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Bio Invasion thought Ballast Water Discharge – A Review of the International Legal Framework

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Abstract

Bioinvasion, or invasion of non-indigenous species into different regions is becoming a major environmental concern globally. Due to rapid globalization, ecosystems that have taken centuries to develop are increasingly facing attack from alien species– and one major cause of such invasions in the marine environment, is the discharge of ballast water from ocean going vessels.

The introduction of steel hulled ocean going vessels, led to sea water being pumped into the ballast tanks of vessels to provide stability and increase maneuverability. This ballast water though imperative for the safety of these vessels, pose a serious ecological threat by transporting millions of organisms from one ecosystem and discharging them in the coastal waters of distant lands. Many of these transferred species survived in these foreign waters and reproduced rapidly, knocking the delicate ecosystem of the host country out of balance even destroying the local population. First recognized in 1903 when large quantities of Asian algae were found in the North Sea, this issue gained prominence in the 1980's with Canada and Australia raising this with the International Maritime Organization (IMO). With the rapid growth of trade worsening this problem, the international community recognized the need for a legal and regulatory framework to tackle this menace. The IMO issued some guidelines in 1991 and this issue was recognized as a major concern at the UNCED at Rio in 1992. In 2004, International Convention for the Control and Management of Ballast Water was adopted by the IMO.

Through this paper, the authors, while highlighting the environmental impact of ballast water discharge, will attempt to review the existing Legal framework to control the problem including the technology available to meet these standards, and in this context the challenge faced by developing countries to effectively harmonize development and the environment.

Introduction

Bio-invasion or the rampant spread of alien, non-indigenous species (NIS) is silently emerging as a major threat to fragile eco-systems world over. NIS are species that have been transferred by human activities to locations where they had not existed historically, and that have established reproducing populations in the wild.[1] In the last decade, NIS have spread to different parts of the globe at a rate far greater than the natural rate of transfer by both native and non-native acts and one of the most pronounced turf in which this battle is raging is in the worlds oceans. Using water analysis and particle size analyzers, it has been established that over 4500 types of Marine Organisms are transported around the world, including bacteria, algae and protozoans.[2] While some of these species have been introduced deliberately, to provide economic or ecological benefit to countries, like the introduction of the Atlantic salmon in Chile, most have not been beneficial and have, in fact, been detrimental and have led to biological impoverishment, with some even destroying their host ecosystems. Many of these alien species are far more aggressive than the local native species and thus, displace or destroy them, altering the food web, community structure and the nutritional cycle of the foreign ecosystem. Apart from their ecological impacts, some alien species also cause massive economic harm such as diminishing fisheries and damaging the hulls of ships, while some even impact human health.[3] It has also been seen that once alien species begin to thrive in an ecosystem, it becomes extremely difficult to remove them and restore the ecological balance that once existed. Thus, we see that even though very few alien species have the prospect to thrive in a foreign land, their impact can be devastating. Quantitative data show that the rate of bio-invasions is continuing to increase, in some cases exponentially, and new areas are being found to be invaded all the time.

Since 1993, alien species have been recognized as one of the biggest threats to endemic species and the ecosystem in which they survive. In the marine environment, introduction of invasive marine species into new environments, whether by ships' ballast water, attached to ships' hulls or via other means has been identified as one of the four main threats to the world's ocean by the Convention of Biodiversity. In this paper, the author will endeavor to outline the ecological problems caused by transfer of NIS and invasive species though the ballast water of ocean going liners and also highlight the response of International Agencies like the IMO in finalizing and implementing global regulation to contain this devastation.

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[1]J.T Carlton (1995) 'Marine invasions and the preservation of coastal diversity' *Endangered Species Update School of Natural Resources, University of Michigan* 12(4): 1-3

[2]Alaa Mohamed Ibrahim and Manal M.A. El-Naggar (2012) 'Ballast Water Review: Impacts, Treatments and Management' *Middle-East Journal of Scientific Research* 12 (7): 976-984

[3]Jennifer L Molnar, Rebecca L Gamboa, Carmen Revenga, Mark D Spalding (2008) 'Assessing the Global Threat of Invasive Species to Marine Biodiversity' *Ecological Society of America* (November 2008), 485-492

The Role of Ballast Water and its Impact on the Environment

What is Ballast Water?

