Asian carp

The value of understanding political, social, and economic effects of prospective policies to mitigate a Laurentian Great Lakes invasion

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ABSTRACT

Bighead (*Hypophthalmichthys nobilis*) and silver Asian (*Hypophthalmichthys molitrix*) carp are invasive species that threaten to populate the Laurentian Great Lakes, located on the United States-Canada border in northeastern North America. Elected officials, at the urging of Laurentian Great Lakes stakeholders, are debating eight possible policy alternatives to stop an Asian carp invasion. The alternatives have been justified scientifically; however, the political, social, and economic impacts of the alternatives are yet to be articulated. This study will discuss these impacts using a cause and effect analysis of each policy alternative. The results of this analysis show that the policies currently being considered, although viewed as scientifically effective, are not politically, socially, or economically feasible. There are doubts about scientific certainty, varying citizen opinions on alternatives and little to no detail about who will pay for policy implementation. Elected officials must gather credible data regarding political opportunities and obstacles, public opinion and economic externalities to recommend and implement the best policy alternative.
The Laurentian Great Lakes (the Great Lakes) are a system of five lakes bordering eight states within the United States and Canada, and the largest bodies of freshwater in the world. They provide drinking water for 40 million people, a home for 250 species of fish, a clear passage for 200 million tons of commercial goods annually and a US$4 billion sports fishery industry (GLERL, 2014). In the last decade, scientists have warned that the services citizens depend on the Great Lakes to provide could be jeopardised by a serious, imminent threat – an invasion of bighead and silver Asian carp.

Stakeholders of the Great Lakes, including politicians, citizens, environmental committees and trade organisations, agree that a US government policy to prevent an Asian carp invasion is an urgent necessity. The chosen policy will target the Chicago Area Waterway System (CAWS), the geological area where an Asian carp invasion will likely occur, and will include several structural and non-structural control methods. The US Army Corp of Engineers released a study in 2014 outlining the eight most realistic policy alternatives. Stakeholders disagree about which policy should be implemented. The 2014 study evaluated the alternatives on scientific merit alone and did not consider the political, social, and economic effects that each prospective policy would have on the Great Lakes and its users. The lack of comprehensive and well-organised data about each policy alternative is a key reason why a policy to prevent an Asian carp invasion of the Great Lakes has not been chosen.

Conducting a cost/benefit analysis of each policy alternative that includes social, political and economic effects would allow stakeholders and elected decision-makers to better understand the strengths, weaknesses, opportunities and threats of each alternative, and perhaps expedite the choice and implementation of an official U.S. policy. This study provides a clearer description of prospective policy alternatives for effectively mitigating Asian
CARP IN THE GREAT LAKES BY INCORPORATING SOCIAL, POLITICAL AND ECONOMIC ASPECTS NOT PREVIOUSLY CONSIDERED.

BACKGROUND

Bighead and silver Asian carp currently inhabit the Upper and Lower Mississippi River basins of the southern United States, which connects to the Great Lakes basin area of the northeastern United States. Local, state, and federal governments as well as environmental committees, the general public, and trade associations are concerned that Asian carp will establish populations in the waters of the Great Lakes in the near future. Asian carp are invasive because they are adaptable, reach maturity quickly and eat phytoplankton and zooplankton – behaviour that can potentially threaten the life and habitat of native fish and plants in the Great Lakes (Reeves, 2014). Government officials, the general public, environmental committees and trade organisations are currently considering various policy alternatives to mitigate the spread of Asian carp into the Great Lakes.

HISTORY

The Great Lakes were formed between 14 000 and 4 000 years ago by glacial retreat (McKenzie, 2014). They are the world’s largest group of freshwater lakes, and account for 21 percent of global freshwater. Edward Mills defines an invasive species as “successfully reproducing organisms transported by humans into regions where they did not exist in historical times” (in McKenzie, 2014, p. 94). Humans have introduced invasive species to the Great Lakes for hundreds of years.

Invasive species can be damaging to an eco-system because they have less natural predators, reproduce at rapid rates and ex-
perience little competition for natural resources. This causes a decrease in native plant and animal populations and may harm the ecological and economic activity of the region (McKenzie, 2014). The Great Lakes now face these risks because of Asian carp. In particular, silver carp can grow up to 18 kg and jump several times their body length in the air, which has caused panic and bodily harm for sport fisherman and recreational lake users. Bighead carp are massive in size. They can grow up to five feet in length and weigh up to 45 kg.

