

Ballast Water Management: Challenges for the Flag State and Port State Control

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Abstract Merchant shipping facilitates 90 percent of global trade by volume, and in performing this vital function around 45000 vessels move more than 10 billion tons of ballast water around the globe annually. When ballast water is loaded and discharged at different ports, immense quantities of aquatic life in the form of larvae, eggs, cysts, bacteria, microbes and small invertebrates are relocated. Introduced aquatic species often become invasive in their new environment, proliferating at dramatic rates displacing native populations, causing damage to local eco-systems, human health and property, and has been recognised as a huge ecological and economic threat to the planet's environment. Overwhelming global environmental concern prompted the International Maritime Organization (IMO) to adopt the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) during the International Conference on Ballast Water Management for Ships' in 2004, defining strict regulations for ship's ballast water and sediment controls. The BWM Convention seeks to protect the marine environment and prevent the global spread of IAS by establishing benchmark strategies and standards for managing ships' ballast water and sediments. Although the Convention remains to be ratified, it is nearing its tonnage requirement of 35% of the world's merchant shipping that will allow it to come into force in the near future. To manage the magnitude of ships that will be obliged to fulfil the requirements of the Convention, IMO has authorized Flag State Control (FSC) and Port State Control (PSC) to enforce compliance. However, regulatory bodies face a number of challenges in ensuring compliance. Based on a review of literature, this paper highlights the various facets of the BWM Convention that are inadvertently creating challenges for the PSCs and FSCs to ensure effective compliance of the Convention.

Keywords: Ballast water management, Port State Control (PSC), Flag State Control (FSC), Compliance, Invasive aquatic species (IAS), marine environmental protection

1. Introduction

Merchant shipping facilitates 90 percent of global trade by volume, and with ever expanding globalization and demand for fast turnaround times, it represents a cost effective method in the international transport of cargo (Maritime Gateway 2016). In performing this vital function around 45,000 vessels move more than 10 billion tons of ballast water around the globe annually (National Geographic 2016). The impact of this is causing significant ecological and economic damage through the transportation of marine aquatic species such as bacteria, eggs, cysts, small invertebrates, microbes and larvae in ships ballast water, which often multiply into pest proportions in the new environment, becoming invasive and displacing native species (International Maritime Organization (IMO) 2016a). Highlighting the seriousness of the problem, Briski et al. (2013) indicates invasive aquatic species (IAS) have caused 20% of global animal extinctions and contribute significantly to an additional 34% of animal extinctions.

Overwhelming global environmental concern prompted the International Maritime Organization (IMO) to adopt the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) during the International Conference on Ballast Water Management for Ships' in 2004. The BWM Convention seeks to protect the marine environment and prevent the global spread of IAS by establishing benchmark strategies and standards for managing ships' ballast water and sediments (IMO 2016b). The BWM Convention, detailing the prerequisites and technical guidelines for managing ships' ballast water and sediments, is set to enter force 12 months after it has been ratified by 30 maritime states representing 35% of global commercial shipping tonnage. As at February 2016, the

treaty had been ratified by 47 States, with less than 35% of world tonnage (IMO 2016d). Although the Convention is not in force yet, on ratification, all ships will be required to implement a ballast water and sediments management plan, carry a ballast water record book and perform ballast water management routines to a defined standard (IMO 2016b). Ballast water management standards are to be eased in over time, with ships exchanging ballast water mid-ocean as an interim measure. Eventually, with the ratification of the BWM convention, all ships would be required to be fitted with ballast water treatment systems (IMO 2016b).

To ensure compliance with the requirements of the Convention, the IMO has authorized the regulatory bodies of Port State Controls (PSC) and Flag State Controls (FSC). However, the regulatory bodies face a number of challenges in ensuring compliance. Based on a review of literature, this paper highlights the various facets of the BWM Convention that are inadvertently creating challenges for PSC and FSC to ensure effective compliance of the Convention.

2. Obligations of the Flag State and Port State Controls

The IMO is the over-arching regulatory body which together with national maritime regulators enforce the requirements of the BWM Convention on maritime nations (or States) that have ratified the convention. The national regulator is usually known as the 'Flag State' (also known as Flag State Control or FSC) which can be an administration or the government of the State under which ships can be registered, e.g. Australian Maritime Safety Authority (AMSA) in Australia. The FSC becomes 'Port State Control' (PSC) when ships of other registry call at their ports (Ghosh, Bowles, Ranmuthugala, and Brooks 2014).

