Prevention of Grass Carp Invasion to Lake Michigan Milwaukee River & Lake Michigan, Milwaukee, WI 53202, United States
-Xuanshu Lin (Team 9) | xuanshu2@illinois.edu

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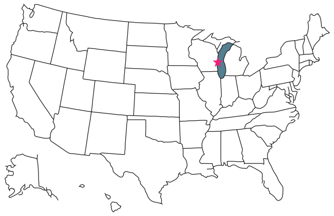


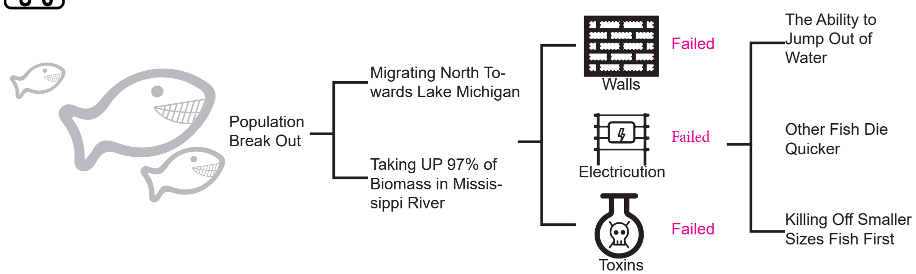
The Challenge

There were concerns about carps entering Lake Michigan while the invasion was in progress in Mississippi River. Now, with the most recent data available on USGS, Grass Carp (Ctenopharyngodon idella) is at the edge of Lake Michigan in Milwaukee River.

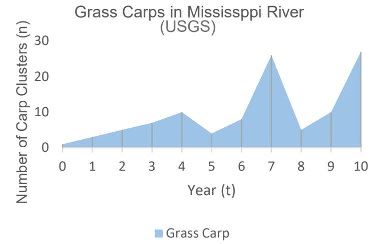
Capable of laying **500,000** eggs that each can grow **2 pounds/month**

No predators against audlthood Grass Carp

Consume massive quantity of food that is **40%** of its body weight per day



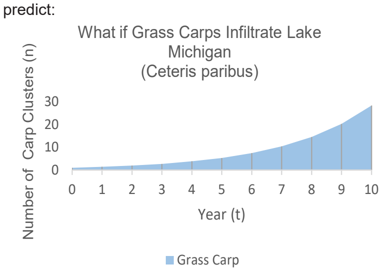
Prediction



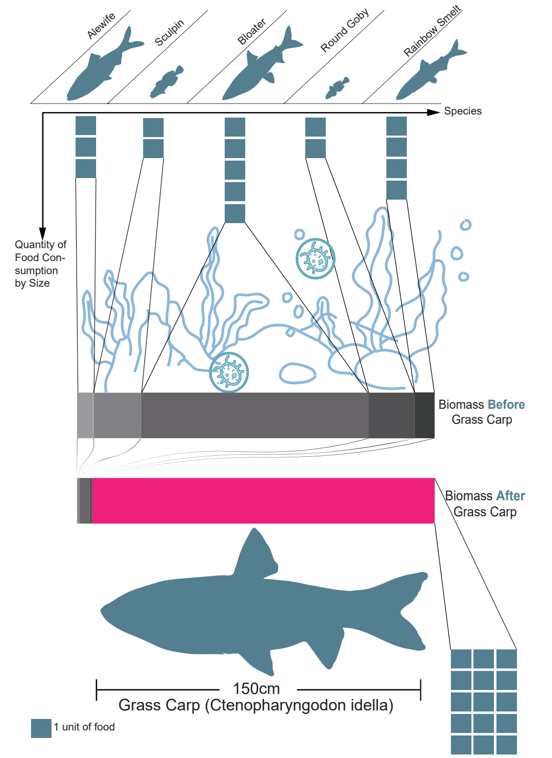
nGLM: Number of Grass Carp Clusters in Lake Michigan
nGMR: Number of Grass Carp Clusters in the Mississippi River
t: Year
Formula: for calculation of the anticipated Grass Carp's population of growth in Lake Michigan:

