Implementation of the Ballast Water Management Convention, 2004 – Background Information on the Subject and Enforcement Procedures

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The views expressed herein are those of the author and do not necessarily reflect the views of the Government of Brazil, the United Nations, the Nippon Foundation of Japan, National Oceanography Centre, or those of Brazil's Navy.

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Abstracts

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The introduction of non-indigenous species is considered the fourth largest hazard for the world's oceans, along with onshore sources of contamination, overexploitation of marine resources and the physical alteration or the destruction of marine habitats, causing severe social, environmental and economic impacts. According to IMO data, approximately 15% of non-indigenous species are known to cause disorders with major ecological and/or economic impacts. Besides that it can be a threat to the public health once alien species may act as a mean of spreading diseases. As main vectors of introduction and spreading of non-indigenous species described to the marine environment are the ballast water of ships, biofouling and aquaculture.

On February, 2004, the ''International Convention for the Control and Management of Ships' Ballast Water and Sediments'' was adopted, with provisions to regulate and control ballast water management to minimize the hazards to the environment, to public health, and to properties and resources in the transfer of living aquatic organisms worldwide in ballast water and ships' sediments. This Convention requires a ships' ballast water management based on two different standards. One is related to the exchange of ballast water in the mid-ocean and the other is called biological performance standard once it is based on organisms' concentration and indicator microbes.

While new technologies for applying D-2 standards are being approved by IMO / Administrations, a long discussion about how port State control officers and / or entities authorized to enforce the BWM Convention should verify ballast water management systems is also occurring within some IMO Subcommittees.

The main objective of this paper is to provide background information about this important theme and it also intends to provide a practical way to verify ships compliance to D-2 standard based on some current experiences developed or being developed in the world regarding to its implementation.

List of Figures

List of Tables

List of Annexes

Annex 1 Ballast Water Reporting Form.

Annex 2 Brazilian Communication to IMO with a summary of the Brazilian National Legislation on Ballast Water Management.

Annex 3 Main Brazilian Ports.

Annex 4 Report of the Imposition of a Control and Compliance Measure to Enhance Maritime Security - Brazilian Maritime Authority Norm for the Management Of Ships' Ballast Water (NORMAM-20/DPC).

Table of Contents

Part One – Non-indigenous Species and Ballast Water

More than 90% of the international trade is done by the sea, in terms of Brazil it reaches about 95% of the international trade. Once ships need to carry water in their ballast tanks mostly to keep the safety and the proper navigation itself and the water needed is caught from the surrounding ocean, it means that from an environmental point of view and in terms of biodiversity, natural barriers are being easily crossed among all distinct biogeographic regions in the world, what contributes to the homogenization of species, affect the ecological balance of aquatic ecosystems, facilitates the dissemination of diseases, among other possible impacts. Although different mechanisms of transference are recognized, ballast water global movement is certainly one of the most important.

Resulting impacts of the introduction and spread of alien species are being increasingly studied because of its relevance, magnitude, irreversibility and for being considered a form of pollution and a big threat to the environment, to the economy and to the human health (Castro, 2008). As a result, international organizations and Administrations around the world are mobilizing international organisms to act in order to avoid more harm and impacts and also to find global and uniform solutions to a very serious problem. In this regard, it is possible to say that some studies and efforts have begun to find solutions for this growing problem, as a result of the increased demand for international environmental actions directly relating to navigation and preservation of the marine environment (Castro *et al*., 2010). However there are some other proposed ways that are still being discussed in international forums like International Maritime Organization (IMO). It is important to highlight that there is a consensus about the theme and about the necessity of implementing solutions as soon as possible.

In order to understand the problem, this part of the paper aims to give brief and important information on shipping, invasive species and ballast water.

1.1 Brief comments about shipping

Sea transport has played a very important role in the world economy since early stages of economic development. As cited by Stopford in *Maritime Economics 3rd ed* (2009) and first published in 1776 in the well know *The Wealth of Nations* by Adam Smith, hereafter is reproduced a very elucidative text regarding to the efficiency of shipping even in primitive economies:

> *"(…) A broad wheeled wagon attended by two men and drawn by eight horses in about six weeks time carries and brings back between London and Edinburgh nearly 4 tons weight of goods. In about the same time a ship navigated by six or eight men, and sailing between the ports of London and Leith, frequently carries and brings back 200 ton weight of goods (…)".*

The first sea trade network known dated from 5,000 years ago and it was between Mesopotamia, which comes from a Greek word and means between rivers (Tigris and Euphrates), Bahrain and the Indus River in western India, to exchange their oil and dates for cooper and possible ivory from the Indus (Stopford, 2009). In modern-day, the area of Mesopotamia corresponds to the eastern Syria, southeastern Turkey, and most of Iraq.

Figure 1: First sea trade network (Mesopotamia, Bahrain and Indus River – western India)[1].

When talking about shipping probably the first memories that comes in mind for the majority of people is regarding to the 15th Century and its great European conquerors and their adventures, when Europe discovered the sea route to Asia. But, in fact, the shipping have always existed as a very efficient tool of economic growth. However, navigation within the Atlantic Ocean that happened during the 15th Century by European Countries certainly laid the foundation for a global sea trade network which would dominate shipping for the next 500 years (Stopford, 2009).

It is possible to say that shipping industry is omnipresent in the human history and from time to time the sea domination changes from one nation to another, Mesopotamia, Egypt, Phoenicia, Greece, Roman Empire, Norway with their fabulous "Vikings" ships were the first great maritime powers.

Initially, with a view to improve the safety, the navigation and to uniform procedures comprehensively, the first international agreements were adopted. Although the first maritime treaties date back to the 19th century, it was only after the Titanic disaster of 1912 that the International Safety of Life at Sea Convention (SOLAS) was adopted. This Convention still the most important treaty addressing maritime safety ever adopted.

As a common sense and being considered the best way to regulate probably the most international of world's industry by means of international treaties, several countries proposed that a permanent international body should be established to promote maritime safety more effectively, but it was not until the establishment of the United Nations itself that these hopes were realized. In 1948 an international conference in Geneva adopted a convention formally establishing IMO (the original name was the Inter-Governmental Maritime Consultative Organization, or IMCO, but the name was changed in 1982 to IMO[2]). So, it was only in the last century with the creation of the International Maritime Organization (IMO), what can be considered a very recent period, that shipping has been submitted to a continuous regulatory

[1] Figure based on Stopford, 2009 (figure 1.2, page 7).
[2] IMO website: http://www.imo.org/About/Pages/Default.aspx . Accessed on 4th of July, 2012

process that was initially related to their construction, equipments and safety. After that, IMO started focusing in the human element and so the environment.

Figure 2: IMO headquarters in London, UK (International Maritime Organization[3]).

1.2 Background information about non-indigenous species and ballast water

The magnitudes of events like hurricanes and earthquakes are easily visualised because their impacts are terrestrial and have direct bearings on human populations. Issues related to oceans and aquatic environments sometimes are hard to conceptualise (Ngoile, 1998).

The introduction of non-indigenous or invasive species is considered the fourth largest hazard for the world's oceans, along with onshore sources of contamination, overexploitation of marine resources, and the physical alteration or the destruction of marine habitats, causing severe social, environmental, economic and public health impacts. These introductions have become even more evident in recent decades as transit times have diminished and ballast water volumes have risen (Carlton & Geller, 1993).

Although the subject of marine pollution started to be discussed deeply in the seventies, and the spread of alien species in eighties, since the second half of the 20th Century, in a period called post-Industrial Revolution, the pollution of the seas has increased significantly drawing attention to the

[3] IMO website: www.imo.org . Accessed on 4th of July, 2012

matter (Camacho, 2007). However, unlike some other forms of ship-related pollution, like oil or chemical spill, the problem of transferring and/or spreading non-indigenous species and/or pathogens is the result of an activity inherent to the ships' operation (Leal Neto, 2007).

Scientists first recognized the signs of an alien species introduction after a mass occurrence of the Asian phytoplankton algae Odontella (*Biddulphia sinensis*) in the North Sea in 1903. But it was not until the 1970s that the scientific community began reviewing the problem in detail. In the late 1980s, Canada and Australia were among countries experiencing particular problems with invasive species, and they brought their concerns to the attention of IMO's Marine Environment Protection Committee (MEPC)[4].

There is also a very unique aspect when talking about aquatic species which is regarding to their boundaries in the sea that can be complex to understand (Zardus & Hadfield, 2005). However, this understanding is even difficult nowadays so by the long-distance transport of alien species by ships, attached on the hulls of vessels and hauling larvae and other invaders in ballast water (Carlton 1985; Carlton 1987; Williams *et al*., 1988 *apud* Zardus & Hadfield, 2005; Wonham *et al*. 2000 *apud* Zardus & Hadfield, 2005).

The potential of discharged ballast water to cause harm is recognized by the International Maritime Organization (IMO) and also by the World Health Organization (WHO). According to IMO data, approximately 15% of non-indigenous species are known to cause disorders with major ecological and/or economic impacts (OTA 1993; Ruiz *et al*. 1997), besides that and also a point of concern, there is also its role as a means of spreading bacteria that may cause epidemic diseases (ICS & INTERTANKO, 2000).

The introduction and spread of alien species also interfere in biodiversity and as cited by Whittaker *et al.* (2005): "*we are within a crucial phase in the development of conservation theory and strategy. There is general agreement that biodiversity is under assault on a global basis and that species are being lost at a greatly enhanced level (Lawton & May, 1995; Royal Society, 2003).*"

[4] IMO website: http://www.imo.org/ourwork/environment/ballastwatermanagement/Pages/Default.aspx. Accessed on 09 of May, 2012.

Figure 3: GloBallast poster[5]

1.3 Introduction and spread of non-indigenous species

After the introduction of alien species there are a lot of aspects described in scientific literature in order to understand in which ways they become an invader, some are related to its own physiological ability, some are related to the environmental conditions basically. However, the impact of an invader in the new environment can be measured at five levels (Parker *et al.*, 1999):

(1) Effects on individuals (i.e., mortality and growth);

(2) Genetic effects (i.e., hybridization);

(3) Population dynamic effects (abundance, population growth, etc.);

(4) Community effects (species richness, diversity, trophic structure); and

(5) Effects on ecosystem processes (nutrient availability, primary productivity, etc.).

[5] (Awareness materials from IMO Globallast Programme: http://globallast.imo.org/)

Rice (2007) in the workshop report “Invasive species data applications and data sharing across the Americas”, mentioned the subject this way:

“Invasive, non-native species constitute a major threat to native ecosystems and the biodiversity they contain. Such species can modify and disrupt crucial ecosystem processes, such as fire regimes, hydrology, and nutrient cycling. Furthermore, they can harm native species through direct competition, displacement, and predation or hybridization”.

There are many ways to introduce and transfer non-indigenous species among distinct biogeographic areas. In aquatic environments, ballast water have been pointed as a very important vector, probably the most important, as a function of its capacity to transfer huge volumes of water from very distant places within small periods of time. It is estimated that approximately 3.5 billion tons of ballast water are transferred globally each year, with a global water volume discharged in the open sea originating from ballast water exchange of 2.8 billions tons and that 7,000 species can be transported in a day in ballast water tanks (Endresen *et al*., 2003c; Endresen *et al*., 2004).

For millennia, natural barriers of oceans and landforms were able to provide essential genetic isolation and evolution maintenance of the diversity of species and ecosystems that comprise the biological wealth of the planet. In a few hundred years these barriers have become ineffective by combined circumstances that allow species to travel great distances to new habitats, where they can become successful invasive and start interfering with the natural dynamic isolation systems, sometimes causing the replacement of indigenous communities and/or the extinction of native species (Leal-Neto, 2007).

1.3.1 Definition of ballast water

There are few definitions of ballast water according to its context but quite similar in its meaning. Among these, there are the definitions for ballast water and ballast water management from the International Convention for the Control and Management of Ships’ Ballast Water and Sediments, 2004 (BWM Convention) which are reproduced hereafter once they are the most appropriate to this research:

- Ballast Water means water with its suspended matter taken on board a ship to control trim[6], list, draught, stability or stresses of the ship;

- Ballast Water Management means mechanical, physical, chemical, and biological processes, either singularly or in combination, to remove, render harmless, or avoid the uptake or discharge of Harmful Aquatic Organisms and Pathogens within Ballast Water and Sediments.

The word ballast is defined as any material used to give weight and or to maintain stability of a given object. As an example there are the sandbags in the traditional hot air balloons that are played out to decrease the weight allowing the balloon rising. Ships also require and use this gimmick to maintain security, boost your manoeuvres, draught and assist in offsetting losses of weight due to the consumption of fuel and water, to keep stability and acceptable levels of stress in the ships' structure (National Research Council, 1996). Used as counterweight during centuries, the ballast on ships was composed of solid material in the form of rocks, sand or metals. In modern times, ships began using water as ballast which greatly easier the task of loading and unloading a vessel, in addition to being more economical and efficient than the solid ballast. Thus, the ballast water should be regarded as essential for the maintenance of stability and safety of the vessel, being generally taken on board when the ship is unloading and discharged when the vessel carries goods. Figure 1 reproduces a classical figure from GloBallast Programme website and shows the balance between the cargo and the ballast water in order to keep ship safety.

[6] Trim is normally defined as the distribution of the load in a ship in such a way that it sits well in the water.

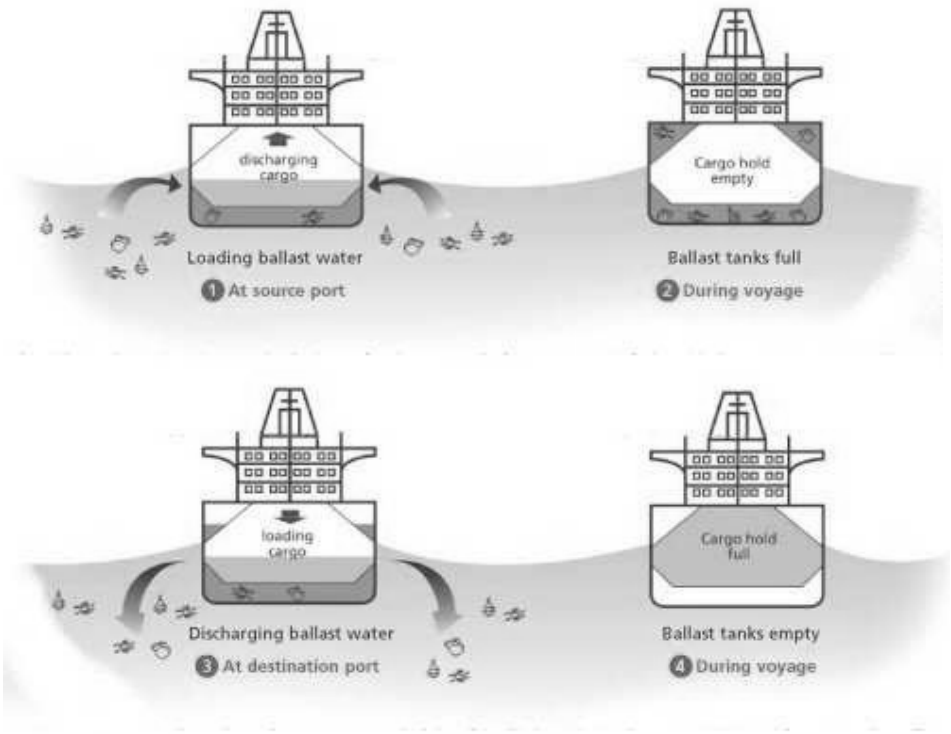

Figure 4: Ballast water cycle (from: http://globallast.imo.org).

1.3.1.1 – GloBallast

The Global Ballast Water Management Programme (GloBallast), initially called "Removal of Barriers to the Effective Implementation of Ballast Water Control Management Measures in Developing Countries" is a joint initiative from the Global Environment Facility (GEF) as funding agency, United Nations Development Programme (UNDP) as implementing agency and the IMO as the executing agency. The Phase 1 of the Programme began in 2000 with a view to prepare developing countries to the adoption of an International Convention on ballast water and also to give support for these countries to implement the voluntary guidelines provided in Res A.868(20). During this first phase six ports were chosen to represent major developing regions in the world, they were: Sepetiba, which the actual name is Itaguaí (Brazil), Dalian (China), Mumbai (India), Khark island (Iran), Odessa (Ukraine) and Saldanha (South Africa), in these ports a risk assessment analyses were developed. The first phase ended at last in 2004, when the Conference to the adoption of the Ballast Water Convention was rescheduled and really

happened, once the original idea was to adopt the international instrument in 2002, in which case the Programme was supposed to finish in March, 2003.

Demonstration Site	Pilot Country	Region
Dalian	China	Asia/Pacific
Khark Is	I.R. Iran	ROPME Sea Area & Red Sea
Mumbai	India	South Asia
Odessa	Ukraine	Eastern Europe
Saldanha	South Africa	Africa
Sepetiba	Brazil	South America

Figure 5: Demonstration sites and Pilot Countries of GloBallast Phase 1[7].

In 2009 started the Programme Phase 2, called Building Partnerships to Assist Developing Countries to Reduce the Transfer of Harmful Aquatic Organisms in Ship's Ballast Water, or simply GloBallast Partnerships. This Phase is already in course and is being implemented in five high priority sub-regions: Caribbean, Mediterranean, Red Sea and Gulf of Aden, the South East Pacific and the West Coast of Africa and one special new region, the South Pacific. The second phase is basically interested in supporting new policies regarding to ballast water, and legal and institutional reforms in areas not covered in the first period.

In the report of the VIII special meeting of Maritimes Authorities from the Operative Network for Regional Co-operation among Maritime Authorities from South America, Cuba, Mexico and Panama (ROCRAM) that occurred in parallel to the IMO 27th Assembly session, in 23-24 of November, 2011, it is mentioned the last meeting of GloBallast Partnerships in July, 2011, where a

[7] http://globallast.imo.org/

report on the results of the Workshop on Standardization of Methodology for the Control and Management of Ballast Water was elaborated. During this last GloBallast meeting it was proposed a guidance with aims to strengthen the capacities of the maritime authorities and environmental agencies of the countries in the region of the Southeast Pacific Permanent Commission (CPSS) composed of Chile, Peru, Ecuador, Colombia, Panama and Argentina. This report was so presented during the special meeting of ROCRAM as a guidance on harmonized standardization of methodologies for the control and management of ballast water from ships in ROCRAM region. Procedures provided are in accordance with the Ballast Water Convention (BWM Convention) and also with the IMO Res.868(20) and are related to the certificates required by the International Convention, there are also procedures to the exchange of ballast water in the mid-ocean, to the existence of a spreadsheet for the control and management of ballast water in order to create a common database and also one format to be used by the port State control officers. Furthermore, there are procedures related to the physical, chemical and biological sampling and suggested methodologies regarding to D-1 and D-2 standards of the BWM Convention. The second phase of GloBallast was planned to finish in 2014, however during MEPC 64 meeting (01-05 October, 2012), Mr Jose Matheickal, Head of Technical Co-operation Coordination & Major Projects of the Marine Environmental Division, announced that GloBallast Partnership are going to be extended till the end of 2016.

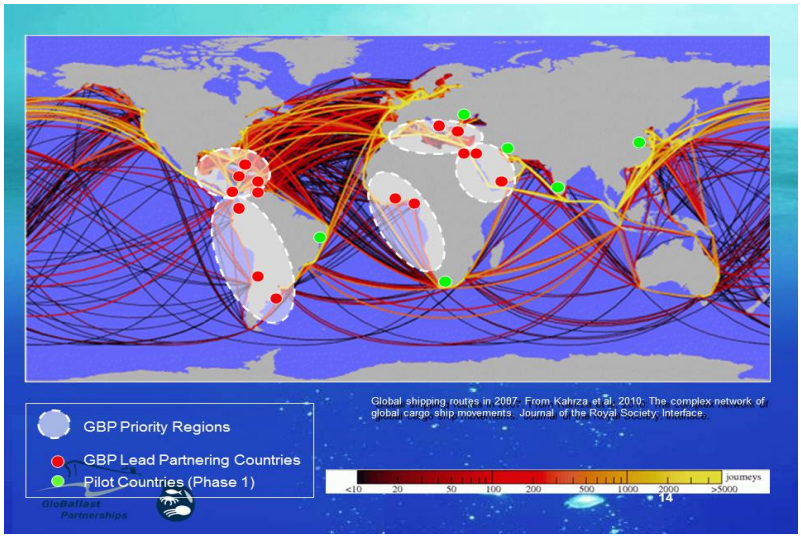

Figure 6: Priority areas for GloBallast Phase 2[8].

1.3.2 Environmental and economic consequences of invasive species

As described in scientific literature it is very complicated to quantify the environmental damage and loss of biodiversity due to alien species invasions worldwide by the fact that only 1.5 million species of 10 million estimated on earth are identified and described (Raven and Johnson, 1992 *apud* Pimentel *el al.*, 2001). Besides that, the total number estimated of introduced species to the United States, United Kingdom, Australia, South Africa, India and Brazil range from about 2000 to 50,000 species, as shown in table 1 (Pimentel *el al.*, 2001).

Alien species invasions in terms of economic losses are also difficult to quantify. There are few studies in literature with this intend. In Lodge *et al.*, 2006, it is said that there was, at that time, only one study to attempt a nationwide estimate of the economic costs to the United States of non-indigenous species, which concluded that the annual costs to U.S. exceed $120 billion. In this same paper, Lodge also refrains to others studies done in United States regarding to some individual species, like zebra mussels which alone cost each infested large power plant $3 million annually, and are still spreading throughout the waterways of the United States (Pimentel *et al.*

[8] http://globallast.imo.org/ ; Accessed on 5th of July, 2012

2005; Leung *et al.* 2002 *apud* Lodge *et al*., 2006; Drake & Bossenbroek, 2004 *apud* Lodge *et al*., 2006; Keller *et al*., 2009). According to the U.S. Government Accountability Office (GAO), the zebra mussel alone is estimated to have caused $750 million to $1 billion in damages between 1989 and 2000 (Nazarro, 2004 *apud* Oliveira, 2008). In 1999, it was estimated that approximately 50,000 alien species have already invaded all types of environments in the U.S., causing at that time an economic impact of more than U$138 billion per year (Pimentel *et al*., 2000 *apud* Oliveira 2008).

A new paper from Roethlisberger *et al*. (2012) used structured expert judgment and economic analysis to quantify annual impacts on ecosystem services[9] in the U.S. side of the Great Lakes basin of non-indigenous aquatic species introduced by ocean-going ships and determined that median damages aggregated across multiple ecosystem services were US$138 million per year, and there is a 5% chance that for sportfishing alone losses exceeded US$800 million annually.

From the Ecological Society of America Report (ESA, 2006) it is mentioned the case of seaweed *Caulerpa taxifolia* in two Californian lagoons, where more than $5 million were spent in the first three years of an on-going eradication program (Pimentel *et al*., 2005 *apud* Lodge *et al*., 2006). However, as mentioned by Lodge *et al.* (2009), the story of *Caulerpa* eradication near San Diego is a successful one and it is related not to a prevent policy but to its "*early detection, rapid response and eradication*", among others acts regarding to the prohibition of new specimen introduction.

In the European Union the damage attributed to toxic algal blooms to fishery, tourism and healthcare industries amounted to €584 million in 2005 (Graneli & Turner, 2008 *apud* Tsaloglou *et al*., 2011).

[9] This study focus on four ecosystem services that are important to the regional economy and for which reliable historical data are available. These are commercial fish landings, sportfishing participation, wildlife viewing, and raw water usage.

Table 1: Total number estimated of introduced species to the United States, United Kingdom, Australia, South Africa, India, and Brazil (Pimentel *et al*., 2001).

