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Review of the capacity of the implementation of Ballast Water Management Convention in Sri Lanka as flag state, port state and coastal state

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REVIEW OF THE CAPACITY OF THE IMPLEMENTATION OF BALLAST WATER MANAGEMENT CONVENTION IN SRI LANKA AS FLAG STATE, PORT STATE AND COASTAL STATE

By

THALATHA SREENI RANASINGHE

Sri Lanka

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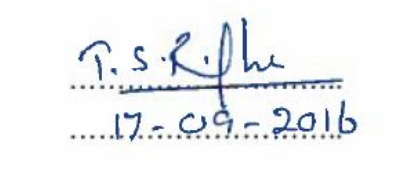
DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature) : 

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ABSTRACT

Title of the Dissertation: Review of the capacity of the implementation of Ballast Water Management Convention in Sri Lanka as Flag State, Port State and Coastal State

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As a result of the international shipping industry, risks from invasive alien species are introduced to the marine ecosystems through ships' ballast water. This global threat affects the health of marine ecosystems, economy of countries and human health. In this respect the International Maritime Organization adopted the Ballast Water Management (BWM) Convention to prevent, mitigate and finally eradicate the harmful aquatic organisms and pathogens from the marine ecosystems.

The BWM Convention will enter into force on 08th September 2017, due to the fulfillment of requirements for the implementation of the Convention.

This dissertation is a study of the risks of Invasive Alien Species (IAS) and overview of the risks associated with the ballast water and sediments management methods introduced by the BWM Convention. Also the measures to reduce the risks associated with the D-1 and D-2 standards by Flag States (FS), Port States (PS) and Coastal States (CS) were taken into account.

Since Sri Lanka is a maritime nation, the risk of IAS is largely relevant to the country. Inclusive study of the risks of IAS was carried out and information collected regarding the exposure and the preparedness of the ratification of BWM in Sri Lanka as FS, PS and CS. The information was collated and critically analyzed the current position of the country in relation to ballast water and sediment management practices.

Financial, legal and institutional capacities are identified as the main challenges of the implementation process of the BWM Convention in Sri Lanka.

Finally, some recommendations are made to fulfill the requirements of implementation of the Convention because prevention is more beneficial than protection measures after the environmental damages.

KEY WORDS: Ballast water management, invasive alien species, harmful aquatic organisms and pathogens, risks assessments, D-1 and D-2 standards, compliance monitoring & enforcement

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LIST OF ABREVIATIONS

AS	Active Substances
BW	Ballast Water
BWM (C)	Ballast Water Management (Convention)
BWE	Ballast Water Exchange
BWMP	Ballast Water Management Plan
BWRF	Ballast Water Reporting Form
BWTS	Ballast Water Treatment System
CBD	Convention on Biodiversity
CGD	Coast Guard Department
CME	Compliance Monitoring and Enforcement
CS	Coastal State
DWT	Dead Weight Tonnage
EEZ	Exclusive Economic Zone
EIA	Environment Impact Assessment
FS	Flag State
ICZM	Integrated Coastal Zone Management Plan
GEF	Global Environmental Facility
GHG	Green House Gas
GESAMP-BWWG	Joint Group of Experts on the Scientific Aspects of Marine Environment Protection- Ballast Water Working Group
GloBallast	GEF-UNDP-IMO GloBallast Partnership
HAOP	Harmful Aquatic Organisms and Pathogens
IAS	Invasive Alien Species
IMO	International Maritime Organization
IUCN	International Union for Conservation of Nature
MARPOL	International Convention for the Prevention of Pollution from Ships

MMDE	Ministry of Mahaweli Development and Environment
MEPA	Marine Environment Protection Authority
MEPC	Marine Environment Protection Committee
MPPA	Marine Pollution Prevention Act
MSC	Maritime Safety Committee
MMS	Merchant Shipping Secretariat
MoU	Memorandum of Understanding
NARA	National Aquatic Resources Research Development Agency
NBWMS	National Ballast Water Management Strategy
NBWMTF	National Ballast Water Management Task Force
NOSCOP	National Oil Spill Contingency Plan
PS	Port State
PBBS	Port Biological Baseline Survey
PSC	Port State Control
RA	Risk Assessment
RO	Recognize Organization
SLPA	Sri Lanka Ports Authority
SOLAS	Safety of Life at Sea
UNCLOS	United Nations Convention on the Low of the Sea
UNCTAD	United Nations Conference on Trade & Development
WWF	World Wildlife Fund

Chapter 1

Introduction

1.1 Background :

Oceans contribute 97% of the world's water availability while balance remains mainly with glaciers and a small amount of fresh water and ground water. Coastal and marine ecosystems are well known as nurseries of marine life and birds, tourism and recreational activities, rich biodiversity and source of food for nearly half of the world's population. This environment consists of different ecosystems such as coral reefs, sea grass meadows, mangroves, mud flats, estuaries and lagoons, sandy beaches, many varieties of fishes and marine mammals. All of these marine ecosystems function as breeding and feeding grounds for many marine organisms. Clean and unpolluted water, golden beaches, rich marine life and abundant fish stocks, clean lagoons, and a variety of marine birds facilitate leisure and recreation and finally all of these ecosystems and natural resources directly contribute to the economy of the whole world.

Oceans and other water bodies are strongly connected with human activities, serving as modes of transportation as well as trade. More than 90% of the globally traded goods are transported through the ocean. Initially, people used wooden sailing ships, yet with the continuous growth of technology, ships were made of steel that used propeller engines. The technologies used in the modern shipping industry have negative impacts on the environment as well as on human well-being. One of the identified major threats is the translocation of species beyond their natural habitat. Invasive alien species (IAS)

are identified as one of the major causes to the environment such as biodiversity loss, changes in ecosystem functions and ecosystem services. It causes a threat for industrial and several socio-economic activities as well. Ballast water and hull fouling are identified as the most common vectors in marine IAS (Tamelander et al., 2010).

Ships are designed and built to move safely through the water while carrying cargo. Years ago, ships carried solid ballast, in the form of rocks, sand or metal. However, since around 1880s', people have used water as ballast, mainly because water is readily available, easier to load on board and off a ship, and therefore, more efficient and economical than solid ballast. Ballast Water (BW) are used to compensate weight on board ship that may affect ship safety & stability. Discharge of ballast water has been recognized as a crucial threat to the marine environment since it is the mode of transportation of IAS (Matheickal et al., 2004).

It is estimated that up to 14 billion tons of ballast water are transferred globally each year, and 7,000 – 10,000 species of living organisms may be present in the ballast water at a given time. Cysts of these marine organisms that are associated with ballast water sediments, can remain dormant until they find a suitable environment to grow. Moreover, many other marine species such as sea-weeds and barnacles survive while adhered to the ship's hull (Lopez & Krauss, 2006).

The problem of harmful aquatic organisms in BW was first raised at the International Maritime Organization (IMO) in 1988. Since then IMO's Marine Environment Protection Committee (MEPC) and the Maritime Safety Committee (MSC) have been taking actions on this issue in order to prevent, minimize and eliminate this risks from the marine environment. The first guidelines were adopted on 27th November 1997 by Resolution A868 (20), and were then developed as the new BWM Convention. The International Convention for the Control and Management of Ships' Ballast Water and

Sediments was adopted in February 2004, in a Diplomatic Conference setting standards for improving BW management worldwide (IMO, n.d.).

This Convention will enter into force 12 months after the date on the combined merchant fleets of which constitute not less than 35% of the gross tonnage of the world's merchant shipping, have signed the Convention. As of 08 of September 2016, 52 countries have ratified or acceded to the Convention with 35.1441% of the world's merchant shipping gross tonnage (IMO, 2016c).

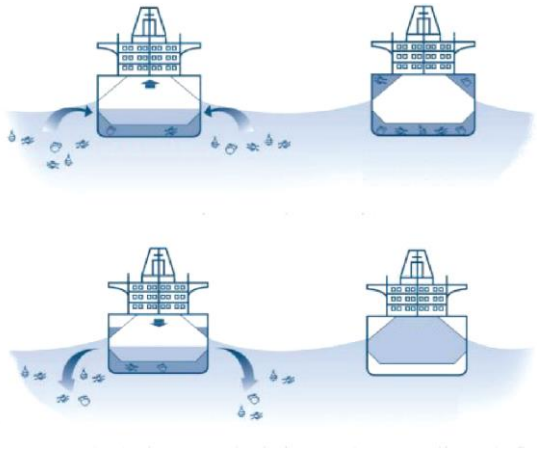

Figure 1: Cross section of ship showing ballast tanks and ballast water cycle
Source : GloBallast, International Maritime Organization

The International Maritime Organization has invited and advised all nations to ratify and agree to the new BWM Convention. The IMO has also established a special technical assistance program, "GloBallast" that assists countries to have the path for funding and technical advice to strengthen the institutional collaborative mechanism.

In Sri Lanka, there are five commercial ports - Colombo, Galle, Trincomalee, KKS and MRMR. As a Flag State, Sri Lanka's annual ship registration for 2015 is 14 and by

2017 it will be 80, while it is projected to 2020 as 240 with the expansion of Colombo port. Annual ship arrivals to the above five ports are around 4,500 in 2015 (SLPA Annual Report, 2015). In the three ports out of five, the annual Ballast Water discharge is 789,600 MT, 12,000MT and 24,000MT respectively (www.slpa.gov.lk).

According to Article 94 of UNCLOS and BWM Convention, as a Flag State Sri Lanka has an obligation to initiate national legislation in order to conduct ships' administration. According to the Marine Pollution Prevention Act No. 35 of 2008 of Sri Lanka, the Marine Environment Protection Authority has powers to create regulations and carry out scientific research on BW and marine ecosystems (MPPA, 2008). Moreover, the Merchant Shipping Secretariat (MSS) and Sri Lanka Ports Authority (SLPA) are obliged to comply with the BWM Convention as a Flag State and Port State respectively.

Along with the acceptance of the Finland to the BWM Convention, it was fulfilled the requirement for the implementation in 08 September, 2017 (IMO, 2016c). However, Sri Lanka has not ratified the BWM Convention, so that it is advisable to study and document the current status of the capacity of implementing the BWMC in Sri Lanka at this stage.

The final outcome of this research could be used to overcome the barriers for the implementation of the Convention in Sri Lanka.

1.2 Objectives of the Study

The objectives of this study are;

- To study the present Ballast Water Management strategies of maritime nations.
- To study the preparedness for implementation of Ballast Water Management Convention.
- To discuss Sri Lanka as Flag State, Port State, and Coastal State to fulfill the requirements.
- To discuss the major challenges and barriers met in Sri Lanka to the implementation of the BWM Convention.

1.3 Research Methodology

The literature review of the background of the Management Strategies of the BWM Convention; study of the risks management, preparedness and implementation and practical ballast water management methods are studied through literature review. A number of prevailing websites and related links were examined with the help of widespread search engines (google, yahoo) and the keywords used in the search included Marine Invasive species, Alien species, and Ballast Water Convention. The challenges in implementing BWM Convention as Flag State, Port State and Coastal State were identified using the articles, the BWM Convention, Guidelines, rules & regulations, ongoing discussions at the IMO and relevant books.

In order to study the Sri Lankan situation and fulfill the data gaps, personal interviews were made to evaluate the current status of the preparedness for the implementation of the Convention in Sri Lanka, through the internet.

1.4 Structure of the Dissertation

The Research dissertation consists of 5 chapters. Chapter 1 is the general introduction for the background to the topic, objectives of the study and the research methodology.

Chapter 2, overviews the Ballast Water Management Convention. Here, the discussion is focused on the impact of invasive alien species carried by ships' ballast water, the issue of ballast water and sediments and the BWMC as a tool for the management of the issue. Further, risks associated with the management of the ballast water and sediments, risks related to D1 & D2 Standards in the BWMC, are discussed. Also, the current status of the convention and main obstacles for the implementation & enforcement are identified.

Chapter 3 addresses the obligations of the Flag States, Port State and the Coastal State. The State's requirements for the preparedness and implementation are identified. Implementation challenges of the Convention of the States' and the relevant strategies are also identified and discussed.

The fourth chapter is focused on Sri Lanka as a Flag State, Port State, and Coastal State. Risks relating to maritime traffic, risks relating to ecosystem vulnerability and present situation of ecosystem assessments are discussed. Then the discussion continues on the level of Sri Lanka's preparedness as Flag State, Port State and Coastal State for the implementation of BWM. Further, the development procedure of National Ballast Water Management Strategies, National Ballast Water Task Force (NBWTF) and related stakeholders are identified in Chapter 4. Furthermore, the obstacles are identified in the ratification process of the BWM Convention in Sri Lanka.

Chapter five is the concluding chapter and it provides the conclusions after the discussion of all the collated information. The concluding part of Chapter five introduces a few recommendations to expedite the preparedness and implementation of the BWM Convention in Sri Lanka.

Chapter 2

2. Overview of the Ballast Water Management Convention

Over the past few decades the shipping community/industry has been discussing the necessity of having a control or standard concerning the Ballast Water used on ships. Ballast water plays an important role with regards to weight distribution on ships. On the other hand this Ballast Water creates negative impacts on the marine environment as well.

With the first report to IMO on the Invasive Alien Species (IAS) Zebra mussels in the Great Lakes, Canada in 1988 and similar reports soon afterward from other countries, IMO has been taking actions to address this issue. Accordingly, in 1991, the Marine Environment Protection Committee (MEPC) of IMO adopted the first international voluntary guidelines on the 'prevention of unwanted aquatic organisms into the marine environment'.

In parallel, the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992, adopted several multilateral agreements. The Convention of Biodiversity, Rio Declaration on Environment & Development and Agenda 21 are a few of them.

Hereinafter, the voluntary guidelines of MEPC were upgraded to an Assembly resolution that was adopted in 1993. Since then, IMO has been working on legally binding provisions on ballast water management guidelines for effective implementation. In 1997 the next milestone of the development arrived, that is the

'guidelines for safe ballast water exchange at sea' was introduced. In the World Summit on Sustainable Development held in 2002, IMO was advised to finalize the Draft BWM convention. Consequently, it was adopted on 13th February 2004 at a Conference held in London.

The relationship between ballast water and Harmful Aquatic Organisms & Pathogens (HAOP), which may become invasive, is clearly identified in the BWM convention. Therefore, technical guidelines and circulars are defined to directly address this issue to minimize, control and finally eliminate the problem (Fonseka, n.d.).

2.1 Background of the ships' Ballast Water and Sediments issue

When pumping ballast water into the ballast tanks it takes all the marine creatures and sediments along with the water. Ship needs to unload ballast water at the destination port, but all of the organisms along with the water are passed into a new environment (Mohomad & El-naggaar, 2012).

2.1.1 How are Invasive Alien Species being introduced to a new environment?

Alien or introduced species can be defined as the species that can be found in the environment as a result of human activities where it cannot be found naturally. The introduction of species could be intentional or unintentional. There are many examples for introducing species by humans such as the release into the wild of fish to increase local habitat or plant species released into sand dunes or mudflats for ecosystem management purposes. However, some of the introduced species meet with a certain environmental condition, becoming more adaptive to the new environment. With the absence of predators or diseases, the introduced species may widely spread and then severely change the whole ecosystem. These species are called invasive alien species (IAS) (Mohomad & El-naggaar, 2012).

Naturally there are some “ecological barriers” such as landmasses, large water bodies with different temperatures or salinity. Therefore, the habitats, species diversity in different ecosystems vary throughout the oceans. However, ecological barriers are now being increasingly broken by human activities; in particular, transport and shipping (Martine et al., 2006).

Unplanned or unintentional IAS introductions are associated with different human activities that are related to economic well-being. These activities may include aquaculture, many fishing gears & fishing crafts, pleasure crafts and the shipping industry. There are many examples which lead to major impacts to the natural ecosystems, biodiversity, human health, economy, fisheries and industrial developments (Martine et al., 2006).

2.1.2 Harmful Aquatic Organisms and Pathogens (HAOP) and the Shipping industry

When considering the shipping industry, IAS can be dispersed by two main vectors; by hull fouling and ballast water & sediments carried by ships. The introduction of IAS is one of the major environmental issues taking into discussions amongst the world community.