Asian carp were introduced to the US in Arkansas and Louisiana, imported largely from China in the 1970s for pest-control in man-made fish ponds. Asian carp spread to the Mississippi River during flooding in the 1990s and have since travelled to the Illinois River, which is linked to the Great Lakes near Chicago (Rodriguez, 2011). Bighead and silver carp compete for food and space with native fish (Hinterthuer, 2012), and will threaten the multibillion-dollar fishing industry of the Great Lakes if populations are established. (Wittmann, Cooke, Rothlisberger, & Lodge, 2014)

**GEOGRAPHIC AREA OF CONCERN**

The aquatic pathways between the Upper Mississippi and Great Lakes basins are the geographical area of concern for most policies. The CAWS – a large area of channels and canals, nearly half of which are man-made – is key. Five major aquatic pathways between the Mississippi River and Great Lakes basins lie within CAWS, making it the primary area of focus for prevention of Asian carp invasion into the Great Lakes (USACE, 2014). The CAWS is a significant water body serving a range of mitigation, provisioning and recreational purposes. Most of the water in CAWS comes from Lake Michigan. CAWS is used for managing storm water and preventing flood; supplying water to industries,
power generation and emergency response systems; as well as for commercial navigation, and recreational boating and fishing (USACE, 2014). The uses and users of CAWS are taken into account while examining the efficacy and cost of policy alternatives in this geographical area. While it is possible that Asian carp can enter the Great Lakes through rivers leading to Lake Erie, one of the five Great Lakes, the Chicago area is the focus of this analysis.

**STAKEHOLDERS**

US policy stakeholders agree that it is important to keep Asian carp out of the Great Lakes. It is likely that no solution will appease every stakeholder and it is desirable to avoid a solution that greatly benefits one party to the detriment of another (Rodriguez, 2011). The policy chosen by decision-makers for implementation should consider the perspectives and concerns of government officials, the general public, environmental committees, and trade associations.

**Government officials.** Politicians want to choose the best policy for mitigating an Asian carp invasion because it is in the public interest to protect natural resources. Political figures have a role in the Asian carp debate because they are authorised to take official action. The U.S. Congress will approve and fund the chosen alternative, multiple governors and state legislatures will implement federal policy, and ground-level administrators and public officials will oversee infrastructure projects.

**Environmental committees.** Formal committees conduct research and advocate for policies to prevent Asian carp from populating the Great Lakes. The Asian Carp Regional Coordinating Committee (ACRCC) and the Great Lakes Restoration Initiative (GLRI) are made up of 20 local, state, and federal agencies that work together to protect and restore the Great Lakes. The ACRCC is funded with US$104 million from GRLI (Hinterthuer,
The Alliance for the Great Lakes (AGL) and National Resources Defense Council (NRDC) are action groups who conduct their own studies to determine how the City of Chicago can best redesign its water infrastructure to allow for hydrological separation in order to keep Asian carp out of the Great Lakes (Hinterthuer, 2012).

**Trade associations.** The Chemical Industry Council of Illinois (CICI) is a trade association that aims to protect the economic interest of the chemical industries of Illinois. Unlock Our Jobs is a coalition of over 60 agriculture, business, communities, and citizens. Both associations are specifically fighting for a solution to keep Asian carp out of the Great Lakes without closing the Chicago locks.

**GOVERNMENT ROLE**

Federal and state US governments play a powerful role in funding, regulating, and protecting policies and laws that affect the Great Lakes. Every viable solution to stop the invasion of Asian carp into the Great Lakes has political considerations, such as the cost to government and taxpayers, the economic impact on stakeholders, and the level of support among citizens.

Major federal funding began in 2010, when President Obama formed ACRCC to stop the spread of Asian carp into the Great Lakes and funded it through the GLRI. Congress funded a comprehensive USACE study of feasible policy alternatives to prevent the spread of Asian carp into the Great Lakes and has the power to fund and endorse the policy alternative of their choice (Reeves, 2014).