Article 4 of the BWM Convention requires Flag States to adopt appropriate measures and oblige ships registered and operating under its authority to comply with the relevant standards of the Convention. To do so, the article stipulates that each Flag State shall, "with due regard to its particular conditions and capabilities, develop national policies, strategies or programmes for Ballast Water Management in its ports and waters under its jurisdiction that accord with, and promote the attainment of the objectives of this Convention". In addition, Article 7 of the Convention stipulates that each Flag State shall require ships registered under its authority to undergo surveys to obtain certification of compliance (IMO 2004). Hence, the Flag States shall develop national legislations that contain procedures for survey of ships by qualified surveyors and include approval of Ballast Water Management Plan (BWMP), Type approval of Ballast Water Management System (BWMS), and outsourcing of tasks that fall out of the area of expertise of the Flag States to recognized organizations (Kim 2013). Flag States are also required to impose sanctions on ships under its domestic law, for any violations of the convention. Concurrently, if the Flag States are notified of a violation of the Convention by any one of its ships, they are obliged to investigate the matter, collect and analyse evidence, and implement procedures according to its legislation (Ahmed and Youssef 2014).

PSCs are required to develop and implement guidelines, plans, and facilities to enforce compliance with the BWM Convention when ships (other than those registered under its authority) visit their jurisdictional waters. Similar to Flag States, PSC must establish sanctions for any violation of the Convention that takes place within its jurisdiction. A violation in such cases may result in the ship being warned, detained, or rejected from entering the port. When a violation happens inside its jurisdiction, a PSC has the choice to take procedures according to its legislation or give information and evidence identified to the violation to the Flag State under whose authority the ship is registered. PSC may also have to carry out additional inspections of ships at the request of other PSCs or FSCs when provided with evidence of the ship's violation of the Convention in the recent past.

However, in their efforts to ensure global compliance of the BWM Convention, PSC and FSC face a number of challenges.

3. Challenges to the Flag State and Port State Controls

3.1 Identification of exchange locations

The BWM convention specifies criteria based on geographic locations for an exchange of ballast water. This criteria requires vessels to carry out the exchange at a distance of normally 200 nautical miles from the nearest land and in water depths exceeding 200 meters. Ships' officers have to record details of such exchanges in the ballast water log book where the geographic location in terms of latitude and longitude as well as nearest distance from land need to be logged. However, PSC and FSC officers have no means to verify whether the ballast water was indeed exchanged on the logged position. The accuracy of the information is completely based on the ethics of the ships' officers who are trusted to carry out the exchange operations as per the Convention's requirements.

In addition, port states are required to determine alternate and appropriate locations for the ballast water exchange to take place. In identification of locations, the BWM convention requires port states to identify areas within its waters where there are risks of harmful uptakes, outbreaks or infestation of AIS, sewage outfalls, and poor tidal flushing (Anstey 2008). This will require PSC and FSC to carry out continued scientific and technical research towards the identification and maintenance of suitable exchange locations, which may result in the imposition of financial restraints.

3.2 Financial costs

Kim (2013) classifies the financial costs to PSC and FSC under 'preparatory' and 'compliance'. The 'preparatory' costs relate to the fulfilment of institutional needs (for example, staff required, equipment, technology, etc.) and developing national strategies (for example, stakeholder involvement, developing cooperative relationships with other States, inspection regimes, etc.). On the other hand, the 'compliance' costs may include expenses related to issuance and renewal of certificates, survey procedures, approval of ballast water management systems, training of crew, and reforms of the national regulatory framework. For example, Australia is a signatory Party to the BWM Convention subject to ratification and The Department of Agriculture is developing the Biosecurity Bill 2014 to provide a framework for Australia to manage risks associated with ballast water (AMSA 2016). The implementation costs of the bill is estimated around \$0.6 million dollars (Queensland Legislation 2013).

To comply with the numerous provisions of the BWM Convention, States should reform their legislations and policies, strategies and institutional arrangements through a consistent review process to achieve the ultimate purpose of establishing a national BWM framework (Ahmed and Youssef 2014). However, such reforms are not achieved overnight and may require a number of years that requires cost considerations. For example, the Biosecurity Bill in Australia took six years to be developed and passed by the Senate (Invasive species council 2016). Hence, for many States, the concerns are not only focuses on financial investments towards 'preparatory' and 'compliance' costs but also towards building national systems towards the compliance requirements of the BWM Convention. For example, Rittel & Webber (1973) describe governmental policy and planning problems as inherently imprecise 'wicked' problems, which rely on intangible political evaluation for resolution, and that solutions are usually found through engaging with stakeholders to build consensus. For many States, it may be challenging to engage all concerned stakeholders, towards compliance with the BWM Convention. Therefore, continuous support for those States through capacity building in international or regional levels is required to the effective implementation of the BWM Convention (Kim 2013).

