Guess who's coming to dinner? Investigating spawning and feeding habits of the invasive Asian carp using remote sensing and GIS
Great Lakes and St. Lawrence Cities Initiative
Earthzine/DEVELOP Virtual Poster Session, Summer 2011
Video Transcript

Slide 1:
"Hello, this is Sarah Geise of the Great Lakes and Saint Lawrence Cities Initiative (GLSLCI) DEVELOP team. Other team members include Cassandra Follett, Robert Bradley, Brendan McAndrew and Rebecca Christhild. We are working to develop decision support for Asian Carp population assessment and management in the Great Lakes using NASA Earth Observation Systems and Geographic Information Systems (GIS) technologies."

Slide 2:
"Asian carp threaten the biodiversity of the Great Lakes ecosystem. Loss of biodiversity could threaten the multi-billion dollar sport and commercial fishing industries of the lakes. In addition to threatening other fish populations, the Carp have posed problems to both recreational and industrial boat traffic as they jump out of the water causing injuries when disturbed.

"Along with the mayors and officials of the Great Lakes and Saint Lawrence Cities Initiative, we worked with the United States Geological Society and the National Oceanic and Atmospheric Administration. To support management decisions regarding the invasive carp, our team developed a methodology of mapping potential spawning locations using ArcMap GIS software and investigated the food sources of the Asian carp in the Great Lakes using NASA technologies. Earlier in this project the DEVELOP HIVE unit was used to project data into 3D for enhanced communication of the Asian carp issue to non-technical audiences."

"The advisors of this project are David Ullrich and Melissa Soline of the Great Lakes and St. Lawrence Cities Iniative and Kenton Ross of NOAA."

Slide 3:
"During the 1970s Asian carp were imported to the United States and have since spread to various rivers including the Mississippi, which is connected to the Great Lakes through the Chicago Sanitary and Ship Canal in Illinois. The study area for this project is the Great Lakes ecosystem. We focused on Lake Michigan initially because there are many possible vectors either through failure of the electric weir or entry through flooding of streams and its close proximity to the Mississippi basin."

Slide 4:
"The MODIS instrument on the Terra and Aqua satellites was used, as well as SRTM. MODIS stands for Moderate Resolution Imaging Spectroradiometer and SRTM is the Shuttle Radar Topography Mission. Oceancolor Web was used to acquire the MODIS data to analyze plankton composition of the Great Lakes. The USGS website provided water data which included flow station monitoring sites and the Great Lakes Information Network supplied a variety of data pertaining to the Great Lakes including streams accessible to spawning fish."

"ArcMap was used to analyze hydrologic and other data to create a multi-variable map of potential spawning locations of Asian carp. MODIS data was processed using the NASA Oceancolor program, SeaDAS, to display cyanobacteria blooms that the Asian carp feed on."

Slide 5:
"Shown here are the rivers or streams surrounding Lake Michigan that have USGS hydrologic monitoring stations. Data from these stations were used for the risk assessment."

Slide 6:
"One of the variables used to assess possible Asian carp spawning habitats was the length of the stream unobstructed by a dam or other structure. Length of the stream was calculated in ArcMap and the USGS provided flow data. Asian carp have been found in all water bodies from stagnant ponds to flowing rivers. The highest rates of spawning have been documented in rivers with flows between .6 and 2.3 ft/s."

Slide 7:
"Seen here is a risk assessment for spawning habitats performed on streams with the most complete data for stream length, flow, temperature, and distance to high chlorophyll concentrations in Lake Michigan which indicates higher levels of plankton, an Asian carp food source."

Slide 8:
"Our partner, the GLSLCI, wanted a risk assessment that went beyond identifying streams that were possible spawning locations, and desired an assessment of streams that indicated level of risk for use in resource allocation and the decision-making process. This information would help them determine which rivers or streams may demand the most monitoring and mitigation. The variables included in the risk assessment were obtained from, 'Asian carps: a biological synopsis and environmental risk assessment' (Kolar et al. 2005) which discussed the living and spawning habits of Asian carp in a variety of locations from their native habitat to the United States. As the carp spawn mostly during the summer months, flow, temperature, and chlorophyll data were extracted for May through August where possible. Mean temperatures and flow from the four months listed were used for each station to derive the final risk classification."

Slide 9:
"One request from our partner was assistance with visualizing the Asian carp problem. For the Great Lakes and St. Lawrence Cities Initiative annual meeting in Niagara Falls, June 2011, our team prepared and showcased a video using 3D visualizations of Asian carp data, designed for the non-technical audience of the annual meeting. Using multi-beam sonar data, our team created a 3D visualization of the Chicago Sanitary and Ship Canal."

Slide 10:
"Because Asian carp are opportunistic feeders, they consume several different types of algae, including blue-green algae, also known as cyano-bacteria."

"Due to Asian carp feeding habits, the USGS expressed interested in mapping cyanobacteria in Lake Michigan. This was accomplished by processing level 2 MODIS products with algorithms that focus on a pigment specific to cyanobacteria. The pigment, phycocyanin, was focused on by converting the algorithm into the interpretive data language for use in the SeaDAS remote sensing program provided by NASA Oceancolor web. Using user-defined operations, MODIS bands can be processed to focus on cyano-bacteria blooms in the Great Lakes. Future work could focus on scripting to allow for batch-processing of MODIS to create time series of cyanobacteria blooms in Lake Michigan. This would allow for insights into the Asian carp problem, but because cyanobacteria are also harmful to human health, there would also be human health applications as well."

Slide 11:
"GIS and NASA's earth observation systems have proven effective in modeling potential spawning habitats of the Asian Carp in Lake Michigan as well as the monitoring of harmful algal blooms in the lake. Our technical paper and modeling methodology will be delivered to our partners for continued use. A tutorial explaining cyano-bacteria mapping using SeaDas, a NASA program, will also be submitted."

"Expected future research includes a series analysis of the cyanobacteria blooms in Lake Michigan compared to the data currently being compiled by the USGS on feeding habits of Asian carp in North America."

"Thank you for listening and we hope you've benefited from this presentation!"

References

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