Table 1
Species number per category in the United States, United Kingdom, Australia, South Africa, India, and Brazil[a]

Category	United States		United Kingdom		Australia		South Africa		India		Brazil	
	Total species number	Alien species number	Total species number	Alien species number	Total species number	Alien species number	Total species number	Alien species number	Total species number	Alien species number	Total species number	Alien species number
Plants	42000 a	25000 a	27515 f	26000 f	20000 l	1952 m	24000 q	8750 r	45000 y	18000 z	55000 p	11605 ii
Mammals	346 b	20 c	54 g	17 g	296 l	20 l	247 p	16 s	316 p	30 aa	428 jj	25 kk
Birds	650 b	97 a	542 h	47 h	850 n	70 n	725 t	8 t	1221 bb	4 cc	1635 ii	3 ll
Reptiles and amphibians	247 b	53 a	80 i	48 i	700 o	20 o	394 u	24 u	741 dd	NA	985 mm	NA
Fishes (Freshwater)	938 e	138 a	54 j	12 j	216 o,p	29 o,p	220 v	20 w	2546 ee	300 ff	3000 mm	76 ii
Arthropods	650000 e	4500 a	24700 k	1700 k	85920 ii	150 ii	86000 w,x	NA	54430 gg	1100 hh	1000000 nn	NA
Microbes	134644 d	20000 e	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a] a: Pimentel et al., 2000; b: WRI, 1998; c: Layne, 1997; d: Palmer and Fowler, 1975; McKnight and McKnight, 1987; Horst, 1990; Fauquet, 1994; LaRoe et al., 1995; Hawksworth et al., 1995; e: estimated; f: Crawley et al., 1996; g: Matthews, 1982; Baker, 1990; h: Gooders, 1982; i: Frazer, 1983; j: Cacutt, 1979; Maitland and Campbell, 1992; k: van Lenteren, 1995; l: Emmerson and McCulloch, 1994; m: Davis et al., 1995; n: Long, 1981; Kitching, 1986; o: Fox, 1995; p: WRI, 1998; q: Russel et al., 1987; r: van Wilgen and van Wyk, 1999; s: Kruger et al., 1989; t: Cock and Koch, 1991; u: Siegfried, 1989; v: Stuart and Adams, 1990; w: Anon., 1989; x: South Africa, 1998; y: Sharma et al., 1993; z: Saxena, 1991; aa: Species Diversity, 1998; Mammals Checklist for India, 1998; bb: WCMC, 1998; cc: Saini and Kaur, 1986; dd: www.emb/-heidelbergde/vetz/living.~reptiles.htul, 1998; WCMC, 1998; ee: WCMC, 1998; ff: Talwar and Jhigran, 1991; gg: Ghosh, 1994; hh: Gupta, 1985; ii: Vitousek et al., 1997; jj: Harcourt and Sayes, 1996; kk: Mares et al., 1989 (calculation based on data); ll: Sick, 1993; mm: Brazil Diversity, 1998; nn: G.S. Rodrigues, Personal Communication, Embrapa Meio Ambiente, Brazil, 1999.

In a study from Capers *et al.* (2007) in 103 lakes from Connecticut (USA) to find out about scale-dependent patterns in native and invasive species richness, surveys shown a total of 87 native aquatic plant taxa and eight invasive species. Invasive species were recorded in samples in a total of 63 lakes (61%). Besides that, results provided further evidence that negative correlation between native and invasive species richness does not occur universally, and that resistance may be limited to communities in which high density leads to competitive exclusion.

As mentioned by Lodge *et al*. (2006), Costello *et al*. (2007) and others, there are few studies in order to quantify economic losses due to non-indigenous species. Besides that, assessments of the effectiveness of attempts to reduce non-indigenous species (NIS) and the consequent economic impacts arising from policies like these, while rare, are crucial for evaluating the efficiency of current approaches to environmental management and for identifying strategies to improve policy responses (Costello *et al*., 2007).

In terms of environmental and ecological losses, the impacts of invasive alien species on native species are also poorly understood. Accumulating evidence shows that invasive plant species can lead to genetic erosion of natives directly through hybridization and gene infiltration, besides that exotic species can also alter genetic diversity of natives indirectly through habitat fragmentation and modification. On the other hand, some studies show that native species, while interacting with invasive species, may exhibit a series of evolutionary events such as adaptation, speciation or extinction (Lei *et al*., 2010).

As an example of how alien interferes in local economies, it is mentioned the large Asian gastropod (*Rapana venosa,* Valenciennes, 1846) a predatory mollusc native to the Sea of Japan, Yellow Sea, Bohai Sea and the East China Sea to Taiwan. This species was discovered out of its native biogeographic range in the Black Sea, and it has subsequently spread throughout the Sea of Azov, and the Aegean, Adriatic and North Seas (ICES, 2004). In North America the first register of *R. venosa* was made in Chesapeake Bay, United States of America, in 1998 (Harding & Mann 1999 a*pud* Mann &Harding, 2003). In South America, the first report of rapa whelks

was in Rio de la Plata estuary (Pastorino *et al*., 2000). This generalist predator usually feeds on bivalves of economic interest like oysters, mussels and clams (Harding & Mann 1999 a*pud* Mann &Harding, 2003, Savini *et al.* 2004 a*pud* Gilberto *et al*., 2006), and has been identified as the prime reason for the collapse of several banks of mussels and oysters in the Black Sea (Drapkin 1963 *apud* Gilberto *et al*., 2006; BSC,2008[10]).

There is also another branch of economy that has been affected by alien species and it is related to technological development. All proposed treatments are associated to new technologies or at least to new applications of known technologies as UV, known by its long use to disinfection of drinking water. So, as others ways of pollution, there is also a business opportunity associated.

1.3.3 The role of invasive species – Classical cases

Several studies were developed in the world intending to understand which patterns allow species to become invaders. Some of these species are normally cited when invasive species are been discussed, either because these are well known cases, or because of their major impact in the ecosystem and/or in the economy. However, some invasive species have become so notorious that when talking about this subject, we are also urged to talk about them.

Zebra mussel - the zebra mussel (*Dreissena polymorpha*, Pallas, 1769) a small eurasian freshwater mussel was introduced into the Great Lakes in the mid 1980's (Hebert *et al*. 1989 *apud* Ricciardi *et al*., 1997). Without predators and/or competitors infested the American rivers and occupies at least 40% thereof. It is a fouling specie, that hauling rocks, piers and pipes of industries throughout the region.

Zebra mussel is one of at least 57 alien species introduced by ocean-going ships that have become established in the Great Lakes, which includes also quagga mussel (*Dreissena bugensis,* Andrusov, 1897), round goby (*Apollonia melanostomus*), and spiny waterflea (*Bythotrephes longimanus*)

[10] Comission on the Protection of Black Sea against Pollution: http://www.blacksea-commission.org/_publ-SOE2009.asp . Accessed on 13th of August, 2012

(Ricciardi, 2006; Rothlisberger *et al.,* 2012). With more than 35 million people living in the Great Lakes (GL) basin, ecosystem services from the GL benefit a large number of households and communities, and are part of a substantial regional economy (Austin and others, 2007 *apud* Rothlisberger *et al.,* 2012).

From the U.S. Geological Survey home page (NAS - Nonindigenous Aquatic Species) it is possible to observe zebra and quagga mussel distribution updated daily (Figure 2) and a sort of information about these two successful invaders. It is also informed in the home page that according to cited studies: "*the quagga mussel must have arrived more recently than the zebra based on differences in size classes and it seems plausible that the quagga is still in the process of expanding its nonindigenous range (May and Marsden 1992, MacIsaac 1994). In the 1990's, the absence of quagga mussels from areas where zebra mussels were present may have been related to the timing and location of introduction rather than physiological tolerances (MacIsaac 1994). The quagga mussel is now well established in the lower Great Lakes. This species is found in all of the Great Lakes, but has not been found in great numbers outside of the Great Lakes. This could be due to a preference for deeper, cooler water found in the Great Lakes region as compared to the zebra mussel (Mills et al. 1996)*"[11].

Besides that, as cited by Wong *et al.* (2012), the quagga mussel is now the first known occurrence of an established population in the western United States and the first known infestation of a large water body not previously infested by the zebra mussel.

[11] http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/ . Accessed on: 2nd May, 2012.

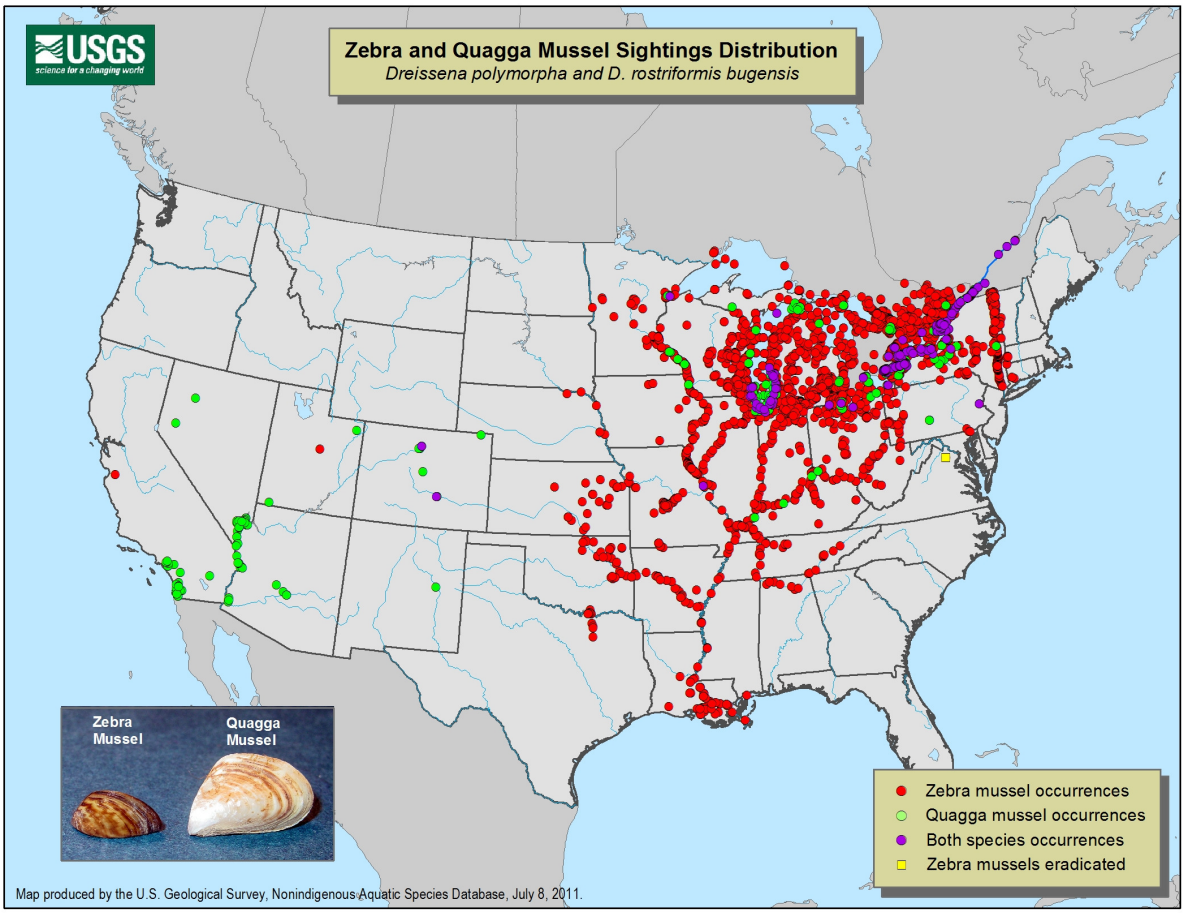

Figure 7: Zebra and Quagga Mussel Sightings Distribution in United States of America.[12]

One point that is intriguing researchers is related to the recent and rapid spread of both *Dreissena* species in Europe and North America and the subsequent impacts. This exponential increase also was reflected in the exponential *Dreissena* research efforts, resulting in many of publications with regards to the vectors and mechanisms of spread, environmental limits, biology, physiology, ecological and economic impacts and control methods of these invaders (Karatayev *et al.*, 2012).

Mnemiopsis leidyi (A. Agassiz, 1965) - A classic example of biological invasion that occurred in the Black Sea, with severe environmental and

[12] http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/maps/current_zm_quag_map.jpg . Accessed on: 2nd May, 2012.

economic impacts. According to the literature, this comb jelly is originally from the east coast of the United States and Caribbean Sea and was probably introduced by ballast water, generating huge impact on the primary resource sector of the region until then, the anchovy, leading to irreparable damage and significant economic losses (GFCM, 1993 *apud* Lopes, 2004). After *M. leidyi* has been accidentally introduced in Black Sea in the 1980s, it has spread rapidly through the Caspian Sea in the 1990s and has most recently invaded the Baltic Sea. This specie is a voracious carnivore, competing with fish, small crustaceans and zooplankton in the European seas.

The introduction of this invader in the Black Sea waters highlights one of the most dramatic scenarios resulting from the combination among biological invasion, eutrophication and overfishing, resulting in total misfit of the pelagic food chain in the region (Leppäkoski & Mihnea, 1996; Zaitsev & Ozturk, 2001 *apud* Skolka & Preda; Mee *et al*., 2005 *apud* Skolka & Preda, 2010; Faasse & Bayha, 2006). As pointed out by Leppäkoski & Mihnea (1996) stressed systems are known to present a shift from predominance by large, native benthic species to small exotic pelagic species. The authors also highlighted that, at that time, *M. leidyi*, seemed to be playing the role of being "small, exotic and pelagic" in the Black Sea.

Skolka & Pedra (2010) using literature data and personal field observations presented an overview of aquatic animal alien invasive species at the Romanian Black Sea coast as shown in Figure 3.

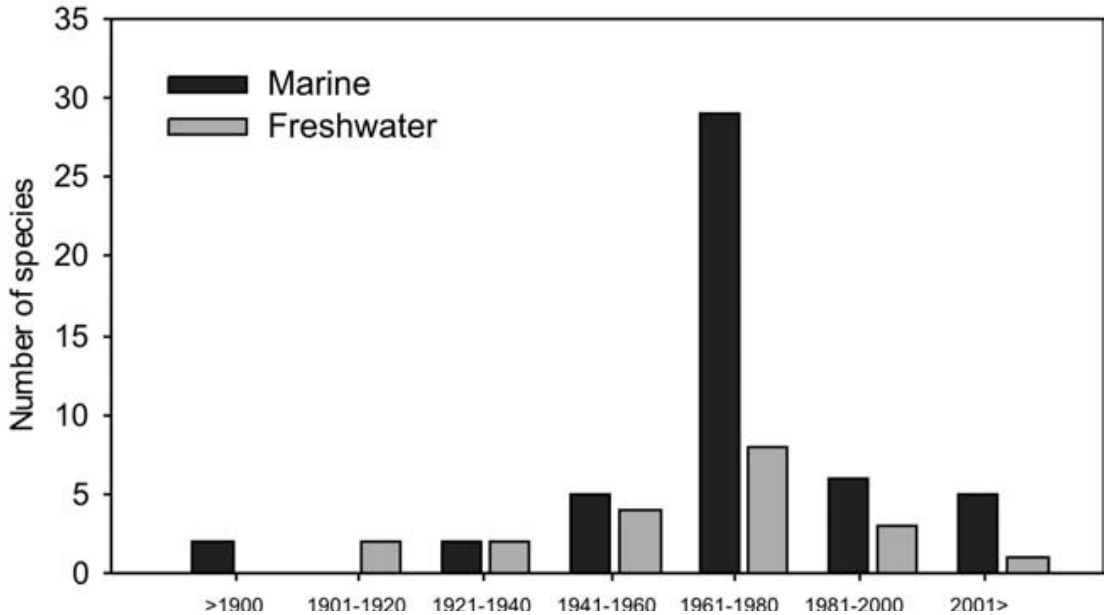

Figure 8: Number of marine and freshwater alien invasive species mentioned at the Romanian Black Sea Coast after 1900 (Skolka & Pedra, 2010).

Golden mussel - In Brazil, we are living with a very successful invader called golden mussel (*Limnoperna fortunei*, Dunker, 1857) since its first register at the end of 1998 in the Guaíba Lake Basin, Rio Grande do Sul State, Brazil (Mansur *et al*., 2003). After that, this specie was register for the the Patos-Mirim Lagoon Complex (Capitoli & Bemvenuti, 2004). Figure 9 shows part of Brazil South Region, where first specimens were located. This mussel is native from rivers in China and Southeast Asia, and it was introduced in 1991 in La Plata River probably brought in ballast water tanks ships from Korea and Hong Kong (Pastorino *et al*., 1993). Through navigation on the Paraguay-Paraná system it was spread out in the Upper Paraguay River Basin, where it was first observed in 1998 in the Paraguay River near the city of Corumbá (MS), State where is located the major part of Pantanal[13] (Oliveira *et al*., 2004). As noted by Belz (2006) there is an interesting aspect that associates the invasion and spread of *L. fortunei* in South America with

13 The Pantanal of South America is one of the most immense, pristine and biologically rich environments on the planet. Often referred to as the world's largest freshwater wetland system, it extends through millions of hectares of central-western Brazil, eastern Bolivia and eastern Paraguay. With its extraordinarily concentrated and diverse flora and fauna, and a landscape spanning a variety of ecological sub-regions, the Pantanal stands as one of the world's great natural wonders. (From: www.pantanal.org, accessed on 16th of May 2012)

the spread of the zebra mussel, *Dreissena polimorpha*, in Europe and in the U.S., which is the fact that the dispersion have occurred primarily through connected waterways and became much slower in disconnected environments (Johnson & Carlton, 1996; Karataev & Burlakova, 1995 *apud* Belz, 2006).

Together with *Corbicula fluminea* (Muller, 1774) and *Corbicula largillierti* (Philippi 1811), *Limnoperna fortunei* is the third kind of freshwater bivalve to invade South America via the estuary of the La Plata River (Darrigran & Pastorino, 1995; Avelar *et al*. 2004 *apud* Capitoli *et al*., 2008). This specie is able to attach to hard substrates, causes serious damage to aquatic ecosystems and also to the functioning systems for water catchment, as observed in North America as consequence of the invasion of *Dreissena polymorpha* (Capitoli *et al*., 2008).

Figure 9: Part of South Brazilian region where first registers of *L. fortunei* occurred (Guaiba Lake basin and Patos-Mirim Lagoon Complex)[14].

In a study from Mansur *et al*. (2003) quantitative samples were taken in a interval of two years at various localities around the area where first individuals were located and it was found out that *L. fortunei* had increased in number to a maximum density of 27,275 individuals/m² one year and five months after the first register to 62,100 individuals/m² two years later. In November 2000, two years after the appearance of the species in Guaíba Lake, it was recorded the first macrofouling in the pipes catching water for the city of Porto Alegre and in filters and pipelines of one cellulose industry in the Municipality of Guaíba. It is also described its preferential occurrence on rhizomes of rushes, initially forming flat clusters that grow to large mass, fixed on the shells and soft parts of native bivalves and on shells and operculum of gastropods, preventing full closure of these molluscs.

Several non-native freshwater molluscs have been introduced to South America, as noted by several authors, and some of them are considered invasive species, like the *Corbicula fluminea* as cited before (Darrigran, 2002). However, among these, *L. fortunei* is considered the most aggressive invader in this Continent, once it is the only freshwater bivalve in the region with a planktonic larval stage that attaches in high densities to hard substrates (Darrigran, *op.cit.*). As mentioned this invasive species also impacts on man-made structures (Darrigran & Damborenea, 2005, 2006 *apud* Darrigran & Damborenea, 2011; Darrigran, 2010 *apud* Darrigran & Damborenea, 2011) in the same way that happened in Japan (Ohkawa *et al*., 1999; Matsui *et al*., 2001; Nagaya *et al*., 2001; Goto *et al*., 2001; Matsui *et al*., 2002, all references *apud* Darrigran & Damborenea, 2011). The golden mussel may cause damages that range from a variation in the benthic community composition by removing native molluscs and increasing the abundance and distribution of other groups such as Oligochaeta, Hirudinea, several crustaceans, Chironomida, and Nematoda Turbellaria, up to changes in the food chain trophic, where species are benefited at the expense of others

[14] Figure adapted from Niencheski *et al*., 2001 and Window & Niencheski, 2003.

(Silva, 2006). Several authors recall *L. fortunei* characteristics to become a successful invader, among them, there are its tolerance to a wide range of environmental conditions as salinity and temperature and also its reproduction pattern / fecundity as represented in table 2. Its current distribution in South America is represented in figure 10.

Table 2: Golden mussel environmental thresholds (Darrigran, 2002; Silva, 2006).

Parameter	**environmental thresholds**
Salinity	0-12
Calcium	3.96 mg/L
pH	6.2-7.4
Temperature Larval development Adult survival	 16-28ºC 8-35ºC
Oxygenic	>1.0mg/L
Air exposition	Up to 7 days

Figure 10: Current distribution of *Limnoperna fortunei* in South America, in red (from Instituto de Estudos do Mar Almirante Paulo Moreira – Marinha do Brasil[15]).

While changing existing habitat, the mussels, *Dreissena* or *Limnoperna* or any other invasive species provide new opportunities for other organisms. They affect trophic interactions and the availability of food for both pelagic and benthic species (Karatayev *et al*., 2012).

The recent rise of the Asian tiger shrimp off U.S Atlantic and Gulf of Mexico coasts has caused concern in scientists from United States Government. The United States Coast Guard (USCG) confirms nearly a tenfold jump in reports of this shrimp in 2011. As said by James Morris, marine ecologist from NOAA and reproduced in the Marine link newsletter[16], it represents another potential marine invader capable of altering fragile marine ecosystems.

[15] Institute for Sea Studies Admiral Paulo Moreira - Brazil's Navy: http://www.ieapm.mar.mil.br/pesquisa/oceanografia/mexilhaodourado.htm, accessed on 14th of May, 2012

[16] http://www.marinelink.com/news/invasive-concerns-causing344254.aspx , accessed on: 2nd of May, 2012

The fact is that any alien species that are inoculated regularly in a yet altered ecosystem has the potential to cause harm to the native ones and may also bring effects to local's resources and thus bring environmental, economic and social effects.

1.4 Enforcement of Ballast Water Management Procedures in order to avoid Alien Species

In previous sections of this chapter attempt was made in order to show how alien species reach new habitats, a major mean of introduction and spread like ballast water, what kind of problem it causes and also some famous cases.

To avoid all known and unknown problems that we realized that alien species might cause, countries / international organizations introduced some practices in a tentative way of minimizing the problem. One of the first rules was adopted by United States of America in1990: The Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990 ("NANPCA"), amended by the National Invasive Species Act of 1996 ("NISA"), "*which authorizes the Coast Guard to develop a regulatory program to prevent the introduction and spread of aquatic nuisance species and requires the Secretary of Homeland Security to ensure to the maximum extent practicable that aquatic nuisance species are not discharged into waters of the United States from vessels. The statutes further stipulate that the Secretary may approve the use of certain alternative ballast water management (BWM) methods if she determines that those alternative methods are at least as effective as ballast water exchange (BWE) in preventing and controlling infestations of aquatic nuisance species. The Secretary is further required to direct vessels to carry out management practices necessary to reduce the probability of unintentional discharges resulting from ship operations other than ballast water discharge. NISA also requires the Secretary to assess and, if dictated by that assessment, to revise the Department's BWM regulations not less than every 3 years based on the*

best scientific information available to her at the time of that review, and potentially to the exclusion of some of the BWM methods"[17].