The federal government has used its legislative power to protect the Great Lakes from invasive species. In 2010, the Asian Carp Prevention and Control Act made it unlawful to import Asian carp, specifically the bighead carp, into the United States.
by labelling it “an injurious species under the Lacey Act” (Rodriguez, 2011, p. 27). While this law does not address the Asian carp population already present in the United States, it is a crucial step toward invasive species management.

State governments have tested their power to influence a solution to an Asian carp invasion using legal channels. The State of Michigan filed a lawsuit against the State of Illinois and the USACE in 2009, requesting a preliminary injunction to close the locks from CAWS into Lake Michigan. Attorneys general from the states of Minnesota, Ohio, Pennsylvania, and Wisconsin joined the lawsuit in 2011. The request for injunction was eventually denied by the US Supreme Court (Rodriguez, 2011).

POLICY CONTEXT AND ALTERNATIVES

Policy alternatives

Short and long-term policies are being considered for implementation to stop the spread of Asian carp into the Great Lakes. The 2014 USACE Great Lakes and Mississippi River Interbasin Study Report (GLMRISR) was the first comprehensive government research highly anticipated by stakeholders. It set out eight policy alternatives to mitigate the spread of Asian carp into the Great Lakes. This section presents a high level overview of the key themes that are important in policy alternatives before introducing the specific alternatives.

Long-term policy alternatives. The baseline policy alternative (status quo) is to continue what is currently being done: USACE operation of two electric barriers approximately 40 kilometers downstream from Chicago and genetic surveillance (eDNA) of CAWS and the Great Lakes. Other methods of controlling the spread of aquatic invasive species currently used include struc-
tural approaches such as locks, electric barriers, treatment plants, screened sluice gates, and physical barriers.

Locks are a two-gate system that open and close when boats pass through and function as a control point to physically prevent invasive species from entering the waterway. Electric barriers located in the bottom of a water channel create an electric field that repels or stuns fish. Treatment plants within the lock system replace the water that contains invasive species, using ultraviolet light, screening, and filtration. Sluice gates are used during flooding periods, allowing water to pass through while controlling fish travel, while physical barriers made from concrete and sheet pile completely separate one body of water from another (USACE, 2014).

Non-structural controls are also part of the baseline approach, including the use of nets and chemicals to remove or control fish and plants in or from a water body, the control of boat access to waterways, the development of boat cleaning stations for vessels passing into different bodies of water and public awareness and education (USACE, 2014). Three of the eight policy alternatives presented by USACE include a combination of structural and non-structural techniques and are estimated to cost US$18 billion and take 25 years to implement (Reese, 2014; USACE, 2014). Concerns relating to time and money are part of the reason why policy alternatives presented by GLMRISR have not been chosen or implemented to date.

Genetic surveillance measures, such as the collection of environmental DNA, are particularly effective at evaluating the presence of an invasive species prior to the establishment of a population (Jerde et al, 2013). Environmental DNA has been found in the CAWS above the USACE electric barrier. This alerts scientists to the possibility that Asian carp populations are already in the Great Lakes waters, although no fish have been positively detected to date. eDNA cannot provide information about how many Asian carp are in the water, whether they are dead or alive, or if
they were transported by an outside source such as a ship. The long-term benefits of genetic surveillance of the Great Lakes region for Asian carp will become clearer with time and additional research (Jerde et al, 2013).

**Short-term policy alternatives.** Human consumption of Asian carp as an invasive species management strategy is a potentially cost-effective, market-based solution. However, Varble and Secchi (2013) caution that humans in the Great Lakes region should only be allowed to consume Asian carp while a population problem exists and argue that Asian carp should not be farmed or otherwise cultivated for sustained profitable commercial activity. Varble and Secchi, after conducting a national survey in 2013, suggest that Americans are willing to sample or even purchase Asian carp, which shows promise for this strategy. Commercial harvesting is another short-term policy alternative that includes overfishing Asian carp in the Illinois River to control population numbers. Both human consumption and commercial harvesting activities as policy alternatives have not received the same scrutiny from stakeholders as long-term alternatives. This is because, despite their low cost of implementation and absence of significant negative externalities they do not significantly mitigate the spread of Asian carp into the Great Lakes.

