BSU and Circle of Blue: Crisis in the Great Lakes

An Honors Thesis (HONRS 499)

By

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Abstract

The Great Lakes hold approximately 20 percent of the world’s freshwater. Climate change is threatening this region in many ways, through decreasing water levels, increasing water temperature, and by allowing invasive species to take over. During Spring 2011, Ball State University journalism graphics students collaborated with Circle of Blue to create interactive information graphics about some of these topics. Circle of Blue is a non-profit news organization that covers global water issues. This honors thesis is a continuation of that project. After sketching, researching, illustrating and making several graphics interactive for the web, I created two interactive information graphics that will be published on Circle of Blue’s website [www.circleofblue.org/waternews]. One graphic introduces climate change as a problem in the Great Lakes. The second specifically focuses on how climate change has affected lake levels in this region.
Acknowledgements

I would like to thank Professor Jennifer George-Palilonis for advising me throughout this project. Although she is involved in numerous tasks on campus and is pursuing her PhD, I’m so thankful for her time in helping me finish these graphics. She has been truly helpful with not only this project, but with all my graphics classes throughout my time at Ball State University.

I would also like to thank Circle of Blue for giving me this real-world experience. I have learned so much from the editors there – especially Aubrey Parker, Keith Schneider and J. Carl Ganter – and have become quite knowledgeable on a topic I would have otherwise not known about. It was a privilege to work with some of the best journalists in the country.

I would also like to thank my partner Shannon Veerkamp, who helped me create the water levels graphic in this project.
Author's Statement

Climate change affects the Great Lakes in several negative ways. It is threatening an environment that is important to billions of people in this region and across the country. The economy, its use as drinking water and all that is prized about living on the Great Lakes is in danger. Through a collaborative partnership with Circle of Blue, I served as a graphics reporter whose role was to tell this dramatic story in visually engaging and interactive ways. My objective was to create visually stimulating graphics that help audiences more easily understand complex processes and data-driven topics. I focused on improving my data visualization skills so that I could create simple illustrations about complex issues, work with and analyze large data sets, and sharpen my editing skills. With help from Circle of Blue, my graphics will reach national and international audiences. “Circle of Blue is the international network of leading journalists, scientists and communications design experts that reports and presents the information necessary to respond to the global freshwater crisis. It is a nonprofit affiliate of the internationally recognized water, climate and policy think tank, the Pacific Institute” (www.circleofblue.org). These stories and interactive graphics will be published in early 2012 and will hopefully help make people more aware of the growing threats to the nation’s largest supply of freshwater caused by climate change in the Great Lakes region.

Each of these graphics took roughly one month to create. Before illustrating and editing the graphics, I started by researching the topics and then showing basic sketches to Circle of Blue editors and my honors adviser. Once each graphic was complete, Circle of Blue editors and my adviser provided several rounds of revision notes. Each graphic was created in Adobe Illustrator and then made ready for the web using Adobe Dreamweaver. Frame captures of the graphics are presented in this thesis; they are also available online at
Climate Change in the Great Lakes Graphic

This graphic provides viewers a small sense of the huge problem that is developing in the Great Lakes. By explaining the harmful effects of climate change, users can see the almost overwhelming nature of this problem. Likewise, through visual representations of the current phenomena, the audience sees the dramatic effects of climate change on one of our country’s most valuable freshwater resources. This story is important to residents of the Great Lakes region because the lakes are a major source of drinking water, recreation and tourism for millions of people.

This is an introductory graphic that is meant to introduce all the stories Circle of Blue is covering related to climate change in the Great Lakes. This graphic was challenging because it is only meant to touch on different problems in the Great Lake region, but not go into too much depth on any of them. Other graphics will cover individual problems.

The first step in creating any information graphic is to determine the significance of the story and the visual elements present in the graphic. In this case the relevance is clear: The Great Lakes basin is home to 20 percent of the world’s freshwater supply. Climate change has begun to affect the water in so many different ways and the supply may run out in the future. These statistics help shed light on the severity of this topic. Thus, a strong introductory graphic provides an overview of the most important stats.