Like USA, other countries start applying their own rules, Australia, Canada, Chile, Israel, New Zealand, Brazil and various individual States within the USA and various individual ports around the world, such as Buenos Aires in Argentina, Scapa Flow in Scotland and Vancouver in Canada, and probably in a few others these days (www.globallast.imo.org)[19]. As a consensus it is believed that international shipping industry needs an international harmonized rule than unilateral ones, once the last might introduce concerns to shipping industry as a whole. In practice, ships are going to comply with several different rules disturbing their final activity and causing economic losses to shipping which will consequently reach final consumers.

When international maritime treaties are adopted and countries start complying with harmonized rules in order to achieve best practices regarding to safety, security or to the environment, despite the fact that some disturbance may occur in the beginning of the implementation process, treaties' purpose shall be reached. However, if an international consensus is not reached, it could cause legal uncertainties among others effects.

1.4.1 Port State Control (PSC) – General Activities

Each maritime State has two different roles, as a flag State and as a coastal State, in the first case it makes and enforces laws governing ships registered under its flag, being responsible for ships flying its flag wherever

[17] http://www.gpo.gov/fdsys/pkg/FR-2012-03-23/pdf/2012-6579.pdf . Accessed on 28th of May, 2012

[18] Globallast Partnerships: Legislation and Regulations: http://globallast.imo.org/index.asp?page=bwlegis.htm&menu=true. Accessed on: 28th of May, 2012

[19] Globallast Partnerships: Legislation and Regulations: http://globallast.imo.org/index.asp?page=bwlegis.htm&menu=true. Accessed on: 28th of May, 2012

they are. On the other hand, when acting as a coastal State, it enforces maritime laws on ships in its territorial waters, what is known as 'port State control' (Stopford, 2009).

As explained in Stopford (2009), the United Nations Convention on the Law of the Sea (UNCLOS, 1982) allows coastal States to legislate for the 'good conduct' of ships in their territorial seas, but not interfering with them. This Convention lists eight areas where this is possible (safety of navigation, preservation of the environment, control of pollution, among others). However, trying to avoid a dire situation in article 21 are listed all subjects to which coastal States legislation shall not apply (design, equipments, etc.). It seems obvious why these areas are not subject to coastal States' rules, otherwise ships would have to comply with a lot of different standards what in practice would be impracticable. However, according to the same author, it endorsed the coastal State's right to enforce international regulations and gave rise to the port State control movement, which started in 1978 when eight European States around the North Sea agree to inspect ships and share information about that (in 1982 this movement was formalized and the Paris Memorandum of Understanding has started with 14 European States). Currently the organization consists of 27 participating maritime Administrations and covers the waters of the European coastal States and the North Atlantic basin from North America to Europe, and aims to eliminate the operation of sub-standard ships through a harmonized system of port State control[20]. According to the Paris Memorandum of Understanding (MOU) website, more than 24,000 inspections take place every year in foreign ships.

[20] http://www.parismou.org/ . Accessed on 11th of May, 2012.

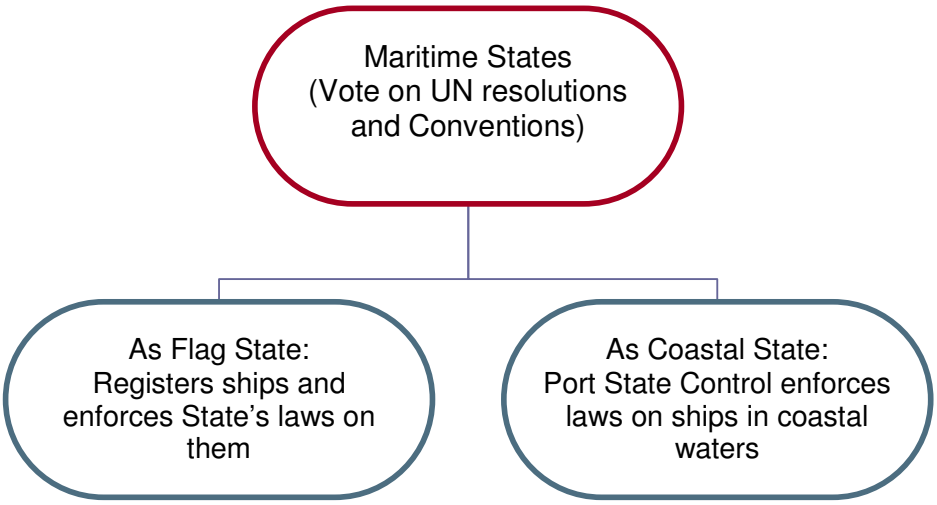

Figure 11: Maritime States playing its two roles as flag and coastal States (diagram adapted from Martin Stopford, 2009)

As defined in IMO website, *"Port State Control (PSC) is the inspection of foreign ships in national ports to verify that the condition of the ship and its equipment comply with the requirements of international regulations and that the ship is manned and operated in compliance with these rules".*

When a ship enters in a port, probably it will be subject to inspections (PSC) related to many shipping aspects, mainly related to safety and pollution control. The more relevant international Conventions and protocols are: Load Lines Convention 1966, Tonnage 1969[21], COLREG 1972[22], SOLAS 1974[23], MARPOL 73/78[24], ILO Convention No. 147[25] and STCW 1978[26], which was recently revised by the adoption of the Manila amendments, into force since 1st of January this year. There are other international Convention / Protocols which requirements might be verified, like the International Convention on Civil Liability for Oil Pollution Damage 1969, International Convention on the Control of Harmful Anti-Fouling Systems on Ships 2001, the International

[21] International Convention on Tonnage Measurement of Ships
[22] International Regulations for Preventing Collisions at Sea
[23] International Convention for the Safety of Life at Sea
[24] International Convention for the Prevention of Pollution from Ships
[25] ILO Convention nº 147 Merchant Ships (Minimum Standards)
[26] International Convention on Standards of Training, Certification and Watchkeeping for Seafarers

Convention on Civil Liability for Bunker Oil Pollution Damage 2001 and the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM).

In Brazil, there are seven major institutions that are involved in this process: Port Authority from each port, the Brazilian Federal Police, the Internal Revenue Service, the National Agency for Waterway Transportation (Antaq), the National Health Surveillance Agency (ANVISA), the Agricultural Surveillance, and finally, the Maritime Authority, primarily responsible for navigation safety and ships pollution control.

To avoid undue delay, IMO recommends the establishment of regional agreements once, as a matter of fact, when a ship is going to a country, there is a good chance to visit another country in the same region before its return voyage. With regional agreements to cover worlds' oceans, like memoranda or memorandum of understanding (MoU), countries in a same region can optimize their inspections' effort which is better for the inspection system and also to the ships. Currently there are nine agreements divided as follows[27],[28]:

[27] http://www.imo.org/blast/mainframe.asp?topic_id=159 . Accessed on 8th June, 2012

[28]

Name of Agreement	Member States
Tokyo MOU (Asia Pacific region)	Australia, Canada, Chile, China, Fiji, Hong Kong, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, Papua New Guinea, Philippines, Russian Federation, Singapore, Solomon Islands, Thailand, Vanuatu, Vietnam
Paris MOU (Europe & N. Atlantic region)	Belgium, Bulgaria, Canada, Croatia, Cyprus, Denmark, Finland, France, Estonia, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovenia, Spain, Sweden, United Kingdom, European Commission
Acuerdo de Viña del Mar (Latin American region)	Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, Ecuador, Honduras, Mexico, Panama, Peru, Uruguay, Venezuela
Caribbean MOU (Caribbean region)	Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Bermuda, British Virgin Islands, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Montserrat, Netherlands Antilles, Saint Kitts & Nevis, Saint Lucia, St. Vincent and the Grenadines, Suriname, Trinidad & Tobago, Turks and Caicos Islands
Mediterranean MOU (Mediterranean Sea region)	Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Palestinian Authority, Tunisia, Turkey
Indian Ocean MOU (Indian Ocean region)	Australia, Bangladesh, Djibouti, Eritrea, Ethiopia, India, Iran, Kenya, Maldives, Mauritius, Mozambique, Myanmar, Oman, Seychelles, South Africa, Sri Lanka, Sudan, Tanzania, Yemen
Abuja MOU (West & Central African region)	Angola, Benin, Cameroon, Cape Verde, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Liberia, Mauritania, Namibia, Nigeria, Senegal, Sierra Leone, South Africa, Togo

- Europe and the north Atlantic (Paris MoU);
- Asia and the Pacific (Tokyo MoU);
- Latin America (Acuerdo de Viña del Mar);
- Caribbean (Caribbean MoU);
- West and Central Africa (Abuja MoU);
- the Black Sea region (Black Sea MoU);
- the Mediterranean (Mediterranean MoU);
- the Indian Ocean (Indian Ocean MoU); and
- the Riyadh MoU.

1.4.2 Acuerdo de Viña del Mar

Brazil is part of the Latin America agreement "*Acuerdo Latinoamericano sobre Control de Buques por el Estado Rector del Puerto Viña del Mar – 1992*" or simply Acuerdo de Viña del Mar[29]. This agreement was elaborated in November of 1992 during the sixth meeting from the Operative Network of Regional Cooperation among Maritime Authorities of South America, Cuba, Mexico and Panama (ROCRAM) and was initially signed by Argentina, Brazil, Colombia, Chile, Ecuador, Mexico, Panama, Peru, Uruguay and Venezuela. Gradually new Member States were incorporated, like Cuba (1995), Bolivia (2000) and finally Honduras (2001), ascending to a total of thirteen Maritime Authorities. The main objective and the commitment made by the Maritime Authorities of the region is to maintain an effective system of inspection in order to ensure that foreign ships visiting its ports are complying with International Conventions and its standards, regardless ships' flag.

Black Sea MOU (Black Sea region)	Bulgaria, Georgia, Romania, Russian Federation, Turkey, Ukraine
Riyadh MOU (Arab Gulf region)	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates

http://www.classnk.or.jp/hp/en/info_service/psc/mous.html. Accessed on 19th, June, 2012

[29] http://www.acuerdolatino.int.ar/ . Accessed on 8th June, 2012

Figure 12: Acuerdo Latinoamericano sobre Control de Buques por el Estado Rector del Puerto Viña del Mar – 1992[30]

In terms of technical cooperation, the members of ROCRAM[31], coupled with resources provided by UNDP and IMO, promote numerous activities aiming training and enhance technical qualities of Administrations' staffs related to maritime safety, prevention of pollution from ships, as well as increased knowledge of international conventions in the Americas and also to share information and experiences from its countries on implementation and to find common ways to do it regionally. So, every year many meetings, seminars and / or courses are promoted by ROCRAM always in compass with current international discussion. In this regard ROCRAM is planning to promote a capacity course on collection and analysis of ballast water on board in accordance with the IMO standards during 2012.

As a main achievement, ROCRAM intends to be a link to share and to enhance experiences and solve common problems of maritime sector. To achieve this goal this organization has focused in promoting group activities and plan joint activities in order to define positions and exchange the Maritimes Authorities' vision of maritime issues, especially in the IMO.

[30] http://www.prefecturanaval.gov.ar/web/es/html/dpsn_index_erp.php Accessed on 2nd of August, 2012.
[31] http://www.rocram.net/prontus_rocram/site/edic/base/port/inicio.php Accessed on 2nd of August, 2012.

The current Secretariat General for ROCRAM, biennium 2011-2012, is The Maritime Authority of Cuba and it is planned to change every two year.

Figure 13: Regional meeting on the harmonized implementation of the Ballast Water Convention, promoted by ROCRAM and IMO (Mr Dandu C. Pughiuc (IMO), Lt. Cdr. Maria Cecilia T. Castro (DPC/MB) and Captain (Ret) Fernando S. Nogueira de Araújo (DPC/MB)).

According to the 2010 annual report submitted to Flag State Implementation Subcommittee in 2012 (FSI 20), it was conducted a total of 8,584 PSC inspections in the area of the agreement, with 20,941 deficiencies and 107 detentions. Regarding to ship types, inspections were conducted mainly in bulky carriers (3,348), followed by general dry cargo ship (1,344) and containership (1,269). When considering all tanker types together it summed up to 1,477 inspections.

In Viña del Mar agreement there is a minimum inspection rate of 15% to be reached over different foreign ships that have entered in ports of such a State during a year. Inspections are to be done by PSC officers when Maritime Authority decides to, when there is a need or a report from another

Maritime Authority or when there is a report or complaint by the master or crew members, unless there are no grounds for such request. Maritime Authorities can also agree to carry out special inspection campaigns from time to time.

In the agreement is related what could be consider as good reasons to conduct a detailed inspection, besides others orientations which are common in this kind of document, such as which international instruments shall be observed, what kind of ship might have special attention and also an annex with all procedures to be done during PSC inspection and some complementary information.

1.5 Scope and Objectives

The main objective of this research is to present an updated background information on ballast water and to propose a practical guidance to be used by PSC officers / entities authorized in order to verify ships compliance to BWM Convention requirements, specially when considering the necessity of sampling for compliance with D-2 standard, taking into account the sampling guidelines (G2) to the BWM Convention and the accessories guidances under developing by the Ballast Water Correspondence Group established in the 15th session of Bulk Liquids and Gases Subcommittee, considering all changes done in the report during BLG 16, by the Ballast Water Working Group.

There is an urgent need to find feasibility and practical ways to verify ships compliance to D-2 standard, in order to provide to PSC officers means of sampling ballast water when Ballast Water Management Systems (BWMS) are not working properly or its survey is needed. This approach is to be applied by port States and / or other entities authorized to enforce the BWM Convention and may also be used for the survey of the ship under the BWM Convention by the flag State.

1.6 Overview of this Report

This report is composed by three main parts subdivided according its own needs to be detailed. In the first part it is presented an introduction to the subject that intends to show background information about alien species and ballast water, classical cases around the world and its environmental and economic consequences. In this regard there are also items in part one dedicated to the enforcement of ballast water management procedures in order to avoid alien species and aspects related to port State control activities, responsible to verify ships compliance. The report contains a part two that presents an overview of present international framework on non-indigenous species and ballast water, since the first time alien species were cited in UNCLOS till the adoption of a Convention in 2004 totally dedicated to non-indigenous species introduced and spread out by ballast water and sediments from ships (BWM convention). Besides that, this part two presents examples of worlds' unilateral legislation in this regard, mainly United Kingdom's regulation where the first phase occurred. It presents also an overview of some Brazilian Federal Laws related to the subject in a broader view and Brazilian unilateral regulation adopted in 2005, "Maritime Authority Regulation on Ships' Ballast Water Management". There is also summarized information about IMO guidelines on sampling (G2) and its additional guides under developing in IMO Bulk Liquid and Gases Subcommittee (BLG) and in the Flag State Implementation Subcommittee (FSI). Finally, there is part three dedicated to discuss the Brazilian experience on the matter until now and with regards to what is happening with respect to the problems caused by invasive species and related to the rules implemented and experience gained in the world. A tentative framework for ballast water inspection is presented and so a final part of recommendations and conclusions ends the Report.

Part Two – International Framework about Non-indigenous Species and Ballast Water

Legislation to deal with invasive species exists at international, regional and national levels. There are over 40 binding and non-binding instruments that deal with the movement of non-native species by land, air and water (Orchard, 2012). Among all international environmental instruments adopted, there are a few where alien species and ballast water are mentioned together. As long as this subject earned importance in the international scenario rather in function of its impacts or because many studies in the world were dedicated to it, this theme started appearing in a more specific way till 2004 when a whole IMO Convention was dedicated to invasive species through ballast water and sediments from ships.

The objective of this chapter is to introduce international instruments and regulations in which this paper theme is mentioned.

2.1 United Nations Convention on the Law of the Sea, 1982 (UNCLOS)

The first time alien species were mentioned in an international treaty was in the United Nations Convention on the Law of the Sea (UNCLOS), adopted in1982 and in force since 1994. In section 1 (general provisions) from Part XII, Protection and Preservation of the Marine Environment, Article 196 speaks about the use of technologies or introduction of alien or new species and stipulates:

1. *States shall take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto*.

2.2 Convention on Biological Diversity (CBD)

After that, in a more specific way, during the 1992 United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, and known as Earth Summit in Rio or Rio 92, this theme was directly addressed in Agenda 21[32], where it was requested to IMO and other international bodies the adoption of appropriate rules for ballast water discharge. Alien species were also referred in the Convention on Biological Diversity (CBD), adopted during the same Conference. In Article 8 is said (*In-situ* Conservation):

> *Each Contracting Party shall, as far as possible and as appropriate:*
> *(h) Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.*

With regards to oceans biodiversity, during the last Earth Summit in Rio which happened between 13 and 22 of June, 2012, twenty years after UNCED and called Rio +20 because of this, the final report affirmed that countries recognize the importance of the seas for poverty eradication, sustainable economic growth and food security, and undertake to protect and restore health, resilience and productivity of marine ecosystems to maintain biodiversity. Specifically regarding to invasive species it is said in item 164 of the final declaration:

"We note the significant threat alien invasive species pose to marine ecosystems and resources and commit to implement measures to prevent the introduction of, and manage the adverse environmental impacts of, alien invasive species including, as appropriate, those adopted in the framework of the IMO"[33].

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[32] A Programme of Action for Sustainable Development that contains the Rio Declaration on Environment and Development, a blueprint to rethink economic growth, advance social equity and ensure environmental protection, which recognizes each nation's right to pursue social and economic progress and assigned to States the responsibility of adopting a model of sustainable development. From: http://www.uncsd2012.org/ ; Accessed on 11th May, 2012.

[33] http://www.uncsd2012.org/content/documents/727THE%20FUTURE%20WE%20WANT%20-%20FINAL%20DOCUMENT.pdf . Accessed on 25th of June, 2012

Besides that, during Oceans Day celebrations, the Co-Chairs of The Oceans Day at Rio+20 that gathered over 375 participants from 169 organizations and 46 countries, call for strong and immediate action on oceans, coasts, and small island developing States (SIDS) and directly mentioned invasive species as a big concern to biodiversity, noting invasive species as a threat that can compromising the ability of the oceans to continue providing essential resources and services, exacerbating existing challenges to sustainable development and endangering the welfare of 183 coastal countries and affirm:

"Invasive species are one of the most significant causes of biodiversity loss and have been reported in 80% of the world's 232 marine ecoregions (IOC/UNESCO, IMO, FAO, UNDP, 2011)"[34].

2.3 Res A.774 (18) and Res A.868 (20) from International Maritime Organization

Regarding to the demand for international actions connected directly to the maritime safety and marine environment protection, IMO major issues, studies and efforts were started in order to find solutions to a problem of increasing dimensions (Castro, 2008). Initially, were adopted by the IMO Assembly two resolutions: Res A. 774 (18), in 1993, and Res A. 868(20), in 1997, with the purpose of avoiding the transfer of harmful aquatic organisms and pathogens.

The first resolution from 1993, called Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges, recalling Resolution 18 of the International Conference on Marine Pollution when MARPOL Convention was adopted in 1973, that called upon the World Health Organization (WHO), in collaboration with the IMO, to carry out research into the role of ballast water as a medium for the spreading of epidemic disease bacteria. It had the purpose to provide Administrations and Port State Authorities with guidance on procedures to minimize the risk from the introduction of unwanted aquatic

[34] http://www.globaloceans.org/sites/udel.edu.globaloceans/files/RioOceanDeclaration.pdf . Accessed on 25th of June, 2012

organisms and pathogens from ships' ballast water and sediment. It is interesting to note that at that time, almost twenty years ago, it was said in the text of the Guideline that all procedures to be adopted would depend on several factor, however ballast water exchange would be considered a short-term operational procedure once it had been shown to be effective and were accepted by Port State Authorities and Administrations. It was also said that it might be necessary to consider more effective solutions / strategies, possibly involving structural or equipment modifications to ships, for the longer term.

This Guidance lists some strategies to manage ballast water in order to prevent alien species, like non-release of ballast, ballast water exchange, ballast water management practices and the use of shore reception facilities. There is also a part dedicated to future considerations, in which it becomes clear that ballast water treatment would be the best way to proceed in this regard, it was already cited the treatment by chemicals and biocides, the heat treatment, oxygen deprivation control, tank coatings, use of filters, and ultraviolet light disinfection, many of them used in ballast water management systems currently approved. There is also a proposed form to be filled by ship's Master with some simple information regarding to the procedures adopted in a voluntary basis.

During the 20th Assembly, in December 1997, it was then adopted the Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens, Res A. 868(20) which revoked Res A.774(18). Major reasons to adopt news guidelines is said in the preamble of the new one and as acknowledgment by MEPC/Circ.288[35] "*that the existing Guidelines did not provide a complete solution towards the total prevention of the introduction of harmful aquatic organisms and pathogens (…)",* and the necessity of development of legally binding provisions on ballast water management together with proper

[35] This Circular was the MEPC recognition against guidelines' inefficiency and it was adopted in May, 1995. It is interesting to note that this Circular also mentions the necessity of sampling and analyzing ballast water and sediments according to prescribed scientific methods, matters still being discussed in BLG Subcommittee and, according to some Parties, the Achilles' heel of the BWM Convention, in other words, what is really hindering the entry into force of this Convention.

guidelines as requested by own resolution A.774(18). Besides that, it was also recognized at that time "(…) *that several States had taken unilateral actions by adopting legally binding provisions for local, regional or national application with a view to minimizing the risks of introducing harmful aquatic organisms and pathogens through ships entering their ports, and also that this issue, being of worldwide concern, demands action based on globally applicable regulation together with guidelines for their effective implementation and uniform interpretation".*

The idea was so to develop a legally bind regulation as a new Annex to MARPOL plus guidelines for their uniform and effective implementation with a view to their consideration and adoption in the year 2000.

The present resolution intended to be more comprehensive and it is presented in thirteen topics, related to the ships' operational procedures, training and education, dissemination of information, port State procedures and also regarding recording and reporting procedures. This resolution introduced the Ballast Water Reporting Form, which was adopted by several Parties when implementing their own rules, like Brazil, with some minor modifications[36].

According to this resolution it is possible to exchange ballast water in mid-ocean by two different ways, called sequential and pumping-through methods. the sequential method, is the one in which ballast tanks are pumped out and refilled with clean water and the flow-through method, in which ballast tanks are simultaneously filled and discharged by pumping in clean water at least three times the tank volume to guarantee its efficiency.

2.4 International Convention for the Control and Management of Ships' Ballast Water and Sediments

The ''International Convention for the Control and Management of Ships' Ballast Water and Sediments'', hereafter called BWM Convention, was

[36] The first time the Res A.868(20) form appeared in a Brazilian regulation (RDC 217, from the National Health Surveillance Agency) the form used was identical to the original one. Once a specific rule was adopted in Brazil by the Maritime Authority in 2005, it was agreed between these two Authorities that the form would be only one and that some minor changes were needed.

adopted on February 13th, 2004, with provisions to regulate and control ballast water management to minimize the hazards to the environment, to public health, and to properties and resources in the transfer of living aquatic organisms worldwide in ballast water and ships' sediments. This convention is not yet into force. It will only be enforced twelve months after the date on which at least thirty countries, the combined merchant fleets of which constitute not less than thirty-five percent of the gross tonnage (GT) of the world's merchant shipping, sign with no restrictions regarding ratification acceptance or approval, or have deposited the requisite instrument of ratification, acceptance, approval or accession. Presently, 36 countries signed as contracting parties, which represents 29.07% worlds' GT[1].

