The Projected Effects of Climate Change on Lake Erie's Biological Processes

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Research Questions

1. How will climate change continue to impact the physical and chemical parameters throughout Lake Erie, and how will these alterations impact future biological processes?

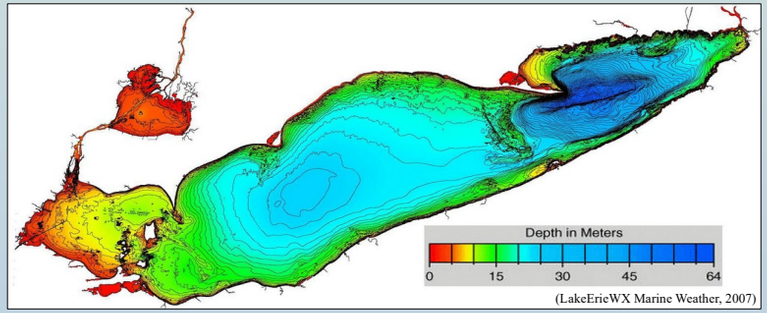
2. How may these negative impacts on Lake Erie resulting from climate change be prevented or mitigated, looking at international, national, provincial/state, and local/municipal climate change efforts?

3. What are the main barriers that currently prevent tangible, effective climate change actions and efforts from taking place?

Abstract – Highlights

- The effects of climate change acting upon Lake Erie are expected to significantly impact future water temperature and water levels.
- Alterations in water levels and temperature will impact the Lake's physical and chemical processes, leading to a wide range of biological consequences.Some of these biological modifications will include increased survival of non-native species, increased respiratory metabolic processes, altered growth and survival rates, altered species distribution, and modified spawning patterns.
- These changes in Lake conditions are expected to result in several economic ramifications, some of which will include an extended shipping season, increased shipping and dredging costs, and negative effects on cold-water fish yields.
- Scientists have suggested that a 'bottom-up' approach of integrating climate change efforts at the municipal level be taken. However, this approach has yet to be adopted as obtaining the funds required to implement municipal climate change plans and projects is difficult (OCCIAR, 2017).
- Current efforts and actions taken to address global climate change emphasize the mitigation of greenhouse gas emissions in climate change action plans.
- Although it is important to reduce greenhouse gas emissions through mitigation measures so that the effects of climate change may be delayed and/or lessened, the fact remains that our climate will continue to change into the future.
- It is essential that climate adaptation measures are placed at the forefront of current climate change efforts to ensure that the world does not find itself unprepared and suffer unnecessary losses.

(OnTheWorldMap, 2021)



(LakeErieWX Marine Weather, 2007)

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Section A: Expected Changes in Lake Erie Water Temp

It is expected that freshwater lake temperatures may increase by up to 1.02–2.16°C by 2050, and 2.72–5.76°C by 2100 (NASA, 2015). The expected increase in Lake Erie's future water temperatures will affect several physical and chemical processes (Smith, 1991). These physical and chemical changes will result in several different biological consequences, as water temperature directly affects water chemistry, biochemical reactions, ecosystem productivity, as well as the presence of organisms (Komatsu et al., 2007). Water temperature is also a key parameter in determining fish spawning, development, growth, and survival, and can influence the distribution of freshwater species (Alofs et al., 2014).

Section B: Expected Changed In Lake Erie Water Levels

Future Lake Erie water levels will be determined by three variables – direct precipitation falling onto the lake, runoff flowing into the lake, and over-lake evaporation (Hayhoe et al., 2010). Over-lake precipitation events are expected to increase in the future; however, it is predicted that Lake Erie will experience decreased inputs from surface runoff. This decrease in runoff, when coupled with increased rates of evaporation, is expected to result in an overall decrease in water levels (Mortsch et al., 1996). Studies completed by the U.S. EPA predict that the effects of climate change will result in a reduction of the Great Lakes water levels by approximately 0.5 to 2.5m under the IPCC's current GCMs (Smith, 1991).

Section C: Action Against Climate Change

Both mitigation and adaptation measures will be required to properly address the paramount issue of climate change (Gregg et al., 2012). The scope at which climate change mitigation and adaptation measures take place is varied, and to be successful, a collaborative effort by international, national, state/provincial, and local/municipal bodies will be required. In this research paper, all climate change efforts made by the countries, states/provinces, and municipalities which border Lake Erie have been outlined in detail.

Section D: Current Barriers to Climate Change Action

1. The'bottom-up' approach of integrating climate change efforts at the municipal level is key in combatting climate change, as this method will result in a cumulative effect and generate tangible large-scale changes over time (Rayner, 2010). However, this approach has yet to be adopted as obtaining the funds required to implement municipal climate change plans and projects is particularly difficult at the municipal level (OCCIAR, 2017).
2. Most nations, provinces, states, and municipalities are currently focused on how they may mitigate climate change through a reduction in greenhouse gas emissions (Burton et al., 2006). Climate efforts focused on mitigation are useful in the fight against climate change; however, it is essential that climate adaptation measures are also highlighted and incorporated into climate action plans (Burton et al., 2006).