Bio fouling species are being carried by fast moving wooden ships, yachts, smaller crafts and modern steel ships. Bio fouling can take place inside or outside the vessels, which will be on hull, underwater fittings such as the propeller, bow thrusters, rudder and damp or wet niche areas such as anchor lockers, sea-chests, bilge etc. Thus, it provides a path which both sessile and moving creatures can spread to new environments (Tamelander et al., 2010).

Ballast water is another major pathway that transfers IAS all over the oceans. Since the 19th Century, water has been used as ballast in ships in order to distribute weight on board. Ballast water is defined as "water with its suspended matter taken on board a ship to control trim, list, draught, stability or stresses of the ship" in the Article 1 of the BWM Convention (IMO, 2009).

When ships upload ballast water, the water is pumped into specially designed ballast tanks with all the creatures, their cysts, all algae, bacteria, and viruses. Meanwhile, ballast water is mostly pumped into ballast tanks from coastal areas, mostly turbid, that leads to making sediments accumulate in the tanks. There are situations where ballast tanks can contain a mixture of water and sediments from different ports and countries. The sediments deposited in the ballast tanks also leads to increase the risk of transport of IAS in the form of cysts by providing a medium for surviving (Ex. dinoflagellates). Then ballast water may be pumped out back on arrival. Ballast water transfer associated with large ships is thus commonly believed to be the main vector for the spread of IAS and HAOP today. Also the shipping routes are the major pathways for the spread of IAS and HAOP (Tamelander et al., 2010).

According to the world records, 3-5 billion tons of ballast water is transferred through ships over the oceans each year and 7,000 species are carrying by ships every day. Some ships may carry more than 130,000 tons of ballast water. Furthermore, many species contained in ballast tanks can be potentially invasive and cause harm to the environment referred to as Harmful Aquatic Organisms (Velduis et al., 2010).

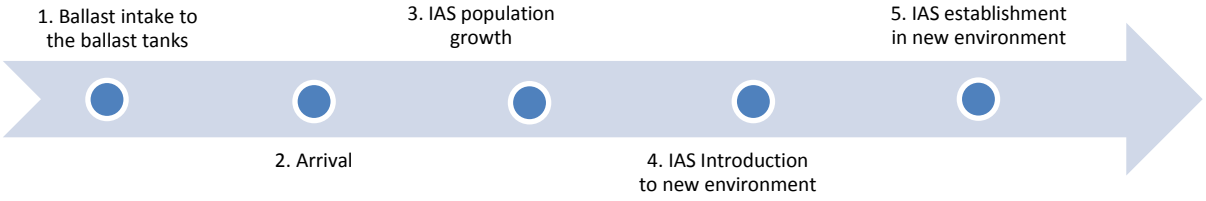

Figure 2: Establishment process of Alien species to new environment

Source: Based on (Wallentinus, I & Werner, M (2008) cited in Bouyssou, n.d.)

2.1.3 Impacts on the marine environment

There are various examples of invasive marine species identified that cause diverse impacts to the environment. These can be environmental impacts, changes of the ecosystem functions, human health and well-being, cultural impacts and economic impacts. Even though the ballast water is the most suitable solution for the ship's stability and integrity while operating, it is clear that ballast water leads to negative externalities for the whole social-ecological system (Wonham, 2004). Some negative impacts are discussed below:

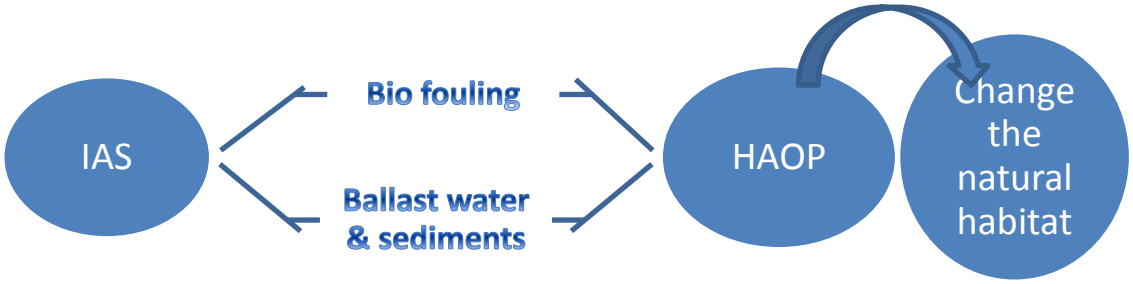

Figure 3: Introduction of IAS to the new environment

Source: Based on (GloBallast 21, 2013).

2.1.3.1 Changes of ecosystem functions

By competing with the native species, IAS causes a loss of native species and habitat accordingly. Overgrowth and introduction of parasites and spreading of disease are other major impacts arose by IAS. Another impact identified is hybridization; for example, the Mediterranean mussel (*Mytilus galloprovincias*) disseminated through the ballast water and fouling in ship hulls. It is now well established in temperate regions around the oceans and it has replaced other South African mussel species which are native and appear to hybridize with the US west coast mussel (Wonham, 2004).

There is another example for the changes of ecosystem functions due to changes of water quality and nutrients content by IAS. The water hyacinth which causes the lowering of the dissolved oxygen level and absorbs a lot of nutrients from the water. That causes the impacts of growth of aquatic organisms and inhibits the growth of native plants species. When the water hyacinth plants dies, it deposits to the bottom of the water, and then causes eutrophication because of the release of all the nutrients. This process declines the water quality and leads to diseases and changes all the ecosystem functions and also causes impact on human health.

2.1.3.2 Impacts on Human health and wellbeing

Due to the spread of IAS, there are many examples which cause negative impacts on the human health and wellbeing. This includes the distribution of diseases by parasites as well as the diminishing of recreational activities, causing algal blooms and smothering in beaches. When spreading of toxic phytoplankton and harmful algal blooms leads to significant health concerns. One famous example is the spread of *Vibrio cholera;* in 1991 this virulent strain of cholera from Asia caused an epidemic in Peru and affected thousands. Another example is the introduction of dinoflagellate named *Gymnodinium catenatum* through ballast water (Rigby, Hallegraeff, & Sutton, 1999). These unicellular

organisms become blooms producing toxins that can be accumulated in molluscs, mainly in bivalves, crabs and snails, those who become transvectors via accumulate the toxins via feeding. Paralytic Shellfish Poisoning (PSP) disease is lethal for humans who are affected through the above toxic contaminated trans-vectors (Fleming, 2015). 30 deaths and 500 contaminations were recorded on the coast of Mexico and Portugal in 1980-1990 (Costa, Robertson, & Quilliam, 2015).

2.1.3.3 Economic impacts

Many IAS have caused major economic impacts on human society. There are many examples identified all over the world due to the IAS through ballast water. Reductions of fishery products due to predators, habitat changes or competition, interference on mariculture by the spreading of algal blooms are among those identified (Jing et al, 2012).

Another example is that the impacts on tourism and recreational activities in coastal amenity areas include severe odors from harmful algal blooms on the beaches (Tamelander et al., 2010). The spread of *Acanthaster planci* (Crown-of-Thrown Starfish) species was recently identified in Sri Lankan coastal waters. This IAS was already started to damage coral reefs (Fernando, 2006).

The damage caused to infrastructure by fouling and the costs for treatment to clean up or control is another identified economic impact (Ex. Zebra mussel).

On the other hand, the costs of responding to the problem including research and development, education, communication, monitoring, regulation, compliance, management and mitigation costs are huge (Mohomad & El-Naggaar, 2012).

2.2 Ballast Water Management Convention-2004 as one solution to address the problem

There are many international and multilateral conventions, agreements and codes to address the IAS issue. Convention on Biological Diversity (CBD) is one example that gives a provision to prevent the introduction, control or eradicate IAS from ecosystems (*The Convention on Biological Diversity*, 1992).

The United Nations Convention for the Law of the Seas (UNCLOS) defines the rights and responsibilities of Flag States, Port States and the Coastal States, for the better management of natural resources of the oceans. Moreover, UNCLOS decrees nations to take all measures to control intentional or unintentional introductions of alien species which may cause significant harm to marine ecosystems. Article 196 directly addresses States to take all measures necessary to prevent, reduce and control the intentional or accidental introductions of alien or new species to the marine environment.

The ICES Code of Practice on the Introduction and Transfer of Marine Organisms 1994 is another instrument which provides guidelines to address this issue (Tamelander et al., 2010).

On 13th February 2004, IMO adopted the Ballast Water Management Convention providing provisions to minimize, prevent and finally eliminate the risks from Harmful Aquatic Organisms and Pathogens (HAOP) from marine ecosystems.

The Convention demands the management of Ballast Water according to its requirements. As per the figure 4, D1 and D2 Standards provide requirements for the better management of the ballast water.

In addition to that, the BWM Convention provides measures to manage HAOP, achieved through either ballast water exchange (BWE), ballast water treatment (BWT) or ballast water and sediment discharge to reception facilities on relevant standards.

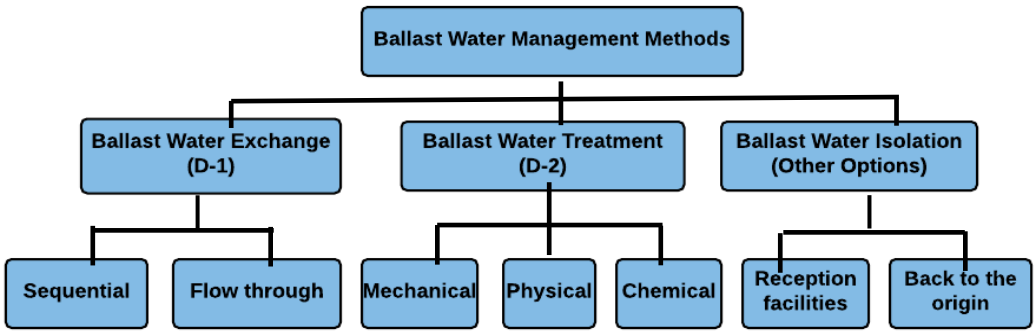

Fig 4: Diagram for Ballast Water Management Techniques
(Source: Based on the IMO 2009 and Karaminas et al., 2000)

Each ship shall have on board implemented Ballast Water Management Plan (BWMP). This ship specific plan should show the detailed description of the actions to be taken to implement the ballast water and sediment management requirements and the management practices accordingly.

Furthermore, the Convention gives provision to implement the Ballast Water Record Book in each ship on board, under the Regulation B-2 of the Convention (IMO, 2009).

The Convention comprises the application of General Guidelines, Management and Control requirements for ships, Special requirements in certain sea areas. Also, it provides Standards for ballast water management and survey & certification requirements for the ship's ballast water management.

Proper applications of these measures by states are one of the best solutions to minimize and eliminate HAOP while ships operations taking place. Following sections are to

identify the management measures specified by the BWM convention to address the HAOP issue.

2.2.1 Ballast Water Exchange Standards – D-1 (BWE)

According to the D-1 standards, ships perform ballast water exchange with an efficiency of at least 95% volumetric exchange of ballast water. Regulation B-4 of the Convention clearly states that the standards in regulation D-1 for ballast water exchange; *whenever possible conduct the ballast water exchange at least 200 nautical miles from the nearest land and in water depth at least 200 meters taking into the account guidelines developed by IMO.* If a ship is unable to exchange ballast water as in the above guidelines, this should be as far from the nearest land as possible, and in all cases at least 50 nautical miles away from the nearest land and in water at least 200 meters in depth (IMO, 2009).

Furthermore, according to the Guidelines for Ballast water exchange (G6) in the Convention, it provides guidance on the safety and operational aspects, while ballast water exchange taking place which affects both ship and the crew. Additionally, BWM Convention provides the specific responsibilities to ship owners and operators with regards to safety aspects associated with methods of ballast water exchange methods on board (IMO, 2009). Also, IMO adopted guidelines for ballast water exchange design and construction standards for the ships by Resolution MEPC 149(55) in 2006, which is given in a G11 Standards of the Convention.

2.2.2 Ballast Water Performance Standards – D-2

The Convention provides ballast water performance standards by the Regulation D-2, delivering indicator microbes concentrations, as human health standards (IMO, 2009). In order to reach D-2 Standards, the usual way is to install onboard ballast water

treatment system, which operates to maintain maximum levels of micro-organisms' size categories and a number of viable organisms allowed ballast water discharges (GloBallast 21, 2013).

The Ballast Water Management System (BWMS) is clearly defined in "Guidelines for approval of ballast water management systems (G8)" as:

Ballast Water Management System (BWMS) *means any system which processes ballast water such that it meets or exceeds the ballast water performance standard in regulation D-2. The BWMS includes ballast water treatment equipment, all associated control equipment, monitoring equipment and sampling facilities* (IMO, 2009).

By the Regulation B-3 of the Convention, the application dates of Ballast Water Management systems are defined, with relation to the capacity of the ballast water and the dates of construction of the ships (GloBallast 21, 2013).

Table 1: Ballast Water Performance Standards according to the D-2 regulation of the BWMC

Name of the organisms	Size	Criteria for the discharge
Viable organisms	Size ≥ 50 μm	< 10 per cubic meter
	10 μm ≤ Size < 50 μm	< 10 per ml
Vibrio cholera (O1 and O 139)		< 1 cfu* 100 ml^{-}
		< 1 cfu per 1 gram of zooplankton
Escherichia coli		< 250 cfu 100 ml^{-}
Intestinal Enterococci		< 100 cfu 100 ml^{-}

Source: Based on the D-2 regulation of the convention (CFU*–colony-forming unit)

2.2.3 Reception facilities for Ballast Water

The Regulation B-3.6 of the Convention allows the use of reception facilities for ships which are not practiced in the above mentioned BWE or BWT methods on board. Those ships should discharge ballast water and sediments according to the guidelines of the Convention.

The convention provides guidelines by Resolution MEPC 153(55) for Ballast Water Reception Facilities in guidelines G5 of the Convention. These guidelines (G5) clearly state that the ballast water reception facility should be capable of receiving ballast water from ships so as not to create any harm to the environment, human health or property by the HAOP (IMO, 2009).

2.2.4 Requirements for Sediments Reception Facilities

Article 5 of the convention provides a provision to establish adequate reception facilities to the sediments removals in the ports and terminals where cleaning and repair of ballast tanks taking place. The guideline G1 of the convention provides guidance to establishment, treatments capability and training requirements for the crew on the proper handling of ballast sediments.

In addition to that Article 5 of the convention illustrated that parties shall ensure to provide adequate reception facilities in ports and terminals designated to cleaning or repairing of ballast tanks according to the guidelines (IMO, 2009)

Also, the member countries shall report to the IMO, ensuring the availability and location of any environmentally safe disposal available reception facility (IMO, 2009).

2.3 Overview of the Risks associated with management practices of Ballast Water and Sediments – D-1 and D-2 Standards in the BWMC

During the past 17 years, IMO has adopted various guidelines and resolutions to implement a proper management of HAOP, which introduces through the ballast water of ships. The applications for the management methods of HAOP should not be caused more harm than the prevention of introduction to the new environment (IMO, 2009).

According to the Regulation B-4 of the Convention, all the ships have to follow the BWE (D-1) or Performance Standards (D-2) to eliminate the HAOP from the Ballast Water.

Nevertheless, while the application of the above-mentioned techniques to mitigate the threat from HAOP have been identified, noticeable risks are arising (GloBallast 21, 2013). This section of the dissertation has discussed the risks associated with the BWM applications.

2.3.1 Risks Related to D-1 (BWE) Standards

Ballast Water Exchange (BWE) at mid-ocean or high seas, which is where the vessels are allowed to exchange the ballast water, is one of the solutions for BWM strategy given in the convention. The expected result of the BWE procedure at mid-ocean is that most of the coastal organisms in ballast tanks would be replaced by oceanic species. After the BWE at the mid-oceans, the oceanic organisms may not survive and loss reproductive ability at the recipient port's coastal ecosystem. Therefore BWE strategy is considered as less likely to invade coastal ecosystems (Ruiz, 2007).