**PREVIOUS EVALUATION OF POLICY EFFECTIVENESS**

Each policy alternative proposed in the GLMRISR was scientifically evaluated on its ability to keep Asian carp out of the Great Lakes. According to Wittmann et al (2014), hydrological separation, with 99 per cent containment of Asian carp access, is the most effective. Underwater electronic and acoustic-bubble-strobe barriers are 92-95 per cent effective.
The use of empirical data to evaluate the efficacy of possible solutions is unfeasible due to financial, ethical and time constraints. Structured expert judgment (SEJ) is more appropriate, because it “aggregates expert knowledge to quantify the uncertainties associated with invasive species pathway management” (Wittman et al, 2014, p. 2152). SEJ also suggests that expert responses should not include the identities of the experts. This helps “quantify scientific uncertainties on important societal issues without the risk of political confrontation, and for policymakers to utilize this information to make risk-based decisions in a transparent and defensible way” (Wittmann et al, p. 2155). Empirical data and structured expert judgment together are accepted tools for comprehensive scientific evaluation of policy alternatives and solutions.

**ALTERNATIVE VIEWPOINTS AND LIMITATIONS**

Not everyone agrees on how policy alternatives are evaluated. A few scientists and scholars doubt the published success rates of measures to stop the spread of Asian carp into the Great Lakes, because of the “expense or infeasibility of experimental tests at realistic field scales” (Wittmann, Cooke, Rothlisberger, & Lodge, 2014). Instead they believe that SEJ should carry more influence in adjudicating policy alternatives. However, expert judgment has its limitations and cannot determine the cost of prevention strategies, the costs of an Asian carp invasion of the Great Lakes, or a relationship between carp numbers and the likelihood they will establish in the Great Lakes (Wittmann et al, 2014).

Questions have been raised about whether Asian carp in the Great Lakes would be as disastrous as speculated by scientists and the media. It is difficult to know the full effect of Asian carp on the Mississippi and Illinois Rivers because
changing water and temperature patterns makes studying rivers difficult (Hinterthuer, 2012). Media, in particular social media, has illuminated the risks of an Asian carp invasion of the Great Lakes and shaped stakeholders’ understanding of the threat and their opinions about the various policy alternatives (Colon, 2014). A YouTube search yields over 40,000 videos of silver carp rapidly flying out of waterways, leading the viewer to believe that these invasive species are likely to cause bodily harm to fishers. Scientists may either downplay the risk, or only be able to influence a small general public audience with their research, while media may over-exaggerate the threat to millions of viewers.

The GLMRISR report, absent of a direct policy recommendation, sparked animated conversations at public town hall meetings along the Mississippi River and Great Lakes basin regions (Reeves, 2014). Some concerned citizens of the Great Lakes basin, frustrated by the abundance of research without decisive action from the US government, wonder if Asian carp will populate the Great Lakes before a policy is implemented and speculate about the health of the Great Lakes for future generations.

ANALYSIS

Method

This study provides a better understanding of prospective policy alternatives for effectively mitigating the spread of Asian carp in the Great Lakes by incorporating political, social and economic effects not previously considered. This study uses a cause and effect analysis of GLMRIS policy alternatives because it allows stakeholders to easily and thoroughly make sense of important policy alternatives being considered. This will help expedite an efficient policy planning and implementation process.
A Goeller Scorecard is used to compare each policy alternative. Goeller Scorecards are a commonly used tool for biodiversity analysis whereby a subjective numerical weight is assigned to various alternatives to allow comparison between alternatives. Assignment of the weight to different alternatives is a critical part of the process. In this analysis, the assignment of relative importance of different policy effects was informed by an extensive literature review.

A subjective weight was placed on each policy effect (scientific, political, social, and economic), using a scale of 1 (not important) to 5 (very important). Scientific effects are rated 5 for importance, because policy makers primarily use scientific principles to adjudicate each alternative. The results of analysis are sensitive to this subjective weighing of effects and could be tailored in the future to accommodate new data and information not known at this time. Political effects are rated 3; while politics alone will not mitigate an Asian carp migration, it sets the timeline and climate for policy choice and implementation. Social effects are rated 2; while public opinion is not likely to influence policy choice, the will of the people as a basic tenet of democracy must be acknowledged and considered. Economic effects are rated 4, because the policy alternative chosen should be economically feasible for stakeholders; economic effects are only second in importance to scientific effects. Each policy alternative was then given four scores – one for each policy effect on a scale of 1 (not feasible) to 5 (very feasible). These scores were then multiplied by the predetermined weight placed on each policy effect totalled (see Table 1).