With the introduction of steel hulled vessels over 120 years ago, seawater has been used by these vessels to increase their stability and maneuverability. The word 'draft' refers to the number of meters a ship is under water and different ships are designed to operate at a specific draft, given the load and weather conditions in a fact situation.[1] Vessels that are very light, laden with little weight will float above their lowest draft, making them unstable due to the high center of gravity. This problem is countered by pumping water into the ballast tanks of these ships, making them heavier, lowering their center of gravity and thus, making them more stable. When the cargo load of such ships increase, the need for the extra weight seizes to exist and hence, the water is discharged so the ship continues to operate at its correct draft.[2] Additional weight maybe needed by these vessels after burning of fuel or during turbulent conditions. Thus, ships take on or release ballast water at their port of origin and destination, depending on these criteria.

Environmental Impacts of Ballast Water and their Role in Spreading Alien Invaders

Shipping moves over 90% of the world's commodities and transfers approximately three to five billion tonnes of ballast water internationally every year. In coastal waters, International Commercial shipping has been identified as one of the most important vectors for these NIS, with ballast water discharge contributing to a large portion of this spread. Water pumped into these huge ballast tanks of ships contain various organisms from large fish to microscopic bacteria and algae that exist in the region from which this water is drawn. This water and with it, the organisms that live in it, are transported thousands of miles and discharged in the port of destination of the ship. While most of these organisms do not survive the harsh environment of the journey in the ballast tank, some do by consuming smaller marine organisms or by adjusting to the adverse conditions through various methods. Plankton, for example, are know to form tough outer coverings or spores for protection, in which they can survive in these tanks for months without food or sunlight and become active once exposed to a favorable environment.[3] Many of the species that survive the journey flourish in the new environment. In North America, it has been estimated that over 80% of the invertebrates and algae have been introduced in the coastal waters due to commercial shipping, with ballast water contributing to over 69% of the introductions.[4] In fact, on an estimate over 3000-4000

[1]Md. Abu Sayed (2010) 'Ship ballast water contaminating marine environment' *The Daily Star* (December 2010) Accessed at: http://archive.thedailystar.net/newDesign/news-details.php?nid=167256 [12th April, 2014]
[2]*Id.*
[3]*Id.*
[4]N. Dobroski, L. Takata, C. Scianni and M. Falkner (2007) 'Assessment Of The Efficacy, Availability And Environmental Impacts Of Ballast Water Treatment Systems For Use In

million tonnes of untreated ballast water is discharged every year globally as cargo is loaded, with over 10000 marine species being transported in the ballast tank of vessels around the world every day.[1] With the steady rise in international shipping around the world, these numbers are only estimated to grow. Every day, a large number of 'alien invaders' 'hitchhike' in the ballast tanks of ocean going vessels and damage the ecosystem of the coast that they are discharged in.[2]

Impact of Spread of Non Indigenous through Ballast Water

Ecological Impact

The ecological impact of these NIS is significant. Many of these species multiply due to the absence of any natural predator and wipe out the native species by destroying their habitat and disturbing the fragile food chain of the region. The United Nations Environmental Program (UNEP) has identified NIS as the second biggest threat to global biodiversity after habitat loss.[3] Moreover, the impact these species have on the environment is very difficult to reverse and increase in severity over time. The Mitten Crab (*Eiocheir sinensis)* native to Northern Asia, for example, has spread to the Baltic Sea, the Western Coast of North America and the lower St. Lawrence River.[4] These crabs undergo mass migration for reproductive purposes and burrow into dykes and riverbanks, causing erosion.[5] Further, these organisms also prey on local fishes, disturbing the food cycle and negatively impact the fishery industry in the region.,

The ecological damage posed by ballast water is far more severe than disasters like oil spills. While the immediate effect of an oil spill is far greater than that of bio invasion, the long term impacts of the same far outweigh the former, with there being only a few documented cases of the mitigation of its impacts.[6] Moreover, while major oil spills occur few and far apart, bio invasion through ballast water occurs on a daily basis, through thousands of ocean going vessels all over the world, further amplifying its impact.[7] Despite these catastrophic ecological impacts, however, the attention given to this concern has paled in comparison to oil spills.