This Convention requires ships to have a ballast water management plan, a ballast water record book, and also requires ships to adopt a ballast water management that varies according to their volume capacities and dates of construction, as shown in table 3 (regulation B-3):

Table 3: Regulation B-3 from BWM Convention

Ship constructed before 2009

Ship Capacity - SC (m^3)	Standard	Year of Compliance
1500≤SC≤5000	D-1/D-2[2]	Until 2014*
1500≤SC≤5000	D-2	From 214 on*
SC<1500 SC>5000	D-1/D-2	Until 2016
SC<1500 SC>5000	D-2	From 2016 on

[1] (Status of BWM Convention on 28th of May, 2012 - http://globallast.imo.org/index.asp?page=announcements.asp#228. Accessed on 12th September, 2012

[2] Regulation D-1: Ballast Water Exchange Standard and Regulation D-2: Ballast Water Performance Standard.

Ship constructed in or after 2009

Ship Capacity - SC (m^3)	Standard	Year of Compliance
SC<5000	D-2	From 2009 on

Ship constructed in or after 2009 up to 2012

Ship Capacity - SC (m^3)	Standard	Year of Compliance
SC≥5000	D-1/D-2	Until 2016
SC≥5000	D-2	From 2016 on

Ship constructed in or after 2012

Ship Capacity - SC (m^3)	Standard	Year of Compliance
SC≥5000	D-2	From 2012 on

* These ships shall comply with these rules not later than the first intermediate or renewal survey, whichever occurs first, after the anniversary date of delivery of the ship in the year of compliance with the standard applicable to the ship.

Is it provided in the BWM Convention also the possibility to ask for an exemption to any requirements from regulations B-3 or C-1[39], according to regulation A-4, granted by the Party on their jurisdictional waters, but only in some situations as in case when it is granted to a ship or ships on a voyage or voyages between specified ports or locations, or to a ship which operates exclusively between specified ports or locations, like fixed routes. According to the regulation these grants are effective for a period of no more than five years subject to intermediate review. Exemptions are granted when ships do not mix ballast water or sediments others than between the ports or locations specified in the exemptions and when exemptions are granted based on the Guidelines on risk assessment developed by the IMO (G7[40]).

[39] Regulation B-3: Ballast Water Management for Ships and Regulation C-1: Additional Measures

[40] Resolution MEPC.162(56): Guidelines for Risk Assessment under Regulation A-4 of the BWM Convention (G7). Adopted on 13 July, 2007

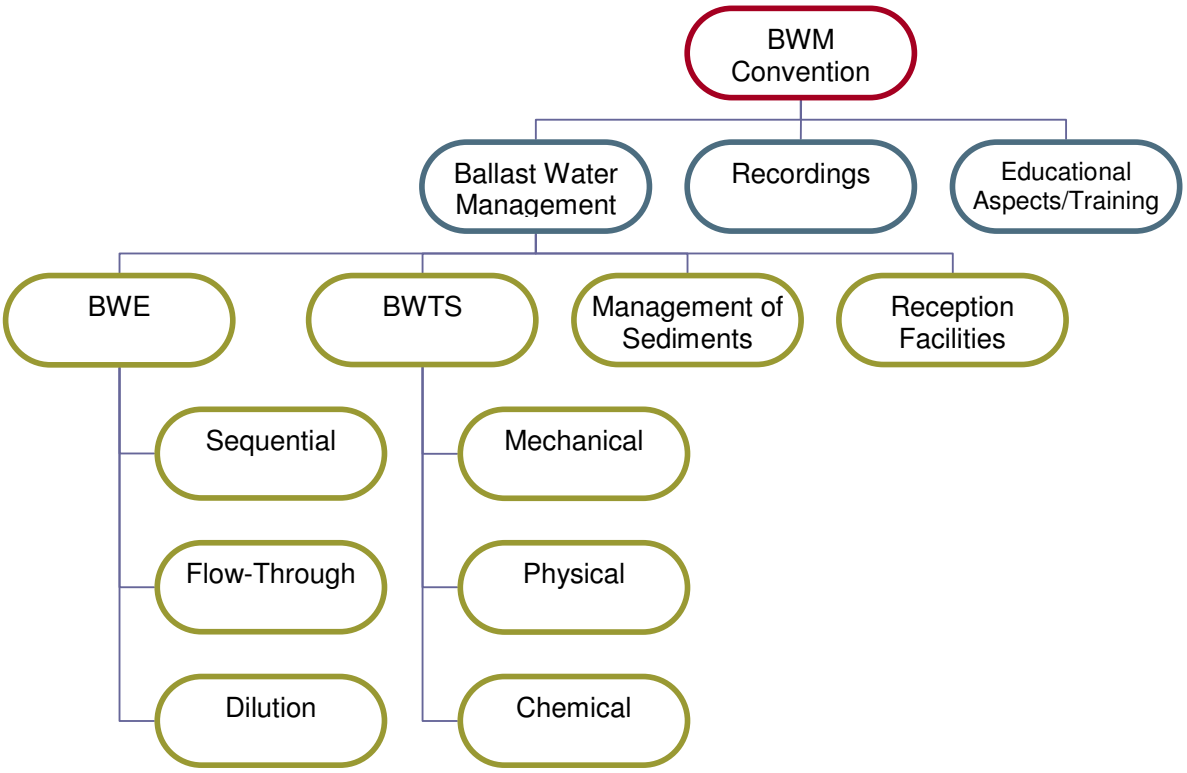

Figure 14: Major requirements from BWM Convention in a diagram framework.

2.4.1 Considerations about D-1 standard

The D-1 standard is based on the procedure to exchange ballast water taken in coastal habitats where ports are usually situated which may be fresh water, salt water or brackish water for mid-ocean waters with higher salinities and lower temperatures. In this process species that normally live in coastal habitats are discharge in the open ocean and are replaced by species that usually occur in the open ocean. Due to changes in the water's chemistry, mostly temperature and salinity, the organisms from the mid-ocean would be less likely to survive once they are going to be discharged into the near shore receiving waters as so the organisms from coastal zones into the open sea. Since IMO started discussion on invasive species this kind of procedure was mentioned as a possible way of avoiding introduction and spread of these species. However, once the procedure can be affected by external conditions specially relating to the weather and sea state, besides the fact that testing

ships compliance to D-1 standard is quite difficult, since the first time it was mentioned, the necessity of developing treatment systems was also noted.

2.4.1.1 Guidelines on Ballast Water Exchange by International Maritime Organization (G6)

As pointed out in item 2.4.1, the called D-1 standard is to be achieving through the ballast water exchange (BWE). In international regulatory frameworks it is normally required to occur 200 nautical miles from the nearest land in depths of 200 meters or more, and in some situations BWE can occur at least 50 nautical miles from the nearest land in water at least 200 metres in depth.

IMO recognizes three methods to perform the BWE, which were evaluated and accepted by the Organization[41]:

Sequential method – a process by which a ballast tank intended for the carriage of ballast water is first emptied and then refilled with replacement ballast water to achieve at least 95 per cent volumetric exchange;

Flow-through method – a process by which replacement ballast water is pumped into a ballast tank intended for the carriage of ballast water, allowing water to flow through overflow or other arrangements;

Dilution method – a process by which replacement ballast water is filled through the top of the ballast tank intended for the carriage of ballast water with simultaneous discharge from the bottom at the same flow rate and maintaining a constant level in the tank through out the ballast exchange operation.

The third method mentioned was developed by Petrobras after the adoption of Res A.868(20), and it is called the Brazilian Dilution Method for Ballast Water Exchange, being recognized by IMO as a possible way to exchange ballast water.

[41] According to Resolution MEPC.124(53): Guidelines for Ballast Water Exchange (G6), adopted on 22nd July, 2005.

(a) (b)

(c)

Figure 15: The three IMO recommended methods to ballast water exchange: a) sequential, b) flow-through and c) Brazilian dilution method. (Photos: Petrobras).

As said in the BWM Convention and also in G6, ships performing BWE in accordance with this regulation shall do so with an efficiency of at least 95 per cent volumetric exchange of ballast water and for ships exchanging ballast water by the flow-through method, pumping through three times the volume of each ballast water tank shall be considered to meet at least 95 per cent, it may be accepted to pump through less than three times the volume if ship demonstrates that at least 95 per cent volumetric exchange is met.

Besides BWE is being required as a possible method to minimize invasive species since the first BWM IMO resolution, it is known that this method don't guarantee the avoidance of new introductions or the spreading of species, once vessels performing ballast water exchange must achieve a

95% volumetric exchange of ballast water. There are also a number of safety conditions to be satisfied when performing BWE, so, in some situations under extraordinary conditions, such as adverse weather or equipment failure, the Master may take the decision not to perform ballast water exchange if he/she reasonably determines that in doing so the vessel's stability or safety of the vessel, its crew or passengers may be threatened. All procedures and decisions taken are to be note in the Ballast Water Record Book, provided in BWM Convention.

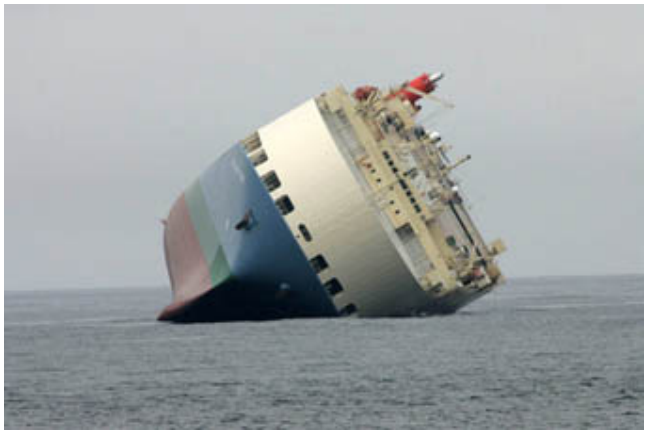

Figure 16: Photo of the M/V Cougar-Ace that while exchanging ballast at sea tumbled but didn't sink on a voyage between Japan and U.S and Canada west coast ports and which became a classical image regarding to safety operational aspects during the BWE.[42]

2.4.2 Considerations about D-2 standard

As proved by scientific studies, BWE can not provide the best way to avoid the introduction / spread of non-indigenous species either with regards to the method itself or when considering all the variables associated to the ship during its sea voyage. Since the first dedicated IMO resolution it is said that it might be considered more efficient solutions to avoid / stop the

[42] http://maritimeaccident.org/categories/ballast/ . Accessed on 31st of May, 2012 ;
The Cougar Ace is Ro-Ro auto carrier of about 650 feet, Singapore flagged. On July 23rd, it was headed from Japan to U.S. and Canadian west coast ports with a cargo of about 4,800 autos, when something went wrong during ballast water exchange operation. The 23 crew members were rescued alive by U.S. Coast Guard. (Photo: Kevin Bell / U.S. Fish Wildlife Service).

transference of species in the ballast water. So, it is correct to say that since the problem has appeared, proper technological solutions have been searched.

In BWM Convention are mentioned all organic indicators (according to organisms' minimum dimension and concentration and with regards to the presence of certain microbes) necessary to be tested in order to verify the ships' compliance to D-2 standard, as reproduced hereafter.

Table 4: Ballast Water Performance Standard

Organism / indicator	Regulation
viable organisms ≥ 50µm*	Discharge less than 10/m^3
viable organisms between 10µm* (included) and 50µm*	Discharge less than 10/ml
Toxicogenic *Vibrio cholerae* (O1 and O139)	with less than 1 cfu**/100ml or less than 1 cfu**/1g (wet weight) of zooplankton samples
Escherichia coli	less than 250 cfu**/100 ml
Intestinal Enterococci	less than 100 cfu**/100 ml

* minimum dimensions ;
** colony forming unit

While standards have became more stringent, equipments manufacturers started developing technology to compliance with, currently there are twenty BWMS which received final approval by GESAMP-Ballast Water Working Group[43], half of them are also type approved by their

[43] The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) is an advisory body, established in 1969, that advises the United Nations (UN) system on the scientific aspects of marine environmental protection.
The GESAMP – "Ballast Water Working Group on Active Substances", GESAMP – BWWG, or WG 34, was established in November 2005 to review any proposals submitted to IMO in preparation for the BWM Convention for approval of Ballast Water Management systems (further referred to as treatment systems) that make use of 'Active Substances'. WG 34 reports to IMO on whether such proposals present unreasonable risk to the environment, human health, property or resources in accordance with the criteria specified in the Procedure for approval of ballast water management systems that make use of Active Substances (G9) adopted by IMO under resolution MEPC.126(53). WG 34 does not evaluate the operation or design of the systems, or their effectiveness, only their potential for environmental and human health risks. In contrast with the hazard-based approach applied by WG1, the evaluation by

Administrations[44], not to mention all systems which have received basic approval and also those that don't use active substances and so can be type approved directly by their Administrations, which would result in about forty systems presently. However, as presented by Japan in MEPC 63 (February/March, 2012), regarding to the availability of ballast water management systems in ships controlled by Japanese shipowners and operators to comply with regulation B-3 from BWM Convention, the implementation of the Convention won't occur in a smoothly way as shown in a Japan paper when analysing the current situation in that country, presented as follows:

Table 5: Present status of ships, controlled by Japanese shipowners and operators, with regard to whether these ships have been equipped with BWMS.

Construction year	Number of ships	Ballast Less than 1,500	Water Between 1,500 and 5,000	Capacity (m^3) Greater than 5,000
	BWMS installed	0	2	3
Before 2009	BWMS not installed	10	41	777
	Total	10	43	780
	BWMS installed	4	3	6
Between 2009 and 2011	BWMS not installed	8	1	274
	Total	12	4	280
	BWMS installed	8*	1*	18*
After 2011	BWMS not	0*	1*	118*

G34 followed a risk-based approach. From http://www.gesamp.org/. Accessed on 07th June, 2012

[44] BWM.2/Circ.34, from 09th August, 2011.

	installed			
	Total	8*	1*	136*

* on orderbook (MEPC 63/2/17)

By analysing the Japanese data and also observed in the MEPC paper, the majority of ships in all categories are not prepared to comply with BWM Convention, mainly the bigger ones with capacities of more than 5,000m^3, which is also a matter of concern expressed by International Chamber of Shipping (ICS) during IMO meetings. The Marine Environment Protection Committee may think about alternative dates and/or ways to deal with the situation presented by Japan which probably reflects at least part of the problem to implement the Convention when it enter into force, what supposes not take long. Corroborating to its positions, Wright (2012) published an article where he estimates that approximately 70,000 ships over 400t will require to be outfitted with a functional certified BWMS by 2017.

2.4.2.1 Guidelines on Ballast Water Sampling by International Maritime Organization (G2)

The G2 guidelines[45] were the last one to be approved by MEPC and it only occurred in October of 2008 during MEPC 58. Even though, in its text is said that regarding to the complexity of the matter, there are still numerous issues to be decided so as the sampling and analysis methodologies to test for compliance with the Convention which are still in development and, at that time, there were no specific sampling or analysis protocols that could be recommended for Administrations to use. It is also said that an IMO circular was going to be developed as a high-priority matter, to provide sampling and analysis protocols to be followed and give advice on the uniform application of these protocols.

As noted in the preamble, these guidelines wants to provide Administrations including port State control (PSC) officers with practical and

[45] Resolution MEPC.173(58): Guidelines for Ballast Water Sampling (G2). Adopted on 10 October 2008

technical guidance on ballast water sampling and analysis for the purpose of determining whether the ship is in compliance with the BWM Convention as provided in article 9 "Inspection of Ships"[46], not addressing legal requirements.

G2 talks about sampling to compliance under D-1 and D-2 standards, although the BWE only be mentioned with regards to the necessity to specify appropriate points to collect samples and to note that it should be taken in-tank or in the discharge line. It also reaffirm that methods used to test for compliance with ballast water exchange requirements should be rigorously validated and widely distributed through the Organization.

When talking about D-2 standard, there still exist uncertainties regarding to the number of samples to be taken, volumes, where (tank or discharge line) and when to take them (in the beginning, middle or final a discharge and/or at fixed time intervals). Some aspects were defined, as that it is preferable to sample in the discharge line as near as practicable to the point of discharge, during the discharge, whenever is possible. Nonetheless other possible ways to sample are also discussed, like through the manholes and sounding or air pipes. These guidelines also present what principles should be observed when testing for compliance, highlighting the recommendation to procedure, as a first step, an indicative analysis of ballast water discharge to establish whether a ship is potentially compliant or non-compliant, once this kind of test can help the Party identify immediate

[46] **Article 9** *Inspection of Ships*
1- A ship to which this Convention applies may, in any port or offshore terminal of another Party, be subject to inspection by officers duly authorized by that Party for the purpose of determining whether the ship is in compliance with this Convention. Except as provided in paragraph 2 of this Article, any such inspection is limited to:
(a) verifying that there is onboard a valid Certificate, which, if valid shall be accepted; and
(b) inspection of the Ballast Water record book, and/or
(c) a sampling of the ship's Ballast Water, carried out in accordance with the guidelines to be developed by the Organization. However, the time required to analyse the samples shall not be used as a basis for unduly delaying the operation, movement or departure of the ship.
2- Where a ship does not carry a valid Certificate or there are clear grounds for believing that:
(a) the condition of the ship or its equipment does not correspond substantially with the particulars of the Certificate; or
(b) the master or the crew are not familiar with essential shipboard procedures relating to Ballast Water Management, or have not implemented such procedures;
a detailed inspection may be carried out.
3- In the circumstances given in paragraph 2 of this Article, the Party carrying out the inspection shall take such steps as will ensure that the ship shall not discharge Ballast Water until it can do so without presenting a threat of harm to the environment, human health, property or resources.

mitigation measures, if necessary. G2 contains an annex that, among others issues, includes a part 6 with recommendations to a PSC ballast water sampling kit, considering where the sampling is occurring.

2.4.2.2 Guidance on Ballast Water Sampling and Analysis for Compliance with the BWM Convention

Once the G-2 didn't bring all needed information regarding to sampling and analysis protocols and following what was provided in the own guidelines, MEPC 58 instructed the BLG Sub-Committee to develop, as a matter of high priority, an IMO circular to provide sampling and analysis guidance to be followed and to give advice on the uniform application of that guidance and the Committee also urged Parties to submit technical contributions in this regard.

A work group was then established in BLG Subcommittee to develop accessories guidance in order to cover those aspects which had remained incomplete. So, during BLG 15 (2011), following the same line of reasoning expressed in BLG 14 meeting and considering the *aide-memóire* developed in BLG 13, it was established a working group (WG) to further develop the BWM circular to provide ballast water sampling and analysis protocols and to give advice on the uniform application of these protocols, as determinate by MEPC. Due to time constraints, the group was unable to complete the hard task, so the Subcommittee decided to establish also a Correspondence Work Group with a view to completing the BWM circular.

The developing of a BWM circular was so divided in two documents taking in account a decision taken during BLG 15 with three specific sections: one covering the sampling proposals, one covering the background and technical issues needed to support these sampling proposals (which would be annexed to the first paper), and one containing the additional guidance for PSC.

During the correspondence phase there were three rounds of discussion and also an informal meeting during the MEPC 62, in October 2011. The following main issues were discussed during the intersessional phase:

a. Meaning of terms indicative and representative for both sampling and for analysis: The final text adopted the nomenclature "indicative analysis" and "detailed analysis" that seem self-explanatory terms, restricting the terms "representative sample" and "representative" to the protocol in use;

b. Introduction of concepts of small and large scale and how these are related to the indicative and detailed analysis, and representative sample;

c. Difficulties in obtaining representative samples. It is difficult to conduct a genuinely representative sample of the total discharged, thus, the sampling protocols should try to be as representative as possible in the time of inspection;

d. If the self-monitored BWMS can be used as indicative analysis;

e. The indicative analysis should be an independent PSC test;

f. The detailed analysis shall use biological parameters with a high confidence level;

g. It was discussed whether indirect measures may be indicative of non-compliance in the indicative analysis;

h. Regarding to the terminology, it was agreed that the focus should be on compliance to the standard D-2 than on sampling for compliance;

i. As a consensus it was defined that guidance should be proactive rather than restrictive in relation to sampling options and also that it was necessary to reduce the focus on the PSC in the main document (guidance on sampling and analysis);

j. Approaches to verify gross non-conformities may be used until specific sampling methods are developed and validated;

k. There was a discussion whether methods for testing the D-1 standard should be included in the detailed analysis. Since it is very difficult to test the ballast water exchange, this issued was overlooked;

l. Regarding to the samples volume, the idea was to set a given volume for all tests (according to the guidelines G8 and G9). However it was agreed that this is not possible, the volume to be sampled must be provided according to the selected methodology;

m. It was agreed that time consummated to perform indicative analysis and the time needed for resources or/and to perform detailed analysis should not be considered unduly delay; and

n. It must be well defined the relationship between the PSC inspection approaches (PSC tiered approach) and indicative and detailed analysis in both guides. A flowchart in this regard has been included first in the sampling guidance and it was next transferred to the additional PSC guidance.

By now, there are two BWM circulars called “circular to provide ballast water sampling and analysis protocols in accordance with the BWM Convention and guidelines (G2)”[47] followed by an annex with technical discussion for the guidance for sampling and analysis for compliance to the BWM Convention and an “additional PSC guidance” which was forwarded to the Flag State Implementation Subcommittee for evaluation and it is going to be discussed in the next meeting (FSI 21), planned to happen between 04 and 08 of March, 2013 according to the preliminary draft programme of meetings for 2013[48].

In a very brief way, it is possible to say that the sampling and analysis BWM Circular have the purpose of providing general recommendations on methodologies and approaches for sampling and analysis to test for compliance with D-1 and D-2 standards. Following a part of definitions, the circular lists some principles for sampling and analysis in order to identify the purpose of the protocol to be used.

There are important considerations about indicative and detailed analysis explained in the circular, which the main qualitative difference relies on the level of statistical confidence, significantly superior in detailed analysis.

The circular mention two approaches to conduct sampling. The first one is sampling the entire discharge from a vessel, which is very difficult to occur once this approach implies by definition that vessels wouldn’t discharge prior to sampling, large number of samples, large volumes and too much time. The second approach is to collect a representative sample of the ballast water being discharge during some chosen period of time. There are tables in the circular with a range of possible sampling approaches and methodologies to be used when testing ships compliance. There is also a comparative table that lists analysis type (indicative or detailed), size class or indicator microbe analysis method (flow citometry, Fluorometric diagnosis, etc) with the

[47] The current text is in a BLG working paper (BLG 16/WP.4) from 01st of February, 2012.
[48] IMO document: PROG/121/Preliminary, from 24 February 2012.

sampling approach (filter skid, plankton net, etc). It seems that the circular is actually very instructive in this regard and could be considered ready to use. The annex brings interesting information regarding the methodologies and approaches in both indicative and detailed analysis and also highlights advantages, disadvantages and limitations of cited methods.

From Maritime Authority / Administration perspective however there are still concerns regarding to possible unfair treatments that may happen once there are many ways to sample and analysis ballast water, besides that, concerns are also related to who is going to be the authorized personnel to conduct those procedures and also how long it is going to take, how ships are going to be enforced in a non-compliance event, etc. So, there are some important and practical issues that can not be solved only by the circular adoption. Part of the problem remains on IMO once PSC procedures are discussed in this forum, but, part of it may rely on the Administrations' reality.

The fact is that due to the complexity of the subject even after all the discussion in the BLG group, up to now the accessories circular have not finalized yet, although so much progress have been accomplished.