Definitions

**Baseline conditions:** the current actions to mitigate the spread of Asian carp to the Great Lakes – scientific, political, and economic data is not provided because the baseline is al-
ready implemented and supported on these merits. Going forward, each policy alternative is evaluated as a continuum of baseline conditions.

**Economic effects:** aspects of a policy alternative that directly involve money and commerce such as total cost of policy implementation and the effect on operating and capital budgets, private industry, employment, infrastructure, and economic development are considered.

**People:** includes assumptions based on voluntary, documented opinions of policy stakeholders, either through a public comment period in town hall meetings and interviews conducted, or information gathered by research professionals.

**Political effects:** qualities of implementing and managing a policy alternative; the role of political actors, and secondary policies that must be developed to mitigate particular consequences of a policy alternative are included.

**Scientific effects:** observations that are measured and judged using scientific principles; specifically, the effectiveness of proposed actions, water quality, potential ecological contamination, and risk of flooding are mentioned.

**Social effects:** relate to any and all concerns and opinions of the general public. Examples include impressions of timelines for implementation and anticipated results, beliefs about the effectiveness of each policy alternative, other inherent (mitigating) costs of each policy alternative, and information about public opinions in each neighbouring state.

**Limitations**

There were several limitations to the data collection process. Records of public opinion show that citizens have minimal knowledge about the specific details of policy alternatives. There is a lack of credible primary data involving political, social, and economic considerations relating to a potential Asian carp inva-
sion of the Great Lakes despite many editorial articles providing biased and often inaccurate information.

<table>
<thead>
<tr>
<th>Policy alternative</th>
<th>Scientific effect</th>
<th>Political effect</th>
<th>Social effect</th>
<th>Economic effect</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Baseline</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>(1 x 5 = 5)</td>
<td>(1 x 3 = 3)</td>
<td>(1 x 2 = 2)</td>
<td>(1 x 4 = 4)</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>5</td>
<td>15</td>
<td>10</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>(1 x 5 = 5)</td>
<td>(5 x 3 = 15)</td>
<td>(5 x 2 = 10)</td>
<td>(5 x 4 = 20)</td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>15</td>
<td>15</td>
<td>6</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>(3 x 5 = 15)</td>
<td>(3 x 3 = 9)</td>
<td>(3 x 2 = 6)</td>
<td>(3 x 4 = 12)</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>20</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>(4 x 5 = 20)</td>
<td>(2 x 3 = 6)</td>
<td>(3 x 2 = 6)</td>
<td>(3 x 4 = 12)</td>
<td></td>
</tr>
<tr>
<td>#5 - #8</td>
<td>25</td>
<td>6</td>
<td>4</td>
<td>8</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>(5 x 5 = 25)</td>
<td>(2 x 3 = 6)</td>
<td>(2 x 2 = 4)</td>
<td>(2 x 4 = 8)</td>
<td></td>
</tr>
</tbody>
</table>

The table below outlines the eight prospective policy alternatives being considered by USACE for mitigating an Asian carp invasion of the Great Lakes. Policy alternatives are itemised by row, and policy effects are listed in columns. Information in the table represents the key elements for consideration for each effect policy and the corresponding effect. Note that GLMRISR policy alternatives #5 - 8 are grouped and analysed together because of their core similarities (Jatkevicius, 2003).
<table>
<thead>
<tr>
<th>Policy alternatives</th>
<th>Scientific effect</th>
<th>Political effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline- sustained activity (GLMRIS Alt. #1)</strong></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Nonstructural control technologies**
Includes the use of nets and chemicals, controlling boat access to waterways, commercial harvesting, human consumption, and public education about invasive species

**Time until reduction of threat:** N/A

**Effectiveness:** Not proven to reduce the risk of Asian carp invasion of the Great Lakes

**Impact on water quality:** None

**Ecological contamination:** None

**Risk of flooding:** None

**Time until Implementation:** Immediate

**Role of political actors:** Very little. The federally-funded Great Lakes Restoration Initiative pays for commercial harvesting activity