However, there is a question and an identified risk with regard to the magnitude of reduction of IAS result through BWE and the risk of HAOP (Ruiz, 2007) at coastal ecosystems. According to the experiments of Minton et al, 2005, BWE considerably reduces the zooplankton concentrations but ≤ 17% of ships undergo BWE will fulfill the IMO standards. Also, there is a possibility of total inoculation ≥ 10^6 of creatures remain possible, even under the more rigorous on the IMO strategy. But transoceanic BWE is highly effective and strong protection to freshwater pelagic and benthic species by invasions (Grey et al, 2007).

If the 3 times water exchange with perfect mixing, 95% ballast water is removed. But this does not mean that it removes 95% HAOP (Gollasch et al, 2007). Also in some tank structures, it is difficult to effectively carry out mixing and flushing due to its configurations (Karaminas et al, 2000). Furthermore, the efficiency depends on the ballast water volume, the pumping rate and the speed of the vessel (Velduis et al, 2010).

However, BWE is a simple practice for ships with prevailing resources, the efficiency of organism removal is uncertain, mainly considering the sediments left over in the ballast water tanks (EPA report, 2011).

On the other hand, because of the applications of the BWE strategy, there are identified risks on the ship's stability, structural strength and the integrity. When the designing stage of the cargo ships, they are not considered on the mid-ocean BWE. Therefore, while the BWE is in operation the, ship's structural stability would be affected. Meanwhile the BWE may result in the safety hazards to the crew of the ship as well (GloBallast 21, 2013).

When operations BWE, there are some navigational safety risks have been identified. These are in relation to the ship's movement with other ships around (GloBallast 21,

2013). While BWE operations are being carried out, propulsion and ship maneuverability is reduced. Also, it reduces the bridge visibility. Due to the temporary reductions of these main functions, it increases the risks of collisions with other vessels (GloBallast 21, 2013).

Extra working hours and higher stress for the crew are other issues and those may lead to the risk of the ship's safety (Balaji & Byaakob, 2011).

2.3.2 Risks related to the D-2 (Performance) Standards

The ships that do not intend to operate the BWE method in mid-ocean are required to discharge the ballast water after the treatments carried out to eliminate HAOP. According to the regulation A-2 and B-3 of the Convention, ships are required to install BWMS onboard to comply with the D-2 standards of the Convention. Also, Guideline G8 of the Convention describes the general requirements for the design & construction, technical procedure for evaluation and procedures to have the Type Approval Certificate for the System.

The treatment technologies currently used in BWMS are physical, chemical or biological processes to destroy the creatures in the ballast water (Greensmith, 2010). Some of the technologies are given in the table below:

Table 2: Ballast Water Treatment technologies

Physical Solid-liquid Separations	**Disinfection**	
	Chemical	**Physical**
Filter	Chlorination	De-oxygenation
Hydrocyclone	Electro chlorination	Ultraviolet
Coagulant	Chlorine dioxide	Ultrasonic
	Hydrogen peroxide	
	Peracetic acid	
	Vitamin K	
	Ozonation	

Source: (Greensmith, 2010)

In general, in the ballast water treatment process, the first step is that the ballast water is passing through the filter for physical treatment. Throughout this process, organisms and particles larger than 50μm are filtered. In the second step, the filtered ballast water is treated by chemicals for sterilization and then sends to the ballast tanks. Then this treated ballast water is required to re-treatment for the neutralization before discharge at the destination. At the neutralization process, toxins are removed which have potential to harm the environment and the crew (KRS, 2010).

According to Greensmith (2010), there have been identified both advantages and disadvantages while using these technologies. There are several kinds of risks that have been identified with regard to the chemicals using in treatment technologies.

Chemicals such as ozone, chlorine, chlorine dioxide, hydrogen peroxide, peracetic acid and perchloric acids are active substances (AS) that contain free radicals. These kinds of chemicals known as chemical hazardous should be carefully handled while both on board and on shore usage. Further, these chemicals need careful handling while being transported, stored, and delivered for safety purposes. If the proper storage is not

provided, there are risks of fire, explosion, leakage or spillage (GloBallast 21, 2013). This would be an additional risk to the marine environment and the human health. Also treated ballast water may contain active substances that course severe damage to the biota in the environment and the human health (IMO, 2009).

The chemicals such as oxidizing agents used in ballast water treatment process may result side-effects on the ship structure and equipment that using in the process. These chemicals lead to the corrosion of the equipment and ballast tank system (Balaji & Byaakob, 2011). Furthermore, ballast tanks are completely dark, inadequate ventilation and limited access. Therefore, the complete inspections of the ballast tanks would be difficult to proceed with (Ibester, 1993 cited in GloBallast 21, 2013).

On the other hand, previous ballast water may remain inside the tanks and there is a possibility of re-growth of organisms in ballast tank after treatment. Furthermore, D-2 standards do not address the organisms below 10 μm. But a considerable number of species which are bloom-forming algae (e.g. *Phaeocystis spp., Pfiesteria spp. and Chrysochromulina spp*.) are less than 10 μm in size and on the other hand, the D2 standards allows to treated ballast discharge from the vessel without giving any restrictions to the locations (Gollasch et al, 2007). Accordingly, the density, extent, and frequency of inoculation are the major risks for an invasion (Minton et al, 2005).

Moreover, the accuracy of the sample testing varies. This is because the multiple samples taken from the same population would be given various statistical calculations due to the density variations of the organisms (EPA report, 2011).

In addition to the above, risks arise from D-1 and D-2 standards for ballast water management, there are other significant risks that have been identified. Both BWE and BWT methodologies need to use powerful equipment. In order to this requirement, the supply of power should be given by burning fossil fuel, so that this leads to additional

CO_2 and other GHG emissions in to the atmosphere (EPA report, 2011). On the other hand, ship owners, operators, and governments face financial risks to fulfill the above requirements.

Other risks identified include vibrations, small and busy crew on board, limited power, logistic handling difficulties on board, a large number of sampling handling. Sometimes short voyages would not be able to properly address the issue (EPA report, 2011).

2.4 How to mitigate Risks - Risk Assessments, Implementation and Enforcement

According to the above analysis of the risks, there are two categories of risks identified in relation to ballast water. One of them is the risks related to the Ballast Water & sediments on the environment & human health and the other is the risks related to the Ballast Water Management procedures (GloBallast 21, 2013).

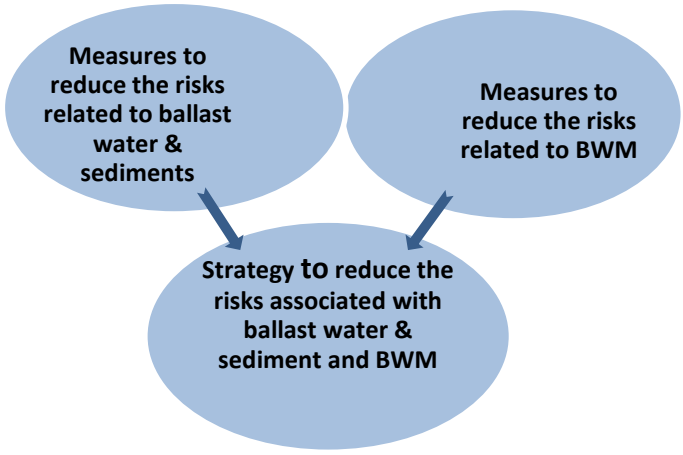

Fig 5: Integration of the risks mitigation strategy
Source: (GloBallast 21, 2013)

To avoid these two types of risks, the convention provides provisions to approach risk mitigation strategies as risks assessments and implementation & enforcement.

2.4.1 Risk Assessments (RA)

Risk assessments and approaches are a powerful tool to evaluate situations of vulnerabilities to determine preventive and protective measures. Also this includes enhancing the efficiency of mitigation measures in limited resource environment (Baumler, 2016). This risk assessment criterion is an exemption regime, which in the Convention is addressed by Guideline G7 by introducing risks assessments and further actions through the adaptation of Resolution MEPC 162(59) (IMO, 2009).

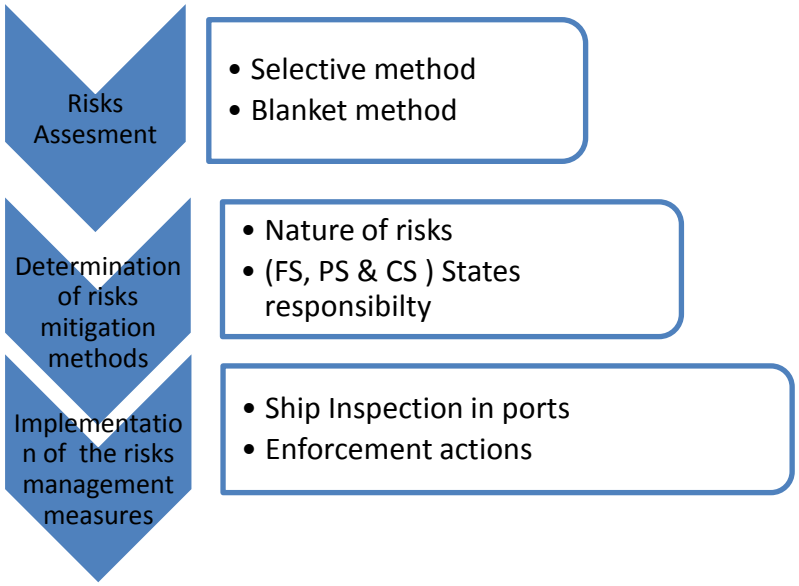

Figure 6: Implementation of risks management process,
Sources: based on (Baumler, 2016)

2.4.2 Risks mitigation, Implementation and Enforcement

Controlling or eradicating the aquatic organisms after they have been established in the new environment is practically difficult (GloBallast 19, 2010). Therefore, the prevention of IAS is the most important aspect rather than the protection of the ecosystems. In order of the complexity of the system, the Convention introduces preventive and protective barriers at three levels. Those are the ballast water

arrangements, ship's arrangement and the donor/recipient biogeographic region & in the port (GloBallast 21, 2013). These three barrier levels have to be addressed by States who are responsible to protect their marine environment.

According to articles 1 and 3 of the Convention on Biological Diversity (CBD), States have their responsibilities to ensure the protection and conservation of their jurisdiction while using marine resources. Also, article-8h of the CBD clearly states that parties have to take appropriate actions to eradicate and prevent the IAS to their marine environment (CBD, 1992). Furthermore, in UNCLOS 1982, Article 235 provides responsibility and liability to States to fulfill their international obligations to protect their marine environment (UNCLOS, 1982).

According to international regulations, Flag States are bearing the nationality of the ships where it was registered. Article 4 of the Convention stipulate that Parties shall obliged ships flying under their flag to comply with the requirements set forth the Convention. Also, the Parties that have ships in their registry shall make effective measures, capabilities and develop national policies and strategies to BWM (IMO, 2009).

Furthermore, as per the receptor of the hazard, the Article 6.1 of the Convention provides provisions to Coastal State for monitoring waters under their jurisdiction as well as promote and facilitate and carry out scientific and technical research on ballast water management. This includes mitigating the impacts of HAOP that effect on human health, ecological system and socio-economic activities of the State. A coastal state may require the additional actions if the control measures is inadequate or not effective to reduce the risks.

Port States are the other responsible sector which can create an additional barrier while compliance, monitoring, and enforcement of international instruments and standards on ships in order to maritime safety and security. Furthermore, according to the Convention, Port States are obliged to inspect foreign ships while in port, enforce regulations and ensure the BWM procedures of ships. Also, Port State can make corrective actions where necessary (GloBallast 21, 2013).

2.5 Adoption and current status of the Convention and the main obstacle to its entry into force during last 12 years

2.5.1 Adoption and current status of the Convention

After more than 14 years of complex negotiations between the IMO Member States, the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) was adopted by consensus at a Diplomatic Conference held at IMO Headquarters in London on 13 February 2004 (IMO, n.d).

> *The Convention will enter into force twelve months after the date of which not less than 30 States, the combined merchant fleets of which constitute not less than 35 % of the gross tonnage of the world's merchant shipping, have either signed it without reservation as to ratification, acceptance or approval, or have deposited the requisite instrument of ratification, acceptance, approval or accession.*

Approval was granted to develop guidelines and procedures for BWM at the fifty-first session of the MEPC in April 2004. This process was continued; 14 sets of guidelines were developed at the fifty-third session of the MEPC in 2005. Then the adoption of

these guidelines was completed by the resolution MEPC 173(58) in October 2008 (IMO, n.d).

Box 1: Year 2016 as a milestone for the implementation of the Convention

The ratification of the Convention shows slow progress during the last 12 years. However, following the accession by Finland on 08 September 2016 it triggered the entry into force of the BWM Convention (IMO 2016c).

2.5.2 Main obstacles to entry into force during last 12 years

Due to some identified challenges, the ratifications of the Convention shows slow progress. States have to properly identify and deal with these challenges.

The main obstacles for the implementation identified are in 3 different areas; technical, legal and economic challenges.

2.5.2.1 Technical challenges

The uncertainty of the sampling techniques for the ballast water is one of the major challenges identified with regard to the implementation of the Convention. States cannot precede the enforcement methods due the complications of the sampling techniques prevailing (Jing, Cheng, Zhang, & Peng, 2012).

As an example, the chemical treatments for killing organisms are complicated and sampling techniques are not completely accurate to reach the D-2 standards of the convention (Gollasch & David, 2013).

The production, storage and use of chemicals for treatment technologies raise long-term harm to the environment and personnel. Also, the BWE are seemed to be not completely effective (Balaji & Byaakob, 2011).

On the other hand, the efficacy of the BWM methodologies, the sampling, and analysis for compliance with D-2 standards are mostly costly and time-consuming (Lloyd's Register, 2015).

Because of these lacks of enforcement methods associated with the BW management procedures, States are challenged to make arrangements to ratify the Convention.

2.5.2.2 The Legal Challenges

The G8 guidelines of the convention deal with the approval for the installation of BWMS, primarily at administrations in order to assess the BWM systems compliance with the regulation D-2. It provides guidelines to land-based and ship based tests. This process is challenging the member States to proceed with the ratification procedures (Gollasch et al, 2007). Also, these regulations still lack guidance for uniform type approval and compliance monitoring (Lloyd's Register, 2015).

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Because of the fewer concerns on these guidelines and regulations, series of debates and discussions were being held in IMO. A draft resolution for the amendments of B-3 regulations and G8 guidelines was developed in the 69th MEPC meeting held on 21st of April 2016. Also, the Committee approved the draft guidelines and the amendments of the B-3 regulations. The GESAMP_BWWWG advised to further review the D-2 regulations (IMO, 2016a). This evidence clearly shows that countries have legal challenges when carrying out the ratification process of the Convention.

2.5.2.3 Economic challenges

"The high economic costs to ship owners, introduced by the Convention, coupled with a lack of confidence that the proposed equipment and procedures can effectively tackle the adverse effects, probably explains why the rush to ratify the Convention has slowed down." ("World Maritime News," n.d.).

The cost of the compliance with the BWMS to ship owners is high; a BWTS unit could cost from half a million to four million US$. In addition, developing BWMP, training costs for the crew, dry docking, and installation, local disposal facilities for sediment removals are the expensive practices for member countries ("World Maritime News," n.d.).

2.5.3 Conclusion

To maintain the stability and structural integrity, ships needs to carry ballast water. Ballast water is one of the major pathways to the introduction of IAS & HAOP to new environments.

In order to minimize this issue, IMO has adopted the BWMC that includes several regulations and guidelines. According to the Convention, it demands several requirements to the management of ballast water. Each ship needs to on board implementation of BWMP, which should explain the actions to be taken to the management of ballast water. Furthermore, the ship should implement the BWRB on board and it should be updated on the BWM.

According to the Convention a ship either follows D-1 or D-2 standards to manage the ballast water. D-1 standards follow ballast water exchange methods at mid-ocean while D-2 standards follow treatment technologies on board. In addition, States have to establish sediment treatment facilities to safely dispose the ballast water sediments.

However, while the application of both D-1 and D-2 methodologies introduced by the Convention, noticeable risks to the environment as well as the safety of the crew and the ships have been identified. Some of the identified obstacles such as technical, legal and economic challenges are delaying the requirements of the ratification of the Convention.