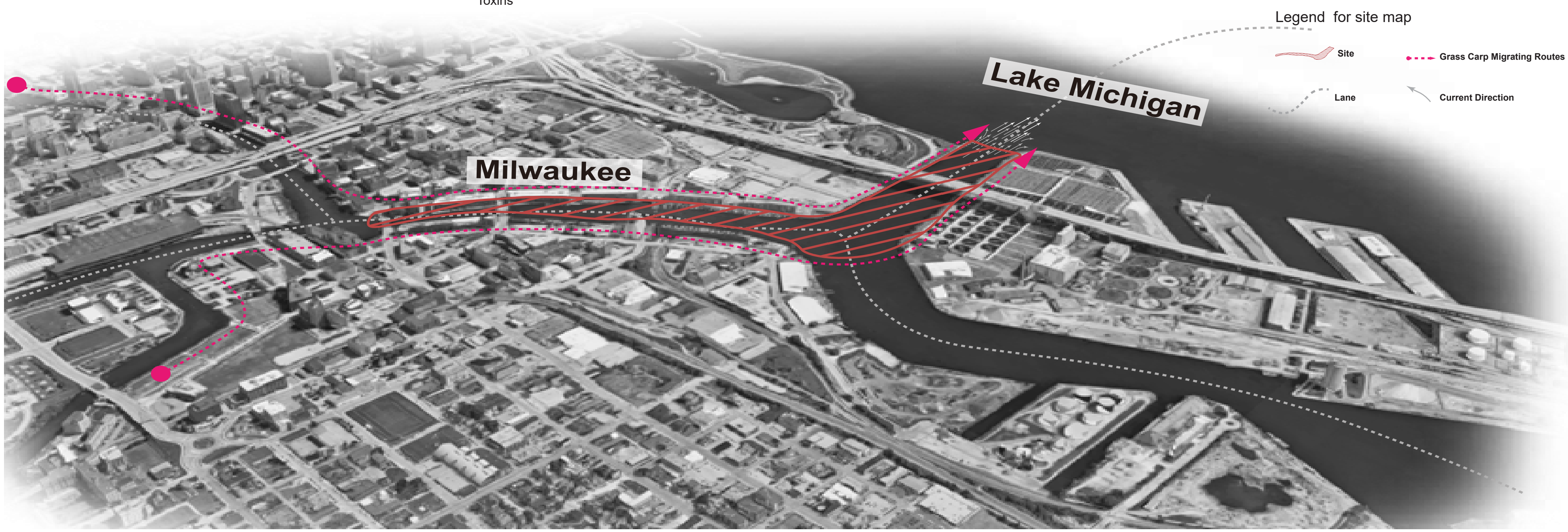
$$nGLM_{(t)}=nGLM_{(t-1)}+nGLM_{(t-1)}*(\sum_{i=0}^{10}(nGMR_{(t)}-nGMR_{(t-1)})/nGMR_{(t-1)}$$

Calculation Assumption: We assume a what-if situation there will be 1 cluster of Grass Carps in year 0 enter Lake Michigan successfully.
Based on what happened in Mississippi River, we may predict:



Fish Species in Lake Michigan Comparison





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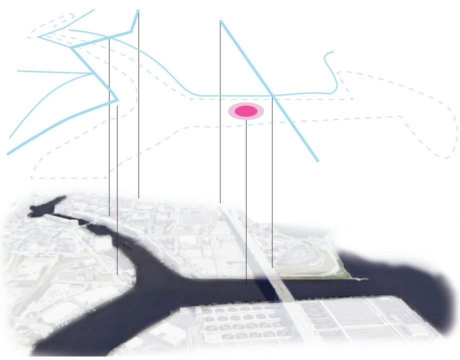
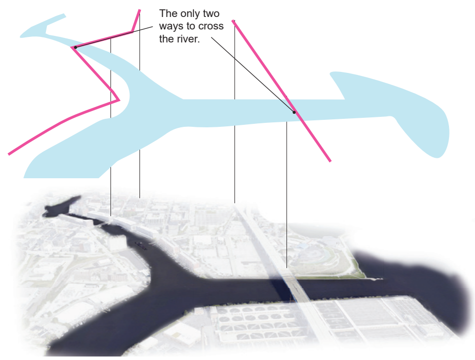
SOLUTIONS