**Secondary policies:** None

**Beliefs about effectiveness:** 98% believe this alternative is not effective enough on its own

**Beliefs about other inherent (mitigating) Costs:**

**Dollar cost of policy implementation (operating budget):** US$68 million/year

**Capital budget(s):** Unknown

**Private industry:** Potential to make money from the private sale of Asian carp though details unknown

**Employment:** None

**Infrastructure:** None

**Economic development:** None

**Structural control methods- No physical separation**
Includes two electric barriers, three reservoirs, and non-structural control technologies

**Time until reduction of threat:** 25 years.

**Effectiveness:** 92% effective at keeping Asian carp out of the Great Lakes

**Impact on water quality:** None

**Risk of flooding:** Present, but quantified

**Time until implementation:** 25 years

**Role of political actors:** Federal funding for existing electric barriers promotes political cooperation between affected states (little effect on state budgets/politics).

**Secondary policies:** Requires modification and implementation of floodwater management plans in numerous Chicago areas.

**Support:** Commercial haulers/shippers
<table>
<thead>
<tr>
<th>Social effect</th>
<th>Economic effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beliefs about effectiveness:</strong> 98% believe this alternative is not effective enough on its own.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Beliefs about other inherent (mitigating) Costs:</strong></td>
<td>Dollar cost of policy implementation (operating budget): US$68 million/year</td>
</tr>
<tr>
<td>Human consumption is not favoured because of negative media portrayal of Asian carp</td>
<td>Capital budget(s): Unknown</td>
</tr>
<tr>
<td><strong>State that Show Majority Support:</strong> Inconclusive</td>
<td><strong>Private industry:</strong> Potential to make money from the private sale of Asian carp though details unknown</td>
</tr>
<tr>
<td><strong>Dollar cost of policy implementation (capital budget(s)):</strong> US$15.6 billion</td>
<td><strong>Employment:</strong> None</td>
</tr>
<tr>
<td><strong>Operating Budgets:</strong> Annual costs not conclusive</td>
<td><strong>Infrastructure:</strong> None</td>
</tr>
<tr>
<td><strong>Private industry:</strong> Private boaters and fisherman have to navigate around electric barriers, may choose other areas. Commercial haulers must limit and adjust their loads.</td>
<td><strong>Economic development:</strong> Jobs created through new infrastructure projects and management.</td>
</tr>
<tr>
<td><strong>Employment:</strong> Unknown</td>
<td><strong>State populations that show equal or majority support:</strong> Ohio, Minnesota, Illinois, Indiana, Louisiana, and Ontario (Canada)</td>
</tr>
</tbody>
</table>
| **Infrastructure:** US$6.4 billion, unknown who will pay for how much. | **continue**
<table>
<thead>
<tr>
<th>Structural control methods—Two (2) physical barriers</th>
<th>Structural control methods—Three (3) + physical barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Also includes three electric barriers and non-structural control technologies</td>
<td>Also includes two electric barriers, and two reservoirs, and two screened sluice gates (GLMRIS # 8 only), and non-structural control measures</td>
</tr>
</tbody>
</table>

