Avoiding the Invasion: An Analysis of Ballast Water Treatment in the Great Lakes

By: Zach Jacobsen

ENVR. 395

Advisors: Derek Larson and Joe Storlien

Introduction

Aquatic invasive species are a threat to the Great Lakes current social, economic, and ecological stability. This leads to the question of, "What is the best strategy to address an invasive species?" The answer is through either prevention, mitigation, and/ or adaptation. As displayed in **figure 2,** prevention is the easiest approach. Species are invading through ballast water on ships and research displays that Ballast water exchange (BWE), the current ballast water treatment, is questionable in efficiency with regards to preventing new species from entering. I sought to answer if current regulation and water treatment is the best solution for protecting the Great Lakes from possible invasions. Through comparative analysis, **I found that current regulation is not as sufficient as other methods and I created a more**

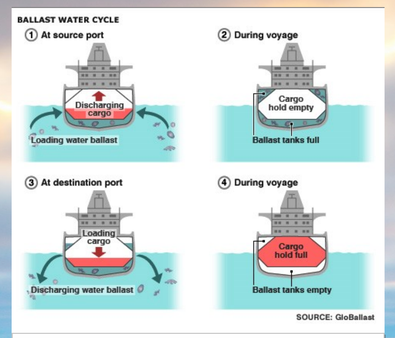

Figure 1. A model of how ballast water works on a ship.

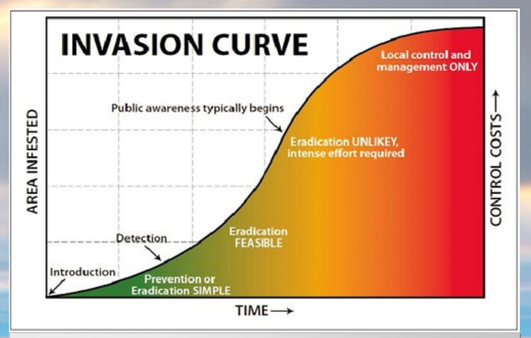

Figure 2. A model of human response to invasion demonstrating why prevention is essential.

Relevant Details

- Sparked by the union of the Great Lakes and the Atlantic Ocean through the St. Lawrence Seaway, it has been observed that over 180 species have invaded the Great Lakes system.
- It is estimated that at least 55-70% of the AIS in the Great Lakes entered through ballast water on commercial ships.
- Even when the ship's pumps stop discharging water, around 5% of a ships' ballast is still full.
- One ship holds 25,000 metric tons and equals 225 rail cars or 870 trucks in capacity.
- In 2015 alone, 455 vessels, the equivalent of 8,361 ballast tanks, were recorded entering through the St. Lawrence Seaway and into the Great Lakes.
- Invasive species in the Great Lakes are estimated to cost $138 million per year with a 5% chance that sport fishing alone loses over $800 million annually.
- The shipping industry in the Great Lakes is estimated to save $4.1 billion annually due to ship efficiency.

Scoring

Cost: 1= the proposed treatment method will cost $500,000 or more annually. 2=treatment costs between one and $500,000. 3= there isn't an additional cost for treatment. 4= the proposed method will earn between one and $500,000. 5= the plan is proposed to bring in $500,000 or more.

Safety: 1=the method is a lot more dangerous than BWE. 2=the method is slightly worse than BWE. 3=this method is not any more dangerous or safe than BWE. 4=the proposed method is slightly safer than current action. 5=the proposed technique is a lot safer than the current treatment.

Effectiveness: 1=the method was seventy-five percent or more worse at killing organisms in ballast water than BWE. 2=the proposed treatment was eleven to seventy-four percent worse at killing organisms. 3=the proposed treatment was within ten percent better or worse of current treatment. 4=the proposed treatment killed eleven to seventy-four percent more organisms in ballast water than BWE. 5=seventy-five percent or more of the organisms were killed when compared to BWE.

Convenience: 1=the method takes over two days to complete. 2=the method takes around two days to complete. 3=the method takes anywhere between a few hours to two days to execute. 4=the proposed method only takes a few hours. 5=the proposed treatment can be exercised while underway.

Status quo: 1=the method is strictly hypothetical. 3=the proposed method was brought up by a study, and practiced on a ship, but more tests are needed to fully understand if it will work as suggested. 5=the proposed method has been practiced on ships and is known to work.

Universality: 1=the method is applicable to less than ten percent of ships. 2=the method is available for forty-nine to ten percent of ships. 3=the method is applicable to fifty percent of ships. 4=the method is applicable for

Treatment Plan	Cost	Universality	Safety	Effectiveness	Convenience	Status Quo	Total
BWE	3	5	3	3	3	5	22
No Regulation	1	5	5	1	5	1	18
Permits	4	5	5	4	4	4	26
Deoxygenation	1	4	5	4	4	3	21
Thermal	2	4	4	4	5	2	21
Electric	2	4	5	3	3	2	19
Ban Shipping	1	1	5	5	1	1	14

Figure 3. A matrix comparing each route to the six standards that incorporate both the desires of the shipping industry and an ecological perspective. An ideal treatment method would balance the ideals of both of these sides. In this matrix, green=better than current regulation, red= worse than current regulation, and yellow=equivalent to current regulation.

Proposal

I propose that vessels entering the Great Lakes use a permit system which views thermally treated and deoxygenated ballast water as the ideal treatment method.

- The permit system would single out ships which are more likely to introduce new species.
- Deoxygenation is estimated to save the average ship owners $70k each year in maintenance costs. This is due to how the process chemically interacts with the ship's paint and structure.
- The thermal method makes up for any inefficiencies in killing organisms in the ballast water.
- Both treatment methods are also safer than BWE.
- The barriers to these treatment methods is that they both have been scarcely exercised and therefore they both would require more research before large-scale

References

http://www.minnesotaexposure.com/wp-content/uploads/2015/05/IMG_8942-1024x683.jpg

Tamburri, Mario N., Kerstin Wasson, and Masayasu Matsuda. "Ballast Water Deoxygenation Can Prevent Aquatic Introductions While Reducing Ship Corrosion." *Biological Conservation* 103, no. 3 (3// 2002): 331-41.

National Research Council. *Stemming the Tide : Controlling Introductions of Nonindigenous Species by Ships' Ballast Water.* Washington, D.C.: National Academies Press, 1996. Book.