One significant challenge I faced while developing this graphic relates to the information on the “effects” page. Climate change is related to so many other issues, including water temperatures, the economy, the environment and the species living in the lakes. This page went
through several iterations and edits to find the right balance of information. One Circle of Blue editor decided we should narrow down our effects to only economic and environmental. When users first arrive on the page, they see simple illustrations that represent the environmental effects of climate change. When they roll over a panel, they are able to see economic affects as well. Most of the environmental issues directly relate to the economy, so this interactivity helps show the connection between the two.

The “future threats” page is a basic fact box, with statistics that show what could happen in the future. The challenge here lies in the fact that these stats are all just estimates. Thus it was important to use language that makes this clear. I used words such as “expected to be,” and “could be.” I also directly included the sources for each data point on this page.

**Water Levels Graphic**

This graphic contains information that is significant to a number of different stakeholders, including those who make a living from the lakes and those who vacation there. The water levels of Lake Superior, Lake Erie and Lake Michigan-Huron have all dropped dramatically. Lake Ontario is the only lake whose levels have risen over time. Lake levels are important to stakeholders such as marina owners because docks will have to be lengthened in order for boats to reach the water. This project shows the problem visually so that viewers can see the levels move up and down, and then read about the effects of this problem.

Originally, I was unsure about how to approach this graphic. I found a database through the United States Army Corps of Engineers (USACE), which has tracked lake levels since 1918. It is an immense database that lists the average lake levels from each month of that year in meters. It also shows the record high or low from each year. After quickly glancing at some of the numbers, it was clear that the lake levels fluctuate dramatically. But I wasn’t certain how to
show that visually. With data visualization, sometimes the simplest way is the best way. My first option was to graph these numbers. In past graphics classes, we were taught that if something has been done before there usually isn’t a reason to do it again. The USACE had an option to see graphs of the recorded data, so I knew that that wasn’t going to work.

My second idea was something more fun and visually appealing than a graph. It would be beneficial for users to actually see the water move up and down, because it would mimic exactly what was happening in the lakes. I decided to illustrate a side view of the lake so that as users roll over the years on the timeline, the water moves up and down accordingly. Since the available data was immense, I had to choose a lake level from a specific time of year. After doing a little research, I found that water levels are a lot shallower in winter than summer. I chose to take the average level from June of each year since it was right in the middle. I also learned that Lake Michigan and Lake Huron share the same hydraulic system, meaning that lake levels are the same. This actually turned out to be a blessing, because I wouldn’t have to create another 10 illustrations for a separate lake. After collecting all the data for each of the four lakes, I noticed that users would not be able to see a distinct difference in the levels if the numbers were kept in meters. Because Circle of Blue has an international audience, they almost always use the metric system. But after asking one of the editors if I could use feet instead, she agreed that it would be best. It was also beneficial since much of the U.S. audience who care about lake levels understand feet over meters. By the end of this graphic I estimate that I did about 120 conversions, because the numbers from the database came in meters. This has been by far been the most data-intensive graphic I have done during my time at Ball State.

After doing the conversions, I began to illustrate. I chose to do increments of 10 years starting in 1920 and ending in 2010, that way users would not be overwhelmed when looking at
the graphic. Sometimes having a lot of data is good for a graphic, but in this case it isn’t. By choosing just 10 years out of the 90 available, viewers will get a good and accurate sense of how the levels fluctuate.

The introduction, comparison and effects pages were done by my partner, Shannon Veerkamp. Together we decided that the introduction page should just be a simple picture of one of the lakes with text that would explain how lake levels rise and fall due to climate change. The effects pages explain what happens when there is too much water in the lakes as well as too little water. For example, when there is too much water flooding often occurs which will delay planting on farms. If there is too little water, recreational boating industries suffer. Shannon also did the coding in HTML to make this graphic interactive for users to click on different sections, as well as roll over different years to see the lake levels.