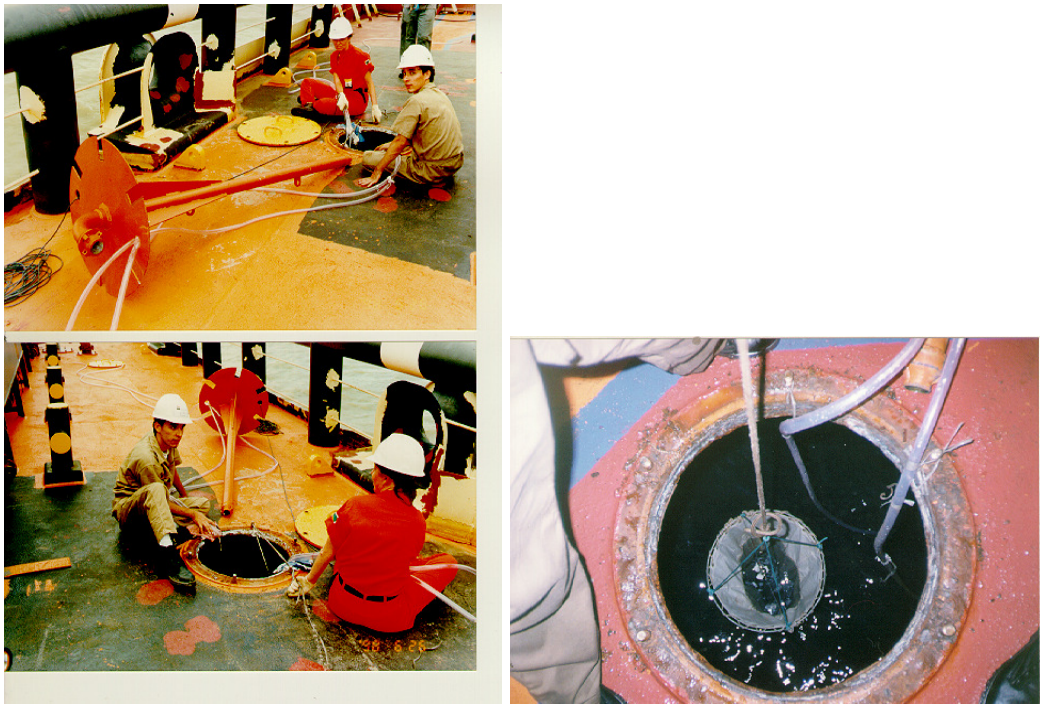

Figure 17: Sampling ballast water during an experiment in NT Lavras (Photos: Petrobras).

2.4.2.3 Additional PSC Guidance

This guidance was discussed also in the correspondence group for three rounds during the intersessional period. The main issues discussed are summarized hereafter:

a. Who does the analysis?

b. How detailed analysis fits in the PSC inspection?

c. What are clear grounds to the BWM Convention?

d. How identify clear grounds during the PSC inspection (initial inspection, detailed inspection, indicative analysis and detailed analysis)?

e. When deballasting should be interrupted;

f. When deballasting should be prohibited;

g. It was agreed that PSC should not test all indicators of D-2 standard;

h. If gross non-compliance is discovered during the indicative analysis, it can be used as evidence of non-compliance as long as the methodology used and results are sufficiently robust; and

i. It is necessary to strengthen criteria for situations when it might be needed to stop the ballast water discharge.

The additional PSC guide aims to provide PSC inspectors or entities authorized to enforce BWM Convention and also the flag State with a view prior to sampling, risk assessment, sampling team mobilization, management options for ballast water since the deballasting has been discontinued or prohibited by PSC, and regarding to the development of protocols for sampling and indicative and detailed analysis that can be used.

The PSC tiered approach described in the guide is like a four level inspection. In each phase, the non-compliance can be detected. The first stage, called initial inspection should focus on documentation and to ensure that there is a nominated officer responsible for the ballast water management and BWMS. If something is wrong, PSC officers (PSCO) move to the second stage, the detailed inspection, where the operation of the BWMS is checked and PSCO clarifies if the BWMS has been operated properly as required in the Ballast Water Management Plan (BWMP) and the operational conditions recorded during the type approval procedures. Sampling is likely to occur during the third stage with indicative analysis to determine whether ships are

exceeding D-2 standard and also if a detailed analysis is necessary to ascertain compliance. The last phase or fourth tier should incorporate a detailed analysis and a full-scale sampling to check compliance / non-compliance.

Four flow charts were submitted to describe the PSC tiered approach. First it was going to be part of the guidance on sampling and analysis, but when it was decided to diminish the focus over PSCO, the BWWG moved it to the additional PSC guide where it is clearly more adequate. The four proposals were sent to FSI Subcommittee to evaluation, in Brazil comments we supported the Australian proposal which is simple and direct. But whichever is chosen it is going to be quite useful and pertinent.

2.4.2.4 Availability of Technology related to Ballast Water Treatment System

As mentioned in item 2.4.2, the last MEPC circular on ballast water management systems that make use of active substances with basic and final approval, BWM.2/Circ.34 from 09th August, 2011, lists 20 BWMS with final approval, half of them also typed approved by the Administration and 34 with basic approval. There are also four systems that don't use active substances and so shall only to be type approved by their own Administrations taking into account the G8 guidelines, what has already happen.

During MEPC 64, between 1st and 5th of October, 2012, it was noted by the review group on ballast water treatment technologies (BWRG) that there are now available on the market 28 BWMS type approved.

Regarding to the treatment systems already available to use, there is a big concern if manufactures could attend for an increasing demand in a very short time, between the BWM Convention requirements for entry into force have been met and twelve months thereof. There are also concerns with regards to the surveys and certificates needed[49], as noted in MEPC paper "International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 – Implications of the entry into force for the

[49] Section E - Survey and Certification Requirements for Ballast Water Management. International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004

survey and certification of ships" (MEPC 63/2/20), submitted by International Association of Classification Societies (IACS), International Chamber of Shipping (ICS), International Association of Dry Cargo Shipowners (INTERCARGO), International Association of Independent Tanker Owners (INTERTANKO), International Parcel Tankers Association (IPTA), Oil Companies International Marine Forum (OCIMF) and NACE International.

In this paper, the co-sponsors note that the BWM Convention allows no phase-in period for ships constructed prior to the entry into force of the Convention to comply with the provisions relating to survey and certification for ships as happen in others IMO regulatory framework relating to marine environment protection, like MARPOL Annex 6 and AFS Convention. In this regard, they consider it will be impracticable for industry, and ballast water management systems, Administrations and their Recognized Organizations to prepare, review and approve BWMP and survey and certify all ships of 400 gross tonnage and above within twelve months, as required by the BWM Convention.

So the paper offers some ways forward to address mentioned concerns, highlighting that there are other possible ways to be discussed. The following were suggested by the group:

(a) IMO to issue a circular urging port States control officers (PSCO) to accept statements of compliance for an interim period until Ballast Water Management Certificates can be issued; or

(b) MEPC to issue a circular urging PSCO to accept unapproved BWMP on board for an interim period until approval of the BWMP can take place; or

(c) To allow the issuance of Ballast Water Management Certificates prior to entry into force, endorsed to state validity begins from entry into force date, combined with a statement issued to the Company when the BWMP was received thereby allowing the vessel to trade for an established period with unapproved BWMP on board.

Nowadays it seems that there is enough available technology but, on the other hand, there are major problems relating to its logistics.

2.5 Flag State Implementation Guidelines

The Flag State Implementation Sub-Committee was instructed by MEPC 52 to develop Guidelines on port State control under the BWM Convention and, in view of the significant volume of the work required, MEPC 61 had agreed to extend the target completion year to the year 2013.

The Sub-Committee was also in charge of developing Interim Survey Guidelines regarding to BWM Convention which had been concluded and approved during MEPC 55 by the adoption of BWM.2/Circ.7 (2006). These guidelines are expected to be transferred to the Harmonized System of Survey and Certification (HSSC) Guidelines[50] after entry into force of the BWM Convention and have the aim to facilitate the survey of ships which are requested by their Administrations or shipowners to certify compliance with the provisions of the BWM Convention.

Regarding to the task on developing BWM guidelines on PSC, the annex 3 from document FSI 19/6 presents a draft which is suppose to be evaluate in the next FSI meeting, together with the Additional PSC guidance submitted by the BLG BWWG. It is called “Draft IMO Guidelines for Port State Control Inspections for Compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004” and have the purpose of providing basic guidance for the conduct of a port State control inspection in order to verify compliance with the requirements of the BWM Convention. These guidelines are not addressed to provide ways of sampling and analysis ballast water, but in providing procedures to PSCO verify ships compliance, based on certificates issued, once PSC inspections are usually related to documental issues. It is clearly said in these guidelines that PSCO may require a representative sample (and analysis) of ballast water discharge when it believes to have clear grounds (listed in item 4.2) to request. It is also said in the draft that the PSCO shall ensure that there is a person recognized as being competent to sample according to IMO guidelines.

[50] Resolution A.997(25) “Survey Guidelines Under the Harmonized System of Survey and Certification, 2007”, as amended by resolution A.1020(26).

Initial and detailed inspections are also described, as well as detainable deficiencies. Regarding to sampling for compliance, there is a reference to the G2 and to the protocols / accessories guidance under developing in BLG Sub-Committee. In general terms it is a simple document really aimed to PSCO and based mostly on the inspection of the Certificates and Plans required by the BWM Convention.

As previously indicated these guidelines have not finished yet, but as the date of completion provided by the MEPC is 2013, it seems probable that the working group from FSI Sub-Committee will discuss the current draft during the next session (FSI 21) with a meaning to approve it and then submit to MEPC for adoption. During the next FSI the Additional PSC Guidance submitted by BLG is going to be evaluated also.

2.6 Examples of Worlds' unilateral regulations regards to Ballast Water

Invasive species first signal came from Europe, when the chinese diatom *Biddulphia sinensis* was discovered in the North Sea, in 1903. In 1910 the chinese mitten crab *Eriocheir*, which is now bringing some concern to United Kingdom (UK), was reported to German rivers, both species were considered to be carried in the ballast water (Carlton, 1996). But, as mentioned before, invasive species became a major concern in the 1980s with the appearance of zebra mussel (*Dreissena polymorpha)* in Great Lakes and the American comb jelly (*Mnemiopsis leidyi)* in Black Sea.

As introduced in Part One, some Countries started developing rules and procedures to be complied by ships while in theirs territorial waters as a way to minimize and to avoid new invasions, like USA, Australia, Canada, Argentina, Brazil and others. The current part is supposed to describe the UK present regulation with regards to ballast water and invasive species once the first phase of my fellowship was in Southampton and also the Brazilian rules on the subject for obvious reasons.

2.6.1 United Kingdom present regulation

UK is part of European Community and as a block they usually have regional rules / agreements regarding to different issues. When talking about environment rules it is not different. Regardless European regional agreements which are beyond the scope of this study, UK have some legislation with regards to alien species and ballast water. In the UK the Wildlife and Countryside Act (1981) is considered the major legal instrument for wildlife protection and consolidates and amends existing national legislation to implement the Bern Convention and the Marine Coastal and Access Act (2009) as the UK part of the EU's Marine Strategy Framework Directive (Orchard, 2012). Also in the literature review elaborated by Orchard, it is mentioned that in March 2001 a working group was set up to review invasive non-native species policy for England, Scotland and Wales, and as a result from this working group, it was settled down the GB Non-native Species Mechanism and the Invasive Non-Native Species Framework Strategy for Great Britain, launched in 2008 (GBNNSS, 2008 *apud* Orchard, 2012).

In a more strict view and considering this paper's theme, there is also a national regulation called "The Conservation of Habitats and Species Regulations, 2010", where is said:

"It is an offence for any person on board a ship in any relevant part of the marine area deliberately to introduce into the area, other than in accordance with paragraph 3[51]*, any live animal or plant of a kind having a natural range which does not include any area in Great Britain."*

The Maritime and Coast Guard Agency (MCA)[52], from UK Department of Transport, is the appropriate authority in UK to regulate subjects related to "safer lives, safer ships, cleaner seas", issues that represent its own mission. Actually, MCA usually issues rules by means of Maritime Notices (M Notices) publicised to the shipping and fishing industries, related to important safety,

[51] Paragraph 3 stipulates exceptions situations related to safety and reasonable steps to avoid a major prejudice to native flora or fauna.

[52] http://www.dft.gov.uk/mca/mcga07-home/shipsandcargoes/mcga-shipsregsandguidance.htm . Accessed on 22nd of April, 2012

pollution prevention and other relevant information. These M Notices are issued as:

• Merchant Shipping Notices (MSN) - often contain the fine detail of UK law and are legally enforceable when referred to by a Statutory Instrument;

• Marine Guidance Notes (MGN) - give guidance and strong recommendations about best practice to industry on interpretation of law and general safety advice; and

• Marine Information Notes (MIN) - provide less important time limited information and changes of address after which they expire.

There are also other ways to regulate subjects related to MCA:

- Statutory Publications - These are a mix of legally enforceable rules, together with guidance on the interpretation of those rules. They may be considered as MSN combined with Guidance for surveyors;
- Navigation Vessel Traffic Monitoring, Charts & Nautical Publications, Navigational Warnings;
- MCA Quality Assurance;
- Hire Boat Code;
- Instructions for the Guidance of Surveyors -these books contain the MCA's interpretation of the relevant regulations. They also contain practical details of design and testing requirements to be considered when approval for new ship board arrangements is requested;
- EC Directive on Technical Requirements for Inland Waterways Vessels;
- International Ship and Port Facility Security (ISPS) Code - Maritime Security Branch applies the MCA's International Ship and Port Facility Security (ISPS) policy;
- UK Ship Register - Flagging into the UK - the UK Ship Register - part of the Maritime and Coastguard Agency - is one of the best performing flags in the major Port State Control regimes with a reputation for maintaining the highest international standards;
- Categorisation of Waters;
- Construction and Equipment;
- Guidance and Regulations;

- Offshore Renewable Energy Installations - Windfarms, Helicopter Trials, North Hoyle Windfarm Report, Windfarm Shipping Route Template, and Guidance;
- Hydrography - Hydrography is broadly defined as "the measurement and description of the features of the sea and coastal areas for the primary purpose of navigation and all other marine purposes and activities";
- Navigation Safety Meetings - papers from the MCA Navigation Safety Meetings;
- International Maritime Organization (IMO) Documents;
- IMO Circulars;
- IMO Mandatory Instruments - information about decisions taken at the IMO that impact on internationally agreed mandatory regulations and Codes; and
- Formal Safety Assessment.

For the purpose of the present study, the standards most related are the ones issued by M Notices. As pointed out before, there are three different types of Marine Notice which are publicised to the shipping and fishing industries important safety, pollution prevention and other relevant information. All these notes have an indication whether documents are related to merchant ships and/or fishing vessels. The suffixes following the number are:

- (M) for merchant ship
- (F) for fishing vessels
- (M+F) for both merchant ships and fishing vessels.

Ballast water information's are present in a form of M Notices. Although there are some Maritime Notices regarding on Ballast Water (table 6), actually only two are into force, the Marine Guidance Note 81 (MGN 81), which draws attention to the IMO Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens, Resolution A.868(20), issued in 1998, and the MGN 363 about

"The Control and Management of Ships' Ballast Water and Sediments" from 2008. Both notices were issued to merchant and fishing vessels (M+F) and notice all Agents, Owners, Operators, Masters and Officers of Ships.

1. MGN 81

This M Notice refers to IMO Assembly Resolution 868, which revokes the previous resolution on this matter (A.774(18)), as mentioned before, and resumes what is required from ships regarding to ballast water and sediments from tanks, noting that those guidelines are not legally binding, but encouraging shipowners and shipping agents to ensure that vessels discharging in UK waters are in compliance with them. Besides that, this M Notice advises Masters to contact destinations ports to ascertain any local requirements relating to ballast water discharge, highlighting the existence of unilateral requirements.

2. MGN 363

This note draws attention to the deployments at IMO of the International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 and its guidelines. At the time this note was wrote (end of June 2007), only ten countries had ratified the Convention, what amounted 3.42% of world tonnage. In this M Notice is said that UK had the intention to begin the process of ratifying the Convention as soon as enough technology would be available to meet D-2 standards.

The note reproduces important parts of the cited instruments, specially the standards D-1 and D-2, the application dates of these standards provided in the Convention (regulation B-3) and also main requirements, like the implementation of a ballast water management plan, approved by Administration, with a remark that for UK Flagged Ships, the Ballast Water Management Plan approval would be delegated to Class Societies. The other main requirements explicit in the note, were the need to carry a Ballast Water Record Book, the phased implementations of the two performance standards, the guidelines related to the ballast water exchange in the middle of the ocean, the efficiency requirements related to the exchange of ballast water

and also about the performance standard to be achieved by Ballast Water Treatment Systems.

There is also a very important remark in MGN 363 which is related to the first application date, 2009. As explained before, it means that for ships constructed in or after 2009, with a ballast water capacity of less than 1500m^3 and between 1500 and 5000m^3, that date was the deadline to comply with D-2. So, when the note was issue, April 2008, MCA urged shipping agents, ship owners and master of UK Flag vessels to comply with 1997 IMO guidelines and also to begin preparing ships to comply with the BWM Convention requirements.

The MGN 363 also notes the guidelines which had been developed to support the BWM Convention. In this regard, the note mentioned two among the 14 guidelines developed as the most significant ones, G8 and G9, Guideline for the Approval of Ballast Water Management System and Procedure for Approval of BWM systems that make use of Active Substances respectively. In this regard, UK Type Approval of Ballast Water Management System, just as for the approval of Ballast Water Management Plans, would be delegated to Class Societies and the subject of a separate Maritime Notice.

Table 6: M Notices on Ballast Water[53] (Maritime and Coastguard Agency).

Type	Number	Distribution	Title	Date Published	Status	To be read with	Date Cancelled/Replaced	Replaced by	Author (Branch)
MSN	1394	M+F	Voluntary Guidelines for the Control of Ballast Water Discharges from Ships Proceeding to the St. Lawrence Seaway and the Great Lakes	01/09/1989	Cancelled				Marine Directorate
MSN	1532	M+F	Voluntary Guidelines for the Control of Ballast Water Discharges	01/08/1993	Cancelled				Marine Directorate
MSN	1533	M+F	International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges	01/08/1993	Replaced		01 August 1998	MGN 81	Marine Directorate
MSN	1662	M+F	Guidelines for the Control of Ballast Water Discharges from Ships Destined for Ports of Israel		Cancelled				Maritime Safety Agency
MGN	81	M+F	Guidelines for the Control and Management of Ships' Ballast Water to Minimise the Transfer of Harmful Aquatic Organisms and Pathogens	01/08/1998	Active				Environmental Quality
MGN	363	M+F	The Control and Management of Ships' Ballast Water and Sediments	01/04/2008	Active	MSN 81, MIN 282 & MIN 283			Environmental Quality
MIN	21	M+F	Research Project 354: Disinfection of Ballast Water	01/02/1998	Cancelled		31 January 1999		Central Support Unit
								Replaced by	Author (Branch)

[53] Maritime and Coastguard Agency: http://www.dft.gov.uk/mca . Accessed on 4th of May, 2012

Type	Number	Distribution	Title	Date Published	Status	To be read with	Date Cancelled/Replaced		
MIN	23	M+F	Research Project 361: Hazards from Ballast Water in UK Waters	01/02/1998	Cancelled		31 January 1999		Central Support Unit
MIN	105	M+F	Research Project 471: Scoping Study for a Formal Safety Assessment of Ballast Water Management	01/06/2001	Cancelled		30 June 2002		Technical Consistency
MIN	253	M+F	Brazilian National Legislation on Ballast Water Management for Ships	01/07/2006	Cancelled	MGN 81	31 July 2007		Environmental Quality
MIN	282	M	Ballast Water Legislation Update: Brazil & U.S. (Washington State)	01/03/2007	Cancelled	MIN 253	13 March 2008		Environmental Quality
MIN	283	M	Practical Guidelines for Ballast Water Exchange in the Antarctic Treaty Area	01/03/2007	Cancelled	MGN 81	13 March 2012		Environmental Quality
MIN	305	M+F	The Control and Management of Ships' Ballast Water and Sediments	01/10/2007	Replaced	MGN 81, MIN 282 & MIN 283	01 April 2008	MGN 363	Environmental Quality
MIN	346	M+F	Research Project 577: The Control of the Spread of Non Indigenous Species through Ballast Water.	01/04/2009	Cancelled		15 May 2010		Environmental Quality

Among all M Notices on ballast water issued by MCA, as seen in table 6, there are the Marine Information Notes (MIN) that always are issued with an expire date once it intends to spread limited information in time or changes in others MIN as previously observed. Among all issued, we observe that some of them aim to disclose unilateral regulations adopted by other Countries (Brazilian regulation on ballast water is the subject of two MIN), and some of them discloses about research projects and their expected results.

In the present moment, MCA is studying ways of implementing some procedures provided in BWM Convention and has hired a specialist in marine science, police and law to develop an exemption system on ballast water.

2.6.1.1 Discussion and interviews on UK rules and intentions

During my first phase in Southampton, I had the opportunity to talk to important people who were in any way involved to marine environmental subjects and regulation. Those people are Mr. Jonathan Simpson, Head of Environmental Policy from United Kingdom Maritime and Coast Guard Agency; Mr Rod Jones from the Chief Environmental and Safety Office of Royal Navy, Mr Adrian Lester from British Chamber of Shipping, Ms Anna Orchard who was in charge of developing an Exemption System to MCA, Mr Roland Rogers, a Marine and Environment Law and Policy Advisor from NOC, among other people mainly from NOC, what gave me a comprehensive understanding of how UK are leading with ballast water among others marine environment aspects. Meetings with Mr Simpson, Mr Jones and Mr Lester were reported and are reproduced hereafter.

Meeting with Mr Jonathan Simpson – Head of Environmental Policy (8th of May, 2012)

We met on Tuesday, 08th of May, 2012 at the National Oceanography Centre. Mr Simpson kindly came to the NOC following a request made by Mr Alan Evans, my supervisor at National Oceanography Centre, in order to talk about what Maritime and Coastguard Agency are doing or intend to do with

regards to ballast water inspections after the biological performance standard entry into force (and also the BWM Convention as a whole).

First of all we had a chat about different aspects of ballast water inspections, mainly related to difficulties in implementing fast and accurate ways of sampling and analysis of ballast water according to D-2 standard[54]. We also talked about the lack of environmental data, which seems to be concentrated only in some study areas, and the need of water samples to be representative of any volume loaded in the ballast tank once ships don't usually discharge all their ballast water at anchor. What happens in practice is that ships while entering ports / harbours are continuing discharging their ballast in order to keep ships' safety and manoeuvrability. Besides that, how samples are suppose to be analyzed? It seems that it will be necessary to send samples to labs where experts are able to verify samples relative to D-2 standard, as such there is a need to consider also the costs involved. There is other points in this regard, as Mr Simpson highlighted, that are related to the guarantee that samples are being preserved once taken from the ship to when they arrive at the lab, once the standard is based on a biological performance, and also all the aspects related to the custody chain.

After some discussion, we decided to focus on a questionnaire formulated by me, which was sent by Mr Evans to Mr Simpson in advance. All questions, eleven in all, are reproduced below and as long as they appear, the subjects discussed regarding to them are presented.

1- According to M Notices in force, it seems that the Ballast Water subject has been treated only in terms of flag State. Through those Notices,

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[54] **Regulation D-2** *Ballast Water Performance Standard* (From BWM/CONF/36)
1 Ships conducting Ballast Water Management in accordance with this regulation shall discharge less than 10 viable organisms per cubic metre greater than or equal to 50 micrometres in minimum dimension and less than 10 viable organisms per millilitre less than 50 micrometres in minimum dimension and greater than or equal to 10 micrometres in minimum dimension; and discharge of the indicator microbes shall not exceed the specified concentrations described in paragraph 2.
2 Indicator microbes, as a human health standard, shall include:
.1 Toxicogenic *Vibrio cholerae* (O1 and O139) with less than 1 colony forming unit (cfu) per 100 millilitres or less than 1 cfu per 1 gram (wet weight) zooplankton samples ;
.2 *Escherichia coli* less than 250 cfu per 100 millilitres;
.3 Intestinal Enterococci less than 100 cfu per 100 milliliters.

