# POLICY BRIEF

## Combating Secondary Spread of Invasive Species via Domestic Shipping

**By Allison Fung**


### Executive Summary

Management regarding ballast water has been implemented to mitigate the occurrences of invasive species for transoceanic vessels, but the exemptions to these management plans prove to be an on-going issue especially for domestic vessels. Geographical boundaries within Canada do not align with established ecological boundaries that are set up by indigenous species, therefore the mere translocation of a species across short distances, combined with an increased survivorship of NIS during these voyages could equate to increased chances of secondary spread of invasive species. BWE should be implemented for domestic vessels to maximize prevention of invasive species, and ecological boundaries instead of geographical or political boundaries should be considered when incorporating new policies or regulations for said vessels.


### Introduction

Invasive species has been a prevalent problem associated with intentional or unintentional ballast water discharge in foreign waters. In attempts to address this issue, there have been many policies and regulations that require ballast water exchange (BWE) in the mid-ocean. However, the focus of such policies and regulations is always placed on transoceanic vessels [3], often leading us to overlook the damage that can be inflicted by domestic vessels.

Ballast water exchange is exempted for domestic vessels that operate within the Exclusive Economic Zone (EEZ), but many studies have shown that this exemption can lead to a secondary spread of invasive species [1,2,3]. At the Great Lakes bordering Canada and the U.S., up to 71% of domestic vessels are exempted from BWE, consequently allowing non-indigenous species (NIS) to invade small but ecologically diverse inland lakes and stream in the region via domestic vessels [3]. This not only threatens the ecological heterogeneity of the area, but it also threatens the range of ecosystem services supported by the diversity of habitat and aquatic organisms in the area.

Considering the number of ships that travel domestically can exceed the number of ships that arrive from foreign waters [4] as well as the increasing frequency of travelling within domestic waters, a new policy or regulation must be enforced to prevent the widespread of invasive species.

## Approaches & Results

Multiple studies conducted in the Great Lakes bordering Canada and the U.S. raise concern for domestic vessels being a vector for invasive species [2,3]. In particular, Briski et al. collected 83 ballast water samples from domestic vessels and compared the community composition of said samples to those from transoceanic vessels with exchanged ballast water (2011). Each tank was sampled through the use of a 30-cm-diameter, 53- μm mesh plankton net, where it was lowered to the lowest accessible point of the ballast tank through an opened tank access hatch. It was also ensured that a minimum of 1000L of water was filtered through each net.

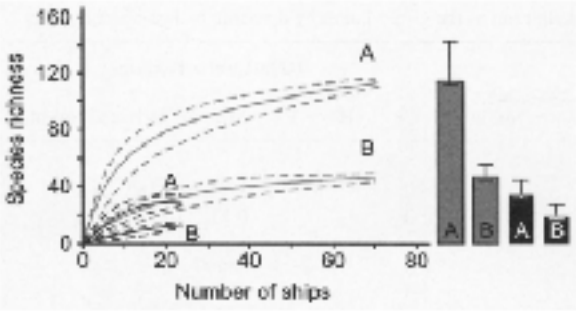


**Figure 1.** Rarefaction curves and species richness data for 72 domestic, and 24 transoceanic exchanged vessels. The black bar and lines denote data sampled from transoceanic vessels, whereas the grey bar and lines indicate data sampled from domestic vessels. A = all taxa, B = restricted taxa.

The mean abundance of zooplankton in domestic ballast water was estimated at 121 369 individuals per $m^3$, which is significantly higher than that reported from the exchanged ballast waters in transoceanic vessels, which had 5194 individuals per $m^3$. Species richness was also significantly higher in domestic ballast water. However, the abundance of NIS found in each respective ballast water was not statistically different as evident from t-test results. Nonetheless, precautionary measures should be taken to prevent NIS that have still yet to establish their populations, such as *N. Hibernica*. as well as *C. pengoi*, a harmful NIS of global concern [2]. Additional preventative measures may also be ideal to address concerns of novel genetic recombination or evolutionary shifts in key life history or morphological characters in known NIS, as such processes will exacerbate the harmful effects that NIS brings.

## Implications & Recommendations

Despite the variability in the success of ballast water exchanges, unmanaged ballast water from domestic vessels still consists of invasive species that far exceeds that of managed ballast water, which highlights the greater risk of biological invasions posed by domestic vessels. As invasive species are notorious for being incredibly difficult to eradicate as well, prevention efforts prove to be essential in mitigating the secondary spread of invasive species. As such, exemptions of ballast water management measures for domestic vessels should be reconsidered, and policies regarding ballast water exchange, or ballast flushing should be implemented for said vessels. It should also be noted that when re-evaluating policies regarding ballast water, ecological boundaries rather than geographical or political boundaries should be respected [2], as ecological boundaries effectively serve as a reference point as to whether the species should be considered native or invasive in the area.

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[1] Bailey, S. A., Deneau, M. G., Jean, L., Wiley, C. J., Leung, B., & Macisaac, H. J. (2011). Evaluating Efficacy of an Environmental Policy to Prevent Biological Invasions. Environmental Science & Technology, 45(7), 2554–2561. doi: 10.1021/es102655j

[2] Briski, E., Wiley, C. J., & Bailey, S. A. (2011). Role of domestic shipping in the introduction or secondary spread of nonindigenous species: biological invasions within the Laurentian Great Lakes. *Journal of Applied Ecology*, *49*(5), 1124–1130. doi: 10.1111/j.1365-2664.2012.02186.x

[3] Zanden, M. J. V., & Olden, J. D. (2008). A management framework for preventing the secondary spread of aquatic invasive species. *Canadian Journal of Fisheries and Aquatic Sciences*, *65*(7), 1512–1522. doi: 10.1139/f08-099

[4] Lavoie, D., Smith, L., & Ruiz, G. (1999). The Potential for Intracoastal Transfer of Non-indigenous Species in the Ballast Water of Ships. *Estuarine, Coastal and Shelf Science*, *48*(5), 551–564. doi: 10.1006/ecss.1999.0467

**Possible contacts to send policy brief:**
Lawrence Hanson - Assistant Deputy Minister of the Policies department from Transport Canada.
Email: lawrence.hanson@tc.gc.ca
Telephone: 613-998-1880