SITE ANALYSIS

No Defensive Mechanisms



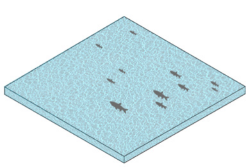
Lack of Connectivity



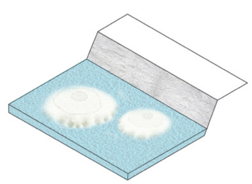
-There are no defensive mechanisms in the river to prevent carps from entering Lake Michigan. Therefore, before any internvention happens to the site, caprs have 100% access to the lake.

-The two shores alongside the river are connected by only two bridges, which greatly limit the connectivity between the two sides. Therefore, people have less choice to access both sides of the river, resulting no pedestrian showing up at the site.

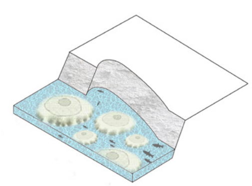
DESIGN INTENTS



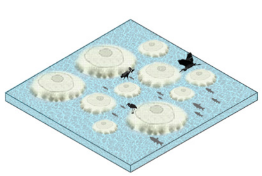
1. Before-Carps can enter Lake Michigan freely.



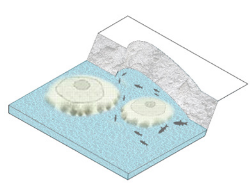
2. Before-River shore is constant and predictable, which makes the current fast and steady.



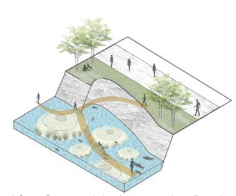
3. Before-People have little interaction with water and little access to the other side of river.



1. After Biological Intervention-Modifying the site to a swamp-like area to keep big-sized adult carps outside. In this case, only the small-sized baby and adolescent carps can have the opportunity to enter. Furthermore, the swamp-like area can increase the likelihood of stranding adult carps and allow other fish species to pass alive. With the gradual screening process by these little islands with closer and closer distances, less and less and smaller and smaller carps can pass through. Next, by introducing great blue herons (Ardea herodias), we can start biological control in this area.



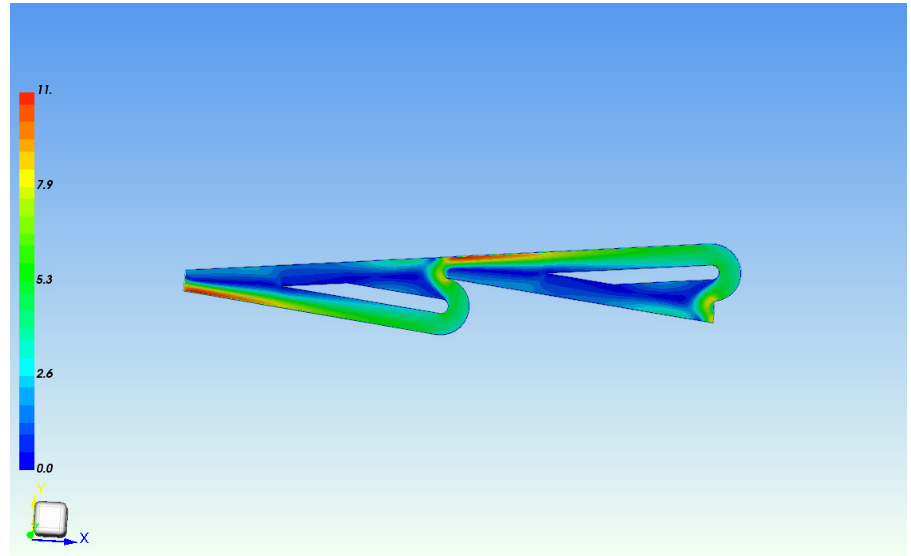
2. After Physics Intervention-The river shore's shape can be modified to a Tesla Valve-like geometry (explained in the following content). Not only can carps' swimming direction be distracted, but also the current flowing speed can be slowed. We also need more Tesla Valve curves on both sides of the shore. The image above shows only one section of the site.