In building a global consensus to ratify the BWM Convention and reduce the environmental impacts of IAS through ships' ballast water, the IMO has taken the 'wicked' approach to solve the problem through extensive stakeholder engagement. Despite the extraordinary amount of time that has elapsed, this strategy has been instrumental in the move towards ratifying the BWM Convention. This may be seen through the GloBallast Partnerships joint initiative between IMO, United Nations Development Programme (UNDP) and the Global Environment Facility (GEF), which has been key to progressing

global ballast water technology solutions; strengthening global understanding and information transfer in support of marine biosecurity strategies; and the formation of innovative public-private partnerships with leading marine companies through the establishment of the Global Industry Alliance (GIA) and assisting developing countries reducing the transfer of IAS (IMO 2016c). Outcomes from integrated and collaborative initiatives such as these are significant, demonstrating to the global community that despite the many complexities involved, challenges can be overcome to protect the marine environment (IMO 2016c).

However, once the reforms are in place, the challenge for Flag States would be to train their staff to understand their national regulatory framework and the aspects concerning ballast water management. Such training would involve monetary investments which may be large in cases where there is an absence of suitable training providers.

3.3 Lack of recognized training providers

The training of Port State and Flag State Control officials in the understanding and implementation of the BWM convention is of a significant interest in the effective compliance of the convention (Kim 2013). Training must cover all aspects of the Convention including requirements for and of a ballast water management plan (BWMP) approval; testing of equipment; sampling requirements; record keeping; and safety considerations for ballast water exchange. Although this list is not exhaustive, it highlights the various aspects of training required and the need for suitable and qualified training providers. However, due to the Convention not being in force and a resulting absence of a formal global recognition leading to varying national standards, there appears to be a dearth of specialised training (Anstey 2008). This is a major challenge for PSCs and FSCs who are required to keep themselves updated with changing nature of the Convention.

A web search revealed that one of the most recognized training providers, Lloyd's Register Marine (2016), provides some degree of training to shore staff who will be involved in planning how to comply with the upcoming ballast water management legislation as well as those who will be responsible for implementing the plan. The training delivered by experts in the field of BWM Convention includes the following:

- Requirements of the BWM Convention and the United States Coast Guard (USCG) legislation, including their implementation schedules.
- Options for complying with ballast water management legislation.
- Operational limitations of the various ballast water treatment technologies.
- Recognise the ship types and trades which may be suited to other alternative compliance options (such as using reception facilities).
- One approach for comparing the suitability of ballast water treatment systems for use on board a specific ship with a defined operational profile.
- Issues associated with retrofitting ballast water treatment systems.
- Approach that port state control inspectors are likely to take when reviewing compliance with the BWM Convention.

However, the training is a one-day course that does not allow it to be extensive, or provide a comprehensive understanding of all the different aspects of the Convention. For example, in April 2008, the IMO sponsored a four-day training in 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' stated that the requirements of the Convention was one of the most difficult to comprehend and implement (Anstey 2008).

A further search on the web for specific training provided to PSCs and FSCs in the area of BWM Convention did not reveal its prevalence. This paper acknowledges that the web search may have overlooked certain training providers, the fact cannot be ignored that there is very little in the way of BWM training being offered. The IMO Resolution A.868 (20) 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. It appears that, so far, this guidance has had very little impact on the provision of national BWM training requirements (Anstey 2008).

3.4 Safety Considerations

Training for PSC and FSC officials is most essential for the recognition of safety hazards that challenge them during routine inspections. For example, officials may be exposed and affected by the IAS present in the sample of ballast water collected for testing and monitoring compliance to discharge standards (Balaji and Yaakob 2014). Sampling of ballast water is primarily a matter for the authorized inspection officers during PSC inspections (Enshaei, Carney, and Mesbahi 2015). One may view the duty of collecting samples as the responsibility of the ship's staff under the supervision of PSC officials, however, the risk of exposure cannot be ruled out. PSC and FSC officials should be trained in the use of biological protocols such as the use of protective equipment which may provide the necessary protection against exposure to infectious elements when handling the samples of ballast water or when entering ballast water tanks for inspections.