Chapter 3

3. State obligations under the Ballast Water Management Convention

Many conventions and legal instruments address marine environmental issues. In the context of the United Nations Convention of the Law of the Sea (UNCLOS) and the Ballast Water Management Convention (BWMC), the member countries are obliged to comply with the requirements of these conventions. In Part XII of UNCLOS, Article 235 highlights the responsibility and liability of the State for the fulfillment of their international obligations concerning the protection and preservation of the marine environment. Accordingly, States are liable in harmonizing with international law regarding marine environment protection.

Moreover, according the UNCLOS, Article 196(1) provides provisions to take measures to reduce and control pollution of the marine environment resulting from the use of the technologies to prevent IAS or HAOP that cause significant harmful damage to the marine environment.

In this Chapter, the States obligations are discussed as Flag State, Port State, and Coastal State in order to prevent, mitigate and finally eradicate the IAS carried by the ships' Ballast Water. Also, it discusses the States' obligations on the applications of BWM measures.

According to the IMO Res. A. 1054 (27) adopted in the year 2011 on the IMO Code for the 'Implementation of Mandatory Instruments', Flag States are required to implement and enforce these instruments. This should be done through proper national legislative processes with ability to disseminate laws which give an authority in administrative, social and technical matters over ships flying its flag. Also according to section 12 of this resolution, States should motivate a culture which provides an opportunity to people to improve marine environmental protection and maritime safety activities (IMO, 2011).

3.1 Definition of the Flag State, Port State and Coastal State.

3.1.1 Definition of Flag State (FS)

According to the Article 92 of UNCLOS, a ship can fly with the flag of one country only. Flag States shall effectively exercise their jurisdiction and control in administrative, technical and social matters over a ship flying its flag. Article 94 of UNCLOS states as, Flag States shall ensure that ships flying their flag are in compliance with the requirements of the international rules. It is necessary to ensure safety at sea with regard to the design & construction of ships, manning equipment and seaworthiness of ships as well as the rules and standards related to environment protection (UNCLOS, 1982).

So, flag States have the authority and responsibility to enforce such laws and regulations applying to the ship as well as to prevent and sanction violations.

Furthermore, Flag States are required to issue the certificates related to international regulations and to ensure the periodical inspections for maintaining the actual condition of the vessel (Article 217.6 of UNCLOS). While the vessels flying their flag have been met with any violations, Flag States are responsible for proceeding without any delay (UNCLOS, 1982).

3.1.2 Definition of Port State (PS)

The Port State (PS) can be defined as the State which has the authority to inspect the foreign vessels that voluntarily enter into their national ports by confirming the condition of the vessel and the equipment. These inspections are focused on to verify the circumstances of the vessels, its operations, manning and its equipment that complies with the requirements of international rules and regulations.

Moreover, according to UNCLOS Article 218, PS may undertake investigations on foreign vessels on any discharge from the vessel outside the internal waters, territorial sea or exclusive economic zone (EEZ) of the State. When the violations have occurred by the foreign vessel in their jurisdiction causing any damage, PS has the authority to precede investigations. Later, the records of evidence of the violations should be transmitted to the Coastal State (CS) (UNCLOS, 1982).

Port States also provides a framework to safeguard and protect port areas.

3.1.3 Definition of Coastal State (CS)

The Coastal State can be defined as the State who is responsible for the protection of their national waters (including marine resources), from any activity that may cause damage or threat. Since 1982, according to UNCLOS, the Coastal States has the power to regulate the right and duties of coastal State and also the navigating of ships in different sea areas (Bardin, 2012).

Furthermore, Coastal States have the authority to execute their legislative authority in their territorial sea in eight different subject areas in different coastal zones. On the other hand, such legislative power should not impair the rights of innocent passage of foreign ships unless those ships violate the international standards rules and regulations

causing damage their marine environment (Bardin, 2012). Accordingly, UNCLOS Article 21 gives provisions to the Coastal States to;

(a) Adopt laws regarding the safety of navigation
(b) Adopt laws regarding the protection of navigational aids and facilities or installations, which would comprise artificial islands and oil rigs
(c) Regulate the protection of pipelines and cables
(d) Adopt legislation regarding the conservation of living resources of its territorial sea
(e) Regulate the fishery activities
(f) Ensure the preservation of the environment by adopting regulations on the prevention, education and control of pollution
(g) Regulate the activities of marine scientific research and hydrographic surveys;
(h) Apply its customs, fiscal, immigration and sanitary laws.

According to the Article 220 of the UNCLOS, Coastal States have enforcement power over these regulations (UNCLOS, 1982).

3.2 State requirements as Flag State, Port State and Coastal State with regard to the Ballast Water Management Convention

3.2.1 Flag State Requirements of Ballast water Management

Flag States must implement and enforce its fleet in the provisions of the BWM Convention and related guidelines which include various technical requirements. They also need to comply with the general obligations specified in the UNCLOS in order to implement the BWM Convention effectively and efficiently (GloBallast 19, 2010). Flag States need to have a comprehensive understanding of the obligations specified by both UNCLOS and BWMC in order to ensure effective implementation.

Even though ship owners are mainly liable for their ships' safety and protection of the environment, the regulating of shipping is a significant component by flag States to ensure ships' safety and pollution prevention (Mansell, 2009).

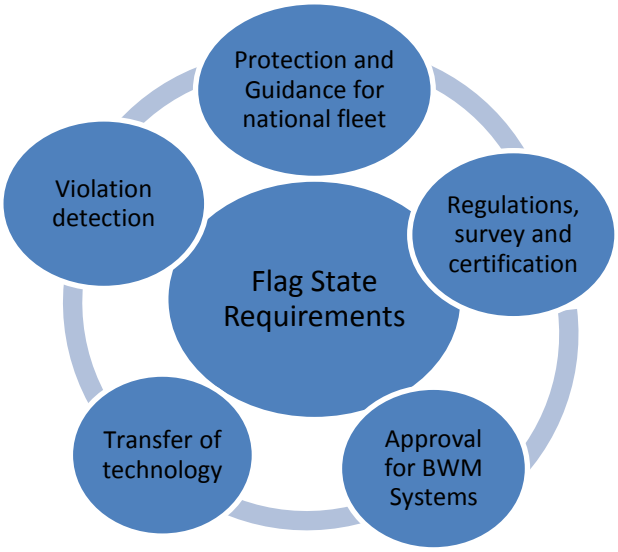


Fig 7: Flag State requirements to address BWMC
Source: Based on (Baumler, 2016)

The technical and legal requirements comprised in the BWM Convention that oblige Flag States are discussed below:

3.2.1.1 Protection and Guidance for the National fleet

According to Part 2 of the IMO Instruments Implementation Code (III Code), Flag States are responsible for process administering a safety and environmental protection program. Such a program should consist of administrative instructions to implement the international regulations.

Flag State provides guidance to ship owners in order to comply with regulations.

3.2.1.2 Establishing National legislations, Survey and Certification

a. Establishing National legislation

According to Article 2 and Article 7 of the BWM Convention, States are obliged to give "[...] *full and complete effect to the provisions* [...]" and "[…] *ships flying its flag or operating under its authority and subject to survey and certification* […]". In addition to that Article 4.2 of the BWM convention says, each Party requires that ships which fly its flag comply with the requirement of this convention and shall apply the relevant standards and take effective measures to comply with those requirements.

The formulation of National Ballast Water Management Strategy (NBWMS) is an essential part of the national legal regime along with the policies, legislations and the institutional arrangements in States. It reflects the international obligations and legal requirements as well as efficient management tool for ballast water management practices. Furthermore, national legislations shall be applied as broadly as possible, giving consideration to the number of local, national and regional issues and stakeholders (Tamelander et al., 2010). After the ratification of the Convention, Parties shall have the ability to supervise ships on board with regard to the BWM compliance.

b. Survey and Certification of ships

Article 7 of the BWM Convention provides provision to the requirements for surveying and certifying ships. According to the Regulation E-1 of the Convention, regular surveys of BWM systems of ships should be carried out. This includes initial surveys on installation, surveys for renewal of certificates and additional surveys as specified in the Convention (IMO, 2009).

As mentioned in Section E of the Convention, all ships must have an International Ballast Water Management Certificate, which would be issued by the Flag State for the ship. According to the Regulation E-1, Flag States shall nominate Recognize Organizations (RO) to conduct a proper survey for the certification.

It is important to mention that certificates are *prema facie* evidence of compliance. In addition to that, Flag State should issue a Type Approval Certificate for the BWM system which complies with D-2 standards (GloBallast 19, 2010).

3.2.1.3 Approval for BWM Systems

As permitted by Regulation D-3 of the Convention, Flag States are responsible for proceeding the Type-approval requirements for the BWMS in order to comply with the G8 Guidelines. The approval process consists of shore-based and on-board testing procedures (Greensmith, 2010).

According to paragraph 6.2 of the G8 Guidelines, the Type approval certificate should be issued for the approval for testing of specific BW capacities, flow rates, salinity and temperature regimes or other limiting conditions as appropriate (IMO, 2009).

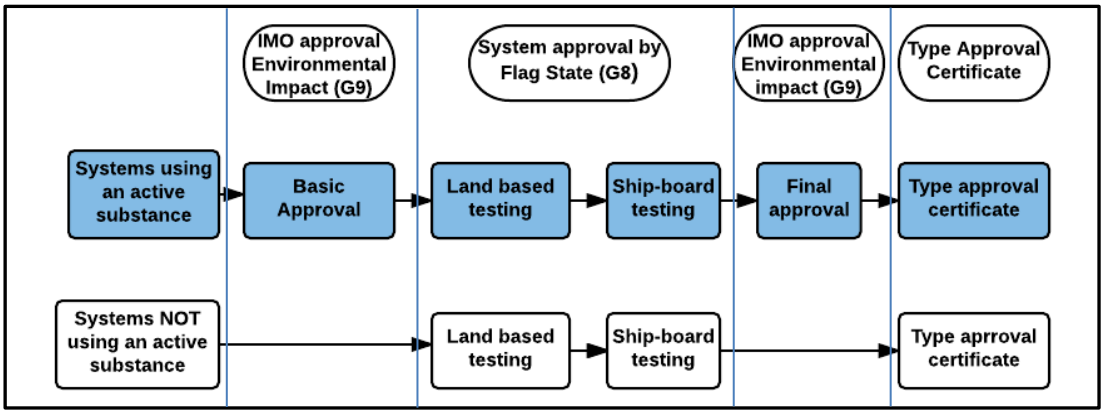


Fig 8: IMO System Approval Process
Sources: (Greensmith, 2010).

In addition, the Convention addresses on prototype ballast water treatment technologies through regulation D-4. The G10 guidelines specify that the procedures for oversight of prototype BW treatment technology programs and the Flag States are obliged to proceed the approval process (IMO, 2009).

Moreover, all vessels are obliged to have a Ballast Water Management Plan (BWMP) on board, illustrating the ballast water management method (D-1 or D-2 Standards). According to the MEPC resolution 127 (53), 2005, the BWMP shall approve by Flag Sate accordance the B-1 regulations of the Convention.

3.2.1.4 Training of crew members

Regulation B-6 determines that officers and crew shall be familiar with their duties in the implementation of the Ballast Water Management Plan, which also includes the safe operation of the Ballast Water Treatment system onboard.

Furthermore, the Regulation B-1.5 indicated that the designated officer should be on board in charge of ensuring the proper implementation of the BWM Plan (IMO, 2009). Flag State should ensure the staff in the shipping industry, such as onshore staff, port managers, and operators, etc. be trained either at national, regional or IMO level (IMO, 2009).

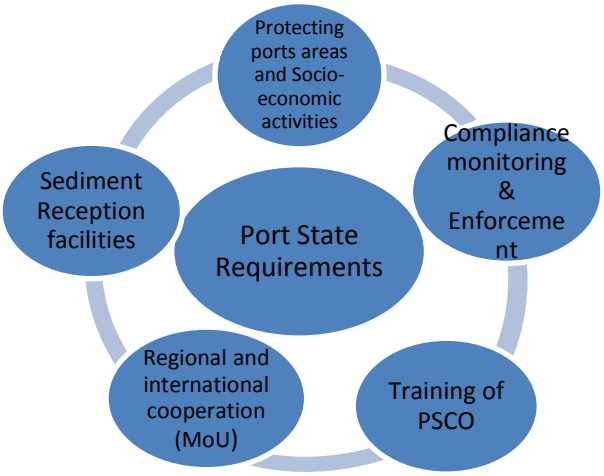
3.2.1.5 Violation Detection and Sanction

Article 8 of the Convention stipulates that any violations of the requirements of the convention shall be prohibited and sanctions shall be established where ever needed according to the law of the Flag States. The flag State shall inform regarding the alleged violation to the relevant country and the IMO as well. In addition to that, if the administration of the Flag State has sufficient evidence on such violations, the immediate legal proceeding has to be taken accordingly (IMO, 2009).

In short, the Flag State must develop the capacity to supervise the implementation of BWMC and Compliance Monitoring & Enforcement system (CME) of its fleet.

3.2.2 Port State requirements for the Ballast Water Management Convention

Ports States are responsible for compliance monitoring and enforcements, inspections of ships, management of sediments reception facilities, communication of requirements to IMO and regional international cooperation for designation of areas for ballast water exchange.



. Fig 9: Port State requirements to address BW management

Source: Based on (Baumler, 2016)

3.2.2.1 Protecting port areas and socio-economic activities

Port States are responsible for the protection of port areas of their territory. Risk assessment and scientific research are obliged to Port States and/or Coastal States to protect the port areas. In line with this, the risk assessment approaches under the G7 guidelines are introduced in the Convention. According to the G7 guidelines, 8 principles are defined to follow risk assessments. The principle 'Comprehensiveness'

provides the guidance to carry out risk assessments considering the economic, environmental, social and cultural values (GloBallast 19, 2010).

Article 6 of the Convention gives the provision to the Port States to carry out scientific researches and monitor the effects of ballast water management under their jurisdiction. Also parties are obliged to facilitate scientific and technical research on ballast water management (IMO, 2009).

Port States are authorized to assess the risks level due to IAS on pre-arrivals. Due to the geographic and hydrographic conditions in some areas of mid-ocean, it may not suitable to exchange the BW. This is clarified in the Regulation B-4.2 of the Convention. Accordingly, G14 guidelines provide guidance to Port States, to designate areas where BW exchanges could be allowed (IMO, 2009).

3.2.2.2 Compliance monitoring and enforcement

Inspection means that; *"A visit on board a ship to check both the validity of the relevant certificates and other documents and the overall condition of the ship, its equipment, and its crew*" (IMO, 2009).

Under Article 9, sections 1 and 2 of the Convention it is stated that Port State Control Officers (PSCO) are duly authorized of inspect of ships who can verify whether the ship has a valid certificate. Also, the PSCO shall inspect the Ballast Water Record Book, or sampling of the ship's ballast water carried out in accordance with the guidelines of the convention. Furthermore, PSC has to ensure that the ship's international BWM certificate and the Type Approval Certificate carried out accordance with the BWM Convention.

The PSC is allowed to follow detailed investigations or in-depth examinations based on "clear grounds".

In 2014, the IMO adopted Guidelines for Port State Control under the BWM Convention by Resolution MEPC.252 (67) (IMO, 2014).

As per the Article 9 of the Convention, providing suitable laboratory facilities to sample tests and analyze ballast water is also the responsibility of the Port State.

3.2.2.3 Training of Port State Control Officers (PSCO)

The Port States are obliged to provide adequate training for their inspectors in several aspects of the Convention. The officials shall be familiar with the implementation of the BWM Plan and the safe operations of the BWT system onboard and sample analyses (Regulation B-5).

3.2.2.4 Regional and International Cooperation

As an example the Indian Ocean Memorandum of Understanding is one of the regional cooperation agreements to deal with Port State Control (Hemachandra, 2012).

Port States are coordinate with the IMO. Also, the Port State shall coordinate with other parties on any requirements and procedures relating to ballast water management including laws, regulations, guidelines and the availability of the reception facilities when necessary (Article 14-1) (IMO, 2009).

