Implications of the International Ballast Water Convention for Law and Policy: Using Optimization to Enhance Policy Development

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Invasive Species are considered to be the second largest cause of biodiversity loss with marine transportation being the leading invasive species vector, particularly in regard to operational introductions. While international concern over invasive species has existed for a long time, only this past February 2004 did the International Maritime Organization adopt the International Convention for the Control and Management of Ships' Ballast Water and Sediments. At that time it also called for the use of "suitable decision-making tools" to analyze ballast water management protocols. When in force, the BW Convention, will provide a ballast water performance standard that will require (between 2009 and 2016, depending on vessel size and construction date) the discharge of less than 10 viable organisms that are greater than 50 micrometers per cubic meter; the discharge of less than 10 viable organisms that are between 10 and 50 micrometers per cubic meter; and specific discharge standards for three indicator microbes. Those performance standards are subject to review by the IMO within three years of their effective date. The Convention also explicitly acknowledges the right of nations such as the U.S. to establish more stringent prevention standards. When in force the Convention will have implications not only for the State Parties to the Convention but for a much larger universe of States through operation of the UN Convention on the Law of the Sea.

As a result of the new Convention significant attention will be directed toward devising (a) practicable treatment technologies to reduce or eliminate the introduction of species from ballast water; and understanding (b) which trade routes and vessel types present the greatest risk of introducing invasive species; (c) which treatment technology or suite of technologies will need to be employed on a vessel of particular vessel type that follows a specific route to reduce the concentration of organisms prior to discharge to a level that is below the specified discharge standard; (d) the least cost solution for that vessel to come into compliance with the standard; and (e) the cost effectiveness of meeting the present standard and/or alternative standard(s); and (f) whether an administratively feasible and enforceable alternative market-based standard can provide equal protection at less cost.

We are developing a mixed, integer non-linear programming model that will allow us to derive optimal reductions of biological pollutants that are introduced into port ecosystems via ballast water. We consider five factors that affect survivability of organisms in ballast water tanks and hence the risk of introduction: environmental incompatibility between the source and destination port ecosystems; voyage duration; environmental conditions within ballast tanks, which are a function of tank size; ballast water exchange (BWE); and treatment. In order to construct the model, data will be collected in five categories: vessel characteristics (type, tonnage, BW tank size); port/port ecosystem characteristics (type, temperature and salinity, location); voyage and ballasting characteristics (voyage duration, BW volume, BWE); treatment options (including their effectiveness and cost) and policy options (e.g., no regulation, BWE, concentration limits, trading). In sum, we apply results of existing research on treatment technologies (a) above, in conjunction with information on the ecology of individual port ecosystems and vessel traffic data, to provide insight into questions (b) – (f) above.