**GLMRIS Alternative #4**

**GLMRIS Alternative #5, 6, 7, 8**

<table>
<thead>
<tr>
<th><strong>Policy alternatives</strong></th>
<th><strong>Scientific effect</strong></th>
<th><strong>Political effect</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time until reduction of threat:</strong> 25 years</td>
<td><strong>Role of political actors:</strong> Michigan and several other states have petitioned U.S. Congress to impose physical barriers in all major water arteries of CAWS and CSSC. States of Michigan and Illinois disagree about respective economic impacts of this policy. <strong>Secondary policies:</strong> Requires significant changes to floodwater management plans <strong>Support:</strong> Natural Resources Defense Council (NRDC), National Wildlife Federation (NWF), and the Alliance for the Great Lakes (AGL)</td>
<td></td>
</tr>
<tr>
<td><strong>Effectiveness:</strong> 92-99% effective at keeping Asian carp out of the Great Lakes.</td>
<td><strong>Time until implementation:</strong> 25 years</td>
<td><strong>Role of political actors:</strong> Michigan and several other states have unsuccessfully petitioned the U.S. Congress to impose physical barriers in all major water arteries of CAWS and CSSC. States of Michigan and Illinois disagree about respective economic impacts of this policy. <strong>Secondary policies:</strong> Requires significant changes to floodwater management plans <strong>Support:</strong> Natural Resources Defense Council (NRDC), National Wildlife Federation (NWF), and the Alliance for the Great Lakes (AGL)</td>
</tr>
<tr>
<td><strong>Impact on water quality:</strong> Implied concern in CAWS without full description</td>
<td><strong>Time until implementation:</strong> 25 years</td>
<td><strong>Role of political actors:</strong> Michigan and several other states have unsuccessfully petitioned the U.S. Congress to impose physical barriers in all major water arteries of CAWS and CSSC. States of Michigan and Illinois disagree about respective economic impacts of this policy. <strong>Secondary policies:</strong> Requires significant changes to floodwater management plans <strong>Support:</strong> Natural Resources Defense Council (NRDC), National Wildlife Federation (NWF), and the Alliance for the Great Lakes (AGL)</td>
</tr>
<tr>
<td><strong>Risk of flooding:</strong> Potential flooding of Chicago land, streets</td>
<td><strong>Time until reduction of threat:</strong> 25 years</td>
<td><strong>Role of political actors:</strong> Michigan and several other states have unsuccessfully petitioned the U.S. Congress to impose physical barriers in all major water arteries of CAWS and CSSC. States of Michigan and Illinois disagree about respective economic impacts of this policy. <strong>Secondary policies:</strong> Requires significant changes to floodwater management plans <strong>Support:</strong> Natural Resources Defense Council (NRDC), National Wildlife Federation (NWF), and the Alliance for the Great Lakes (AGL)</td>
</tr>
<tr>
<td><strong>Impact on water quality:</strong> Expected contamination of Lake Michigan and CAWS water</td>
<td><strong>Time until implementation:</strong> 25 years</td>
<td><strong>Role of political actors:</strong> Michigan and several other states have unsuccessfully petitioned the U.S. Congress to impose physical barriers in all major water arteries of CAWS and CSSC. States of Michigan and Illinois disagree about respective economic impacts of this policy. <strong>Secondary policies:</strong> Requires significant changes to floodwater management plans <strong>Support:</strong> Natural Resources Defense Council (NRDC), National Wildlife Federation (NWF), and the Alliance for the Great Lakes (AGL)</td>
</tr>
<tr>
<td><strong>Risk of flooding:</strong> Significant to the City of Chicago and suburban areas.</td>
<td><strong>Other consequences:</strong> Would exacerbate existing concerns about Chicago’s flood water systems</td>
<td><strong>Time until implementation:</strong> 25 years</td>
</tr>
</tbody>
</table>

### Table 2. Comparison of GLMRIS policy alternatives and known effects (continuation)

<table>
<thead>
<tr>
<th>Beliefs about effectiveness</th>
<th>Dollar cost of policy implementation (capital budget(s)): US$7.2 billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beliefs about other inherent (mitigating) costs: some people believe that mitigating costs are inflated in policy cost estimates</td>
<td>Operating budgets: Annual costs not conclusive</td>
</tr>
<tr>
<td>State populations that show equal or majority support: Michigan, Wisconsin, Ohio, New York, and Minnesota</td>
<td>Economic impact: An estimated US$70 million loss to the State of Illinois.</td>
</tr>
<tr>
<td>State populations that show equal or majority support: Michigan, Wisconsin, Ohio, New York, and Minnesota</td>
<td>Private industry: US$18 billion loss to commercial shipping industry</td>
</tr>
<tr>
<td></td>
<td>Employment: Unknown.</td>
</tr>
<tr>
<td></td>
<td>Economic development: Possibility of new marine rail/lift systems in place of ships/navigation vessels, jobs created through new infrastructure projects and management</td>
</tr>
</tbody>
</table>

**Social effect**

**Beliefs about effectiveness:** 45% support policies that involve physical separation of the Great Lakes and Mississippi River basins; believe this is the most effective method of mitigating a Great Lakes invasion of Asian carp.

**Beliefs about other inherent (mitigating) costs:** some people believe that mitigating costs are inflated in policy cost estimates.