Also, according to Article 13 and the G7 (11.3) guidelines, parties are responsible for coordinating with international bodies to train personnel, and ensuring the availability of technologies & facilities. Carrying out joint research programs for the effective management of BW and sediment are included for better management of the BW issue (IMO, 2009).

According to Regulation B-4.2 of the Convention, the Port State has the authority to designate areas to exchange Ballast Water, where the distance from the nearest land or depth does not meet the conditions given by the convention. This may be designated by the Port State with the consultation of adjacent or other States as applicable (IMO, 2009).

Port States are liable to promote scientific and technical measures with other parties. According to Article 6.2 of the Convention, this includes the effectiveness of BWM deduced from the monitoring and assessment programs (IMO, 2009).

3.2.2.5 Sediments Reception Facilities

According to the Article 5 of the Convention, ports, and terminals of the member states shall ensure that to provide adequate sediment reception facilities where, cleaning and repair of ballast tanks taking place. These reception facilities must be in accordance with the G1-guidelines to provide safe disposal of ballast sediments. In addition, parties are obliged to notify the IMO where the reception facilities are inadequate. Furthermore, parties shall report to the IMO the information on the availability and the location of the facility (IMO, 2009).

Guidelines G1 invite parties to provide the reception facility for ballast water sediments (IMO, 2009). This guidance directs and encourages building a world-wide uniform system among such facilities and the vessels.

3.2.3 Coastal State requirements for ballast water management

The Coastal State should take all necessary measures to ensure the observation of international rules when exercising its rights and fulfilling its obligations. It should consider developing and implementing a control and monitoring program which could be part of an international management system. The State should evaluate performance on a periodical basis to identify weakness and strength (IMO, 2016b).

There are identified main responsibilities shown in figure 10 below:

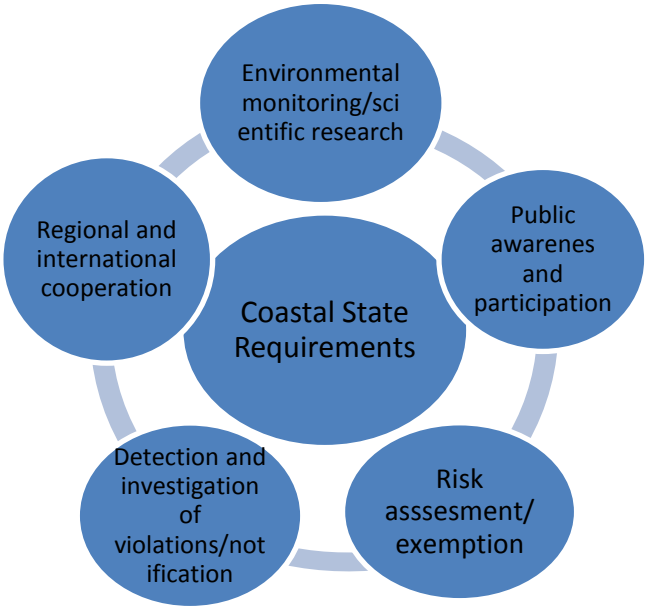


Fig 10: Coastal State requirements to address BW management
Source: Based on (Baumler, 2016)

3.2.3.1 Environmental monitoring and scientific research

The main responsibility of the Coastal State is to make the necessary arrangements to control and prevent the risks arising from the BW on human & animal health, the environment and the socio-economic activities, impacts on the coastal and maritime

areas in their territory. In order to do that, Article 6.1 gives provision to the Coastal State to promote and facilitate scientific research and monitor waters under their jurisdiction on the impacts of HAOP introduced from ballast water sediments. Observations, measurements, sample analyses and evaluations are to be included in such research. The G7 guidelines provide comprehensive risk assessment procedures to Coastal States in a logical process.

Port Biological Baseline Survey (PBBS) is one of the main processes included in the research sector that provides the baseline information and also enables the detection of new introductions through regular monitoring. Considering the information of PBBS, quantification of possible impacts could be determined and it is important for implementing the response strategies to the Coastal States (GloBallast 19, 2010).

3.2.3.2 Contingency Plans, Preparedness, Awareness and additional measures

i. Contingency Plans and Preparedness

Another major responsibility for the Coastal State is to take action in emergency situations. There plans must be ready to implement in case of emergency and mechanism to seek support from neighboring countries.

ii. Awareness

According to Regulation C-2.2 of the Convention, parties are liable to aware mariners and the IMO administration of any potentially affected Coastal States regarding emergency situations. Also, parties shall warn mariners on the alternative areas suitable for the uptake of ballast water. Moreover, when the potential threat is no longer, parties shall aware mariners and the IMO as well (IMO, 2009).

According to these regulations, parties are obliged to notify mariners by precise and accurate coordinates for areas where ships should not uptake sea water due to identified reasons. Due to the toxic algal blooms near sewage outlets and the improper tidal flushing are some of the identified reasons for these warnings in different geographic or oceanographic sea areas (IMO, 2009).

iii. Additional measures – Special requirements in certain areas

If a State determines that, the measures taken are not adequate to reduce or eliminate HAOP, such State shall make additional measures to meet specified standards. Regulation C.1 of the Convention states that States shall take the necessary additional measures when required to eliminate the HAOP from their environment. These additional measures are required in certain areas in addition to the D-1 and D-2 management measures. Parties shall jointly or individually make standards according to the international law and guidelines while describing the additional measures and precise co-ordinates where applicable (IMO, 2009).

If the ship is identified as a high risk situation, the State may require additional measures based on the guideline G13 of the Convention (David & Gollacsh, 2015).

3.2.3.3 Risk assessment, Exemptions and determination of designation areas

i. Risk Assessments (RA) and Exemptions

Paragraph 6.5.1 of G7 guidelines indicated that any exemptions from BWM methods for ships shall granted if there are no negatively impacts on the environment, human health, property or resources of neighboring or other states (David & Gollasch, 2015).

To grant Exemptions, the convention introduces 3 risk assessment methods to carry out, namely environmental matching risks assessment, species' bio-geographical risk assessment, and the species-specific risk assessment.

According to the Guideline sections 7.3 and 7.4 of G7, when the Party determines that, the ship operator undertakes the RA, the Party should provide all the relevant information to the ship owner to follow the RA guideline. (David & Gollacsh, 2015; IMO, 2009).

ii. Determination of Designated Areas

Guideline G14 states that in sea areas where the distance from the nearest land or the depth does not meet the parameters given in the Convention, the State may designate areas by consulting other States to exchange ballast water. The process for the determination of Designation of sea areas includes identification, assessment and designation. Therefore, these risks assessments could be useful when decision making for the designated areas where BW exchanges could be allowed (GloBallast 19, 2010).

3.2.3.4 Detection and investigation of violations and notification

In the case of the detection of violations, Coastal States are responsible for further actions accordingly. As per the Article 10 of the Convention, Parties shall cooperate in the detection of violations and the enforcement of the regulations given in the Convention.

According to Article 10.4 of the convention, if a request for an investigation received from any State together with sufficient evidence, States may have the authority to inspect the ship when it enters their port or terminals under its jurisdiction. Also, Article

11.1 illustrates that after the proper investigations, the identified violations shall be notified to the administration of the Coastal State, including the evidence. In addition, the investigation report shall be sent to the requested State while the competent authority of the Coastal State should take appropriate actions against the suspect (IMO, 2009).

3.2.3.5 Regional and international cooperation

Article 13.3 of BWMC provides provisions to States to enhance regional cooperation by regional agreements (IMO, 2009). For the successful implementation of the Convention, it will be important to take into account the regional and local features (David & Gollasch, 2008).

The sharing of scientific knowledge concerning BWM, training personnel, initiating joint research and development programs, and sharing the relevant technology & facilities are expected activities through regional and international cooperation.

3.3 Conclusion

States have to harmonize their domestic law with international regulations regarding marine environment protection. According to the international laws, the States obligations can be distributed as Flag State, Port State, and Coastal State.

All ships have to be registered in a State. It is the Flag State which effectively exercises its jurisdiction and control in administrative, technical and social matters over ships flying its flag. In the context of BWM, the Flag State has specific responsibilities such as ship survey & certification, training of crew, approval of BWMS and transfer of technology to other member States.

To comply with the BWMC, Port States have to develop CME regime. Inspections of ships, Sediments reception facilities, Communication of requirements to IMO and regional cooperation for Port State Control via MoU and international cooperation for the designation of areas for ballast water exchange is the other main role for Port States. To comply with the BWMC, the Coastal State should establish and implement policies and guidelines to the implementation and enforcement procedures in their territory with the responsible organizations in the State. The supervision of coastal areas and its availability as well as issuance of exemptions and preparation of contingency plan, are part of its main obligations.

The overall effort of these three institutions should be to cooperate regionally and internationally to successfully manage BW and eradicate HAOP from their territory.

Chapter 4

4. Implementation of Flag, Port, and the Coastal States obligation in Sri Lanka

4.1 Situation related to BWM in Sri Lanka

Sri Lanka is Party to most of IMO's conventions and Protocols such as MARPOL 73/78, OPRC, SOLAS and STCW etc. Table 3 shows that some of the ratified IMO conventions, the responsible agency and the related national legislation.

Table 3: Legislations for IMO Conventions in Sri Lanka related to III Code

IMO Convention	**Sri Lanka National Legislation**	**Responsible Institution**
SOLAS	Merchant Shipping Act No. 52 of 1971	Directorate of Merchant Shipping
STCW	Merchant Shipping Act No. 52 of 1971	Directorate of Merchant Shipping
COLREG	Merchant Shipping Act No. 52 of 1971	Directorate of Merchant Shipping
Load Lines	Merchant Shipping Act No. 52 of 1971	Directorate of Merchant Shipping
International Tonnage	Merchant Shipping Act No. 52 of 1971	Directorate of Merchant Shipping
MARPOL 73/78	Marine Pollution Prevention Act No 35 of 2008	Marine Environment Protection Authority

Source: Author, based on www.imo.org

According to the IMO Resolution A.Res. 1070(28)/(III Code), Sri Lanka should introduce and follow the regulations and guidelines when the BWM convention enters in to force. In order to implement this requirement Sri Lanka has been taking a few

initiatives in the ratification process of BWMC to prevent HAOP in/from Sri Lankan waters.

This section discusses the risks relating to Sri Lankan waters due to the maritime traffic and ecosystem vulnerability from ships' BW. Also, it elaborates the current situation of the ratification procedure and how Sri Lanka deals with the challenges to the implementation of the BWM convention through adopting national regulations.

4.1.1. Risks relating to maritime traffic

In the Indian Ocean's Bay of Bengal and in the Arabian Sea, the average amount of maritime shipping has increased more than 300% within the last 20 years (Oskin, n.d.). Geographically, the third largest in the world, the Indian Ocean belongs to one of the most important shipping lanes in the world. This geographic location provides many important global and regional economic transactions.

Sri Lanka is an island country that has a great maritime heritage and is located in a significant geographical point in the Indian Ocean as shown as in Fig 11. Because of this unique situation, it creates trans-shipment activities and trade to the country. Therefore it is more dependent on the shipping industry according to the main vision of becoming a global naval and aviation hub along the Indian Ocean Silk route (Galle Dialogue, 2012).

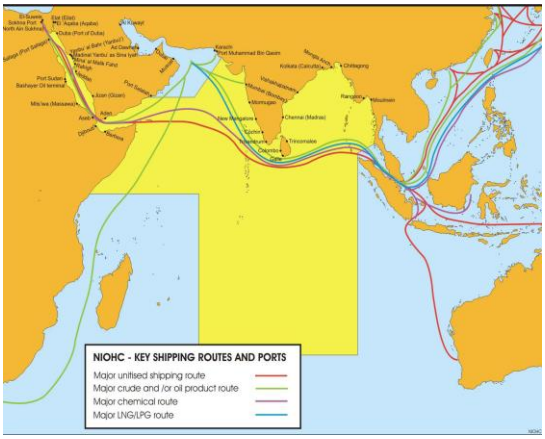


Fig 11: Major shipping routes (South East Asia) Source: www.prds.gov.lk

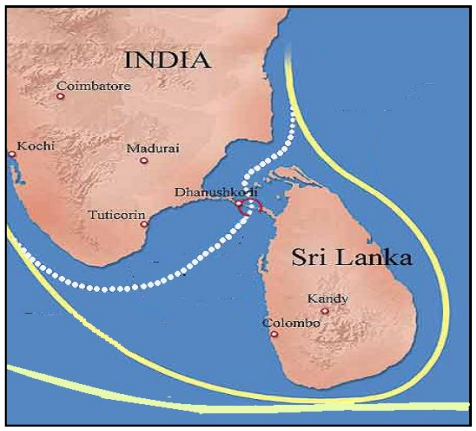


Fig 12: International shipping routes near to Sri Lanka Source: www.nara.gov.lk

Since the major shipping route is very close to the offshore southern part of Sri Lanka, services such as ship channeling, the supply of water, fuel, crew changes for international shipping are being undertaken from the Sri Lankan ports.

According to the statistics of the Sri Lanka Ports Authority, there are about 300 vessels passing daily through the southern traffic separation scheme of Sri Lanka to become a strategic naval link between Europe, South & West East Asia (Galle Dialogue, 2012).

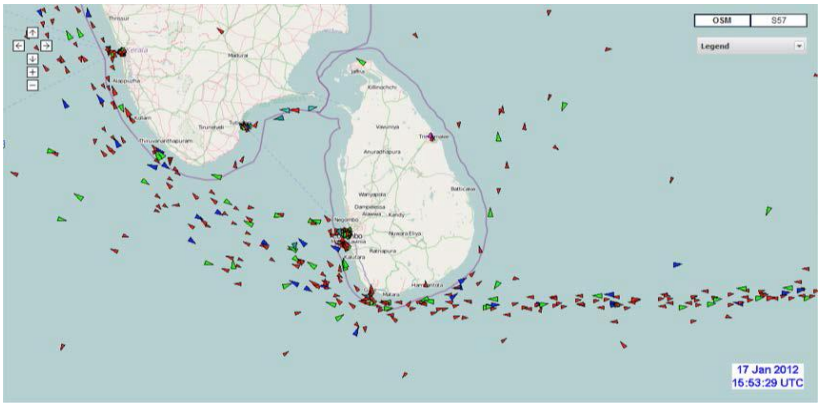


Figure 13: Snapshot of vessel traffic around Sri Lanka at 15:53:29 UTC on the 17th of January 2012. Source: (ExactEarth cited in Vos, Wu, & Brownell, 2013)

According to the ITOPF reports-2005, the South Asian Region is the one of the highest oil transporting shipping lanes in the world. Oil tankers from the Middle East to Far East countries pass via this shipping route. Therefore, there is a high risk of oil pollution in Sri Lankan waters (Gunesekara, n.d.).

Another risk for the country due to the high vessel traffic in this shipping lane is the threat for the whales' population in the southern coast of Sri Lanka. According to the studies of blue whales, the offshore southern area is highly populated by *Balaenoptera Sps.* Recent observations of dead whales in the vicinity overlap with the highly productive whales feeding ground and the shipping lanes results in ship strikes (Randige et. al, 2014). The NO_2 concentration of this shipping route is at a very high range due to the high vessel traffic as well. (Oskin, n.d.).

There are 5 ports existing in Sri Lankan coast named Port of Colombo, Port of Galle, Magam Ruhunupura Mahinda Rajapaksa Port (MRMR), Port of Trincomalee and Port of Kankasanthurei (KKS). Port of Colombo is the major port that heavily connected with the international shipping community for many decades. Port of Galle, port of Trincomalee and the Port of MRMR contribute to the industry in small scale. Table 4 shows the annual ship calls to Sri Lankan ports.

Table 4: Number of ships arrivals to Sri Lankan Ports in the year 2015. (All Ports)

Name of the Port	**Number of ships arrived**
Colombo	4,197
Galle	69
Trincomalee	161
MRMR	295
KKS	44
	4,766

Source: (SLPA Annual Report, 2015)

In general, more than 4,000 ships arrive in Sri Lankan ports annually. Conventional ships, Containers, Oil & gas tankers and RO-RO ships are among them. The Colombo Port is one of the busiest ports in the world and ranks 28 among the top 50 ports (Weerakoon & Perera, 2014). It is also one of the biggest artificial harbors in the world handling most of the country's foreign trade. The Port of MRMR has located 10 nautical miles away from the world busiest shipping lane in the Southern coast (SLPA *Annual Report*, 2012).