MCA advises their ships to comply with Res A.868(20), to accomplish the requirements from BWM Convention and also, to prepare themselves to obey to unilateral requirements. Is there any intention to issue M Notices related to PSC?

Yes, there is an intention to regulate this subject, however it is going to be done after MCA discuss with others Coast Guards / Maritime Authorities about the matter.

2- Does the PSC officer inspect ships in terms of Ballast Water nowadays? If so, which are the requirements and how PSC verifies ships compliance?

No, there are no specific rules / inspections in this regard.

3- MGN 81 draws attention to the Res A.868(20) from IMO. Once (as it seems) that MCA hasn't settled requirements in this regard yet, are there any procedures that ships coming to UK ports are asked to do in a voluntary basis?

MCA didn't establish any requirements, but some Ports are demanding procedures in a voluntary basis since no national rule has been established in UK yet. In this regard, Mr Simpson exemplified the requirement of an oil terminal in the Minch Channel which asks ships to exchange ballast water before entering the terminal. When exchange threaten the safety or stability of the ship because of adverse weather, ships are allowed to proceed to the terminal in order to wait for better weather conditions when then they are suppose to leave it again and exchange their ballast water.

4- As we know UK is not Party of Ballast Water Management Convention (BWM). Do you know if there is any intention to be part of it in a near future? Do you consider that technology available these days is enough?

Yes, the UK will be Party of the BWM Convention, but the idea is to be a Contracting Party only after the Convention comes into force. Regarding to the available technology, Mr. Simpson believes that there is enough technology nowadays, the problem would be how to supply, mainly for high ballast water ships.

5- How about the Ballast Water Management Systems? Do you intend to elaborate a specific Maritime Guidance Note on Ballast Water Management Systems in terms of inspection?

There is something in this regard from Lloyd's Register based on IMO guidelines. There is no intention, at this moment, to elaborate Maritime Notes related to inspections on Ballast Water Management Systems.

6- Are you aware if ships demanding UK ports (especially in Southampton port) are equipped with BWMS?

Yes, it has been increasingly noted that new ships are being equipped with BWMS, mainly container ships, and that these Systems are preferably based on active substances.

7- Have MCA ever imagine how to sample water from ballast water tanks in order to verify if ships are complying with the D-2 standard? Do you think PSC officers are capable to do that or it is going to be necessary a sampling team (as mentioned in the additional guidance to G2)?

This is a very complex subject that we had talked a lot in the beginning of our conversation. As pointed out by Mr Simpson, nowadays there are some procedures being developed in this regard, one of them, mentioned by him is a kind of filter which is supposed to be installed in ballast water pipes which lead the treated water out of the tank (during the discharge, once this is the better situation to sample) in order to store treated ballast water. This filter can be used as a representative sample of the ballast water tank and should be

analyzed by an expert in the lab. Of course it is not as simple as it seems, there are concerns about representativeness, about samples feasibility, about samples quality until its arrival in lab and also related to how much it is going to cost and how long it is going to take until results are provided. Added to all mentioned concerns, there is also a bigger one: with all possible faults listed, there are evidences showing that many penalties applied by Maritime Authority would possibly be contested and so decided in Courts of Justice.

8- How your Environmental Policy might act in this regard?

As previously discussed, there is no MCA policy related to ballast water at this moment. MCA is concerned about the matter and wants to discuss the subject with different maritime authorities before implementing an enforcement policy in this regard.

9- In all M Notices I have read, there is no specification related to the enforcement and prosecution of non-compliance ships? Do you intend to stipulate any fees or detention for ships to enforce them to act in such way to avoid alien species introduction and/or spread?

Mr Simpson explained that M Notices don't bring this kind of information. Legal penalties like detention and fees are related in Merchant Ships Notes and are based in a national regulation. He also explained that there is a fine maximum value, which is £ 25,000.00. In order to apply fees larger than the maximum permitted by law, MCA has to take the case to Courts which are able to decide about it.

10- As we are aware there are a lot of alien species spread by ballast water and some of them may turn to invasive species. It seems that in Southampton harbour there are around 50 non-indigenous species. How do you deal / intended to deal with this kind of subject?

Mr Simpson said that fortunately UK has been very lucky in this regard. Alien species found in UK waters haven't brought as much losses as they

did, for example, in areas like Black Sea. But he highlighted that it is just a matter of luck and that UK can't count on it. I asked him about the Chinese mitten crab, a new concern in the region, and he said that they are encouraging people to catch these crabs, as they are tasty and have a very big claw. Losses in the environment are related to mitten crabs' strength, able to kill other crabs / individuals, they are capable of causing structural problems burrowing into fragile mud riverbanks, they are greedy feeders and also able to colonize quickly.

11- As said in MGN 363, some studies about the management of BW were conducted in North-East Atlantic (OSPAR Convention). Are there any public results from them?

There are some research projects that Mr Simpson said that he was going to send me, but in terms of practicality, these studies didn't bring many results. Besides that, scientific research seems to be concentrated in some areas, while there are other areas where not enough data is available. As a matter of fact, it seems to represent Brazilian reality also, where data are concentrated in areas where bigger Universities are.

During all the conversation, I have also mentioned what Brazilian Maritime Authority is doing regarding to Ballast Water, what is required in our unilateral regulation (NORMAM 20), which are, basically, ballast water exchange conducted as described in Regulation B-4 from BWM Convention, Ballast Water Management Plan approved by a Class Society, and a Form with ballast water history, based on Res A.868(20) form. I also mentioned port State control officers' use of portable salinity refractometers in order to verify the ballast water exchange and our concerns about implementation of D-2 regulation once we have already ratified BWM Convention.

Meeting with Mr Rod Jones from Royal Navy

Following a suggestion from Mr Roland Rogers[55], I went to Whale Island in Portsmouth to meet Mr Rod Jones who works for the Chief Environment and Safety Officer at Royal Navy Headquarters and is responsible for advice to HQ on operational aspects of environmental requirements applied to warships. We turn our conversation mainly to talk about ballast water and the possible implementation of ballast water requirements from Ballast Water Management Convention to warships, although these ships are exempted by International Conventions in general.

As a curiosity I asked Mr Jones about the new aircraft carrier being built by the Royal Navy (RN), which had been reported on the television the night before we met. He told me that this new warship is going to be equipped with a Ballast Water Management System, called HYDE Guardian[56], from a US manufacturer.

He also told me that as far as practicable and reasonable, new warships are intended to be equipped with BWMS. Then, he added that all Navy's ships are adopting the ballast water exchange when possible or are sealing their ballast water tanks and, in order to keep proper stability and manoeuvrability conditions, they control the distribution of the water kept in their tanks. There is a third possibility, to carry freshwater in their ballast tanks.

Mr Rod Jones explained to me briefly how works the Defence Secretary & Ministers and also its current philosophy regarding to Environmental Legislation either domestic or from International Treaties, which intends to apply to warships all current environmentally soundly

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[55] Roland J Rogers, BSc MSc CSci CMarSci FIMarEST FSUT, Advisor Marine and Environment Law and Policy - National Marine Facilities Sea Systems, National Oceanography Centre

[56] Hyde GUARDIAN employs a chemical-free process that combines filtration with ultraviolet disinfection to treat the ballast water of a ship to prevent the spread of invasive species. This ballast water management system received International Maritime Organization (IMO) Type Approval in April 2009. http://www.hydemarine.com/ . Accessed on 23rd May, 2012

practices, as far as possible and without compromising the ship's core activity[57].

The Navy is in charge of operating their means and should work in coordination with the Department of Defence Equipment & Support (DE&S) responsible to supply warships' demands. It is supposed to happen this way: the Navy Command notes that there is a new international rule, or some unilateral rules or even a domestic law regarding to an environmental aspect to be implemented and so this demand is send to DE&S where are naval architects and engineers responsible for design and supply all those necessities in order to comply with those rules. However, it is important to bear in mind that in some occasions, some requirements won't be implemented due to costs or capability constraints.

He emphasized that as far as practicable and reasonable Royal Navy warships are complying with International Conventions, although they are exempted. But, he cited that sometimes and in some situations it seems impracticable to apply some rules to every warship, especially the small ones. In this regard, he mentioned the Tier III (NOx emissions) from Annex VI to be applied from 2016 on and also the new Annex V expected to enter into force on 1st of January, 2013, with rules related to the general prohibition on discharge of garbage into the sea.

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[26] UK Secretary of State for Defence policy regarding safety and environmental protection:

1. As Secretary of State I am responsible for all safety[1], environmental protection (EP) and other sustainable development (SD) matters within Defence.

2. I require that:

- Within the United Kingdom (UK) we comply with all legislation which extends to the UK (including legislation giving effect to the UK's international obligations).
- Overseas we apply UK standards where reasonably practicable and, in addition, comply with relevant host nations' standards.
- Where there are exemptions or derogations from either domestic or international law applicable to Defence, we introduce standards and management arrangements that produce outcomes that are, so far as reasonably practicable, at least as good as those required by legislation.
- Where there is no relevant legislation, our internal standards aim to optimise the balance between risks and benefits. This does not mean avoiding risks but managing them responsibly, on the basis of impact and likelihood.
- We seek to disapply legislation on the grounds of national security as far as possible only when such action is essential to maintain operational capability.

We talked also about Maritime and Coast Guard Agency (MCA) and whether or not Navy and MCA work together and how they cooperate. He explained that MCA is responsible to license all auxiliaries and logistics ships from Navy once they are operated by non military personal and also because of it owns purposes. He noted that Navy is represented by MCA in IMO meetings, as an example of cooperation. Navy is also invested by some MCA powers to act like Maritime Authority, but, in practice it only happens in emergency situations.

Finally, I asked Mr Jones what he thinks about all current environmental requirements that ships are enforced nowadays. He replied that they are necessary, that environmental stuff must be considered as a major subject as it is notorious that the world is changing with regards to its natural resources and environmental conditions, but he also highlighted that some rules are so restrictive that become impracticable to comply with and also to verify its compliance. I added then, as a matter of fact, that currently the environment has been seen also as an economic opportunity, and that it seems to be fair to align environmental protection and economic growth.

Mr Rod Jones highlighted that RN sees environmental performance as improving the sustainability of their operations. For example, if their ships are more fuel efficient (and put less CO_2 into the atmosphere) they can stay at sea and on task longer, go further, will become cheaper to operate and will need less support from ashore or from auxiliaries. They will be less vulnerable to fuel availability and price fluctuations. So fitting better (more efficient) equipment has benefits all round even if it is more expensive to begin with.

Meeting with Mr Adrian Lester from British Chamber of Shipping

UK flag represents about of 2%[58] of world merchant shipping in terms of deadweight tonnage, with a combined gross tonnage of 184,435 GT[59]. The

[58] Review of Maritime transport 2011, United Nations Conference on Trade And Development (UNCTAD).

British Chamber of Shipping is the trade association for the UK shipping industry, and currently it represents 139 members and associate members, which means over 927 ships of about 28.4 million gross tons and is recognised as the voice of the UK shipping industry[60]. On 21st May, Mr Adrian Lester came to National Oceanography Centre to talk about UK shipping industry's understanding, expectations and intentions regarding to Ballast Water Management Convention. During our conversation we discuss about some bigger points of concern, as related hereafter.

I asked Mr Lester if as a representation of UK shipping industry, British Chamber of Shipping is aware of any problems BWM unilateral requirements have caused to ships, like fines or detentions. He said that major concerns are related to California requirements which are stricter than BWM Convention, but he is not aware about problems with UK Flag ships.

I also asked about ships' expectations regarding to BWMS, if he believes that shipowners are prepared to BWM Convention, and if UK ships are equipped with BWMS, especially new ones. He replied that ships are preparing themselves very slowly, but new ones are more effective in this regard, most of them are reserving an area onboard to ballast water management systems and about 30% of them are equipped with BWMS.

During our conversation, I told him that my impression sometimes is that many shipowners believe that the Convention dates regarding to standards application are going to be delayed[61] and that's why even new ships are not hiring BWMS. Besides that, some complain about BW system prices, and also that some systems not proven to be manageable in particular cases, and, as BWM Convention is not into force, shipowners don't fell like an obligation to have these expensive huge systems onboard. Exceptions made for green ships, Mr Lester agreed with this impression, and added that there

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[59] 21st edition of Flagging Up, the UK Ship Register's quarterly e-newsletter (http://www.dft.gov.uk/mca/mcga07-home/shipsandcargoes/mcga-ukshipregister/mcga-ukshipregister-merchantships/mcga-uksr-newsletter.htm). Accessed on 07th of September, 2012

[60] http://www.british-shipping.org/About%20the%20Chamber/. Accessed on 21st May, 2012.

[61] Regulation B-3: Ballast Water Management for Ships.

are not many systems type approved in the market depending on ships types and sizes. He said also that BWMS are going to require surveys, crew training, specialized people and in terms of BWMS inspections, it is going to be necessary a big structure to sample an analyses ballast water, once PSC officers doesn't seem to be able to conduct this kind of inspection, what will only be possible in big and busy ports.

Regarding to unilateral requirements, I asked him if ships are aware of U.S. requirements (recently postponed) and if UK ships are complying with them. He told me that ships travelling to U.S. waters are more concern because of U.S. requirements, especially from California he emphasized again. Besides that, I asked about European requirements and he said that in some areas there are voluntary requirements, especially from OSPAR Convention[62] and in Baltic Sea[63] that demand ship ballast water exchange. Mr Lester mentioned that UK and France, for example, are discussing exemptions in some journeys depending on journeys particularities, like fixed routes, same biogeographic areas, etc. Mr Lester also mentioned the requirement from an Oil terminal in Minch Channel regarding to the fact that isolated actions might not have desired effects, not avoiding invasive species spreading and, at same time, causing economics losses.

Another aspect that we discussed was regarding to shipowner responsibility once even if ships are complying with BWM Convention, with a Ballast Water Management System type approved, if it fails, it is going to be ships fault, the system manufacturer is not going to be involved, and he highlighted that it is also a big point of concern from shipowners' perspective.

[62] Convention for the Protection of the Marine Environment of the North-East Atlantic. The OSPAR Convention entered into force on 25 March 1998. http://www.ospar.org/. Accessed on 21st May, 2012

[63] Helsinki Convention: Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992, entered into force on 17 January 2000. http://www.helcom.fi/Convention/en_GB/convention/. Accessed on 21st May, 2012

2.6.2 Brazilian Regulation about Ballast Water

Brazil is known to have a very good national legislation on Environmental issues. The objective of this item is to introduce in a very brief manner Brazilian regulations that are in such a way related to ballast water until the adoption of the Maritime Authority Regulation for the Management of Ships' Ballast Water nº 20 (NORMAM 20) in 2005 and the legislative Decree No148 in 2010, both the most recent and specific regulations on ballast water and also being described in this item.

2.6.2.1 Lei 6.938/1981 – "National Environmental Policy"

The current Brazilian Constitution, the most comprehensive and important law in the Country, has a whole dedicated chapter on environment. Every law in Brazil shall be subordinated to it and so as the environmental ones. In this regard, The National Environmental Policy from 1981 was adopted due to the Brazilian Constitution of 1967 replaced by the Brazilian Constitution of 1988 which still into force, and it is considered the most important law on environment ever adopted, called 'the mother' of Brazilian environmental legislation.

Besides other important goals of the Brazilian National Environmental Policy, it is proper to say that its main goal is to establish standards that enable the sustainable development through mechanisms and instruments capable to better protect the environment. This law has created the Brazilian National System for the Environment (SISAMA), that brings together environmental organizations and institutions of the Union, States, Municipalities and the Federal District, whose primary purpose is to give effect to the principles and standards introduced in the Constitution.

Law No. 6.938/1981 also defined pollution in a very comprehensive manner and in its Article 3, paragraph III, pollution is defined as: *"(...) Pollution: the degradation of environmental quality resulting from activities that directly or indirectly;*

a) *adversely affect the health, safety and welfare of the population;*
b) *create adverse conditions for social and economic activities;*

c) *adversely affect the biota;*
d) *affect the aesthetic and sanitary conditions of the environment;*
e) *launch materials or energy at odds with established environmental standards. "*

2.6.2.2 Lei nº 9.537/1997 (LESTA)

The “LESTA” law or in a free translation “The Law of Maritime Traffic Safety” is the law that establishes several assignments for the Brazilian Maritime Authority (MA), and is therefore the foundation for the development of all Brazilian Maritime Authority Regulations. Thus, LESTA provides that the MA will establish all preventive requirements and regulatory instruments to prevent pollution at sea and interior waters, where ballast water is included. It is said in Article 4, section VII of that Act:

"Art. 4 - The duties of the Maritime Authority:

(...) VII - to establish the requirements concerning safety and habitability and for the prevention of pollution from vessels, platforms or their support facilities."

2.6.2.3 Lei 9605/1998 - “Environmental Crimes Law”

The Environmental Crimes Law is a very important law since it was the first time that a national law in Brazil established criminal (besides administrative) sanctions to harmful behaviors and activities against the environment. Furthermore, it should be mentioned that there is an international understanding that ballast water is included in the pollution definition and so, in the absence of a specific rule on ballast water, a comprehensive law with regards to environment and pollution prevent could be applied (Kesselring, 2007).

The Law No. 9.605/1998 has defined in Article 70, in a comprehensive matter, what should be considered an environmental administrative violation and establishes that non-compliance with environmental prevention shall be punished. The Decree 6.514/2008, which revoked Decree 3.179/1999, regulates this law, provided in addition that the competent authority has the

possibility of issuing normative and administrative acts in order to regulate all necessary procedures for the correct application of administrative penalties and establish fines' values to be applied in cases of non-compliance with the law. That said, based on those articles from the Law 9605 and its Decree, it was so defined the rules to establish penalties for ships non-compliant with Brazilian rules on ballast water (NORMAM 20).

2.6.2.4 Lei 9966/2000 – "Oil Law"

Although called "oil law", law 9.966 of 2000 deals with prevention and control of pollution caused by oil or other hazardous or noxious substances in Brazilian territorial waters. In its text, ballast water is cited but with regards to possible occasions when oil or hazards / noxious substances and ballast water are in such way together or mixed. As pointed out by Kesselring (2007) the intention of this law is not regulate over deballast or invasive species.

2.6.2.5 RDC 217/2001 and RDC 72/2009 from National Health Surveillance Agency

In November of 2001, the National Agency of Sanitary Surveillance (ANVISA) issued Resolution RDC No. 217 approving technical regulations for health surveillance at ports installed on the Brazilian Territory regarding to vessels that carry goods and passengers. In articles 6 and 19, it is required from ships to fill the Health Authority Form on Ballast Water in order to get Free Practice[64]. In this resolution there is still forecasting the possibility of sampling in ballast water tanks for purposes of identifying the presence of pests and pathogens and to verify physical and chemical parameters, at the discretion of the Sanitary Authority (art. 28).

In late December, 2009, ANVISA published a new resolution called RDC No 72 that establishes health control procedures to be adopted in the Brazilian ports and to vessels carrying goods and passengers. This resolution revokes Resolution RDC. 217.

[64] The Health Authority Form on Ballast Water is based on Ballast Water Reporting Form, appendix I from IMO Resolution A.868(20).

This new regulation provides health requirements that must be followed in port areas for entry, transit and stay of vessels operating in Brazilian territorial waters. These new rules also establish minimum requirements for health promotion in health control ports to ships, updating concepts and health formalities provided in the International Health Regulations. There is a whole part dedicated to ballast water[65] and as provided in the former resolution it is also foreseen the possibility of sampling and analysis ballast water. In annex X there is a form to be completed and delivered by ships to Sanitary Authority. This form is exactly the same form provided in NORMAM 20 from Maritime Authority. Furthermore, this sanitary resolution reproduces a similar text that is also said in the Maritime Authority Norm nº 20 regarding to the application of new ballast water treatment technologies:

> *"As long as new technologies and new ballast water management are going to be developed, the Maritime Authority, in due course, shall establish new appropriate regulations"* (Art. 65).

2.6.2.6 Maritime Authority Regulation for the Management of Ships' Ballast Water nº 20 (2005)

The first time that a Maritime Authority Norm mentioned ballast water was in NORMAM 08 in 2000, a comprehensive norm with provisions about traffic and stay of vessels in Brazilian territorial waters which required the Ballast Water Form among other documents to be filled in two copies, one to be sent to the Local Maritime Agent and other to be kept on board by the vessel and to be shown in case of inspection. After the NORMAM 20's adoption, its requirement was excluded from the previous Norm and now there is a text that says that when ships intend to deballast in Brazilian water, they must comply with NORMAM 20[66] .

Since October 2005, The Brazilian Maritime Authority requires some procedures to be comply by ships when in Brazilian territorial waters through the enforcement of the ''Maritime Authority Regulation on Ships' Ballast Water

[65] Section VI from Chapter IV regarding to the health surveillance of vessel and port support services

[66] Maritime Authority Norm for the Traffic and Stay of Vessels in Brazilian Territorial Waters (NORMAM 08/DPC), section III, item 0307.

Management'', adopted by the Directorate of Ports and Coast from Brazilian Navy (NORMAM-20/DPC). As said in Chapter 1 of the Norm, it applies to all ships, equipped with ballast water tanks / holds that utilize Brazilian ports and terminals. Besides, the Norm says that it is essential that the procedures for Ballast Water Management and sediments are efficient and, at the same time, environmentally safe, viable, and don't generate neither unnecessary costs and delays to the ship and its cargo nor imply in risk to its safety, its crew and to the navigation.

NORMAM 20 stipulates that ships or their agents were obliged to send the ballast water form (Annex 1), which is based on IMO Res A.868(20) ballast water form, but not identical, at least 24 hours in advance to the local Maritime Authority Agent of the port area where the ship will berth. Besides that, it requires ships to have a Ballast Water Management Plan approved by Administrations or Recognized Organizations and also to conduct the mid-ocean ballast water exchange as request by the International Convention (BWM). There are also some special procedures to be taken by ships entering into the Amazon basin. The BWM.2/Circ.1, from 22nd of September, 2005 contains the Brazilian Communication to IMO with a summary of the Brazilian National Legislation on ballast water management (Annex 2).

As mentioned in the Norm, all inspections with regards to ballast water requirements are going to be conducted by PSC officers and non-compliances should be considered administrative violations punished with pecuniary fines that can vary from R$ 5,000.00 to R$ 50,000,000.00[67] as provided in Decree 6514/2008.

Finally it is important to say that it has been chosen to regulate ballast water by means of a Maritime Authority Norm, regardless its prerogative to do so, once it is an easier way to give the Norm flexibility and celerity, once the creation and implementation of a federal law has to obey to many steps and so it would demand much more time to be adopted and updated, what in ballast water case, an evolving issue, would be undesirable. As provided in the Norm text (Chapter 2, item 2.3.6):

[67] R$ (Reais) is the monetary unit from Brazil what in today rate conversion R$ 1.00 is equal to 0.495 USD (2nd of July, 2012).

"As new technologies and new Ballast Water Management Systems are developed to prevent, minimize and control the transport of exotic aquatic organisms and pathogens through ballast water, provided they are evaluated and accepted by the Maritime Authority, the Directorate of Ports and Coast shall, in due course, the appropriate regulatory instructions".

2.6.2.7 D.L.148 (2010)

The Legislative Decree No148 from 12th of March, 2010, approved the text of the International Convention for the Control and Management of Ship's Ballast Water and Sediments. It means that the Brazilian National Congress through the adoption of this Decree approves the text of BWM Convention, and also establishes that any acts that can result in review of that Convention, as well as any additional adjustments are subject to the National Congress' approval.