**State populations that show equal or majority support:** Michigan, Wisconsin, Ohio, New York, and Minnesota.

**Economic effect**

**Dollar cost of policy implementation (capital budget(s)): US$7.2 billion**

**Operating budgets:** Annual costs not conclusive.

**Economic impact:** An estimated US$70 million loss to the State of Illinois.

**Private industry:** US$18 billion loss to commercial shipping industry.

**Employment:** Unknown.

**Infrastructure:** US$500 million expenses incurred by State of Illinois.

**Economic development:** Possibility of new marine rail/lift systems in place of ships/navigation vessels, jobs created through new infrastructure projects and management.
RESULTS

The results of the Goeller Scorecard and cause and effect analysis show that the most feasible policy alternative, non-structural control technologies (#2), is also the least likely to prevent an Asian carp invasion of the Great Lakes. Policy alternatives (#4 and #5) with the highest scores for scientific feasibility, or the greatest potential to prevent an Asian carp invasion, also have the lowest overall feasibility scores. The most effective alternative is the least feasible, while the most feasible alternative is the least effective. It is no surprise that a new policy has not been chosen or implemented to date.

While the scientific effectiveness of each policy is acknowledged, it is not a perfect justification for choosing a policy to prevent an Asian carp invasion of the Great Lakes. For example, five of eight prospective policy alternatives would have an effect on flooding and water quality in the City of Chicago and nearby suburban areas. The management of current mitigation methods (baseline condition) is a stable and effective political process. If one of the eight policy alternatives is chosen, however, management and funding of mitigation under the alternative scenario may face political scrutiny.

While the GLMRIS outlines eight policy alternatives, people usually adopt one of three opinions – support for hydrologic separation, support for electric barriers, or support for protection against Asian carp with no specific opinion about which method should be implemented. Public opinion varies based on geographic location. For example, stakeholders who work or live in communities that are directly affected by commercial hauling are more likely to oppose hydrologic separation. Stakeholders who work or live in communities that are directly affected by recreation and tourism are more likely to support hydrologic separation. The media presentation of the Asian carp as a looming threat to the Great Lakes has increased the sense
of urgency within the citizen base to implement a solution. The negative portrayal of the Asian carp however, may cause doubt about human consumption as a viable control method. It is unclear how each policy alternative would affect the economies of states, cities, towns, and citizens in the Great Lakes basin region. It is also unclear who would be responsible for funding the chosen alternative.

**RECOMMENDATION**

Decision-makers can choose the policy that ranks the highest in scientific effectiveness even if this policy is not politically, socially, or economically feasible. This will fulfil the primary goal of mitigating an Asian carp invasion of the Great Lakes. However, the recommendation is to increase the political, social, and economic feasibility of a scientifically effective policy. Policy alternatives should be presented to government officials, the general public, environmental committees and trade organisations only when they include specific and concise information about scientific, political, social, and economic effects. A failure to acknowledge these effects is why policy planning and implementation are currently stalled. Comprehensive information behind each policy alternative will allow for an accurate cost/benefit analysis of each policy alternative, and will facilitate better policy decisions and a speedier policy implementation.

**CONCLUSION**

Policy decision-makers must increase the political, social, and economic feasibility of the most scientifically effective policy in order to best mitigate the spread of Asian carp in the Great Lakes. Policy alternatives are best understood when they address
the political, social, and economic concerns of every stakeholder. Failure to understand the multiple facets of a policy decision may lead to profound consequences for the Great Lakes and its users, beyond inheriting a sustainable and invasive Asian carp population.

If decision-makers wait to choose an official government policy, the Asian carp threat to the Great Lakes might change. Problems tend to amplify or worsen with time if they are not properly addressed. The facts that support a particular policy choice now may be invalid or irrelevant later. The cost of implementing an Asian carp prevention policy in five years may be greater than it is now, and political considerations may change as new elected officials take office.

Policy analysts have quantifiable data regarding the scientific validity of each policy alternative, but do not have primary data that positively identifies the political or social considerations. Stakeholders and decision-makers need a viable tool for measuring political and social opinion, such as a Great Lakes regional survey. At minimum, the potential economic externalities facing stakeholders needs to be factored into a proper cost/benefit analysis of each policy alternative.

REFERENCES