Through my work with Circle of Blue and this thesis project, I have gained valuable journalism experience. I have become a better graphics reporter because the project has challenged my creativity and ability to come up with new and interesting ways to visually tell stories. I have learned a lot about HTML and JavaScript that I never had the opportunity to learn in classes. In an age when the Internet is so influential and inherent in the public’s everyday media consumption, this was especially helpful. I also learned how to tighten my writing, an important skill for graphics reporters to master. All of the skills I have learned in this project will definitely help me in my career as a journalist. I believe that the hard work I put in for these graphics will show audiences just how much climate change negatively affects the Great Lakes.
Works Cited


Climate change is a threat to the Great Lakes Basin, home to 20% of the world's fresh surface water.
CLIMATE CHANGE IN THE GREAT LAKES

WARMER WATER TEMPERATURE

Longer stratified season:
Stratification occurs regularly every year, when the warmer surface water in a lake stays separate from the colder, deeper water.

WATER LEVELS

AS A RESULT OF LOWER WATER LEVELS:

1. More of the shoreline will be exposed & the frequency of toxic contaminants will increase.
2. Coastal wetlands will decrease.
3. Docks will be too high and ramps too short. Locks and berths will be too shallow, so ships will have to carry less to float higher.

ICE

When Bayfield Harbor on Lake Superior is covered by enough ice that boats cannot traverse it's known as an ICE DAY. The amount of ice days has declined greatly since 1975.

Earlier stratified season = longer time for warming = higher mean summer temperature
<table>
<thead>
<tr>
<th>Water Levels</th>
<th>Lower Water Levels = Lighter, Less Efficient Loads = More Trips = Increased Cost of Goods</th>
</tr>
</thead>
</table>

For every inch of lower water, a ship must reduce its cargo by 89.8 to 115.2 metric tons.

WARMER WATER TEMPERATURE
Invasive species caused $5 billion of economic losses in 2005. Due to an increase in warmer habitats, native cold-water species like lake trout and brook trout were overrun.

ICE
The average number of days without ice has dropped below 80 since 1975. This means that boats will be able to navigate the waters more often and it may actually help the economy.

Researchers believe that this instance may explain trends throughout the Great Lakes region.

CLIMATE CHANGE IN THE GREAT LAKES

INTRODUCTION
These are environmental effects of climate change. Roll over a panel to see how the economy is affected.
CLIMATE CHANGE IN THE GREAT LAKES

INTRODUCTION  EFFECTS  FUTURE

A LOOK AT FUTURE THREATS FROM CLIMATE CHANGE:

BY 2090, LAKE ERIE IS EXPECTED TO BE 96% ICE-FREE DURING THE WINTER.

BY 2030, BASEFLOW COULD DECLINE BY 20%.

Baseflow is the contribution of groundwater to streamflow, which ends up in the Great Lakes. This will increase the amount of droughts and floods in the region.

source: ic.ucsc.edu

IF ASIAN CARP - AN INVASIVE SPECIES - INVADES THE GREAT LAKES, THE REGION'S $7 BILLION SPORTFISHING INDUSTRY WILL BE THREATENED.

Warming waters provided a highway to the Great Lakes for this species.

source: gtc.org

Warmer water temperatures and lower water levels may increase mercury levels in the lakes. This would disrupt the current food chain.

source: ucsusa.org

BY 2050, SPRING AND SUMMER TEMPERATURES IN THE GREAT LAKES REGION MAY INCREASE BY MORE THAN 7° FAHRENHEIT.

By 2090, Lake Michigan's and Lake Huron's water levels could drop by 1.38 METERS due to a decrease in precipitation and an increase in evaporation.

source: globalchange.gov

source: National Park Service
Climate change can lower lake levels and effect the inhabitants in or around the water. See the past lake levels from the 1920s to today or learn about the effects of lake levels becoming too high or too low.
Water levels in Lake Superior have dropped below the long-term annual average over a span of 90 years. The National Oceanic and Atmosphere Administration’s Great Lakes Environmental Research Laboratory believes that this trend will continue.