California Waters' *Produced by the California State Lands Commission* Accessed at:http://www.slc.ca.gov/spec_pub/mfd/ballast_water/documents/final_techreport_revised.pdf [7th March, 2014]

[1]http://www.emsa.europa.eu/implementation-tasks/environment/ballast-water.html

[2]Julie Palakovich Carr (2009) 'Turning the Tide on Aquatic Warriors' *BioScience* (November, 2009) Vol. 59(10): 830

[3]Alaa Mohamed Ibrahim and Manal M.A. El-Naggar (2012) 'Ballast Water Review: Impacts, Treatments and Management' *Middle-East Journal of Scientific Research* 12 (7): 976-984

[4]Toby Royal, Sandy Apostolatou (2013) 'The Ballast Water Convention: a sea change of volumetric proportions' *Watson, Farley and Williams: Maritime Briefing* (February 2013)

[5]*Id.*

[6]*Id* at 11

[7]*Id* at 11

Economic Impacts

Invasive species are also known to have adverse ramifications on the economy of the region they infiltrate into. They lead to the reduction or even the collapse of the fisheries industry of the host economy and can also have a detrimental impact on the aquaculture leading sometime to the closure of fish farms.[1] The introduction of *Mneplopis* in the Black Sea is one of the starkest examples of the negative impacts of these invaders, with these small, superfluous feeders contributing heavily to the near collapse of the fishing industry of this region by significantly reducing the plankton resource in the region. [2] Likewise, the *Sea Lampery* are known to feed on local fish that have high sporting and commercial value. Invaders are also known to damage coastal infrastructure and facilities, with states having to spend millions on their repair. For example, the introduction of the Zebra Mussel (*Dreisenna Polymorpha),* a native of the Black Sea, in the Great Lakes in the United States have caused tremendous problems to industrial raw water users by clogging intake pipes of various factories and electric generators and it has been estimated that over $1 billion has been spent in repairing the damage caused by these them.[3] Plants can also be spread in ballast tanks, an example being the introduction of the *Eurasian Milfoil* in the United States in the 1990's, causing widespread economic issues as they clogged equipment by forming thick mats in the same. [4] The cost of solving the problem at hand is also significant. Given Given that each bio invasion must be tackled in a unique way, depending on the species that has caused the invasion and its impact on the local ecosystem, the research costs for tackling the problem is significantly higher than setting up a uniform system to prevent it in the first place.

Health Impact

Invasive species also have the ability to have numerous health impacts on the regions they invade. This is amplified in port cities with high population densities, where there is increased exposure to water and seafood hazards.[5] Pathogens like *Vibrio Cholarae* and *Escherichia Coli* use ballast water tanks as a medium of transportation, spreading diseases around the world. A cholera outbreak in three separate ports in Peru of a strand of cholera earlier only found in Bangladesh, for example, has been attributed to ballast water. Mitten Crabs, also transported in these tanks, are known to be hosts of the oriental lung flu *(Paragonimus westermani),* a parasite that can be ingested and can severely impact human health,[6] while the Zebra mussel are also known to take in

[1] *Id.* at 11
[2] GEF-UNDP-IMO GloBallast Partnerships Programme and WMU, (2013) Identifying and Managing Risks from Organisms Carried in Ships' Ballast Water. *GloBallast Monograph No. 21*
[3] *Id.* at 8
[4] Dr. Stephan Gollasch (1997) 'Removal of Barriers to the Effective Implementation of Ballast Water Control And Management Measures in Developing Countries' Accessed at: http://www.gollaschconsulting.com/download/IMO_report.pdf [April 13th, 2014]
[5] *Id.* at 17
[6] *Id.* at 7

harmful chemicals like polychlorinated biphenyls (PCBs) that enter the food chain and, due to bio magnification, have an adverse impact on human beings.[1] Likewise, harmful algal blooms of the dinoflagellates *Alexandrium Catenella* have caused Paralytic Shellfish Poisoning to numerous residents of the coastal regions in South Africa. It was, once again found that these organisms, generally found in the Western Coast of the United States of America, were transported in the ballast tanks of ocean going vessels.

Global Concerns and the IMO's Response

In the 1980's, the world witnessed an alarming increase in the number of the cases of the introduction of alien invaders due to ballast water transport and thus, countries like Canada and Australia approached the International Maritime Organization (IMO) with the hope of mitigating this crisis. In response, the IMO's Marine Environment Protection Committee (MEPC) adopted the "Guidelines for Preventing the Introduction of Unwanted Organisms from Ships Ballast Waters and Sediment Discharge" in 1991. Subsequently, this matter was brought forward for discussion in the United Nations Conference on Environment and Development (UNCED) in Rio De Janeiro wherein Article 21 of the Summit called upon the IMO and various other organizations to take steps to address this issue.[2] Replacing less concrete guidelines laid down, the IMO established the "Guidelines for the control and management of ships' ballast water, to minimize the transfer of harmful aquatic organisms and pathogens" in 1997, that included broad guidelines relating to the reduction of intake of pathogens known to cause harm to avoiding the unnecessary discharge of ballast water. This was brought up for discussion once again in the 2002 World Summit on Sustainable Development (WSSD), held in Johannesburg, South Africa and this translated into the adoption of the "International Convention for the Control and Management of Ships Ballast Water and Sediments" (the Convention) by the IMO in 2004. While there already exists numerous national legislations in countries like the United States of America, New Zealand and Canada, this convention hoped to lay down certain standard guidelines for nations to follow to help curb this crisis.

International Convention for the Control and Management of Ships Ballast Water and Sediments, 2004

Highlights of the Convention

The Ballast Water Management Convention, 2004 was adopted in order to spell out and lay down guidelines for the contemporary role of ports and flag

[1] *Id.* at 7

[2] IMO, *The International Convention on the Control and Management of Ships Ballast Water and Sediments*, Accessed at: http://globallast.imo.org/index.asp?page=mepc.htm&menu=true [April 14, 2014]

states in the preservation of marine resources. The Preamble of the Convention calls upon member states to ensure the control of the spread of invasive species through ballast water and the conservation and sustainable use of resources to ensure the preservation of marine life. It would come into force 12 months after 30 states and representing 35% of the worlds shipping tonnage have ratified the same (Article 18). Once implemented, Article 7 mandates that every member nation will be responsible for enforcing the guidelines laid down in this convention for ships with their flags and in their jurisdictional waters and must setup effective legislations to ensure the same and impose sanctions on defaulters. Article 2 also lays down that member states must fulfill the provisions of this convention to ensure the reduction and subsequent elimination of the transport of invasive species in the ballast tanks of vessels. Similarly, Article 6 of the Convention also calls on states to monitor the discharge of non-indigenous species in their jurisdiction and also to develop new technologies to combat this crisis. The Convention also establishes that help will be provided in the form of technology transfers and training assistance. As of 2nd December 2013, 38 states equaling 30.38% of the worlds shipping tonnage had ratified the Convention as against the requirement of ratification by 30 States representing at least 35% of world's merchant shipping tonnage.

The Convention also sets down the standards that are to be met through ballast water exchange. The D1 standard applies where a treatment system is not installed and D2 standards apply where a treatment system is installed in a ship. In an effort to encourage future innovation, B3 standards have also been established allowing for alternative methods, provided they offer the same level of protection as are approved in principle by the IMO.

The D1 regulation requires that a ship is capable of performing an exchange of ballast water that will achieve at least a 95% volumetric exchange of water using one of IMOs recognized forms of exchange. Such exchanges are to be performed 200nm from the nearest land and at a depth of 200m and if this is not possible, is to be performed at least 50nm from the land at a depth of 200m. However, they are most effective at a depth of around 2000m.[1] Thus, the coastal organisms that are unable to survive the harsh ocean environment are often killed and thus pose little threat to the foreign ecosystem. IMO approved methods include the *sequential exchange*, wherein ballast is flushed out until suction is lost and the *flow through method* wherein at least three times the amount of the water in the tanks is pumped into the tank. While requiring far lower capital and being significantly faster, due to the fact that it is performed during the course of the voyage, mid ocean ballast water exchange is also criticized as it is often considered to be comparatively less effective and is considered to be unsafe to the structural integrity of the ship, especially during stormy weather.[2] The D2 regulations, on the other hand, lay down that the water should be treated to meet certain conditions before they

[1]Dandu Pughuic (2010) 'Invasive Species: Ballast Water Battles' *Seaways* (March 2010), 5-7
[2]*Id.*

can be discharged. Thus, it has been established that following treatment, the water should contain

- less than 10 viable organisms per cubic meter of organisms that are greater than or equal to 50 micrometers in dimension
- less than 10 viable organisms per milliliter of organisms less than 50 micrometers in dimension
- There must also be a certain level of indicator microbes, like *Vibrio Cholarae* and *E.Coli* that must not be exceeded.[1]

The treatment can be performed with the help of, *inter alia*, biocides, oxidizing agents, UV and ozone, using various 'type approved methods' validated by the IMO. The process must be chosen not only keeping in mind the weight of the ship and its year of manufacture but also the route the ship will be plying, given that different systems are more suited to treat the water in different ways. Given that it is more effective, however, the IMO has laid down deadlines for ships to comply with the more D2 standard, based on the ships size and year of manufacture, with all ships complying with the D2 standard by 2019 (2016 before the MEPC 65). This convention also requires that ship contain 'Ballast Water Management Plans' and approved by the flag state and keeping in mind the safety of the ship on one hand, while ensuring efficacy on the other. There is also a need for ships to maintain a 'Ballast Water Record Book,' indicating the amount of water taken on board and the amount treated.

The Convention in Practice

The Convention has several practical ramifications that must be kept in mind to ensure implementation of the convention. Ship owners have to comply with various regulations within the timeline specified in the Convention based on the ships capacity and year of manufacture. There are 33 (as of MEPC 65) "type approved" ballast water treatment systems in the market at the moment and the ship owners must choose the type best suited to the load they are likely to carry, while ensuring the efficacy, safety of the crew and various economic constraints.[2] The ballast water treatment method chosen must also be comply with the (sometimes stricter) regulations in the nations whose territorial waters the ship owner hopes to send her.[3] The Convention also requires that ships maintain a Ballast Water Plan, specifying the method and procedure of treatment to be used by the ships safety procedures and other such important operational instructions.[4] The ship owners would need to ensure these plans are prepared well in advance as they are customized for each ship. Such a plan should be simple, realistic, practical, and effective and should be understood by the ships personnel. Many nations like New Zealand, the United States and

[1]*Id.* at 12
[2]Steve Raymaker, 'IMO Ballast water Report 2002' International Maritime Organizations
[3]*Id.*
[4]John M Drake, Reuben P Keller (2004) 'Environmental Justice Alert: Do Developing Nations Bear the Burden of Risk for Invasiv Species' *Bioscience* (August 2004) 54(8): 719

Brazil already have legislations in force and hence, ships sailing to and from these countries must have an approved plan in place. Once implemented, it also becomes imperative that the crew is well trained to use these equipment.

The Convention and Developing Countries

The monitoring of the spread of aquatic invaders and the presence of the same in ballast water discharge is an expensive procedure and one of the major sources of criticism of the Convention today is that it institutionalizes an inequality between developing and developed country in their fight to manage ballast water discharge. This is primarily because the asymmetrical relationship between exports and imports in developing nations translates into a higher burden being placed on them to regulate and monitor the discharge of invaders into their waters. As the biological invasions in an ecosystem are directly correlated to the volume of trade in a port, it is a common notion that the costs nations have to bear to monitor the discharge are directly proportional to their volume of trade. This is not, however, the complete truth. In order to maintain the ideal trim, ships discharge ballast water before taking on cargo and pump water into the tanks when the cargo load reduces. Hence, countries with a high export to import ratio by weight and not value have to bear a higher cost regulating and monitoring ballast water discharge. Moreover, developing nations are placed at a further disadvantage because most of their exports are composed of raw materials that are heavy and are generally have to be transported in purpose built vessels. Thus, unlike container ships that are almost always laden with a variety of cargo, ships used to transport raw materials like iron ore often return empty, with ballast tanks full of water, thus increasing the costs on these nations. Furthermore, these nations already bear the environmental costs of extracting these raw materials and thus, the burden of the entire environmental cost is effectively shifted upon these poor nations that lack the infrastructure to refine these raw materials. While there are provisions in the Convention calling upon developed countries with the technology to assist developing countries, many argue that like many other agreements, this does not suffice and that more pronounced assistance should be given to these nations to help combat this inequity. Thus, it has been suggested by some that an international fund be created, where from member states can draw resources during the time of a bio invasion; to help prevent the same and combat it, if it ever were to occur (Drake & Keller, 2004).