3. After Connectivity Intervention-By placing a linear park alongside the river and pedestrian bridge across the river, we can attract more people to the site and connect them to both sides of the shore, providing more equitable access to the facilities on both sides of the shore. What is more, by doing so, we also allow people to have more intimacy with the water and more activities such as fishing and carp fishing competition which can also contribute to the reduction of carp population. We can also add tall trees and brushes to the site, not only because of their greenery views, but also they can serve as herons' nests.

Implementation

TESLA VALVE- Further Explaination of Design Intents #2.



In this Tesla Valve model, the water flowing direction is from left to right. The initial velocity of water entered from the left end is greater than the right end, as shown in the simulation above. By applying multiple tesla valve-like shapes into the Milwaukee River's shore, we can manage to decrease the current's speed, preventing carps from being flushed into the lake.

Operation

Time: If implemented, islands in the river can be filled within 3 months. River shore adjustments can start at the same time of the implementation of middle islands. After the river parts are ready, we can start to construct the pedetrian bridge which can be done within 2 months.

Partnership: We can also have partnerships with nonprofits and governmental agencies to host fishing competitions to add contributions to eliminate carps in this area.

Progress & Potential Obstacles: The program can be monitored by the adaptiveness of herons. Once they settle down, a biological control forms, which makes our intervention of controling carp species more steady. Some other water birds to consider in case herons can not adapt to the environment: Cranes, Loons, Geese, Grebes, etc.

Job Opportunities: The islands can also serve as urban farms for growing food in supply of the nearby neighborhoods. The stranded carps can be further processed to fertilizers for food growing. Potential job positions like maintenance, farmers, fertilizer producers, and product sellers can be created.

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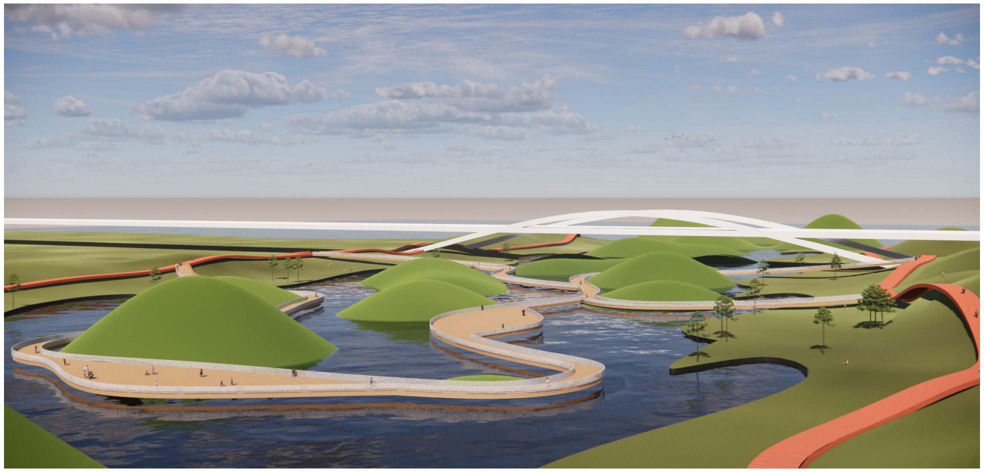
VISION



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ACKNOWLEDGEMENT

Dr. Liu Yonghui (Tel:+86 13357511855), former scholar of Chinese Academy of Sciences in Physics--significant contribution to Tesla Valve. Professor Arnab Chakraborty (arnab@illinois.edu), Professor of Urban and Regional Planning--significant advising on writting and page layout. Professor Daniel Schneider (ddws@ illinois.edu), Professor of Urban and Regional Planning--significant advising on idea formation and the water flow direction of Milwaukee river. Software used: Google Maps@2021, Adobe (Photoshop, Illusrator, InDesign), Rhino, Enscape, Simflow.

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