When considering ballast water discharges around the ports, there are some statistics on the annual BW discharges in Sri Lanka as shown in Table 5.

Table 5: Annual Export, Import and Ballast water discharges in 3 ports in Sri Lanka

(MT)	Colombo	Galle	Trincomalee
Total Export	10,368,292	233	172,950
Total import	17,830,071	481,677	1,646,616
Annual BW Discharge	789,600	12,000	24,000

Source: (SLPA Annual report, 2012)

According to Table 5, Sri Lankan waters receive an estimated 825,600 MT of ballast water annually. This may cause a threat to the Sri Lankan marine ecosystems, economy and human health by HAOP.

One of the studies was done by University of Kelaniya, Sri Lanka in 2007, by sampling testing for planktons from the ballast water of five cargo ships calling at Colombo port. Twenty eight (28) totally alien planktonic taxa were identified but the study did not focus on the viruses or bacteria of the samples. Therefore an actual number of all taxa might be greater than the values reported in the study (Chandrasekara & Fernando, 2009).

In the other study that focused on the planktons in the ballast water in the ships that visited Colombo harbor in 2010, the report referred to the harmful, toxic dinoflagellates. Among thirty-three plankton species, six were identified as *Ceratiumfusus, Ceratiumfurca, Peridinium* sp., *Protoperidinium grande, Protoperidinium obtusum* and *Protoperidinium robustum.* These six species are potentially bloom-forming species so this would be a threat to Sri Lankan waters (Senanayake et al., 2010).

Another study was done by the University of Sri Jayewardenepura in the Colombo Harbor area in 2010. There were 26 different marine aquatic species identified; those were not found in the previous study carried out in 2007. Among these species, *brachyuran larvae* were recorded (0.37 to 0.45%). There was evidence of the presence of the European Green Crab (*Carcinusmaenus*) in Sri Lankan waters. In addition, the Global Invasive Species Program (GISP) indicates that the European Green Crab was identified in Sri Lankan waters. The evidence demonstrates the vulnerability of Sri Lankan coastal waters from the AIS from ships' ballast water (Ranatunga et al, 2010).

4.1.2 Risks relating to ecosystem vulnerability

Sri Lanka and the Western Ghats of India have been identified as one of the 34 global biodiversity hotspots with a high concentration of endemic species. This area is also identified as one of the eight biodiversity hotspots based on a number of endemic plants and vertebrates (Samarakoon, May 09, 2012). The coastal waters of the country are highly productive, more than the open ocean due to the supply of nutrients and surface runoff from rivers (Azmy, 2013).

As a continental island, Sri Lanka has a significantly wide continental shelf around the most coastal parts of the marine areas. The coastal belt supports the array of reef and shoreline types with bays, lagoons, and inlets. These various features result in a wide

range of ecosystems with high biological diversity. These ecosystems and the biota are vulnerable to sea level rise with regards to climate change. Also, this rich biota effects and is vulnerable to human activities, particularly to marine pollution by different ways.

The WWF's Global 200 Eco-regions Project has identified this region as one of the most biologically distinct terrestrial, fresh water, marine eco-region on the planet and also identified as vulnerable so that, given highest priority for conservation (Olson & Dinerstine, 2000).

Sri Lanka has diverse coastal marine habitats that include mangroves, coral reefs, sea grass meadows, sand dunes, estuarine and lagoons. These habitats comprise the rich biodiversity and high genetic diversity as well. Much of various groups of marine coastal organisms are not yet completely documented (ICZMP, 2006). Table 5 shows a short description of identified marine faunal species in Sri Lankan waters:

Table 6: Marine Biodiversity of Sri Lanka

Category	**Type**	**No. of species**
Invertebrates	Hard corals	208
	Soft corals	35
	Crustaceans	742
	Bivalves	287
	Echinoderms	213
	Marine Molluscs	228
Vertebrates	Pelagic fish	1,800
	Reptiles	20
	Birds	200<
	Mammals	30
	Shark and Rays	92

Source: (Weerakoon, 2014)

Since the huge number of ships arriving in Sri Lankan ports, there will be a great potential of the introduction of IAS and HAOP into the coastal and marine environment of the country.

According to the above observations made on the ecosystems vulnerability of Sri Lankan waters, it is clear that the threats of invasive alien species are at a significant risk. If the country does not take immediate measures to prevent the introduction of IAS and HAOP, it would be more harmful to the marine ecosystems and the rich marine biodiversity. Regarding the provisions provided by the BWM Convention, Sri Lanka should carry out continuous assessments in this regard in order to prevent and contain any risk.

4.1.3 Present situation of ecosystem assessments

During the last decades some ecosystems assessments have been carried out by research institutions and universities in Sri Lankan waters.

The National Aquatic Resources and Research Development Agency (NARA) is the national researches institute that mainly undergoes marine research in Sri Lanka. This institute is conducting a long-term survey on coral reefs and coral rehabilitation programs with support from universities. NARA is also conducting marine biodiversity assessment in 2010 in Trincomalee, which is located in the Eastern coast of Sri Lanka (Joseph, 2008).

Also, researchers from 3 universities (University of Colombo, University of Sri Jayewardenepura and the University of Kelaniya) have carried out work on the introduction of HAOP through ballast water in to Colombo harbor waters. These researchers are continuously monitoring the Colombo waters starting from the year 2007 and it was clear that the invasive species density of the Colombo waters is increasing with time (Senanyake et al., 2010).

Recently, in March – April 2016, another ecosystem assessment program was started by the Marine Environment Protection Authority (MEPA) in collaboration with the IUCN. This program intended to identify HAOP in the region between Western and Southern offshore marine environment. Two IAS species were reported as *Semibalanus balanoids* (Australian acorn barnacle) and *Crassostrea vigrginicia* (Oyster) at Beruwala fishery harbor in Western coastal area (M. Subasinghe, Personal communication, August 09, 2016).

MEPA is continuously monitoring 6 selected coastal sites in Western, Northern, Eastern and North-Western to maintain baseline data on distribution pattern on marine fauna and flora from 2013 to date (M. Subasinghe, Personal communication, August 09, 2016).

In addition to that, Coral Reef Degradation of Indian Ocean (CORDIO) program is in progress in supported by SIDA, jointly with 11 countries including east Africa. This project is focusing on biophysical impacts of the bleaching and mortality of corals, reef rehabilitation, and management options. A baseline survey of the coral reefs in the eastern coast, effects of coral reef degradation on tourism and monitoring of collection of marine ornamental fish are some of the ongoing few activities of this program (Joseph, 2008).

Furthermore, the distribution pattern of sea-grass meadows at Gulf of Mannar and Putlam lagoon (North-Western coast) was completed by universities in collaboration with IUCN, in 2013.

In addition all major development projects are required to carry out Environment Impact Assessments (EIA) according to the National regulations in Sri Lanka. This EIA conducts to ensure that the impacts on the environment and the mitigatory measures are incorporated into the particular project (Joseph, 2008).

According to the records of PBBS, there were 5 invasive species of phytoplankton among the 125 different phytoplankton species identified. In addition to that Table 6 shows the 11 harmful non-native dinoflagellates were recorded in the study.

Table 7: Harmful dinoflagellates reported in the PBBS at port of Colombo

Species	Status
Alexandrium tamarense	Rare
Dinophysis acuminate	Rare
Dinophysis rotundata	Rare
Dinophysis caudata	Medium
Dinophysis tripos	Rare
Dinophysis fortii	Rare
Gyrodinium brave	Medium
Gyrodinium mikimotoi	Rare
Gyrodinium sanguincum	Rare
Lingulodinium polyedrum	Rare
Noctilua scintillans	Medium

Source: (Ranatunga et al., eds., 2016).

Other scientific research has been carried out on bryozoans (which live on firm substrates) in Colombo harbor in the years 2014-2015. The non-indigenous highly invasive *Schizoporella errata* were reported in that study for the first time in the Colombo harbor. The *S. errata* is native to the Mediterranean Sea and has made a high invasion in many countries spread over the world's oceans. It may provide secondary substrates to other fouling organisms by facilitating to spread in new environments (Marasinghe et al., 2015).

According to the above investigations on the current marine ecosystems assessments in Sri Lankan waters, it is clear that the assessments are not addressing them in a comprehensive manner; mostly the activities are done in an ad-hoc way. However, up to-date information on the distribution of marine species is essential to control and

finally eradicate the HAOP in Sri Lankan waters. Currently, this information is lacking in Sri Lanka (Ranatunga et al., eds., 2016).

Sri Lanka is not only subject to IAS but also host native species known as being potential invades as shown in Box 2.

Box 2: Threat to other Marine eco-regions

According to the studies of Gollasch et al, 1998, a copepod named *Tisbe graciloides* in ballast intake from Colombo waters has been found to multiply by high rate inside the tank (Gollasch, 1998). According to that, the release of the BW intake from Colombo waters causes threat to other marine eco-regions as well.

Source: (Gollasch, 1998)

4.1.4 Present Framework to address IAS

Sri Lanka has ratified the CBD; accordingly the country's ocean governance legal regime has a protective framework for ocean resources including biota and the non-living resources. When considering the protective measures for biodiversity, the country is obliged to protect marine biodiversity mainly through the Flora and Fauna Ordinance 49 of 1993. Furthermore, according to the National Bio-Diversity Strategic Action Plan in Sri Lanka, there are ongoing activities on marine ecosystem assessments in the Sri Lankan coastal system.

When considering the risks on IAS through ballast water, the current legal frame work is not sufficient to address the issue. The country decided to proceed towards the ratification of BWMC. Therefore few initiatives are taken in the ratification process.

Among the marine environment assessments programs focusing on IAS, Port Biological Baseline Surveys (PBBS) were finalized during the year 2014 to 2015 in four ports namely Colombo, Galle, MRMR and Trincomalee. The Report for PBBS in Colombo port is finalized and other reports are currently underway (H. B. Asanthi, Personal communication, August 03, 2016). The PBBS were conducted by Marine Environment Protection Authority (MEPA) with the support of universities and research institutes and the Ports Authority. Several numbers of non-native species were identified as discussed in the paragraph 4.1.2.

MEPA is the main responsible agency for the ratification process of the BWM Convention in Sri Lanka. In addition to PBBS a few other initiatives have been taken:

- Economic assessment for the ratification of the Convention.
- Preparation of draft National Ballast Water Management Strategy.
- The implementation of the national ballast water management task force.

The Chapter 4.2 discusses these initiatives as FS, PS and CS.

4.2 Level of Preparedness in Sri Lanka

To eradicate HAOP, both UNCLOS and the BWMC give provisions to member countries to take measures. Accordingly, the Article 235 of the UNCLOS provides the responsibility to fulfill the requirements on concerning the protection and preservation of the marine environment. Hence, States are responsible in harmonizing with international laws in their national legislations as shown in the Figure 14.

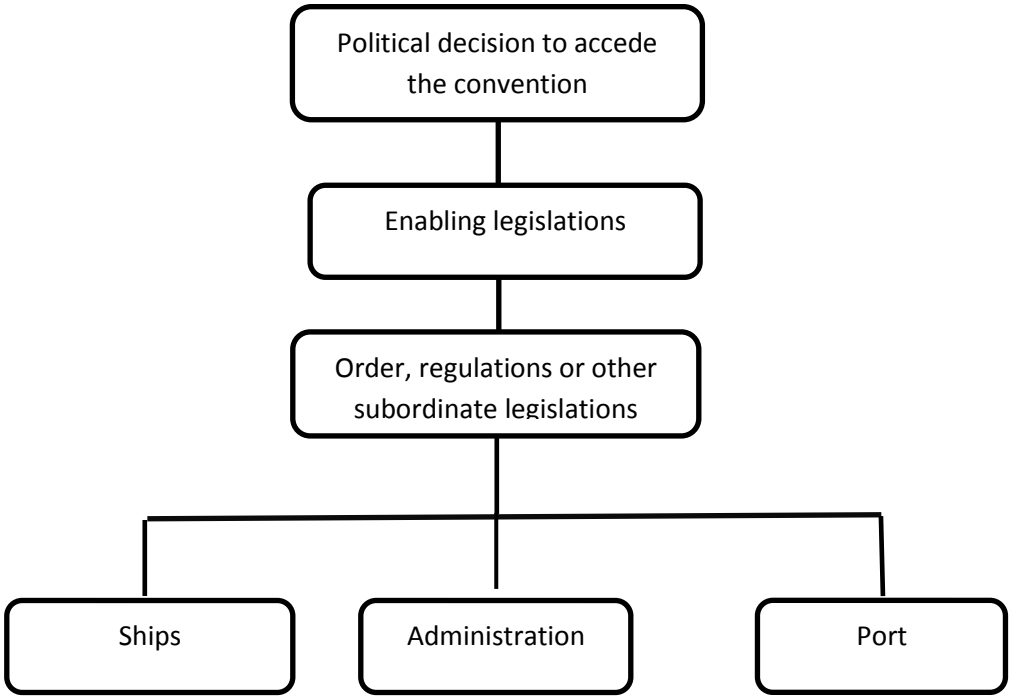


Fig 14: Integrating the Convention into domestic law and implementation
Source: (IMO, 2016b)

The Manual Entitled "Ballast Water Management – How to Do It" (PPR 4/8) by IMO provides a comprehensive guidance to the member countries on the way of integrating the requirements of the Convention into their national legal regime.

In Sri Lanka, a few organizations are involved with both the maritime industry and marine environment protection sectors.

- Merchant Shipping Secretariat (MSS)
- Sri Lanka Ports Authority (SLPA)
- Marine Environment Protection Authority (MEPA)
- Sri Lanka Coast Guard Department (CDG)

The SLPA and MSS are functioning under the Ministry of Highways, Ports and Shipping (2016). The MEPA is functioning under the Ministry of Mahaweli Development and Environment (2016) and the CDG is functioning with the Ministry of Defense (2016).

The sections below explain the level of application of the requirements in BWM in Sri Lanka as a Flag State, Port State and Coastal State.

4.2.1 Level of Preparedness in Sri Lanka as Flag State

As discussed in Chapter 3, the Flag State has different kinds of responsibilities which are related to the shipping administration. In Sri Lanka as a Flag State, the overall activities on maritime administrations are vested with the Merchant Shipping Act No. 52 of 1971. In addition the Licensing of Shipping Agents act No. of 1972 and the relevant clauses of the Admiralty Jurisdiction Act No. 40 of 1983 with related regulations made afterwards for the better governance of the shipping field.

4.2.1.1 Protection and Guidance for National Fleet

When considering the global shipping fleet, Sri Lanka contributes 14 vessels with 64,000 DWT in 2014. This respects 0.004% of the world fleet (UNCTAD, 2014). Accordingly the administration of ships flying under the Sri Lanka flag is vested with the MSS.

The Merchant Shipping Secretariat (MSS) deals with:

- The registration of ships under Sri Lanka flag.
- Survey of the ships
- Certification

In order to act on the above responsibilities, MSS has developed and implemented the government's maritime safety policy.

According to the information received from the shipping sector officials, Merchant Shipping Secretariat (MSS) has not taken initiatives to provide guidance to ship owners on BWMC (A. Ratnayake & R. Karannagodage, Personal communication, August 23, 2016).

4.2.1.2 Establishing National Legislation and Survey & Certification

The development of a national response to address IAS requires the coordination and involvement of national stake holders. This includes the range of ministries, line agencies, implementing agencies, research institutes, shipping companies and other interest groups as well.

However, the first step would be a political decision, recognizing that the HAOP poses a significant threat. After the political decision, the following three steps are needed to establish a national framework (Tamelander et al., 2010).

i. Development and endorsement of a National Policy on BWM and IAS
ii. Formulation of National Strategy on BWM
iii. Finalize the National Strategy while putting into practice and managed by developing a BWM Action Plan.

a.) Sri Lankan Policy development

In Sri Lanka MEPA is the responsible agency for preparation the legal framework on BWM.