3.5 Determination of sampling size

Article 9 of the BWM Convention stipulates that a ship may, in any port or offshore terminal of another Party, be inspected by officers duly authorized by that Party (i.e. PSC Inspection) in order to determine the ship's compliance with the applicable requirements. Such an inspection involves checking certificates, crew familiarization and BW sampling. Sampling of ballast water is required to monitor ship's compliance with the BWM convention. Testing the samples will provide PSC officials with key information regarding the measurement of IAS in the ballast water, effectiveness of water treatment systems in reducing/eliminating the IAS, and ship's discharge as per BWM Convention standards. For example, a ship will be banned from discharging ballast water where the ship ballast waters' sampling results show that it present harm to the environment, property, natural resources or human health. The IMO has developed publications that provide "Guidance on ballast water sampling and analysis (G2)" adopted by Res.MEPC.173 (58) in 2008. However, PSC and FSC officials face a number of challenges due to the vagueness that still exist in the standards described for sampling (Kim 2013).

The problem is that the G2 guidelines are not sufficient for practical use by PSC officers in many aspects. For example, the Guidelines stipulate that "the sampling and analysis methodologies to test for compliance with the Convention are still in development and at the present time, there are no specific sampling or analysis protocols that can be recommended for Administrations to use". Accordingly, after long discussion at the MEPC 65th session held in May 2013, "Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2)" was approved to provide sampling and analysis methodologies and disseminated by BWM.2/Circ.42. However, the aforementioned Guidance will be used for trial purposes only because there is still technical uncertainty with regard to BW sampling and negative opinion about BW sampling. For example, there are no clear guidelines on the volume and frequency of sample required, areas where the sampling should be collected from, etc. (Ahmed and Youssef 2014). Enshaei et al. (2015) highlight that IAS present in the ballast water tanks are known to be heterogeneously distributed throughout the tank. Hence, it is a challenge to determine the amount and location of sampling that will reveal accurate estimation of the population of IAS.

3.6 Lack of technical expertise and guidelines

Flag States require access to the appropriate technology prior to approval of the ballast water management systems (BWMS) or ballast water treatment systems (BWTS). Currently, there are reviews that have used vendor supplied information or data to evaluate the potential efficiency of these systems (Enshaei et al. 2015). Therefore, Flag States may need to improve their capacity for establishing

procedures for Type Approval of BWMS and its proper application. Flag States may face difficulties to assess the required technologies (Kim 2013). Before Type Approval Certificates are issued there may also be costs incurred in order to be able to provide a detailed review of the test results and technical documents. Flag States that lack the required technical expertise or facilities may have to rely on outsourcing. In such cases, they may struggle to verify and assure the quality of the tests (Kim 2013).

Flag States also face challenges in the sampling process due to the absence of comprehensive technical guidelines (Kim 2013). To verify compliance with the BWM Convention, two kinds of sampling are required. One is Regulation D-1 (BW Exchange Standard) that requires vessels to exchange their ballast water while in the open ocean during transit; and the other is Regulation D-2 (BW Performance Standard) that defines concentration of live organisms that can be present in ballast water at the point of discharge (Enshaei et al. 2015). In absence of comprehensive technical guidelines, some States are promoting that inspection of ship's documents (such as BWMP, Ballast water record books, etc.) should be sufficient to confirm compliance, shading the need of sampling (Kim 2013). Although ship's documents may confirm compliance with D-1 (subject to accuracy of information provided), they cannot verify D-2 compliance. To determine accurate levels of IAS, complex scientific procedures are required.

3.7 Managing inspections

As mentioned in Section 2 (obligations of the Port State and Flag State Control) of this paper, PSC and FSC have to carry out inspections to ensure compliance. They may also have to carry out additional inspections of ships at the request of other PSC or FSC when provided with evidence of the ship's violation of the Convention in the recent past. However, PSCs and FSCs are required to ensure that such inspections do not result in the undue delay or detainment of the ship. In cases of undue delay, ship owners may have to be compensated (financially) by the relevant PSC or FSC (Ahmed and Youssef 2014). Considering the time restrictions and the fact that PSC not only inspect ships for complying with the Convention of BWM but numerous others, it is a possibility that PSC may struggle to conduct a comprehensive inspection within a stipulated time frame.

3.8 Varying Standards

The BWM Convention allows States to take additional or more stringent measures than the requirements stipulated in the Convention. In this regard, Article 2.3 of the BWM Convention stipulates as follows: 'Nothing in this Convention shall be interpreted as preventing a Party from taking, individually or jointly with other Parties, more stringent measures with respect to the prevention, reduction or elimination of the transfer of Harmful Aquatic Organisms and Pathogens through the control and management of ships Ballast Water and Sediments, consistent with international law'.

