins in fish and produce exposed to HABs water

Assessing liver disease risks associated with algal toxins
The Bottom Line:

- Fish flesh and fresh produce
- People who are predisposed to or already have liver damage may be more susceptible
- Detecting toxins in biological samples
Engage Stakeholders

Homeowners on Lake Erie

Farmers and Farm Advisors

Policymakers

Agencies and Nonprofits
The Bottom Line:

• Social network analysis
• Stakeholder-Informed decision-making support system
• 56 on 80; BMPs to optimize agriculture outputs and water quality
Identify Effective BMPs

- Soil-test-informed application rates (??%, 60%, then 30%)
- Adopt subsurface placement (25%, 36%, then 29%)
- Cover crops (27%, 20%, then 38%)
- Other BMPs:
  - Blind inlets (Phosphorous reduction by 60%)
  - Water management (1% increase = .75” rain)
  - Majority of farmers are concerned and know issue…but are not convinced that proposed BMPs are effective (either feasible or ability to reduce P loss)
What is Causing the Harmful Algal Blooms in Lake Erie?

Clean Air Act
Climate change
Commodity prices
Cropping systems
Crop uptake
Equipment size
Ethanol
Fertilizer placement
Fertilizer rates
Fertilizer source
Fertilizer timing
Glyphosate
GMOs
Increased soil pH

Ignoring amounts of P loss
Larger farm size
Lower levels of sediment in the water
Manure
Misconceptions about P by researchers
Conservation Tillage (No-till & reduced till)
Nitrogen
Rental agreements
Products sold to increase P solubility in soil
Soil biology alterations
Soil testing and analysis
Stratification of P
Tile drainage
Zebra mussels, “near-shore shunt”

Smith et al., 2014