The decision was made in 2012 to initiate the National Strategy to BWM in Sri Lanka. The Draft National Strategy was prepared in 2013, but is yet to be finalized. Regulations for BWM are not incorporated in the Marine Pollution Prevention Act No. 35 of 2008 (N. Piyadasa, Personal communication, August 14, 2016). MEPA has conducted situation analyses and made recommendations to the Ministry of Environment with regard to the ratification of the Convention.

The ratification process of BWMC is associated with certain costs while planning, monitoring, enforcement, and capacity building (GloBallast 19). In line with this reason, the Economic Assessment of BWM is being carried out by MEPA and it will be finalized soon. Total Economic Value (TEV) is the economic concept used in this study (T. Kumara, Personal communication, August 10, 2016).

b). Survey & certification of national fleet

As seen previous, a key task of Flag State is to survey and certify ships. Sri Lanka uses 11 different Recognized Organizations (RO) to survey and certify ships. However, Sri Lanka is not processing the survey and certification with regard to the BWM in Sri Lankan fleet (A. Ratnayake & R. Karannagodage, Personal communication, August 23, 2016) because the country is not party to the BWM Convention.

4.2.1.3 Other responsibilities: Approval of BWM Systems, Training of crew members and Violation detection and sanction

According to the shipping administration procedures, MSS should be the responsible agency for issuing BWM system approvals in collaboration with MEPA.

The MSS has a training Institute for the training of crew members and PSCO as well. Also, MSS should be responsible for the training of crew in several areas such as BWMP and BWMS.

In the context of violations detections and sanction related to BWMC, the responsible organization should be Sri Lanka Coast Guard Department with the assistance of MEPA. The legal procedure is yet to be decided.

Table 8: Summary of the Level of Preparedness as Flag State

Responsibility	Status	Expected responsible agency
Protection and Guidance for National fleet	X	MSS
Establishing National legislation & related activities/Survey & Certification	Draft National BWM Strategy, Economic Assessment, Established National BWM Task Force	MSS & MEPA
Approval of BWM Systems	X	MSS
Training of crew members	X	MSS
Violation detection and sanction	X	MSS, MEPA & CGD

Source: By the Author X – Do not exist

4.2.2 Level of Preparedness in Sri Lanka as Port State (PS)

The total ship arrivals to Sri Lankan ports are estimated as 4,500 annually. As described in Chapter 3, Sri Lanka is responsible for the protection of port areas and socio-economic activities and Compliance Monitoring & Enforcement (CME) with this shipping industry. PS also, establishes port reception facilities, provide training for PSCO and international cooperation. Sri Lanka Ports Authority (SLPA) is the responsible agency for these actions.

a). Port State Control

In the port of Colombo there are only 3 PSCOs are currently engaged in the PSC division. When considering the activities, such as CME and providing training for PSCO on BWMC, SLPA is still not in a position to carry out these activities (X. Officer, Personal communication, August 18, 2016).

b). Port Reception Facilities

Colombo Dockyard PLC is the major shipbuilding and ship repairing yard in Sri Lanka which has been connected with the Port of Colombo since 1974. Dry docks & afloat operations, offshore engineering and heavy engineering works are carried out in this dockyard and the maximum capacity is 125,000 DWT. The available sediment removing system is not totally complying with the G1 guidelines of BWMC, but there is a process to remove ballast water sediment. In this process, all the sediments are to be safely removed and stored, avoiding contact with the surrounding soil. The process is carried out with the prior approval of the Central Environmental Authority which issues an Environmental Protection License (EPL) (M. Hettiarachchi, Personal communication, August 16, 2016).

However, in line with the ratification process of BWM, Colombo Dockyard PLC-Sri Lanka has an ongoing process for the establishment of sediment reception facility. The

feasibility study of the system was completed and expecting the government supports (M. Hettiarachchi, Personal communication, August 16, 2016).

c). International Cooperation

Sri Lanka is a party to the Indian Ocean MOU established in 1998. Further, at the first meeting held in India in 2012 on the BWM in the South Asian region, the recommendations were made to work along with the IOMOU to manage the ballast water (Hemachandra, 2012).

In 2014, the IMO-GloBallast program has conducted a Regional meeting in Colombo for the purpose of several regional initiatives on BWM. The objectives of this meeting were to develop a Regional Strategy and Action Plan for BWM and to initiate on the appointment of Regional Task Force in South Asia. In addition, it provided the updated information on the CME and informed on the latest developments on BWM. The 5 countries of the South Asian Region participated in this workshop (Hemachandra, 2014).

Table 9: Summary of the Level of Preparedness as Port State

Responsibility	**Current Status**	**Expected responsible agency**
Compliance monitoring and enforcement	X	SLPA
Sediments Reception Facilities	Initiation stage	SLPA
Training of Port State Control Officers	X	SLPA & MEPA
Regional and International Cooperation	On going	SLPA & MEPA

Source: By the Author X – Do not exist

4.2.3 Level of Preparedness in Sri Lanka as Coastal State (CS)

As described in Chapter 3, the Coastal State is responsible for all the necessary measures ensuring applications of international rules. In the context of BWM, scientific research & environmental monitoring, preparedness and public awareness, risk assessments & grant exemptions, violation detections, and regional & international cooperation are the main responsibilities identified.

4.2.3.1 Scientific research & environmental monitoring

Sri Lanka has been carrying out PBBS in 4 ports, namely Port of Colombo, Galle, Trincomalee and Magam (MRMR). The report of the survey for Colombo Port is finalized and the other three are currently in progress (H. B. Asanthi, Personal communication, August 03, 2016).

However, as the main responsible agency, MEPA is currently carrying out small-scale environment monitoring programs that do not broadly address on the HAOP issue for fulfilling the BWMC requirements. MEPA has to undergo comprehensively addressed environmental monitoring programs in collaboration with NARA and Universities. This is to maintain an up-dated data base on native marine species as well as the new introductions to the environment. This information is necessary in the decision-making stage of the implementation of the BWMC.

4.2.3.2 Preparedness and Public Awareness

As per the C-2 regulation of the Convention, the Coastal State should notify shippers of the areas that are not to up take water into ballast tanks due to the risks of HAOP. In Sri Lanka there is no such kind of notification system available. Also, Sri Lanka has not taken any steps to investigate additional measures according to the C-1 regulation of the Convention.

The main responsibility for the preparedness and public awareness is vested with MEPA in collaboration with the Sri Lanka Ports Authority.

4.2.3.3 Risk Assessments & grant exemptions and violation detections

The main responsible agency for the risks assessments should be MSS with the collaboration of NARA and the MEPA. According to the G7 guidelines, MSS should be provided with all the necessary information to ship owners to carry out the risk assessments and accordingly MSS would be granted exemptions, whenever necessary.

The responsibility of detection of violations and further investigations are vested with the SLCG & the SLPA, but the further juridical actions should be taken by MEPA as the Law enforcement body. However, in Sri Lanka there are no regulations created with regard to the detection of violations or further investigations. Risk assessments & grant exemptions are still not incorporated within the Sri Lankan shipping field (X. Officer, Personal communication, August 18, 2016).

4.2.3.4 Regional and international cooperation

Article 13.3 of BWMC provides the provision to involve regional and international Cooperation. Sri Lanka cooperates through the South Asian Environmental Program (SACEP) which is based in Colombo. MEPA is the main responsible agency in this regard.

The first workshop was held in India in May, 2012 by IMO to establish a regional strategy for a harmonize approach on BWM consistent with the Convention. Out of seven countries, five South Asian countries namely India, Bangladesh, Pakistan, Maldives and Sri Lanka that have maritime involvements, participated to work on it (Hemachandra, 2012).

In addition, regional and international cooperation is required to share the scientific knowledge for successful implementation of the Convention. For that purpose, MEPA has conducted training for relevant officials on sample analysis on IAS in collaboration with Indian scientists in 2013. This program was much helpful for the completion of PBBS.

Table 10: Summary of the Level of Preparedness as Coastal State

Responsibility	**Current Status**	**Expected responsible agency**
Scientific research & environmental monitoring	On going	MEPA
Preparedness and Public Awareness	X	MEPA & SLPA
Risks Assessments & grant Exemptions	X	MEPA & MSS
Violation detections	X	MEPA, SLPA & CGD
Regional and international Cooperation	On going	MEPA & MSS

Source: By the Author X – not exist

4.2.3.5 Conclusion of the evaluation of Sri Lankan status for the preparedness for the ratification of BWM Convention

As a maritime nation Sri Lanka is obliged to protect its marine environment. When considering the protection of HAOP, Sri Lanka has been taking a few initiatives to implement the BWM Convention. As a Flag State, Policy decision for the ratification, draft NBWM Strategy, establishment of NBWM Task Force and Economic evaluation for the cost benefit analysis have all been carried out during the last five years.

As a Coastal State, a few marine ecosystems survey programs and a few PBBS programs were carried out while maintaining international and Regional cooperation with SACEP and IMO.

As a Port State, Sri Lanka does not take measures in line with the implementation process, except for the initiative of the reception facility.

4.3 Development of National Ballast Water Management Strategies (NBWMS) & National Ballast Water Task Force (NBWTF)

The country should take the necessary precautions to manage the risk of HAOP introductions through ballast water. For effective management, the national policy framework should be developed while being strengthened by scientific and technical baseline information. NBWMS should be an integral part of the national regulatory framework and be incorporated into the national action plans.

Box 3: Why do countries need a NBWMS?

The given standards in the International Convention for the BWM are often not operationalizing in national level. On the other hand, management of IAS is not commonly covered in prevailing national legislations because the legislations for BWM should be broad, comprehensive and specific. Also, the prevailing institutional arrangements, responsibilities and the existing approach to managing IAS are not clear enough. Because of these main reasons, countries should have developed their NBWMS for the effective management of BWM and the IAS.

Source: Based on (Tamelander et al., 2010)

Many countries and their local authorities have their specific requirements to prevent IAS and protect their native ecosystems. Australia, USA, and New Zealand have been taking measures to BWM accordingly, because of the uniqueness of their ecosystems and the threat of IAS through the BW. However, the existing NBWMS vary from each other according to the structure, technical & scientific applications and the overall approach, but most of the countries still lack specific laws and strategies to address IAS issue (Tamelander et al., 2010).

4.3.1 Principles incorporated with the preparation of national strategy addressing marine IAS

Also, with regard to the difficulties associated with the long-term control or eradication of IAS, prevention is identified as the most appropriate and the cheapest approach. In order to make a legal regime, there are five principles recognized at the international level that should influence national strategies and work plans to address the IAS issue.

i. The precautionary principle
ii. The ecosystem
iii. The polluter/user-pays
iv. Cross-sectoral integration
v. Regional and international cooperation

- **In Sri Lanka**

In the Sri Lankan context of the formulation of NBWMS, the draft NBWMS is prepared but has yet to be finalized. The draft NBWMS clearly identified the lead agency as MEPA and the responsibilities incorporated hereto. Furthermore, other line ministries and government institutions were identified such as universities, research institutes, the shipping community & NGOs with their responsibilities on BWM as per the Convention. According to the draft NBWMS of Sri Lanka, the following table describes the responsibilities of MEPA.

Table 11: Responsibilities of MEPA according to the draft NBWMS

Responsibilities of MEPA
Implement the national strategy
Establish national legislations
Implement ballast water management activities to all ships calling Sri Lankan ports
Ensuring all stakeholder agencies are fully aware and conversant with the national strategy
Ensure and continuous monitoring of the effectiveness of implementation of the national strategy. (amendments should be done whenever necessary)
Administration of relevant international instrument related to ballast water management
Develop research and technologies for BWM and incorporate to the NBWMS
International and Regional Cooperation on BWM

Source: Draft (NBWMS Sri Lanka, 2013)

As per the draft NBWMS, the following institutes and ministries are other stakeholders for the national ballast water management practices in addition to MEPA.

In the NBWMS of Sri Lanka, there are seven national strategies identified and prioritized as follows:

Strategy 1: Comply with the guidelines as per the Convention

Strategy 2: Capacity building on scientific knowledge and institutional strengthening

Strategy 3: Develop advanced knowledge on IAS/HAOP and carry out scientific researches in Sri Lankan waters.

Strategy 4: Risk assessments; decide designated areas and CME

Strategy 5: In cooperation with South Asian Regional BWM program

Strategy 6: Review and assess the NBWMS

Strategy 7: Make necessary measures to identify adequate resources to implement national strategy

According to the Draft NBWMS, the proposed Action Plan reflects the actions from ratification up to the implementation of the BWM procedures in all ports in Sri Lanka. However, some of the measures incorporated in the proposed action plan are still not in line with the time frame due to several reasons that are discussed in Chapter 4.5.

Table 12: Summary of the Action Plan for the implementation of MWM procedures in Sri Lanka

Action point	**Time Frame - Year**				
	2013	**2014**	**2015**	**2016**	**2017**
Establish National Taskforce	✓	✓			
Implement Capacity building program		✓	✓		
Establish certification procedure		✓	✓	✓	
Set up a web base system for ballast water discharge notification and other information exchange	✓	✓	✓	✓	✓
Carry out PBBS and RA programs	✓	✓	✓	✓	✓
Raise Awareness of Ballast Water issue and IAS issue	✓	✓	✓	✓	✓
Regional and international coordination	✓	✓	✓	✓	✓
Implementation		✓	✓	✓	✓

Source : By Author, based on the draft NBWMS of Sri Lanka ✓ - For Action

4.3.2 National BWM Task Force

Table 12: Stakeholder group for the BWM and NBWTF

Merchant Shipping Secretariat	Sri Lanka Ports Authority
Ministry of Environment-Biodiversity Secretariat	Ministry of Fisheries and Aquaculture
Ministry of Agriculture	Ministry of Tourism
National Aquatic Resources and Research Development Agency	Universities
Sri Lanka Coast Guards	Shipbuilding and ship repair yards
Ceylon Association of Ship Agents	Ship Owners Association & NGOs

Source: Draft (NBWMS of Sri Lanka, 2013)

In Sri Lanka, the NBWTF was established in 2013 and the representatives from all of the above institutions mentioned in the Table 12 were included in this task force. In addition to that, these institutions are responsible for specific tasks at the institutional level, but the lead agency has overall responsibility for the BWM (Annex ii).

According to the draft NBWMS in Sri Lanka, NBWTF is responsible for the formulation of NBWMS and evaluates the status of implementation and revision of the NBWMS whenever necessary. Also the development and implementation of the Action Plan provides guidance, oversight, and advice to take measures to proper implement and finally irradiate HAOP.

4.4 Assessment of development of a national strategic framework as proposed by IMO in relation to Sri Lanka

Each of the following steps proposed in GloBallast Monograph – 18 are discussed in the context of Sri Lanka.

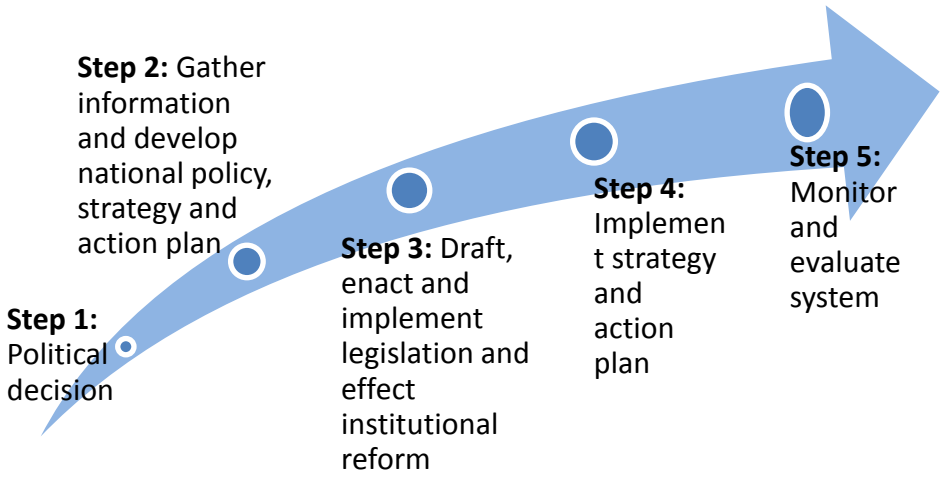


Fig 17: Steps in the development of a national strategic framework for ballast water Management Source: *Based on* (Tamelander et al., 2010).