Therefore, it can be construed that any Administration has a right to take more stringent measures than the requirements of the BWM Convention to protect their jurisdictional water by adopting and enforcing their national legislation. Some individual maritime states view their national interests require higher standards than the IMO's Type approval standards (Bartlett 2014b). In the absence of uniform standards, the Flag States face the risks of ships registered under their authority to violate requirements of other PSC. For example, in the absence of a uniform standard, newly installed ballast water treatment systems may not pass some member port state inspection standards, leading to heavy port state fines, vessel detentions or even the prospect of a complete ballast water treatment system replacement, despite having an IMO Type approved treatment system fitted (Bartlett 2014b; IHS Maritime 2014, p. 10). Although ship owners will face the brunt of the fines and additional costs, Flag States may face flak from the ship owners that may result in ships being deregistered from the respective Flag States.

Nationalistic approaches to BWM by some States are raising concerns that vessels with IMO type approved treatment systems installed, may still be penalized due to differing type approval, port state and testing standards (Water and Wastewater International 2015; Bartlett 2014a). For example, despite the USCG treated ballast water standard being the same as the IMO D-2 standard, US regulations require ballast water treatment systems to be USCG type approved, the process of which is considerably more

exhaustive than IMO type approval (DNVGL 2014). Recognizing the importance of the issue, the International Chamber of Shipping (2015) called for flag states to abstain from ratifying the BWM Convention, and submitted a proposal calling for legal changes to make IMO type approval guidelines mandatory at the IMO Marine Environment Protection Committee (MEPC) meeting in October 2014.

However it does seem that steps are underway to overcome this barrier. The USCG established the Alternate Management System under which type approvals from other flag states may be accepted as a five year interim measure until they are tested to conform to USCG type approval standards, and currently nine BWTS are approved for use in US waters (DNVGL 2014). Perhaps if the approach of an interim five-year acceptance period is applied to other areas such as port state and testing standards, these barriers too will be overcome.

3.9 Complicated BWMS Installation Schedule

Table 1 Installation schedule for the systems in accordance with the IMO resolution (In case the Convention comes into effect not later than 31 December 2016) (BIMCO 2016).

BWM Capacity	Keel Laid	BWMC Regulation	Compliance date from which D-2 is required
1,500 or more but less than 5,000	Before 2009	B-3.1.1	By the first renewal survey of the International Oil Pollution Prevention (IOPP) Certificate following the date of entry into force of the Ballast Water Management Convention
Less than 1,500 or more than 5,000		B-3.1.2	
Less than 5,000	During 2009 to the date of entry into force of the Convention	B-3.1.3	
5,000 or more	During 2009 but before 2012	B-3.1.4	
5,000 or more	During 2012 to the date of entry into force of the Convention	B-3.1.5	
All ships	On or after the date of entry into force of the Convention	B-3.1.3 B-3.1.5	

All ships engaged in international voyages shall install BWMS on board by a given time in accordance with schedules stipulated in Regulation B-3 of the BWM Convention in order to achieve the goal of the Convention. In case of existing ships, it is allowed to carry out ballast water exchange for a certain period depending on the ships' construction year and capacity of ballast water. It is construed that the complicated B-3 schedule was developed because of the lack of technical development of BWMS at that time the BWM Convention was adopted and a desire for a smooth transition from Ballast water exchange to ballast water performance standard (i.e. BWMS) between 2009 and 2020 (Kim 2013). According to the estimates of BIMCO (2016), by the end of 2021, more than 50000 ships would have to be fitted with a BWMS. Table 1 (BIMCO 2016) provides the installation schedule for the BWMS in accordance to the IMO resolution, in case the Convention comes into force in 2016.

Considering the estimated number of ships and the complicated B-3 schedule, it will be a challenge for the Flag and Port State Controls to understand the schedule correctly and ensure its effective implementation (Kim 2013).

4. Conclusion

This paper does not claim to provide an exhaustive list but does highlight a number of challenges faced by FSC and PSC towards ensuring compliance. In seeking to protect the marine environment from the threat of IAS through the compliance of the BWM Convention, a global consensus is required to resolve issues such as nationalistic approaches to port state control and treatment system type approval. The issues may be overcome through extensive stakeholder engagement, while maintaining benchmarks that protect the marine environment. The need for qualified and national training providers is essentially required for all States to comprehend various facets of the Convention. To ensure its effective compliance, FSC and PSC have a mammoth task towards managing their resources such as increased workload, technical expertise, and monetary investments. Although, the Convention is nearing its tonnage requirement (35% of the gross tonnage of the world's merchant shipping) for coming into force, lack of specific guidelines towards its requirements are still creating gaps towards enforcement and must be addressed by IMO. Future research should address the challenges faced by other stakeholders such as seafarers on ships, BWMS manufacturers, ship owners, and ports.

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