1920

High
602 ft. 4.3 in.
in August.

Low
601 ft. 3.3 in.
in February.

602 ft. 1.2 in.
June 1920
Water levels in Lake Michigan and Huron have greatly dropped below the long-term annual average over the last 20 years. The two lakes are actually connected as one lake, which is why statistics are represented by one lake.

High
580 ft. 0.2 in. in July.

Low
578 ft. 11.6 in. in February.

579 ft. 9.9 in. June 1920
Water levels in Lake Erie dropped sharply between 1997 and 1999. The lake's levels have remained low ever since.

High
571 ft. 3.5 in. in July and August.

Low
569 ft. 4.7 in. in February.
Water levels in Lake Ontario dropped sharply around the 1930s and 1960s. More recently, they maintain levels around the long term annual average.

1920

High
244 ft. 11.4 in.
in July.

Low
244 ft. 2.7 in.
in February.

244 ft. 9.8 in.
June 1920
WATER LEVELS IN THE GREAT LAKES

INTRODUCTION  LEVELS  EFFECTS
LAKE SUPERIOR  LAKE MICHIGAN-HURON  LAKE ERIE  LAKE ONTARIO  COMPARISONS

LAKE SUPERIOR
604 ft.

599 ft. 6 in.

LAKE MICHIGAN-HURON
581 ft.

576 ft.

LAKE ERIE
573 ft. 6 in.

569 ft. 6 in.

LAKE ONTARIO
250 ft.

242 ft.
Climate change has a direct relation to lowering water levels of the Great Lakes. A small change in temperature can cause detrimental changes for the ecosystem. Lake temperatures and evaporation are the beginning factors to permanent changes such as the loss of certain fish species. Read more to see the effects of a minor climate change.

**BAD**
Temperatures cause more run-off during winter and spring.

**WORSE**
Flooding and erosion damage properties.

**WORST**
Additional resources and labor are needed to recover the damages. In one week in March 2011, 88 counties in Ohio flooded due to snow run-off into the lakes.

**BAD**
Extreme run-off can result in metal pollution or toxic organisms in the water.

**WORSE**
Beaches and tourist areas close. The water isn’t safe for human contact.

**WORST**
Insects such as mosquitoes live in the polluted water, spreading vector-borne illnesses. More than 1,000 of the 1,400 U.S. fish consumption advisories are found in the Great Lakes states.

**BAD**
Spring flooding delays planting on farms.

**WORSE**
Soil erodes and loses nutrients.

**WORST**
Agriculture and forestry industries pay high price to restore soil and fight pests. USDA’s Natural Resources Conservation Service gave a $296,924 grant in 2010 to fight soil erosion.

[Source: Associated Press]
[Source: TEACH Great Lakes]
[Source: The Great Lakes Basin Program]
Climate change has a direct relation to lowering water levels of the Great Lakes. A small change in temperature can cause detrimental changes for the ecosystem. Lake temperatures and evaporation are the beginning factors to permanent changes such as the loss of certain fish species. Read more to see the effects of a minor climate change.

### Too Much Water

**BAD**
- Streams and rivers become hotter due to outside temperatures.

**WORSE**
- Fish migrate or die from the heat. Certain areas become "dead zones."

**WORST**
- The Atlantic salmon is now extinct due to overfishing and loss of prime spawning habitat.

### Too Little Water

**BAD**
- Higher temperatures cause water evaporation. Consequently, droughts occur more often.

**WORSE**
- Crops may not get needed irrigation to survive. Fruit trees are greatly at risk.

**WORST**
- The Great Lakes region has more than 6,000 wildfires each year.

**BAD**
- Evaporation increases and snow coverage drops.

**WORSE**
- Lake levels decrease.

**WORST**
- Recreational boating, hydropower generation and boating industries suffer.

- Sports fishing contributes $4 billion to the economy around the lakes.