4.4.1 Evaluation of each step in the context of Sri Lanka

Government organizations and other leading agencies in Sri Lanka are making efforts to follow these steps but many challenges have been identified in this study.

Table 14: Current status of implementation of national strategic framework in Sri Lanka

Step	Current situation	Evidence
Step 1: Political decision	Yes	Cabinet Approval-2012
Step 2: Gather information and develop national policy, strategy and action plan	Under way	Draft BWMS of Sri Lanka developed in 2013
Step 3: Draft enact & implement legislations and effect institutional reform	No	Through Information
Step 4: Implement strategy and action plan	Under way	Draft action plan prepared
Step 5: Monitor and evaluate system	No	Through information

Source: By the author

4.4.2 Challenges for ratification and implementation of BWMC in Sri Lanka

As a developing and a middle-income country, Sri Lanka is faced with huge financial constraints to comply with the all the requirements of the Convention. According to Tamelander et al., 2010, step 2 has three (03) important phases which are the development of task force, development of national strategy and the development of implementation plan.

These 3 steps include gathering information on IAS, carrying out PBBS, and developing a CME system as per the IMO guidelines. Also, it needs to have scientific research skills, Research and Development programs (R & D) and continuous monitoring & training PSCO etc.

Furthermore, establishment of reception facilities and facilitating efficient laboratory requirements are needed to implement as per the BWMC.

- **Ocean Governance of Sri Lanka**

The 1978 Constitution of Sri Lanka provides the foundation for the government's policies to conserve and sustain the marine resources. Under the above constitution, there have been 14 Acts and policies (Annex iii) are having been created based on following different areas: Environment protection, marine resources, marine non-living resources, shipping and science & technology. In this context the legal and policy framework has been established and there are different ministries and organizations involve in ocean governance process.

The legislative powers of the above ministries are exercise by the parliament, with cabinet ministers and executive power of the President. All the above legislations for

ocean governance is well defined but cannot identify the leading ministry for the process.

One of the major challenges in Sri Lanka is the absence of consolidated ocean management policy. Numerous policies, strategies and laws are currently in progress with regards to ocean governance. But none of them directly addresses to IAS and HAOP introduced by ships.

According to that legal framework, the Marine Pollution Prevention Act No. 35 of 2008 (MPPA) is the main legal instrument to incorporate legal authority to address the HAOP issue. MEPA is the responsible agency for MPPA to tackle the HAOP issue. But, currently no regulations incorporated in the MPPA to on this regard. Also the legal framework of Merchant Shipping Act No. 52 of 1971and the Coast Guard Act No. 41 of 2009 are overlap with the MPPA (Azmy, 2013).

While implementation of the ratification process and the implementation of the BWMC, all the stakeholders in line with the NBWMS are required to have a better coordination and collaborative work in a comprehensive manner. According to the personal interviews had during this study, it was identified that less interest of some organizations also lead to delay in this process.

- **Lack of scientific know-how**

Conversely, another challenge identified is that the scientific know-how and the inadequate laboratory facilities. In Sri Lanka, there are few scientists that are engaging in the researches in IAS and HAOP issue. Due to this reason, lack of baseline data on marine indigenous species is a major constraint to the identification of IAS. It leads in drawing sound conclusions on the effect of poor BW management practices of Sri

Lankan waters (Ranatunga et al., eds., 2016). The complexity of the sample analysis is challenging the implementation of the Convention.

As per the Convention, the enforcement regime is not only a legal framework but also it should have an efficient scientific sample analysis process. The experience, expertise and lack of resources to handle the scientific activities are a big challenge in PSC division in the ports.

- **Port State Control (PSC) challenges**

Furthermore, when consider the PSC division in the port of Colombo, there are only 3 PSC officers currently engaging in a number of inspections regimes and these officers are already overwhelmed with the various inspection activities. The existing PSCO division is faced with lack of staff and lack of resources as well. This is common to all ports in Sri Lanka. Also, the biological sample testing for ballast water and the complexity of the sample analysis procedures lead to another challenge and those are done at PSC for the first time. The scarcity of the experienced, technology and trained personnel is also challenging.

- **Lack of Resources**

Rationally, it is hard to deal with decision makers with scientific presenting manner and it is difficult to relate the science and management (Chircop & Hildebrand, 2006). This leads to ministerial level prioritization on other economic development areas in the country. Due to this issue, insufficient budgetary allocations and resources are getting. Hence, the implementation of the BWMC becomes a slow process.

4.5 Conclusion

Because of the unique location of this island, it has significant importance to the shipping industry at the global level by providing a link between Europe, and South & West East Asia. Because of this reason, high vessel traffic can currently be seen within the international shipping route which passes approximately 19 nautical miles from the southern coast of Sri Lanka.

There are 5 commercial ports currently functioning around the country, while the port of Colombo, the main port, receives around 4500 ship calls per annum. During the operations of these vessels, Sri Lankan ports receive a considerable amount of ballast water, which may introduce HAOP to Sri Lankan waters.

Sri Lanka is identified as a biodiversity hotspot as a global level. There are a variety of marine ecosystems found around the country, which are directly linked with the country's economy and wealth. During the past decade, some investigations are made to identify the risk of ballast water and introduction of HAOP. There is evidence of the IAS in Sri Lankan waters through ballast water accordingly.

Sri Lanka’s leading agency to address this issue is MEPA. Accordingly MEPA is preparing a NBWMS and a NBWMTF. Sri Lanka has completed PBBS in all ports and is currently finalizing the reports. The country is also finalizing the cost-benefit analysis of the ratification process of the convention. Few initiatives have been taken for reception facilities for ballast water sediment treatments.

As a developing country, Sri Lanka is facing some difficulties including financial, technical, skilled personnel and legal constraints in the ratification process of the Convention. This situation leads to delays of the implementation process.

Chapter 5

5. Overall Conclusions and Recommendations

5.1 Overall Conclusion

With the clear understanding of the environmental threats relating to ballast water and IAS & HAOP issue, IMO adopted the Ballast Water Management Convention and Guidelines.

Furthermore, according to the Convention, countries are liable to take significant measures to prevent the introduction of HAOP.

As a Flag state, the country has a responsibility to protect and guide their national fleet, create regulations at the national level, issue certificates & surveys of ships, issue approval for BWM systems, detect violations and the transfer of technology to address the issues.

As Port States, countries are liable to protect their port areas from the ballast water issue by compliance monitoring & enforcements, providing reception facilities for sediments, providing proper training to PSCO and keeping regional cooperation for necessary requirements.

As Coastal States, countries are liable to protect their marine waters by environmental monitoring, preparedness for contingencies, risks assessments, detection and notifications of violation of the rules, notifications and keeping regional and international cooperation as well.

Currently, Sri Lanka has been taking a few initiatives as a Flag State, Port State and Coastal State with regard to involving it in the ratification process. According to IMO's guidance, a draft National Ballast Water Management Strategy was created but not finalized.

5.2 Recommendations

Due to high risk for the country, immediate ratification of the BWMC is recommended for Sri Lanka that will fulfill all of the requirements of the convention.

MEPA is the responsible and leading agency that makes the necessary arrangements to establish a proper legal regime to the implementation of the BWMC. While other initiatives are being carried out, MEPA should incorporate the proper regulation scheme to the Marine Pollution Prevention Act No. 35 of 2008 with regard to the proper management of the BW issue. This should be developed for violation- detections, compliance monitoring, system approvals and cover all the Flag State, Port State, and the Coastal State requirements.

To bridge the gap in the scientific knowledge, international cooperation should be strengthened. The collaborative-joint scientific research program within the South Asian Region is recommended as the best solution to enhance research skills and maintain a baseline data of the marine ecology of the region. In line with this program, the South Asian Regional BWMS should be finalized and international and regional cooperation should be strengthened.

Further, it is necessary to establish an efficient funding mechanism to develop risk assessment and monitoring systems with regard to the IAS & HAOP issue. The funds may be used to develop laboratory facilities, train relevant officials and ensure institutional strengthening for the implementation of requirements of the Convention. This should be incorporated in the CME and the system approval process as well.

To consolidate existing ocean and environmental policies, a comprehensive National marine conservation policy is needed for proper ocean governance which includes addressing the IAS & HAOP issue.

Coordination and interaction among the organizations in Sri Lanka are hardly seen and communication pathways are not open (Perera & Vos, 2007). In order to minimize this issue, a proper coordination mechanism should be developed through the NMWMTF among the government institutions and other stakeholders for a fruitful outcome.

As the leading agency, MEPA should enlighten relevant officials in stakeholder agencies, as well as all the technical staff of the MEPA itself, with regard to the IAS & the HAOP issue. Furthermore, awareness building of the MEPA technical staff on the current situation of the risks and the ongoing activities of the implementation process of BWMC is essential. This would lead to the efficient and inclusive involvement of the officials in the implementation procedure of the Convention.

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Annex i

Technical Guidelines for the implementation of the ballast water convention

Guideline	Subject
G1	Guidelines for sediment reception facilities
G2	Guidelines for Ballast Water sampling
G3	Guidelines for ballast water management equivalent compliance
G4	Guidelines for ballast water management and development of ballast water management plans
G5	Guidelines for ballast water reception facilities
G6	Guidelines for ballast water exchange
G7	Guidelines for risks assessment under Regulation A4-4 of the BWMC
G8	Guidelines for approval of ballast water management systems
G9	Guidelines for approval of BWM systems that make use of active substances
G10	Guidelines for approval and oversight of prototype ballast water treatment technology programs
G11	Guidelines for ballast water exchange design and construction standards
G12	Guidelines for design and construction to facilitate sediment control on ships
G13	Guidelines for additional measures regarding ballast water management including emergency situations
G14	Guidelines for designation of areas for ballast water exchange
2 Guidelines are under development stage at IMO on Survey guidelines and Port State Control under the BWM Convention.	

Annex ii

Responsibilities of the Stakeholder agencies of the Draft National Ballast Water Management Strategy in Sri Lanka

Stakeholder Agency	Responsibility
Marine Environment Protection Authority (Leading Agency)	Implementing national BWM Strategy Preparing national legislations for BWM Implementing of port state and flag state rules & regulations Leading the National Ballast Water Management Task Force and control and direct NBWMTF activities Monitoring implementation of NBWMS Monitoring implementation of national legislations Revision of NBWMS Execution of PBBS and risk assessment Execution of BWM inspection Introduce ballast water discharge notification system-online Participating and coordinating International & Regional meeting and carry out studies related to BWM
Merchant Shipping Secretariat (MSS)	Consulting to the lead agency Aware Sri Lankan ships requirement of ballast water management Assist to execute ballast water management inspections & CME Issue Approval for the Ballast Water management Plan. Issue certificates related to the BWM to ships flying with Sri Lankan flag Issue type approval certificate to BWTS after obtaining of recommendation of MEPA

Stakeholder Agency (Cont.)	Responsibility
Sri Lanka Ports Authority (SLPA)	Compliance Monitoring and Enforcement of the BWM of ships that enter to the Sri Lankan Ports. Giving permission to ships with respect to the ballast water reporting forms. Cooperation with the PBBS to carry out research on HAOP Awareness building of ship owners on implementation of ballast water management activities who visits to Sri Lankan ports.
National Aquatic Resources Researches and Development Agency	Consulting to the lead agency Assist to carry out the PBBS Carry out studies related to the economic and environmental impact of marine invasive species Reporting of the invasive species detected
Universities	Consulting to the lead agency Assist to carry out the PBBS Reporting invasive species detected.
Coast Guard Department of Sri Lanka	Controlling the ballast water discharge in certain areas
Ship building and ships repair yards	Provide sediment reception facilities to the ships Coordinating the installation of ballast water treatment equipment to the ships Coordination with the lead agency
Ship owners Association	Coordination of the installation of BWMTS to the ships with the relevant agencies Reporting the activities to the lead agency Coordination with national and international shippers on the implementation of ballast water management methods

Stakeholder Agency (Cont.)	Responsibility
Ceylon ship Agents Association	Assist to MEPA on ship inspection activities Completion of the online ballast water notification form.
Maritime Universities and Colleges	Educate seafarers regarding ships BWM requirement, BWMP and related legal instrument. Update with latest requirement
Department of Fisheries	Control IAS from aquaculture activities Aware fishermen on IAS issues
National Aquaculture Development Agency	Control IAS from aquaculture activities Awareness building of the fish farmers on IAS issue
Ministry of Environment- Bio Diversity Secretariat	Consulting to the lead agency Control land based invasive species and integrates with the NBWMS.
Tourism Development Authority	Consulting to lead the agency Assists lead agency to raise awareness building
NGOs	Assist to the PBBS Raising awareness on the IAS issue among the Shippers
Ministry of Agriculture	Control land base invasive species Integrated the activities with the NBWMS
Ministry of Fisheries	Controlling of invasive species that introduce through fish farming Educate fishermen on impacts of invasive species Consulting to lead agency

Annex iii

Current Acts and Policies prevailing on the ocean governance in Sri Lanka.

Sector addressing	Legal instruments
Marine Environment Protection	Marine Pollution Prevention Act No. 35 of 2008
	National Environment Policy (NEA),
	National Wetland Policy – 2005 (NWP)
Conserving Living marine Resources:	National Bio-Diversity Policy – 2009
	National Flora and Faua Protection Ordinance No.2, 1937, (recent amendment-2009)
	National Aquatic Resource and Research Act No. 54 of 1981 (NARRA)
	National Wild Life Conservation Policy-2006 (NWLCP)
	National Bio-Safety Policy – 2000 (NBSP)
	Fisheries Act No. 2 of 1996 (FA)
	Fisheries Sector Development Strategy
Conserving Non-Living marine Resources	Coast Conservation Act no. 58 of 1982
	Integrated Coastal Zone Management Plans (ICZMP)
Shipping Sector	Coast Guard Act No. 41 of 2009 (CGA)
	Merchant Shipping Act No. 52 of 1971

Annex iv

List of Officials contacted to collect information on BWM in Sri Lanka

	Name of the Officer	Institute	Interview/e-mail title
1	Dr. Terney Pradeep Kumara	Marine Environment Protection Authority	MEPA activities on BWM
2	Dr. H. B. Asanthi	University of Ruhuna	PBBS
3	Mr. Manjula Hettiarachchi	Colombo Dockyards (PLC)	Sediment Reception facility
4	Mr. Nilantha Piyadasa	Marine Environment Protection Authority	Legal Background of BWM in Sri Lanka
5	Mr. Ajith Ratnayake	Ceylon Shipping Cooperation	Shipping sector information
6	Ms. Rashmi Karannagodage	Ceylon Shipping Cooperation	Shipping sector information
7	Ms. Mihirani Subasinghe	Marine Environment Protection Authority	Ecosystem monitoring in Sri Lankan waters
8	'X' officer	Sri Lanka Ports Authority	SLPA information on BWM

Annex v

Glossary

"Active Substances" means a substance or organism, including a virus or a fungus that has a general or specific action on or against harmful aquatic organism and pathogens (IMO, 2009).

"Biogeographic region" is a large natural region defined by physiographic and biologic characteristics within which the animal and plant species show a high degree of similarity. There are no sharp and absolute boundaries but rather more or less clearly expressed transition zones (IMO, 2009).

"Ballast Water Management Plan" means the document referred to regulation B-1 of the Convention describing the ballast water management process and procedures implemented on board individual ships (IMO, 2009).

"Donor Port" means Port or location where the ballast water taken onboard (IMO, 2009).

"Prototype ballast water treatment technology" means any integrated system of ballast water treatment as under regulation D-4 of the Convention, participating in a program for testing and evaluation with the potential of meeting or exceeding the ballast water performance standard in regulation-2 including treatment equipment, all associated control equipment, monitoring equipment and sampling facilities (IMO, 2009).

"Recipient Port means" Port or location where the ballast water is discharged (IMO, 2009).

"The Convention" means the International Convention for the Control and Management of Ships' ballast water and sediments (IMO, 2009).

"Viable organism" means organisms and any life stages thereof that are living (IMO, 2009).