According to our Constitution, a legislative decree is a normative instrument from the National Congress and its binding is independent of presidential authorization. However, it is also part of the procedure that once the bill is approved by the Congress it has to be sent to the Presidential sanction, which happens by means of a presidential decree or simply decree. These decrees are administrative acts within the competence of the heads of the Executive power (President, Governors and Mayors). A decree is usually used by the Executive-in-Chief to make appointments and to give effect to laws, among other things.

Part Three – How to Implement Ballast Water Convention

The transport of goods by the sea is the principal mean of world trade and as mentioned by Stopford (2009), since the first cargoes were moved by sea more than 5,000 years ago, shipping has been at the forefront of global development. In Brazil, with recent investments in the development of maritime transport and it consequently growth within Brazilian waters, from the environmental point of view, it is correct to say that the volume of ballast water has reached significant proportions, not mentioning other means of pollution. Besides that and as mentioned in previous Parts of this paper, the Brazilian first big problem resulting from ballast water was the appearance of the golden mussel in the South region, a freshwater mollusc originating in Southeast Asia, and certainly one of the reasons for the maritime community and environmentalists claim on a national rule on ballast water.

It is not easy to define the better way to implement rules, but in Brazil the chosen way, which means, the adoption of a Maritime Authority Norm has been the best way to do it up to now according to the common sense of the Brazilian maritime community. Probably the major advantage in regulating the matter by a Maritime Authority Norm is the possibility to get it updated easily than it would be if the regulation were by an Ordinary Law. Thus, it is possible to make any needed changes in its text with much less bureaucracy, what means that it is the best way to accompany all rapid evolutions on the subject, especially technological ones related to the ballast water management systems under developing. Regarding to the same subject, many bills were proposed in the National Congress and there were also State initiatives, all of them were withdrawn.

In Costello *et al*. (2007) it was proposed a model for assessing the efficacy of policy instruments aimed at reducing the introduction of non-indigenous species in Great Lakes, USA. As cited by the authors, introductions of non-indigenous species by ships have resulted in the establishment of at least 24 animal species in the North American Great Lakes since 1959 (Holeck *et al*., 2004 *apud* Costello *et al*., 2007). Data from 1959 to 2010 inclusive revealed 34 aquatic ship-mediated non-indigenous species reported from the Great Lakes and that the rate of aquatic alien

species discovery was relatively linear between 1959 and the mid-1980s, after which time it began to increase (Bailey *et al*., 2011).

As a form to avoid these invasions United States has required ships entering the St. Lawrence with declarable ballast water on board to have exchanged that water in the ocean prior to discharge within the Great Lakes since 1993, and in a voluntary basis since 1990. Although few studies have examined the effects of BWE on the viability of biological propagules, it is not known if BWE has been effective at reducing invasion rates so it is not know if the adopted policy has been efficient after all (Costello *et al*., 2007).

Trying to exam the BWE efficiency in Great Lakes, Fisheries and Oceans Canada has worked closely with various levels of Canadian and U.S. governments to examine how effective existing ballast water policies are at keeping invasive species out of the Great Lakes and as a result, they have found that BWE, coupled with the intensive inspection program provides robust, but not complete, protection against ship-mediated biological invasions into the Great Lakes system[68]. The results of this study are reported in Bailey *et al*., 2011, where it is demonstrated that year 1995 was identified as the most likely point of decline in discovery of aquatic non-indigenous species (NIS) rate, what may correspond to a six year time lag after the inception of voluntary ballast water management, or a two year time lag after implementation of mandatory BWE regulations. Since 2000, shipping activities have been responsible for three of eight aquatic NIS introductions and no new species have been reported since 2006, the first time there has been a four-year gap in ship-mediated aquatic NIS discoveries since 1974-977, indicating that tank flushing regulations may have been an important addition to the management regime. Thus, what is clearly known nowadays to the Great Lakes is that it has one of the most stringent regulations in the world to prevent invasive species and since 2006 no new species have been discovered due to ballast water.[69]

[68] http://www.dfo-mpo.gc.ca/science/publications/article/2011/06-13-11-eng.html. Accessed on 10th of September, 2012

[69] http://www.marinedelivers.com/press-releases/canadian-media/city-st-catharines-rejects-new-york-ballast-water-regulations. Accessed on 10th of September, 2012

It is a fact that a Norm should be efficient as a whole and it is necessary to establish some parameters to evaluate its efficiency, some are related to bureaucratic aspects as previously exemplified and other are regarding to the goal proposed by the rule, which means to evaluate if it is really accomplishing what was proposed, in this case, to avoid the introduction and/or spread of alien species.

3.1 Brazilian Experience

It is correct to say that Brazil is playing a significant role in the global search for control and management of ballast water from ships. To support this affirmative it must be mentioned that the National Health Surveillance Agency (ANVISA) stand up for since the beginning of the discussion the inclusion of microbes indicators in the D-2 standard of BWM Convention, and also the important initiative from Petrobras in developing the Brazilian Dilution Method proposed as a variation of the flow-through method. This method, as introduced in Part Two, involves ballast loading through the top with simultaneous unloading from the bottom of the tanks and was firstly presented as an idea in an IMO paper.

Brazil paper on dilution method was welcomed by the Organization, which so encouraged Brazil (Petrobras) to carry out a field trial, what happened in June 1998 in the product carrier M/V Lavras (Mauro *et al.*, 2002). The “Dilution Method” as cited, involves the loading of the ballast water through the top of the ballast tank and, simultaneously, the unloading of the ballast water through the bottom at the same flow rate, controlling the ballast water tank level in order to keep it constant. A special deck ballast pipeline, specially fitted for this purpose, is required to inject the ballast water through the top of the ballast tanks during ballast water exchange on high seas. This way, the vessel can maintain its normal ballast loading condition during the entire time of the ballast voyage, when ballast water is exchanged. This method can be considered as a safer way to perform the ballast water exchange on high seas (MEPC 38/13/2, MEPC42/8/12, MEPC 42/INF.14 and

MEPC 53/2/24)[70]. Regarding to the traditional flow-through it has some advantages once it avoids internal pressure in ballast water tanks and problems of overflowing water in the deck of the ships, which involves safe and health matters to the crew. Not mentioning that the method is simpler and cheaper in terms of shipbuilding and also when compared to other treatment methods, to which the Brazilian Dilution Method may be associated.

Regarding to the Dilution Method and its flexibility to be associated to BWMS, another research project[71] was carried out by Brazilian experts in March/April 2005, in Arraial do Cabo, Rio de Janeiro, Brazil, in a vessel called "Diadorim" from the Institute of Sea Studies Admiral Paulo Moreira (IEAPM)/Brazilian Navy, with voyages between the local port (23º S and 42º W) to an adjacent ocean location 50 miles off the coast and more than 500 m deep. Six boxes simulated ballast water tanks and the water inside the boxes were treated with one of the four arrangements, filtration[72] + chlorination[73]; ballast water exchange (BWE); BWE + filtration + chlorination; and BWE + filtration. Two boxes weren't treated by any methods, acting as controls. The results were prosperous, despite some expected difficulties, and could verify if organisms' concentration was above or below to 10 viable organisms, as required by regulation D-2 of the Convention. As results from the research project it was verified that the usage of organisms filming technique has been proven to be suitable for verifying the viability of organisms but, it wasn't possible to quantify them, what was done in laboratories. These experiments have shown that the viability of organisms greater than 10 µm and smaller than 50 µm was null or very low, lower than 10 organisms per millilitre; boxes

[70] The cited text is part of the Brazilian MEPC 53/2/24 paper submitted to the 53rd meeting of Marine Environment Protection Committee, held from 18th to 22nd of July, 2005. The Dilution Method was initially proposed in paper MEPC 38/13/2, results in paper MEPC 42/8/2 and MEPC 42/INF.14 and technical aspects were also submitted to the Ship Design and Equipment Subcommittee, in paper DE 42/11/1.

[71] Experiment described in MEPC 53/2/24 and MEPC 53/INF.18.

[72] For filtration, plankton net with a 10 µm (micron) mesh was used. An industrial filter was also tried with a 10 µm mesh (specially made for this test).

[73] Chlorination was done with sodium hypochlorite using a 3 ppm concentration of free chlorine, based on previous experiments presented to IMO. The concentration of tri-halo-methane was determined in the water after chlorination. In order to ensure the consistency and statistical reliability, 03 (three) replicates were made for each treatment and control.

with chlorination showed that organisms greater than 50 µm did not survive and the formation of tri-halo-methane was lower than 100 micrograms per litre, which means that D-2 standards always were reached when using chlorination. In the other experiments, these standards were partially met. The experiment performed only with ocean ballast water exchange (BWE) did not meet D-2 standards, since more than 10 live organisms greater than 50 µm per m^3 were observed. Microbiological analysis for bacteria has revealed that Arraial do Cabo has very clean waters, with extremely low concentrations of *Escherichia coli*, fecal coliforms and enterococcus and absence of *Vibrio cholerae*. Some physical, chemical and biological complementary analysis were also carried out showing Porto do Forno in Arraial do Cabo as an oligotrophic environment, poor in nutrients and chlorophyll, with salinity above 35 psu and temperature around 24°C.

Figure 18: Pictures from Porto do Forno (Porto do Forno, Arraial do Cabo, RJ)[74].

Other Brazilian important initiative came from the Brazilian Health Surveillance Agency (ANVISA) when the Agency supported a research during 6 months between 2001 and 2002, called "Exploratory Study for the Identification and Characterization of Pathogenic Species in Ballast Water" with the purpose of better supporting the Brazilian Delegation's position regarding to the regulations provided in BWM Convention, at that time a draft. The main objective of the research was to assess the risk inherent of introduction / spread of pathogens by ballast water from vessels moored or

[74] http://www.portodoforno.com.br/galeria.asp . Accessed on 09th of July, 2012.

anchored in the ports of Belém (PA), Fortaleza (CE), Suape and Recife (PE), Salvador and Aratu (BA), Ponta Ubú, Praia Mole, Paul and Tubarão (ES), Sepetiba (current Itaguaí) and Rio de Janeiro (RJ), Santos (SP), Paranaguá (PR) and Rio Grande (RS). The microbiological indicators targeted were viable marine bacteria, vibrios, fecal coliforms, *Escherichia coli*, enterococci coliforms, *Clostridium perfringens* and F-specific coliphages. It was also checked the presence of the bacterium *Vibrio cholerae*, a common organism in marine environment but pathogenic in certain situations (ANVISA, 2002).

As a result of the surveys conducted from October 2001 to March 2002, a robust report was written. All samples were measured regarding to the physical and chemical variables (temperature, salinity / conductivity, pH), analysis of the zooplankton composition and abundance were done by filtering the ballast water through a sieve with a mesh of 100 µm (micron). Additional samples were obtained from a sieve mesh of 20 µm, for phytoplankton analyses. The zooplankton samples were collected in triplicate for the analysis of composition and abundance of organisms and to the count of vibrios and to research of *Vibrio cholerae* in the plankton. Besides that, the research aimed to quantify microbiological indicators as mentioned before and it was done according to recognized protocols described in the report. This study also collected information about ballast water (ship origin, ballast water origin, local of ballast water exchange) during ships surveys and from the Ballast Water Form required by ANVISA. Most of samples in ships ballast tanks were classified as coastal waters or from the continental shelf, a high percentage of vessels engaged in international navigation (74% of this total category) were carrying ballast water with salinity above 30, so to the coastal shipping, to which lesser samples were collected.

Regarding to the organisms, a total of 81 zooplankton taxa were observed, Copepoda was the most diverse group, with 56 taxa recorded, followed by other crustaceans (11 taxa). All surveyed ports showed high densities of zooplankton in the ballast water (above 500 Ind/m^3), but most samples were low values. Very interesting results were also obtained regarding to microbiological indicators, where marine viable bacteria were found in 70.7% of the samples analyzed. Vibrios were present in 30.3% of ballast water samples and in 16.2% of zooplankton samples. Fecal coliform

bacteria were detected and quantified in 12.1% of samples. *Escherichia coli* occurred in only 4% of the samples, while enterococci coliforms were found in 21.2% of the samples of ballast water. Bacteria belonging to the specie *Clostridium perfringens* were found in 14.4% of the samples and the coliphage (viruses which utilize *Escherichia coli* as host bacteria) were detected and quantified in 32.3% of ballast water samples analyzed. Many other important results were obtained with this research from ANVISA as the observation of typical shallow water species in samples with high salinities, others typical from low salinities environment in 28 to 35.5 waters. All those results supported Brazilian delegation decisions during BWM Convention discussions in MEPC/IMO (ANVISA, 2002).

As a general result, it is possible to say that the collected data suggested that at least 62% of the ballast replacements declared in the ballast water forms had not carried out in the open sea or involved only partial replacements (*op. cit.*, 2002).

In 2001, Brazil promoted a meeting on invasive alien species. The event was conducted by the Brazilian Government with the participation of South America Countries. The meeting also had the cooperation of the Government of the United States of America, as well as the support from the GloBallast Programme. Also in 2001, the Environment Ministry, through the Project for Conservation and Sustainable Use of Brazilian Biological Diversity - PROBIO, in partnership with the National Environment Fund - FNMA, released and announcement to select projects aimed at the management of species endangered and / or to control of invasive species, with major objectives concerning to the biological diversity conservation and for the formulation of public policies related to conservation and sustainable use of biological diversity in the Brazil. From this Notice, 27 subprojects were selected, nine related to invasive alien species. In 2003, the Ministry of Environment so decided to draw up the “First National Report on Invasive Species" and to select subprojects aiming the production of reports on invasive species which affect the terrestrial environment, marine environment, inland waters, human health and production systems (agriculture, livestock and forestry) (MMA, 2006).

The National Report on Invasive Species is the first national diagnosis related to the distribution of these species and shows also the installed capacity in the country and their means to deal with the problem. Results could allow the development of a plan focused on concrete measures to implement the priority actions aimed at prevention, control and eradication of invasive species in Brazil. The National Report brings information on invasive species of greatest impact, the areas most threatened, geographic situations and existing capacities in the institutions responsible for the prevention and control as well as their own needs (*op. cit.*, 2006).

In the subproject regarding to the marine environment and called "organisms that affect the marine environment", 58 species were identified as alien species divided among three groups: detected, established and invasive, according to the table hereafter (MMA/SBF, 2009):

Table 7: Marine alien species according to the biological group (MMA/SBF, 2009).

Organisms	Detected	Established	Invasive	Total of species	Relative contribution (%)
Phytoplankton	-	1	2	3	5
Zooplankton	3	3	-	6	10
Phytobenthos	1	3	1	5	9
Zoobenthos	21	13	6	40	69
Fishes	3	1	-	4	7
total	28	21	9	58	100

In this report there are also a very important data regarding to the transport vectors of alien species that show that 26% of species were introduced by ballast water and 20% from biofouling vector. It is also shown how the natural movement of marine currents acts efficiently as secondary path of introduction (23%) and that 18% of species came from the mariculture or aquaculture.

In late December, 2003, The Minister of State for the Environment, so Ms. Marina Silva, officially established the Golden Mussel National Task Force (NTF) composed of many entities from Federal, State and Municipal Governments, Companies like Furnas[75], Itaipu[76] e Eletrobras[77] and with the possibility to be supported by an Expert Group.

Through the NTF an Emergency Action Plan was launched, with the involvement of State and local institutions on the control of the golden mussel. The actions of the Emergency Action Plan were centered in the control of the golden mussel in the river basins of Guaíba, Alto Paraguay and Alto Paraná and also in outreach activities, training and monitoring.

It is important to mention that the Environment Ministry was the Leader Agency regarding to the implementation of the GloBallast in Brazil, a very important initiative mentioned in Part One.

During 2007 and 2009, Petrobras developed a research in some of their marine terminals known to be ballast water "importers". To conduct its research Brazilian consulters and one consulter from Australia were hired in order to apply the GloBallast risk assessment methodology in the selected terminals. Results didn't show significant risks, except regarding to one or two shipping routes that had been identified as important paths since the ports of origin had reasonable environmental similarity with some of the national terminals studied (personal communications). It is important to note that this study did not take into account the risk reduction provided by the ballast water exchange procedure required by the Maritime Authority Norm on ballast water (NORMAM 20), adopted in June, 2005 and into force since October of the same year.

Nowadays in Brazil, although just a few initiatives have been in course, some are very interesting regarding to its purposes and novelty. Some research is being focusing on the development of innovative devices and procedures for faster ballast water sampling and analysis. In this regard, in 2009 it was celebrated a Statement of Cooperation between Petrobras and the University of São Paulo (USP) / Oceanographic Institute (IO/USP) with a

[75] Furnas Centrais Elétricas S.A.
[76] Itaipu Binacional
[77] Centrais Elétricas Brasileiras S.A.

view to attempt developing an onboard automated and expeditious method for ballast water monitoring. Although very little time of research have been performed till now (about 1 year and a half), it is possible to affirm that polls are showing good results. The first phase of the project shall be concluded by the end of 2012. Results and additional information are not available at this time once there are protected data and patent matters interests involved. This research also is focused in the development of a portable automated flow injection system for the determination of nutrients in the water that can be useful as an indirect measure and correlations regarding to the D-2 standard analysis and also to check D-1 standard in addition to the salinity measurement. One of the advantages of the know-how acquired with the development of this method / system refers that afterwards any chemical substance present in the water which chemical reaction is known for its quantification analysis and can be related to a biological response, may be incorporated into the system and be continuously and automatically monitored in situ. A second phase of the research is still being negotiated and, probably, it shall start in the beginning of next year (2013). One of the concerns that should be explored in the second phase is the complex issue on the organism's viability. In this step it is also intended to further explore more capable and sophisticated techniques to assess promptly the occurrence of microorganisms in the ballast water.

Besides that and regarding to the purpose of development of faster techniques to analyses ballast water, the project is developing methods to capture images in flux in order to monitor ballast water. It aims also to transfer basic laboratory resources to a low-cost system for taking images, with the appliance of software to help in the analysis thereof. This research is been conducted at Cenpes[78] with the objective to streamline the ballast water analysis in the bench. According to personal communications, the current work is focusing in the refinement of the "software" of images analysis and in the improvement of captured images in terms of organisms' viability.

[78] Centro de Pesquisas e Desenvolvimento Leopoldo Américo Miguez de Mello (Cenpes) or simply Petrobras' Research Centre, the biggest one in Latin America.

All information regarding to researches in course were given by professionals and researchers engaged in the mentioned research developments and were sent directly to the paper author.

Academic initiatives also happened and still happening regarding to the identification of invasive species and microbes in the ballast water, application to risk assessment to ports and terminals in Brazilian coast, in order to verify the ships' compliance to the ballast water exchange and to check the data filled in the ballast water forms and also some studies about the efficiency of ballast water exchange, to test methodologies of exchange and with a view to conduct experiments regarding to treatment methodologies. In this regard, this paper cites hereafter some academic studies carried on.

Silva, 2001, pursued a research to determine the ideal chlorine concentration required to be use as an efficient way to treat ballast water, evaluating the survival of organisms during the carriage and also the formation of tri-halometane (THM). The experiment was carried out in the bulky carrier Frotargentina in July 2000 and four chlorine concentrations were used: 1, 3, 5 and 10 ppm.

Daily in each researched tank physical-chemical parameters were analyzed (salinity, pH, temperature, oxygen, nitrite, nitrate, ammonia, phosphate, chloride and THM), besides qualitative and quantitative analysis of the zoo and phytoplankton. The maximum mortality of organisms resulting from the application of chlorine was 76.46% and no significant differences ($p < 0.05$) were shown among treatments applied. Another important conclusions obtained were regarding to the use of chlorine concentrations above 3 ppm due to high rates of formation of THM (> 100mg / l). The lowest concentration (1 ppm) showed good performance and resulted in small concentrations of THM. In the paper the author discussed herein the use of chlorine dioxide as an alternative to chlorine and suggested further studies regarding to the use of low chlorine concentrations applied daily or continuously.

In 2004, Medeiros held a research in Ponta Ubú terminal, Espírito Santo, Brazil, applying the GloBallast risk assessment methodology in order to better understand inherent risks to the terminal. According to the author, its terminal has the capacity to export 12 million tons of iron ore pellets per year, getting about 5 million tons of water ballast in the same period, about 13% of

the total estimated deballast in Brazil. Regarding to its origins, 79% of the total volume came from Europe, mostly from Rotterdam (Netherlands) and France. As a final result, the overall risk which ranks the risk level of each donor port to the studied port, pointed out 12 very high risk ports, eight of them in Brazil and 13 high risk ports, 11 from Mediterranean sea (Medeiros, 2004).

In 2007, Caron Jr. developed a research in Itajaí (SC) a containership busy port to, among others objectives, analysis the ballast water discharge through the development of an equation to estimate the rate deballast / ballast with data available from year 2003. The estimated volume of deballast was 761,048m^3, most of it from other Brazilian ports and so not conducting ballast water exchange in the mid-ocean, showing the vulnerability of the port to the introduction / spread of alien specie regarding to the factor environmental similarity, one of the factors considered by the risk assessment methodology (G7).

In 2008, Castro presented a study with the main objective to characterize Rio de Janeiro Port according to ballast water discharges, through some available methodologies and tools, as the ballast water reporting forms, the ballast water estimates from port recorders, know as GloBallast method, and through another estimating formula, proposed by Caron (2007), called Caron method. This study was based in 2005's data (from October on) and 2006's, after the adoption of NORMAM 20 by Brazilian Maritime Authority. Results seemed to show differences among the methods, although results were coherent and have confirmed Rio de Janeiro port as a ballast water “importer”, being the major donors national ports located in the Northeastern region of Brazil. Besides that, and also one goal of the study, it was possible to observe an improvement in the ballast water form filling and that all ships coming from international waters had declared to exchange ballast water in mid-ocean as required by NORMAM 20 (Castro, 2008).

There are several others Brazilian academic papers regarding to ballast water, some focusing on risk assessment methodology, as the one proposed by GloBallast, others aiming to study possible pathogens introduced / spread by ballast water, as *Vibrio cholerae*, *Escherichia coli* and others. However, quite a few are related to harbour surveys and monitoring or even to the development of treatment technologies and devices.

3.2 NORMAM 20 implementation

According to cited NORMAM 20 all ships that carry out ballast water discharge in Brazilian territorial waters shall comply with Brazilian unilateral Norm on ballast water and are subjected to be inspected by port State control officers (PSCO).

Inspections conducted by PSCO are mainly related to the following aspects:

- Does the ship have a Ballast Water Management Plan (BWMP)? Is it approved by a Class Society accredited by Brazilian Maritime Authority, by the ship's Administration / flag State or by Class Society acting as recognized organization (RO) or by the ship's Class Society?
- Did the ship exchange ballast water in mid-ocean, according to what is defined in the Norm?
- Did the ship fill the ballast water form properly and sent it accordingly 24 hours before entering in Brazilian territorial waters?
- For ships entering in the Amazon Basin: Did they do the second ballast water exchange as provided in the Norm?

PSCO conducting ballast water inspection has a portable refractometer in order to verify ballast water’s salinity when it seemed to be necessary or needed. Besides that, these officers must fill a report after the ballast water inspection (Annex 2), so every PSC inspection generates a separated report and all data collected are inserted in a database.

Figure 19: Port State Control Officer and ship's crew sampling ballast water through the sounding pipe to verify its salinity with a portable refractometer (CPRJ/MB)[79].

