Predicted biomass and food web impacts of Bigheaded carp across Great Lakes habitats

Background
Bighead and Silver Carp (collectively, bigheaded carps 'BHC') are highly invasive planktivorous fish that threaten to invade and impact Great Lakes food webs.

Hypothesis:
Bigheaded carp had negative effects on planktivorous fish, that were greater in more productive habitats *

Methods
Simulation Scenarios
Zhang et al. (2016) showed bigheaded carp biomass and population growth were sensitive to vulnerability of their prey, adult carp production to biomass rate (i.e., mortality), and predation on young. We ran the following scenarios for each Great Lake habitat, and compared variation in prey vulnerability (LV, HV), adult mortality (LZ, HZ) and consumption by salmon and trout (Pred) to a baseline scenario of no bigheaded carp.

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Prey vulnerability</th>
<th>Carp P/B</th>
<th>Eaten by Salmonines?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline/No AC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HZLV/Pred</td>
<td>Low</td>
<td>1.08</td>
<td>yes</td>
</tr>
<tr>
<td>HZHV/Pred*</td>
<td>High</td>
<td>1.08</td>
<td>yes</td>
</tr>
<tr>
<td>LZLV/Pred</td>
<td>Low</td>
<td>~0.6</td>
<td>yes</td>
</tr>
<tr>
<td>LZHV/Pred</td>
<td>High</td>
<td>~0.6</td>
<td>yes</td>
</tr>
<tr>
<td>LZLV</td>
<td>Low</td>
<td>~0.6</td>
<td>no</td>
</tr>
<tr>
<td>LZHV</td>
<td>High</td>
<td>~0.6</td>
<td>no</td>
</tr>
</tbody>
</table>

* (All results of BHC impact on food web groups below assumed scenario HZHV/Pred).

Results
Predicted Bigheaded Carp Biomass is highest in more productive Great Lake habitats when prey vulnerability is high

Results (cont.)
Bigheaded Carp may lower zooplankton biomass through consumption, but increase phytoplankton biomass through predator release *

Summary & Future Work
- Predicted BHC biomass and food web impacts were higher in more productive habitats compared to less productive habitats. BHC impacts were mainly negative for plankton and planktivores, and positive for some piscivores.
- BHC population growth and impact were more dependent on assumptions of prey vulnerability than on assumed carp vulnerability to predators.
- Simulate BHC population growth and impact on the Lake Ontario food web.
- Test model skill in the Illinois River food web where BHC are present and food web impacts are documented.
- Simulate food web impacts of Grass Carp and Black Carp in the Great Lakes.

Literature Cited and Acknowledgments

This work was supported US EPAs Great Lakes Restoration Initiative and the Asian Carp Regional Coordinating Committee.