Controlling the Spread of Invasive Aquatic Species with the Ballast Water Management Convention

By Chris Wiant, M.P.H, Ph.D.

Ballast water is the marine or fresh water taken into the ballast tank of a ship to improve the vessel's stability, buoyancy and maneuverability. Unfortunately, the process of adding and subtracting ballast water, so vital to a ship's operation, can have unintended consequences for aquatic ecosystems.

Ballast water release

Ballast water may include aquatic life forms native to the ecosystem of the water "take in" point, but foreign to the ecosystem of the water "release" point. This watery exchange can promote the spread of invasive aquatic species, a global environmental issue that is the subject of the Ballast Water Management Convention. The Convention requires participating nations to have a ballast water management plan to help avoid disrupting native ecosystems with invasive aquatic species.

Many Years in Development

Zebra mussels are freshwater mussels originally indigenous to lakes and rivers of Russia and Ukraine; they are now thriving in numerous bodies of fresh water worldwide. Their dense growth blocks pipelines and clogs water intakes, among other detrimental

The new Convention is an initiative of the International Maritime Organization (IMO), a specialized agency of the United Nations. The Convention was adopted in 2004, but did not "come into force" until September 8, 2017, "twelve months after the date on which not less than 30 'states' [a state is a nation in 'UN speak'] with combined merchant fleets of not less than 35% of the gross tonnage of the world's merchant shipping have signed it," according to the official convention language. Although a ballast water management plan is a requirement for those nations that have ratified the Convention, many ships from both ratifying and non-ratifying nations already implement ballast water management plans.

Rooting out Aquatic Stowaways

There are two ballast water management tools through which the maritime industry can be regulated. The first is through the Ballast Water Exchange Standard, which requires ships to exchange a minimum of 95% ballast water volume at least 50 nautical miles from the nearest shore and in waters of 200 meters depth or more. This helps prevent invasive species spread in coastal and shallow waters that may be most vulnerable to the problem.

The second tool, the Ballast Water Performance Standard, involves meeting limits for aquatic organisms, including *Vibrio cholera* and *E. coli* in the ballast water. These water quality limits may be achieved through physical and/or chemical treatment methods.

Among physical treatment methods are filtration, heat and UV radiation. The most common chemical methods used are chlorine-based disinfectants, such as chlorine bleach (a solution of sodium hypochlorite and water). Other chemical methods include ozone, peracetic acid and chlorine dioxide.[1]

Weighing the Risk of Disinfection Byproducts

Some concern has been expressed over the unintentional production of disinfection by-products (DBPs) from ballast water treatment and the potential health and environmental effects on aquatic life of DBPs in released ballast water. DBPs are unwanted products of the chemical reaction between disinfectants and organic matter in water. To avoid the potential human health effects from exposure to DBPs in municipal chlorinated drinking water, for example, the US Environmental Protection Agency regulates the most common DBPs to levels based on the best available science, incorporating a margin of safety. In weighing the risks of exposure to DBPs in drinking water, versus not disinfecting water appropriately, the World Health Organization notes:

> *"In attempting to control DBP concentrations, it is of paramount importance that the efficiency of disinfection is not compromised and that a suitable residual level of disinfectant is maintained throughout the distribution system."*[2]

Similarly, if we wish to control the spread of aquatic invasive species, we must evaluate a risk versus risk scenario in which we ask: Is it better to disinfect ballast water (to help prevent the spread of invasive species) or not disinfect ballast water (for fear of DBPs entering the aquatic environment)? This is the type of evaluation we perform when we decide, for example, whether it is better to get the annual flu shot (to help avoid the flu) versus not getting the flu shot (for fear of potentially rare side effects). Whereas most DBP research to date has been focused on drinking water, further work is needed to identify and evaluate the toxicity to marine life of DBPs produced and released in ballast water, especially marine ballast water.

According to the IMO, over 90% of the world's trade is carried by sea because it is "the most cost-effective way to move en masse goods and raw materials around the world." We think the entry into force of the Ballast Water Management Convention is a giant step in the right direction toward curtailing the unintended but potentially harmful spread of aquatic invasive species.

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[1] Werschkun, B. et al. (2014). Emerging risks from ballast water treatment: The run-up to the International Ballast Water

[2] WHO (2011). *Guidelines for Drinking-water Quality*, 4th Edition, WHO Press: Geneva, Switzerland. On line, available: http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf