BALLAST WATER MANAGEMENT: A TIME FOR ACTION

Fred ANSTEY
Faculty, School of Maritime Studies
Fisheries and Marine Institute of Memorial University of Newfoundland (Canada)
P.O. Box 4920, St. John’s, NL.
Canada, A1C 5R3
Telephone: 709-778-0581
Cellular: 709-749-4223
Fax: 709-778-0659
Email: fanstey@mi.mun.ca

ABSTRACT
The mission statement of the International Maritime Organization (IMO) of ‘safe, secure and efficient shipping on clean oceans’ is pursued through the development and maintenance of numerous and comprehensive regulatory frameworks. From the beginning improvements in maritime safety and the protection of the marine environment have been paramount. It is recognized that the traditional enemies of the marine environment, such as oil pollution, are now accompanied by added environmental threats. The harmful effects caused by the pathogens and the aquatic invasive species that are being transported to new environments, through the uptake and discharge of ship ballast water, has been identified by the maritime community as one of the four principal threats to the world’s oceans. In response to this global threat, the IMO in 2004 adopted the Ballast Water Convention in order to properly manage vessel ballast water and sediment. This Convention enters into force only after a minimum of thirty member states with a combined merchant fleet of at least thirty-five percent of the world’s gross tonnage ratify it without reservation. Currently only fourteen states, which constitute merely 3.55% of this global merchant fleet have ratified. The resultant inactivity, particularly by many of the major seafaring states, has allowed unwanted species and pathogens to proliferate, and to cause injury or damage to the environment, human health, and resources. The sporadic and non-uniform development of national ballast water regulations necessitate that seafarers struggle to keep abreast of the varying national legislation while involved in the global seafaring trade. In addition, due to non-consistent requirements and due to inadequate training, seafarers are exposed to safety concerns, particularly because of improper ballast water exchange methods. They are also subjected to fines or penalties because of non-adherence to those diverse regulations. Ballast water management technology has been relatively slow to evolve because the Convention is not globally accepted or enforced. Most institutions involved in MET are not designing or offering related training due to the non-mandatory and varying global requirements of ballast water management. The speedy development and implementation of the ISPS Code in response to the events of 9/11 attests to the fact that the maritime community, through the IMO, is able to respond to global events in a timely fashion when it has the desire to do so. Will it take an environmental catastrophe or major safety incident for the maritime community to respond in a similar manner in the area of ballast water management?

AIS – Aquatic Invasive Species
Ballast Water Convention - International Convention for the Control and Management of Ships’ Ballast Water and Sediments
MET – Marine Education and Training
IMO – International Maritime Organization

Keywords: Ballast water management, Aquatic invasive species, MET- Marine education and training

1. INTRODUCTION
The International Maritime Organization (IMO), from time of origin in the late 1950’s focused on the improvement of marine safety and upon the prevention of marine pollution, most notably of oil pollution inherent within the tanker trade. The Marine Environment Protection Committee (MEPC) was established by the IMO in 1973 to coordinate the ever expanding array of activities regarding the control and prevention of all types of marine environmental pollution.
However it was not until 1988, with the report from Canada of the invasion of the Zebra mussel into the Great Lakes system that the IMO began to fully understand the potential magnitude of the consequences caused by the transfer of unwanted harmful aquatic invasive species (AIS) and pathogens in ships’ ballast water. The IMO (2005b) has estimated that there are up to ten billion tonnes of ballast water transferred globally each year. Consequently the IMO (2005a) has identified the transfer of AIS and pathogens in ships’ ballast water and sediment – in addition to land-sourced pollution, overexploitation of marine resources, and destruction of habitat - as one of the four major threats to the world’s oceans. The IMO subsequently developed guidelines for the control and management of ships’ ballast water in 1993 and more comprehensive ones in 1997 (GloBallast 2008c). Through the MEPC and its Ballast Water Working Group the IMO focused on formulating a convention that would address the global control and management of ships’ ballast water and sediments and that would eventually become mandatory. In February 2004 it adopted the International Convention for the Control and Management of Ships’ Ballast Water and Sediments (The Convention).

2. AIS PROLIFERATION
GloBallast (2008b) estimates that there are approximately 7000 different species transported globally via ships’ ballast water. While some are too fragile to survive the journey, and still more will not be able to adapt to the new location, others will flourish to the point of transforming the host ecosystem.

The proliferation of the Zebra mussel in Canadian and US waters first alerted the international community to the potential magnitude of this problem. The introduction of this mussel, most likely from the Black Sea, has changed the ecosystem of eastern North America. The Zebra mussel tends to accumulate on all hard surfaces in mass quantities. Notable affects of the migration of this mussel to the North American ecosystem includes the displacement of some native marine life, severe fouling and clogging of certain infrastructure, and the alteration of the habitat and food chain. It has been estimated by IMO (2004) that billions of dollars have been expended towards pollution control and the clearing of underwater structures and pipes that have been fouled by the Zebra mussel.

The IMO (2004) iterates a number of other examples of AIS and the destruction that they have caused. The Mitten crab is another species that has caused significant damage. It is primarily native to Northern Asia, but has been documented as being introduced to other areas of the world including Western Europe, the Baltic Sea and the West Coast of North America. This species is known to undergo mass migration for the purposes of reproduction. Its natural tendency to burrow has caused siltation and erosion, but more alarming is its ability to prey on local species to the point of extinction. In recent months this species has also been found on the east coast of Canada - in Placentia Bay, Newfoundland. It is suspected to have arrived through ballast water discharge from one of the numerous tankers arriving there and that are involved in international trade. Already there is evidence that it will endanger the native snow crab population, a lucrative source of income for the local fishery.

It is not only the North America ecosystem that is threatened by AIS. The North American Comb Jellyfish has been introduced to the Black, Azov, and Caspian Seas. This jellyfish reproduces rapidly and due to its intake of plankton through filter feeding has significantly contributed to the demise of the commercial fishery in the Black and Azov Seas and now similarly threatens the Caspian Sea.

Toxic algae commonly referred to as red, brown and green tides, have been spread to numerous areas. The ingestion, by humans, of shell fish that have consumed the toxic algae, has lead to paralysis and even death. Algae have caused significant destruction of marine life through the depletion of oxygen in waters where they have flourished. Some such algae, in particular the ‘red tide’, are very visible and when fouling marine beaches can severely curtail tourism and recreation in those areas.

These are only some examples of the hundreds of species that have been so far transferred globally with sometimes catastrophic results. There is evidence that pathogens and diseases, such as cholera, have also been transported throughout the world in similar fashion.

Unfortunately this proliferation of aquatic invasive species seems to be increasing while actions to counter the spread have met with little success. The Convention, envisioned to be the enabling weapon in the fight against AIS, and predicted to receive quick ratification, still moves at a snail’s pace towards international endorsement.
3. BALLAST WATER MANAGEMENT CONVENTION
This IMO (2005) Convention delineates the measures that the signatory states have agreed are necessary to minimize risk to the environment, human health, and resources from the transfer of harmful aquatic organisms and pathogens by ships’ ballast water and sediment. Once ratified and in force, it will oblige all parties to follow it to full extent in order to minimize harmful consequences. It requires each state to develop national policies for ballast water management for ships, ports and waters under its jurisdiction. Each must ensure that ballast water sediment reception facilities are provided in the appropriate ports and terminals. Further, nations are to partake in technical research and monitoring, ideally in conjunction with other jurisdictions in order to provide seamless and effective global ballast water management.

Those parties are also required to provide ballast water management related port state control measures. Each Administration is obliged to ensure that vessels flying its flag are appropriately surveyed and certified according to the Convention. Further they will be tasked with verifying through port state control visits that all visiting ships hold a valid certificate and have properly completed their ballast water record book. Ballast water may be sampled to ensure compliance and more detailed inspections may be performed as required.

Each vessel is required to develop, implement and maintain its unique and approved ballast water management plan. Such a plan will detail associated safety procedures, including stability considerations. It is to provide a descriptor of all actions and systems required to implement such a management plan, and it will outline the reporting requirements. It is to identify how the vessel will dispose of sediments, whether at sea or at a shore-based reception facility. Further it requires procedures for coordinating with coastal authorities when discharging ballast water in that country’s waters, and it requires the identification of a designated shipboard officer who is responsible for ensuring the plan is properly implemented. A ballast water record book must be used to record any ballast water operation, whether intentional or accidental, including, uptake, treatment, circulation, or discharge, and to record details regarding the disposal of sediments.

The Convention stipulates standards for ballast water management, including those for ballast water exchange, performance, systems, and prototype treatment technologies. It specifies the time-frame for the phasing-in of the performance standards and requires the IMO to undertake periodic and ongoing reviews to determine if appropriate technologies are being developed to meet the standards.

4. CONVENTION RATIFICATION - CURRENT STATUS
Article 18 of the Convention outlines the time-frame for its entry into force throughout the global community. It demands that the global maritime industry conform within twelve months after a minimum of thirty member states, representing not less than thirty-five percent of global shipping tonnage, have appropriately ratified it. Although the IMO (2008a) lists 167 states, representing 97.2% of global tonnage, as signatories to the primary IMO Convention, as of June 2008, it totals only 14 of these states, representing 3.55% of global tonnage as ratifying the Ballast Water Management Convention. Ratifying countries are enumerated as Barbados, Egypt, Kenya, Kiribati, Maldives, Mexico, Nigeria, Norway, Saint Kitts and Nevis, Sierra Leone, South Africa, Spain, Syrian Arab Republic and Tuvalu. Even the timeframe for ratification by these countries has been painstakingly slow, with the Maldives ratifying in June 2005 and the most recent, South Africa, ratifying in the spring of 2008. Of these countries, only Norway has enough tonnage to be placed in the top twenty flag states, and although it has ratified the Convention, it is showing impatience with the slow pace of endorsement by other countries. Its parliament has authorized the government to proceed with national ballast water management legislation, effective 2007 (Maritime Journal, 2007). The pace of ballast water management in a number of the other ratifying countries is slow with some willing to wait for full ratification and implementation through IMO.

The MEPC (2008) has constantly reminded the international community of the emphasis that this community has placed on the issue of invasive species and continues to urge them of the need for ratification at the earliest opportunity. The Secretary General of IMO, in his address to this meeting of the MEPC seems to project frustration in his appeal for them to ‘exert whatever influence you can back home to have this important Convention ratified without further delay...as this slow pace of ratification is a major impediment to the control of the proliferation of AIS’. One of the repercussions caused by the inability or unwillingness of the requisite number of nations to endorse the Convention is that there is no consistency or clarity provided to vessels that are involved in the global trade regarding ballast water management. Further it significantly detracts from large scale efforts of research and development towards cost effective and efficient treatment technology.
5. ALTERNATE INITIATIVES – NON-RATIFYING COUNTRIES

The implementation of ballast water regulations according to the Convention will create additional expenditures for the ships’ operators and an increase in workloads for ships’ crews. However this problem has been exacerbated by the fact that a number of countries, states and ports have unilaterally developed ballast water management legislation or regulations with requirements that are at times outside of the IMO requirements (GloBallast 2008a). A list of such countries includes Australia, Canada, Chile, Israel, New Zealand, and the United States of America. Although some of these regulations are generally consistent with the international Convention, other jurisdictions have imposed additional or new requirements on the shipping industry. Within some of these countries there are further layers of state or port regulations. It is unfortunate but imperative that ships’ owners and crews will have to remain current with these varying requirements in order to be compliant in each jurisdiction.

In the United States, in addition to federal regulations, some states, notably Michigan and California, have instituted their own performance standards that differ not only from the IMO and federal legislation but from each other. By way of example, one ballast water management performance standard set by the IMO (2005) requires that any ballast water discharged shall contain less than 10 organisms, per cubic meter, that in size are greater than or equal to 50 micrometers in minimum dimension. According to Bryant (2007) United States federal performance standards require no more than 0.1organisms of the same size, while the California performance standard prohibits any such organisms of similar dimensions.

The shipping industry, international by nature and operating throughout numerous jurisdictions will have difficulty not only adhering to the multitude of international, national, state and port regulations, but indeed even being aware of such differences. In addition, technology installed shipboard to meet international requirements may not be able to meet the stringent requirements of other jurisdictions such as California. Nonconformance to such regulations can be costly for the ship-owner and for the ship’s crew. A perusal of the USDA (2008) regulations reveals a penalty of up to $27,000 per violation per day, and up to a year imprisonment for certain violations.

Canada has also formulated its own Ballast Water Control Management Regulations. While these regulations, in force as of December 2006, generally mirror the Convention, Canada has yet to ratify. The port of Vancouver had instituted port regulations governing ballast water as early as 1998, but these are now superseded by the Canadian regulations. Both Canada and the port of Vancouver determined that with the slow movement of the international community in attacking this issue, it was imperative that they act unilaterally to mitigate the threat. According to one senior Transport Canada Marine Inspector (Anderson, 2008) it was felt that it was more advantageous to expend effort in dealing directly with the problem in Canada rather than wait for the international response. He projects that Canada will ultimately ratify the Convention.

The Australian Government (2008) implemented voluntary compliance as early as 1992, but enforced mandatory requirements in 2001. These regulations while generally consistent with the Convention are designed to maintain tight control over ballast water entering Australian waters. Any ballast water originating from outside the Australian territorial sea is deemed to be of high risk, and the discharge of such water, or sediment, in the country’s ports is prohibited. No ballast water exchange must occur inside the Australian 12 nautical mile limit. Ballast water reporting requirements, to occur up to 96 hours prior to arrival, are specified, and vessels failing to submit will not be given formal quarantine clearance to enter port.

The Orkney Harbours (2008), in the United Kingdom, has also instituted stringent ballast water management requirements, exceeding the requirements of the Convention, in order to protect its fragile ecosystem. This jurisdiction does not rely solely on the ability of the vessel to exchange or treat ballast water, rather it insists that if discharge of ballast water is to occur in its jurisdiction it will only be to the terminal reception and treatment facility. The facility in turn will analyze the ballast water and will if necessary treat it before discharging it to a remote predetermined location.

These examples serve to illustrate the concerns that some countries have with the potential consequences of AIS. It appears that these nations are unwilling to wait for the Convention to enter into force. Even if/when the requisite number of countries ratify the Convention there will be a 12 month waiting period before the entry into
force date occurs, and with the current pace of ratification it is not expected to be globally recognized any time soon.

6. BALLAST WATER MANAGEMENT CHALLENGES
There are a number of concerns and challenges with implementing a global Convention on ballast water management, and many of these challenges are exacerbated due to the fact that countries are unilaterally, in a non-consistent manner, imposing regulations, which ships’ owners and crews must follow. Ballast water exchange methods; the quantity and quality of reception facilities; the progress of research and development of ballast water treatment technology; and the consistency of port state requirements and controls are but a sampling of areas of concern.