In an attempt to address this inequality and assist developing nations, the IMO, in association with the UNDP and the Global Environment Facility (GEF) has also established the GloBallast Partnership program in the year 2000 and initially invested $10.2 million, focusing on 6 pilot projects in India (Mumbai), China(Dhallan), Iran, South Africa(Saldanha), Brazil(Sepetiba) and Ukraine(Odessa), representing the six major developing regions in the world.[1]

[1] *Id.*

The success of these pilot projects also prompted the IMO to expand this partnership and partner with numerous other developing countries and provided funding and assistance to help them reduce the impact of bioinvasion. Implementing the lessons learned from the pilot projects, the IMO is assisting various nations in regions like the Caribbean to further improve the nation's reception facilities and promote regional and international cooperation. It also seeks to promote the partnership between the private and public sectors in these countries to ensure the development of economical and effective technology. With this assistance, it is hoped that this inequity is reduced and ensure that the spread of marine invaders through ballast water is minimized.

Conclusion

Despite the rise in awareness for this issue and the realization that action must be taken, the Convention is clearly not the magic elixir that solves the problem and there continues to be numerous concerns regarding various provisions of the same. Some of the key concerns included the implementation schedule and if the schedule would be effective retroactively for existing ships too. The effectiveness and test criterion for the approved ballast water treatment systems as well as adequacy of yards for fitting such systems was another concern. The complexity and accuracy of sampling of ballast water was also worrying. A major concern in the minds of the ship owners is that there could be divergence in the laws enacted by varied Party States in this regard and thus there would not be "uniformity of application, interpretation and enforcement of the Convention requirements or a standard level of sanctions imposed by Party States". A similar concern was whether the convention would automatically become applicable or would each Country have to pass their own laws – in which case the date of applicability of the convention would differ country to country. The economic aspects of the implementation of these systems in existing ships and the setting up of reception facilities in major ports are also emerging as a cause for worry and has acted as a deterrent for many major shipping nations, who continue to delay the signing of this convention. The IMO in the Marine Environment Protection Committee (MEPC 65) held in May, 2013 has tried to address some of the above concerns and challenges to facilitate the smooth implementation of the Convention. Many of the uncertainties and concerns raised above in the implementation of regulation B-3 have been clarified and detailed. Despite these steps, however, nations, especially those like Panama that represent a major portion of the worlds commercial shipping, continue to be delay the acceptance of this Convention. Infact, the MEPC 65 has further delayed the mandatory conversion of the Ballast Water Exchange standard (D1 standard) to the Ballast water treatment standard (D2 standard) to 2019 from 2016, further delaying the process of ensuring that safer, more fool proof systems are installed in ships.

These economic considerations, however, cannot continue to outweigh the greater environmental considerations of such an issue. In a recent interview, the IMO Secretary General Mr. Koji Sekimizu continued to urge member states to accept this convention and said that its ratification has been far too long underway. While it is without doubt that such a move will have an economic toll on the shipping industry, we cannot continue to overlook the devastating impact of bio invasion through sources in ballast water and must ensure that we mitigate this ticking bomb before it continues to wreck more havoc on the worlds marine ecosystems. Thus, there is without doubt a need for domestic and international legislations to ensure the same and the realization that a lack of commitments from the nations involved could irreversibly damage the worlds oceans in the near future.

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