6.1 Ballast Water Exchange
For most vessels and Administrations, and as outlined in the Convention, the primary method of ballast water management will initially be through ballast water exchange, in deep water and far from shore. The normal objective is to replace at least 95 percent of the ballast water with uncontaminated ocean water through the more common methods of sequential or flow-through ballast water exchange. The use of ballast water for trim, list, and stability requirements is a familiar and necessary procedure for the mariner. However the practice of loading or discharging such large quantities at sea would be the exception rather than the norm. Ballast water exchange will continue to be the preferred management technique used at least until technology is able to replace it with a safe, economical, and reliable alternative. There are, however a number of safety issues to be considered when using the at-sea exchange method. One of the most obvious is the potential lack of adequate stability or excessive list caused by poor planning and execution of ballast water transfer or discharge.

A high profile example of reported improper ballast water exchange was illustrated by the case of the Cougar Ace, a 19000 grt car carrier. While en-route from Japan to Vancouver, July 2006, it suffered an 85 degree list, which was attributed by the owner to an imbalance in the intake of ballast water (Countryman & McDaniel, 2006). In addition to the cost and time of the salvage operation and opportunity cost, it also resulted in the destruction of more than 4700 new vehicles worth more than $90 million.

There are a number of other potential and negative consequences of ballast exchange while at sea. The Convention makes provision for the possibility of poor weather and sea states, and in any case it would be expected that the prudent mariner would factor in these conditions when determining if and when to perform the operation. However there are other dangers, as identified by Karaminas (2000) that are associated with exchange operations. The sequential method – the emptying and refilling of tanks containing ballast water – has a number of associated risks. Along with increased workload on pumping and piping systems and on ships’ crews, there are risks imposed in respect of longitudinal strength, dynamic loads, excessive trim, bottom slamming, propeller emergence, and poor bridge visibility. He also identifies additional risks that are associated with the flow-through method – the replacement of ballast water by allowing tanks to overflow so as to replace the tank volumes a sufficient number of times. The effectiveness of such a method for some vessels may be in question due to the ship design or configuration. Care would be required where icing is encountered so that vents would not get blocked and so as to address stability concerns due to the possible accumulations of ice on deck. Over-pressurization that may lead to structural damage is another identified risk.

There is no doubt that there are other hazards related to the various exchange methods, but those listed serve to illustrate some areas for concern. Administrations must outline appropriate criteria for performance standards and ensure that safety is paramount. Ship-owners will need to determine the best suited methods for ballast water management for each company’s vessels including the introduction of new technology, particularly with new builds, or and even consider refit for older ones. Appropriate training for ships’ crews is paramount.

6.2 Reception Facilities
Most of the discussion regarding ballast water management has centered on the exchange or treatment of ships’ ballast water. However it is also recognized that the discharge of sediment that has settled out of ballast water within the ship, and that accumulates in ballast tanks is also a vector for AIS. Therefore the Convention outlines the acceptable procedures for the control of such sediments and dictates that an approved management plan detail how ships will remove and dispose of such sediment from ballast tanks whether at sea or to a shore facility.
The Convention also includes, in Article 5, provisions for sediment reception facilities. This Article requires that parties to the Convention provide adequate sediment reception facilities in any ports and terminals where cleaning or repair of ballast water tanks might occur. It further stipulates that such facilities be designed to operate so as to allow vessels to discharge without undue delay to the vessel. Disposal by the facility is also required in a manner that there is no damage to the environment, human health, property or resources.

As Karaminas (2000) states, the mandatory discharge of both ballast water and sediment to approved reception facilities would eliminate the problems associated with ballast water exchange and also prevent introduction of AIS into those areas via these vectors. This solution would also negate the necessity for development and installation of new ballast water technology. However this as an only solution is unrealistic as it would require a profusion of such facilities to be located in all areas where ballast water would need to be discharged.

Some ports do mandate shore-based discharge of ballast water and normally have high performance reception facilities. One example is Scapa Flow which is capable of treating 40,000 barrels per hour. However, this appears to be the exception and indeed most ports have no reception facilities available for either ballast water or sediment (Lloyd’s Register, 2006b). There are no readily available statistics for the total number of ballast water and sediment reception facilities that are in use globally. Canada, for example, which does have mandatory ballast water management regulations that do include provision for the use of such facilities, has no known reception facilities available at this time (Anderson, 2008).

Some port reception facilities, constructed to meet other IMO regulations that deal with the dumping of ship waste streams such as waste oil, garbage and sewage, have identified a problem that is worthy of note. It is evident that some vessels prefer to dump waste at sea, where there is a low risk of being caught, rather than use the provided facilities and thus pay the required user fees. There is little evidence to suggest that a similar fate will not await ballast water slated for such facilities if regulations required such widespread usage. One organization, Seas at Risk (2008), proposes that ports should institute a system of so called ‘no special fee system’, which requires all vessels to pay a set fee, normally based on tonnage, whether they use the reception facilities or not. This would have the benefit of lowering the across the board fee, but more importantly minimize the advantage of improper dumping any waste including ballast water at sea.

6.3 Technology Research and Development

The initial focus of the Convention has been on mid-ocean ballast water exchange due to insufficient or inadequate technology available to treat ballast water to the extent that it could meet the performance standards as outlined in the Convention annex. IMO has recognized (GloBallast 2008d) that such exchange methods pose safety concerns and have limitations. Additionally it is a less than 100 percent effective means of eliminating AIS and pathogens from ballast water even when used by the trained and conscientious seafarer.

It is envisioned that research and development will continue to be conducted in this area, and equipment will be developed to use mechanical, physical, and chemical methods to treat ship ballast water and to replace or supplement the ballast water exchange method. The Convention therefore has included an annex that outlines approval requirements for prototype treatment technologies and allows for an ongoing review of performance standards and equipment.

It was foreseen that system development would be hampered by a number of factors, not the least of which was the tremendous amount of ballast water requiring such treatment, particularly on the largest classes of tankers. Developed technology would also be required to be safe, be economically viable, be contained in an appropriate footprint within the ship’s design, and conform to the performance standards as outlined in the Convention. However the current inability of IMO to convince the required number of member states to ratify the Convention has also created confusion that has hindered technological development.

As only a small number of countries have thus far ratified, and with still others formulating national regulations with varying performance standards, there is currently no performance standard for the treatment of ballast water that is internationally and uniformly recognized. Companies interested in the research and development of such systems will invest significant funds to meet a standard set by the Convention but that may not be recognized by a host of other state regulations. A submission to IMO (2007b) for approval requires a deposit of $50K to $100K and requires a lead time of at least 28 weeks. Any supplemental submission would also be subject to new and
similar fees and timelines. Of course this is in addition to the millions of dollars spent on the research and development with no guarantee of final approval. A measure of the ability to meet even the Convention performance standard is demonstrated by the number of such systems currently approved. According to the IMO (2007a), as of October 2007 there were six systems with basic approval, and only one that had received the coveted final approval.

The Convention standard appears to be palatable to most parties but as demonstrated even this standard is causing some difficulty in the development of acceptable systems. What then of the standards such as those set by the state of Michigan which, for organisms of 50 micrometers or greater, are 100 times more stringent than the Convention? Standards such as those set by the state of California, which allow no such organisms, are considered by some to be impossible to meet (Bryant, 2007). For manufacturers this creates a dilemma as the cost to develop to a higher performance standard such as that of California, if possible, would no doubt cost considerably more, but if achieved may become the gold standard. For the ship owner, purchasing ballast water treatment systems without knowing the ultimate required standard would be a ‘crap shoot’ and could result in purchasing equipment with a lower or even higher performance standard than that which is eventually required.

The Convention outlines expected performance standards with the requisite implementation dates. Of particular note, in regulation B-3, are the requirements for ships that are constructed in or after 2009. Those vessels will be required to meet the performance standards as per the Convention. However, at the current rate of ratification there is no guarantee that this instrument will be globally accepted by that time. Because of this and due to the fact that the pace of research and development in this area is lagging, there is little wonder that ship owners are not rushing to have vessels constructed that are able to meet any standard. Even the IMO (2008a) acknowledges that the installation of type approved treatment systems on vessels scheduled to be built as at that date will be difficult or even impossible to achieve, particularly without excessive costs or delays. In a ‘catch-22’ situation, the IMO has realized that it could extend the implementation date past 2009 however it would only be allowed to do so if the Convention has first achieved global ratification so that it can then be amended. This would also apply to the ability to grant exemptions for vessels not appropriately outfitted.

6.4 Port State Controls and Requirements
The Convention imposes certain obligations on port states. Without global ratification or in lieu of similar national requirements these requirements will not be universally applied. Vessel inspections are required to ensure that crews are abiding by these regulations. Visits by port state officials will ensure that vessels have valid ballast water management certificates, have and implement a management plan, and that they record all related activities in the appropriate record book. A scrutiny of these records and application of techniques such as ballast water sampling and analysis are crucial as a check to ensure that the vessel adheres to the regulations. Such scrutiny may be supplemented with fines, or sanctions such as warnings, detentions, or expulsions. Without such control actions being carried out by all signatories, vessels may use such inaction, where possible, to skirt the intent of the Convention.

The Convention sets criteria for ballast water exchange locations, normally 200 nautical miles from land and in water depths exceeding 200 meters. However port states, due to the vagaries of location are also required to determine appropriate or alternate locations for such exchange procedures. The Convention also requires port states to identify locations within its waters where there are risks of harmful uptakes, and to notify vessels of any such areas. Areas known to contain outbreaks, or infestations of AIS; that have sewage outfalls; or that exhibit poor tidal flushing would be identified and warnings issued. The identification of appropriate areas for ballast water exchange and the areas to avoid uptake of ballast water, will not singularly prevent invasion by unwanted species or pathogens but this information, particularly when gathered and promulgated by all states does constitute a part of the puzzle to be constructed for the control and prevention of these harmful effects.

The parties are also encouraged by the IMO (2005a) Convention to cooperate for the purpose of effective implementation, compliance, and enforcement. It also requires parties to work together to improve ballast water management standards, and stipulates that they continue scientific and technical research and monitor the effects of management procedures or lack thereof.
While those obligations listed are only some of the requirements placed on port states by the Convention, it is obvious that maximum benefit will be gained only if all jurisdictions are party to that Convention and are vigilant in these duties.

6.5. Training
The IMO (2008b), along with its responsibility for drafting codes, conventions and the like, provides technical assistance and lists the subject of training as one of its most important tasks. IMO initiatives such as the Convention will only be successfully implemented if stakeholders are successfully trained. In April 2008, the IMO sponsored an introductory course on the topic of ballast water management for the Mediterranean region. While the four-day training was of value, some of the participants’ comments were most telling. One stated that a global ballast water management system was one of the most difficult systems to put in place as all stakeholders have to work collectively and accurately together. Another likened the Convention to the first step in a long walk (REMPEC 2008).

Such training will increase regional awareness however the Convention also calls for a more grass-roots type of training. In particular such training should target the designated shipboard officer, and other ship and company personnel involved in ballast water management as well as the associated port state control personnel. Training must cover all aspects of the Convention including requirements for and of a ballast water management plan; record keeping; various port state control requirements; and safety considerations for ballast water exchange. This list is not all inclusive – there may be other topics. However because there has been no formal global recognition of the Convention, and because there are varying national standards, there appears to be no wide spread offering of such training. The varied national standards should be a reason for more training, and not less, as mariners now struggle on their own to remain current with the latest regulations.

One of the most recognized training providers, Lloyd’s Register (2008), does continue to provide some degree of training on this topic through a one-day course, and with a total of five offerings in 2008. However it is uncertain if this training goes far enough. A review of the Lloyd’s Register (2006a) course program reveals that the first half of the day – three hours - covers the topics 1) an introduction to ballast water management, 2) what will a ship need and how Lloyd’s Register can assist, and 3) ballast water management plans. The second half of the course has participants involved in practical exercises. The adequacy of the course will really depend on the needs of the individual participant however to the organization’s credit they are at least offering such training.

A web search, for similar training by MET institutions, while not to be considered statistically accurate, reveals that there is very little in the way of ballast water management training being offered. The IMO Resolution A.868 (20) contains a section specifically directed to the topic of training. It specifies the need for training for ships’ masters and crews and goes further by directing governments to ensure that their marine training organizations include this in the contents of their syllabus. It also encourages them to include knowledge of duties regarding the control of pollution of the sea by harmful aquatic organisms and pathogens in their training requirements for certificates (IMO 1997). It appears that, so far, this guidance has had very little impact on the provision of national ballast water management training requirements.

7. SUMMARY AND CONCLUSIONS
There is no one answer to the crisis created by the transportation of AIS through the movement of ballast water and sediments. The solution will result from the parties working together to identify an array of solutions, some unique to certain geographic locations. Some jurisdictions may deny access to international shipping. For example a study by Grand Valley State University as reported by Dahlstrom (2007) revealed that 77% of the AIS imported to the fresh water Great Lakes of Canada and United States arrived via saltwater ocean freighters, but that these vessels handled only 5% of cargo moved on the Great Lakes. This report determined that if such ocean going vessels were barred from trading on the Great Lakes and other means of transportation were used to move these goods to the intended destination, the additional annual cost would be in the vicinity of $55 million, which is miniscule compared to the estimated $3.1 billion in damages caused by the zebra mussel alone.

The major stumbling block appears to be the non-ratification of the Convention by the required number of states. Ratification by some of the larger flag states, such as Panama, Liberia, and the Bahamas, which according to IMO (2005) control almost 37% of global gross registered tonnage, is imperative. Other counties that have unilaterally developed ballast water management legislation need to ratify the Convention in order to break the
current impasse. On a go-forward basis these countries, through the IMO would then be able to monitor the effectiveness of the Convention and to suggest improvements as technology and compliance improves. Performance standards such as those set by California is not an immediate solution.

Ratification of the Convention will also translate into more research and development in a number of areas. As expected companies will continue to work towards the better ‘mouse-trap’ concept for ballast water systems, which are anticipated to be more effective, efficient and cost effective. Certainty of the performance standards will entice more players into this potentially lucrative field of development and will also entice more ship-owners to use the new technology, ensuring safer ballast water management procedures, while having confidence that treated ballast water will meet the requirements of the international regulations.

Research is also to be expected in the area of ship design, with the goal of designing ballast free and zero discharge ships. According to Mei (2007) of the Herbert Engineering Corporation research is already being carried out on a number of non-traditional ship design models. Some types of vessels will more readily accommodate such design changes while others such as tankers and bulk carriers will probably require other solutions. However it is important to note that the latter types of vessels are those that have the greatest capability, through large ballast water capacity and ability to travel to distant ports, to transfer AIS to significantly different ecosystems.

Training should be more structured, and while there may be some debate as to whether it should be mandatory, the IMO needs to take the lead and develop model courses to insure consistency of training. International and national MET institutions and related organizations should exert pressure to ensure that ballast water management training is an important focus and initiative. There is increasing concern being exhibited towards the marine environment by the global community. Traditional marine topics will not be replaced but are destined to be increasingly supplemented by those related to the marine environment. Ballast water management is but one of those areas.

Governments must, as directed by the Convention, work cooperatively together for effective implementation, compliance and enforcement of the Convention. A global capability and needs assessment regarding ballast water and sediment reception facilities is required.

This paper only touches on the problems and solutions related to ballast water management. However the current pace of action will not suffice. The time for action is now!

8. REFERENCES