In 2009 during the "First Brazilian Workshop on Biological Invasion", whose theme was "Invasive Species and its Impacts", Castro & Poggian submit a paper with regards to the first years of ballast water inspections in Brazilian territorial waters, after the adoption of NORMAM 20 and based on inspections' resultant reports. By analysing more than 3,500 reports with regards to all Brazilian requirements provided in the Norm, they have found that almost 94% of all inspected ships were in conformity and just over 6% showed non-conformities according to the Norm. Most part of non-conformities was related to the absence of the BWMP or regarding to its approval. In fact, the approval requirement was the most difficult one to implement in the early years of NORMAM 20 and it was necessary to postpone the requirement date for two times. It finally came into force in December 2006.

After the cited study from Castro & Poggian (2009) and up to now, inspections data have been continuously reported and analyzed, so in 2011, during the "ECOBRASIL"[80] workshop, the Environmental Superintendence from the Directorate of Ports and Coast / Brazil's Navy, presented some data

[79] Capitania dos Portos do Rio de Janeiro/Marinha do Brasil.

[80] EcoBrasil is a Brazilian seminar that occurs almost every year and has the objective of disseminating knowledge, promoting and updating discussions related to environment in harbor areas and in the shipping industry.

in this regard up to 15th of April, 2011. Among more than 5,500 PSC reports, more than 95% didn't show any kind of non-conformity.

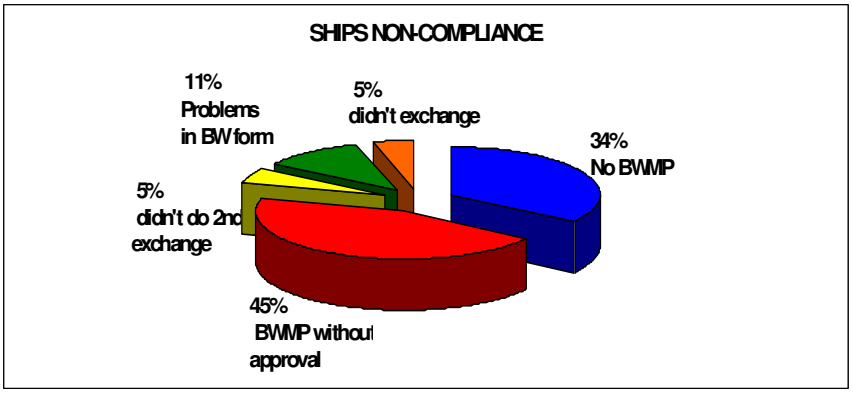

Figure 20: Ships' non-compliance verified by Brazilian PSCO[81].

Even with a very difficult situation in terms of inspections either with regards to the great number of ports having less inspectors than it should have, or to some peculiarities regarding to its access and means of inspections, it was possible to note that, in every way and in every regions of Brazil the number of ships in compliance with NORMAM 20 had grew over time. The main Brazilian ports are represented in Annex 3.

Nowadays Brazilian Maritime Authority is concerning about how to update NORMAM 20 with regards to D-2 standard and the verification of ship's compliance. As previously noted, there is no BWM Circular on ballast water inspections adopted up to now, despite the fact that much progress had been achieved during the last ballast water working group's discussions in BLG Subcommittee. The search for uniform ways to verify ship's compliance to D-2 standard is evolving well, but up to now there isn't a consensus regarding to PSC procedures. The idea to have an unique protocol rely on the fact that ships wherever they are, should be aware to which procedures are going to be applied to them and also to avoid differences regarding to the port where they are going or others relating to more subjective aspects. Brazil's concerns are also with regard to its own legal system once BWM Convention was already ratified and approved by the National Congress of Brazil.

[81] Adapted from the presentation of the Environmental Department from Directorate of Ports and Coast during the EcoBrasil Seminar (speaker Lieutenant Junior Grade Cecilia Poggian).

Some recent researches are searching for means and/or devices to check organisms' presence in ballast water *in situ* as mentioned before, which could simplifier PSCO work. During my first phase at National Oceanography Centre I was informed about a research being conducted in this Centre with a aim to develop devices able to be used for the detection of any species with a known target nucleic acid sequence for *in situ* environmental monitoring, through an integrated system that intend to perform sub-cellular analysis of RNA using nucleic acid sequence-based amplification and would be used in large scale biochemical analysis and experimentation (Tsaloglou *et al.*, 2011).

3.3 Tentative Framework for Ballast Water Inspection

As a main objective of this paper, the author based on all conversations, discussions, collected material and read documents, decided to provide a tentative guidance to the Brazilian PSC with respect to procedures for inspecting ballast water in national ports. Besides that, it might be use to update some guidelines of NORMAM 20.

3.3.1 Procedures to PSC inspections with regards to BWM Convention:

As said by Wright (2012) enforcement of the BWM Convention will be the responsibility of individual port States, despite the fact that it is of common interest of the maritime sector that it happens as uniform as possible world wide.

This subitem aims to be a consolidated document mainly based on IMO guidelines being developed in BLG and FSI Sub-Committees and also it aims to establish current possible procedures to be used by PSC. Everything that has been doing at IMO must be considered as best practices; thereby this paper's purpose has the intention to clarify procedures with regards to Brazilian port State control officers (PSCO) and Brazilian regulations on Ballast Water.

To start it should be clear that PSC should means PSC or another appropriate inspection regime, according to the Administration. In the same

way, it must be clear for involved parts that the Maritime Authority is going to fix the date from when requirements are going to be enforced with regards to the ballast water discharge standard. These dates are going to be established for new and existent ships, in this case according to its ballast water capacity and taking in account the first scheduled drydock after the regulation gets into force for new ships.

As said in the Additional PSC Guidance, Inspections of a ship can be instigated:

- through the normal PSC procedures;
- when the port State has due cause to believe, or has received information, that the ship may not be compliant with the BWM Convention; or
- Targeted or random inspections through PSC, based on identified or specific problems with ballast water management or non-indigenous species within the coastal State.

The inspection may follow an initial / detailed inspections scheme depending on the observations collected by PSCO on board. When it seems that good standard of maintenance is achieved by the ship, only an initial inspectional should be done.

In a first stage or initial inspection should focus on documentation and is conducted also to ensure that there is an officer responsible for BWM on board (and of course is in charge of the BWMS):

- Check if the international ballast water management certificate (IBWC) is on board and in accordance with Appendix I of the Convention and its validity;
- Check the BWMP:
    - if it is approved by Administration or Recognized Organizations in accordance with BWM Convention
    - if it contains what BWM Convention sets as minimum requirements
    - If it is in compliance with G4
    - If voluntary biofouling management is described

- If sediments management are provided

- Check the type approval of BWMS:
  - Verify its validity and if the conditions carried out during approval tests meet with conditions existing on board
- Check the ballast water record book (BWRB) and if its format follow Appendix II:
  - Note if all registers in BWRB are signed by the officer in charge of the operation and all completed pages are signed by the master
- Check whether the ship is exempted of any procedure;
- If ships are adopting BWE, as long as it is complying with Convention dates (regulation B-3), PSCO may request to check the salinity of a random tank;
- Check if there is a certificate of sediments management onboard.

In a second stage, between the initial inspection which is basically documental and the detailed inspection, if PSCO notes that there is something that must be better verified, the PSCO should ask:

- To verify if ships have an onboard monitoring system[82];
- Check if the BWMS is properly working (or whether it had been working prior the arrival);
- If the ship doesn't have an onboard monitoring system and / or the data registered seems to indicate that the BWMS wasn't working during the trip (item 4.3 from Additional PSC Guidance)[83], the PSCO should ask for an indicative analysis.

[82] The BWMS might have operational procedures to register its functioning.

[83] .1 A BWMS making use of Active Substances or Preparations may monitor and/or record the concentrations of these in the ballast water before any neutralization step, to determine the dose of neutralizer required. In such a case, concentrations at a certain level would be considered indicative of the proper operation of the system. These can be found in the BWMP and/or the instructions on how to use the BWMS. For example: ca.[80]% of the maximum allowable dose (MADs) set as a condition evaluated under Procedure (G9).

.2 A BWMS making use of Active Substances or Preparations with variable doses may monitor and/or record the actual dose during the uptake and treatment of ballast water with a sensor. In such a case, these concentrations would be indicative of the proper operation of the system, if the actual dose is consistent with the maximum allowable dose (MADs) set as a condition evaluated under Procedure (G9).

If there is a needing to sample, PSCO should move to a more detailed inspection which relies on sampling and analysis and have 2 tiered approaches, the first one when an indicative analysis is done and the second one when a detailed analysis is required:

- Ask for a sample (as long as a recognized competent person is available to conduct indicative sampling and analysis);
- Based on indicative analysis results that idealistically should be provided in a short time by means of *in situ* sensors easily manageable, decide if a more detailed analysis is required, PSCO should move to a last stage in the detailed inspection:
    - When detailed analysis and full-scale sampling[84] is required. To conduct detailed analysis, all time needed won't be considered undue delay.

In case of detailed analysis any of the three indicators set in D-2 standard could be adopted and used by PSC to verify the non-compliance. It is important to assure that there is a recognized competent person available to conduct sampling according to the Circular on Ballast Water Sampling and Analysis for Compliance with BWM and/or to best practices available and/or according to an international and recognized protocol

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.3 A BWMS making use of UV light may irradiate the ballast water during the ballast water discharge, as well as at uptake, to ensure successful compliance with the D-2 standards. If the actual UV intensity and/or power consumption for the UV lamp are consistent with the specified level for the system evaluated under Guidelines (G8), then this measurement could be envisaged as indicative of the proper operation of the system. There may be other energy consuming BWMS (heat) where this method may also be appropriate.

.4 During the operation of the BWMS specific monitoring equipment may indicate that a secondary treatment is [necessary][required] during the ballast water discharge. If the actual measured value is consistent with the specified level for the system evaluated under Guidelines (G8), then this measurement could be envisaged as indicative of the proper operation of the system.

[84] Regarding to the possibility of PSCO to conduct the full-scale sampling what is not usually part of PSCO activities, it suggest to be conducted by a trained personal. Besides that, the detailed analysis should require also more trained personal, unless *in situ* sensors are able to produce accurate data in this regard. In current situation it could be done by a sampling team supported by Universities / Researchers Centres along the coast, nominated and/or authorized by the Administration.

The sampling and analysis procedures during detailed inspection are not intended to be implemented as a routine, for several practical reasons. The intention is to conduct efforts in this regard when there are clear grounds, when other Administrations ask the current one to do it or when PSCO is still suspecting that something is wrong. In any other occasion, the intention should be verify the documentation and once it satisfies the inspection should be finalized.

Detailed inspection should occur as part of planned inspections in some national ports along the coast every year when competent people should joint efforts with PSCO to conduct it.

Exemption System

There are two ways to grant an exemption according to BWM Convention. The first one is an automatic exemption and the second one is when shipowners apply for an exemption according to Regulation A-4. The possible exempted situations are listed in the Convention and are the following:

- Granted to a ship or ships on a voyage or voyages between specified ports or locations; or to a ship which operates exclusively between specified ports or locations;
- Effective for a period of no more than five years subject to intermediate review;
- Granted to ships that do not mix Ballast Water or Sediments other than between the ports or locations specified above; and
- Granted based on the Guidelines on risk assessment developed by the Organization (G7).

The automatic exemptions are granted to[85]:

(a) ships not designed or constructed to carry Ballast Water;

[85] Items (a) (e) and (f) of BWM Convention article 3(2). The remain items to which Convention shall not apply and all items from regulation A-4 (exemptions) are suppose to be granted taking in account that it would impair or damage their environment, human health, property or resources, and it is more specific in the regulation A-4(1.4), where it is said that any grants shall be based on the Guidelines on risk assessment (G7).

(b) any warship, naval auxiliary or other ship owned or operated by a State and used, for the time being, only on government non-commercial service. However, each Party shall ensure, by the adoption of appropriate measures not impairing operations or operational capabilities of such ships owned or operated by it, that such ships act in a manner consistent, so far as is reasonable and practicable, with this Convention; and
(c) permanent Ballast Water in sealed tanks on ships, that is not subject to discharge.

Once the Brazilian Maritime Authority has listed only automatic grants in its Norm, besides the one regarding to vessels whose design does not allow the exchange of ballast, in which case the shipowner shall request for a grant sending needing and supporting documentation, it shall be clearly defined by the Authority if any exemption system are going to be applied. If the Administration intends to implement an exemption system in line with the BWM Convention it shall be based on the Guidelines on risk assessment (G7). The Administration should consider this option and release the rules and norms applied to ships in order to grant an exemption of ballast water management procedures.

3.4 Recommendations & Conclusions

There are many uncertain questions regarding to the ballast water management. Some treatment systems proposed up to now are showing that it is necessary to let such technology gets maturation that comes from usage. The conditions and all of the associated operational and environmental variables that systems will face on trading vessels cannot be adequately simulated in off ship testing, like during type approval test. This real world

experience is essential to enable further development of existing technologies and to reveal new opportunities and cultivate innovation (Steward, 2012)[86].

Other examples are associated to some biological groups and its capacities to survivorship and re-growth after ballast water treatments, as cited by Liebich *et al*., 2012. In this study it was possible to observe after the application of a UV treatment that some diatoms were able to re-growth. This is because they are small, robust as vegetative cells or resting stages, and able to survive in dark and unfavourable conditions in the ballast water tanks, besides the fact that most diatoms also have a broad temperature range (Liebich *et al*., 2012), what happens, for example, to the marine gastropod *Rapana venosa* with regards to the salinity (Mann & Hidering, 2003). Yet with regards to the treatment efficacy, Perris *et al*., 2006, conducted a study on ballast water ozonation treatment and results obtained have indicated that seawater characteristics, including the organic content and ammonia, affect the amount of ozone required for ballast water treatment, what it is related to the chemistry of ozone in seawater considerably different than while in freshwater, and so interfering on the disinfection effects.

Many others studies have been conducted in this regard and once results are not been the most expected ones, not to mention that this technological field is very recent and that is necessary to conduct many more researches and monitoring, many doubts arises in the shipping industry. Besides that, although certification / type approvals has become standardised worldwide, there are still remain important aspects regarding to test conditions, sampling strategies and endpoint determination (Wright, 2012).

The present world economic situation, more than in other times, are also being a robust excuse to the adoption of more expensive requirements, in check by some recent studies. Furthermore, as everyone knows every new investment from shipping industry, regardless its importance is going to be reflecting at the end over consumers in a very uncertain period of the recent economic history.

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[86] http://www.marinelink.com/news/technology-treatment344898.aspx. Ballast Water Treatment – The Evolution of the Technology Market, from Jon Steward. Published on 22nd of June, 2012. Accessed on 4th of July, 2012

Besides all mentioned questions regarding to BWMS, it has been mentioned some others problems that may arise with the get into force of BWM Convention. A point mentioned in the proposed framework on ballast water for PSC procedures is the possibility to the Administration to apply an exemption system in some cases provided in the BWM Convention. In almost every situation listed in the convention on regulation A-4 or in Article 3(2), a ship must apply for an exemption in a much grounded way so it can be considered and granted by the Administration. On the other hand, it generates an obligation to the Administration and thus it becomes indispensable to the Administration to develop an exemption system based on risk assessment guidelines (G7), if the Administration thinks this kind of system must be applied.

Once Brazil has already a Norm on ballast water where it is provided some possible exemptions, all of them are automatic grants with the exception of item d, which is regarding to vessels whose design does not allow the exchange of ballast, upon request from the shipowner to the Directorate of Ports and Coasts (DPC), and is also Party of the BWM Convention, if the Administration is thinking about the possibility to grant any other possible exemptions listed in regulation A-4 or even in Article 3, it is better developing a system based on risk assessment as required by the Convention. Of course that there is the possibility of not granting any other exemptions besides the automatic ones mentioned before. However, all exemptions already given which were based on the fact that ships were sailing through fixed routes shall be based in risk assessment according to the Convention. So, in terms of Brazil, all grants based in fixed routes, are suppose to be reviewed and/or withdrawal. In this regard, the United Kingdom Maritime and Coast Guard has hired a Consultant to develop such an important work, although UK is not Party of the Convention, but mainly because UK shipowners start asking for guidance in this regard.

Besides that, the Maritime Authorities / Administrations should decide if voluntary procedures regarding to biofouling should be attached to the Ballast Water Management Plan and also with regards to sediments' management plans, to which some procedures are provided in current Brazilian Norm and

also in the BWM Convention, in which case more concern is going to be needed.

Other important and big issue to be thought is related to vessels that operate in exclusive economic zones, how the Administrations are going to implement the procedures provided in BWM Convention, once it is very important to enforce compliance within national waters.

All administrations are supposed to prepare themselves for applying BWM Convention requirements one year after conditions to get into force are met. So the fact that Brazil is already Party and has a Decree on BWM Convention makes the issue even more urgent, and Brazil is looking for appropriate and better ways to apply BWM Convention requirements once we are aware of all these aspects. That is considered a big issue and the main reason for applying to the Fellowship Programme and share information in this regard. But as said by Leonardo da Vinci[87] knowing is not enough, we must apply, so this paper also proposes some procedures already discussed in IMO meetings and in some part already in use by Brazilian Administration among others. Despite the fact that some issues are not well discussed till now and more information will be need before its inclusion among PSC procedures on ballast water.

Once again, for MEPC 64 (October, 2012), Japan is submitting a paper[88] updating document MEPC 63/2/17 cited in Part Two of this paper, where it is clearly showed that if BWM Convention gets into force soon, in current basis, ships won't be prepared to comply with Regulation B-3. There is also a figure in this paper that illustrates the estimated number of ships that will require installing BWMS up to 2020, with main peak in year 2017, when more than 16000 vessels are expected to be required to install BWMS.

India following the MEPC invitation to Members States to provide update data with regards to BWMS already on board, also submitted a paper in this regard, showing the same scenario of the others Member States who

[87] "I have been impressed with the urgency of doing. Knowing is not enough; we must apply. Being willing is not enough; we must do." (Leonardo da Vinci)

[88] MEPC 64/2/10: Updated data and information on the status of ballast water management system installation. Submitted by Japan.

did this survey, where almost 94% of ships that replied to the Indian National Shipowners' Association's questionnaire have not installed BWMS yet. China, in paper MEPC 64/2/13 also presented the current status of BWMS in China flagged ships engaged in international voyages. Data available on 20th of March, 2012 showed that only 12 ships have BWMS installed and that all ships that the keel will be laid in 2012 have arranged spaces for the BWMS but not installed onboard yet. As possible reasons, China lists the uncertainties regarding to sampling and analysis methods used during port State inspections; uncertainties regarding to the date of entry into force of BWM Convention and also related to the constant review and updated of G8 and G9[89] and the possible adoption of alternative methods of ballast water treatment. The document point out that the uncertainty of sampling and analysis method used by PSCO, makes it impossible for BWMS manufacturers or recognized organizations to guarantee that the BWMS they produce/certify will really comply to D-2 standards during these inspections.

ICS paper (MEPC 64/2/16) presented also the same concerns of China and highlights the BWMS costs and the current economic situation. Besides that, this paper talks also about the challenges to compliance with B-3 Regulation and proposes timelines to be reconsidered, treating ships as existing ones and new ones, among other suggestions. Once there is no way to amend the Convention before it entry into force, ICS urges States to ratify it in order to amend it as soon as possible. A paper submitted by Liberia, the Marshall Islands, Panama, BIMCO, INTERTANKO, CLIA, INTERCARGO, InterManager, IPTA, NACE and WSC keep the same discussion regarding to all those cited issues that are probably preventing the entry into force of BWM Convention and the need to be reviewed by the Marine Environment Protection Committee and IMO Member States. This document summarized the four big issues, which are the following:

- Reviewing of G8 to improve transparency and ensure BWMS' robustness;
- Availability of BWMS and enough facilities to install BWMS;

[89] G8: Guidelines for approval of ballast water management systems; and
G9: Procedure for approval of ballast water management systems that make use of active substances (G9).

- Survey and certification for existing vessels; and
- PSC sampling and analysis methods.

So, it is clearly demonstrated in a current and comprehensive basis that things are not going to proceed in a smooth way, bearing in mind also that once BWM Convention reaches 35% of the gross tonnage of world merchant fleet, Administrations will have just a year to adequate themselves to comply with all requirements.

Regarding to the application of regulation B-3, it was established during MEPC 64 that a correspondence group coordinated by Japan is going to prepare an Assembly resolution in relation to the implementation dates provided in regulation B-3 of the BWM Convention, with a view to its adoption by the 28th session of Assembly in 2013.

Besides that, all major concerns here mentioned and not solved yet with regards to ballast water inspection applied by PSC around the word, seem to be inefficient in some cases when in terms of enforcement only documental aspects are possible to verify and/or PSC methodology for sampling and analysis is not standardized. All these doubts need, mainly those concerns regarding to G8[90] tests for type approval and possible PSC procedures, to be solved as fast as possible once it has been considered a big deal in the implementation process. All issued guidelines, guidance and circulars seem to turn things even more obscured for those who have to implement the rules and also to those who need to comply with them.

Maybe, when referring to BWMS' test conditions, manufacturers when type approving their systems could be able to develop a 'recipe' for each case addressed to PSC inspections and also making clearer principal aspects of testing during type approval, giving them more transparency. Other possibility is to better developing possible ways to verify (sample/analyses) BWMS in some situations, through few robust methodologies, among which PSC inspections would be based.

[90] It was decided during MEPC 64 that G8 are not going to be open to a new set of amendments as required by the industry at this stage. In this regard it was defined that MEPC 175(58) should be improved and BWM.2/Circ. 28 should be expanded during BLG 17. Besides that, MEPC 64 approved a draft circular on issuance of BWM Certificates prior the entry into force of the BWM Convention.

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Annexes

ANNEX 1

BALLAST WATER REPORTING FORM

☐ Amended Reporting Form ☐ Ballast water exchange (mid-ocean) ☐ 2ª Ballast water Exchange (Amazon and Para rivers)

1. SHIP INFORMATION

2. BALLAST WATER

Vessel Name:	Type:	IMO Number:	Specify Units: M^3, MT
Owner:	Gross Tonnage:	Call Sign:	Total Ballast Water on Board:
Flag:	Arrival Date:	Agent:	
Last Port and Country:		Arrival Port:	Total Ballast Water Capacity:
Next Port and Country:			

3. BALLAST WATER TANKS BALLAST WATER MANAGEMENT PLAN ON BOARD? YES _____ NO _____ MANAGEMENT PLAN IMPLEMENTED? YES_____NO_____
TOTAL NUMBER OF BALLAST TANKS ON BOARD: _____ NO. OF TANKS IN BALLAST: _____ IF NONE IN BALLAST GO TO NO. 5.
NO. OF TANKS EXCHANGED: _____ NO. OF TANKS NOT EXCHANGED: _____

4. BALLAST WATER HISTORY: RECORD ALL TANKS THAT WILL BE DEBALLASTED IN PORT STATE OF ARRIVAL; IF NONE GO TO No. 5. (SHIPS TOWARD AMAZON BASIN: ITEM 3.4, NORMAM 20).

Tanks/ Holds (List multiple sources per tank separately)	**BALLAST WATER SOURCE (4.1)**					**BALLAST WATER EXCHANGE (4.2)** Dilution (1), Flow Through (2) or Empty/Refill (3)						**BALLAST WATER DISCHARGE (4.3)**			
	DATE DDMMYY	Port or Lat/Long*	Volume (units)	Temp (units)	Salinity (units)	DATE DDMMYY	Endpoint Lat/Long.	Volume (units)	% Exch	Depth (m)	BW exchange method	DATE DDMMYY	Port or Lat/Long*	Volume (units)	Salinity (units)

Ballast Water Tank Codes: Forepeak = FP, Aftpeak = AP; Double Bottom = DB; Wing = WT; Topside = TS; Cargo Hold = CH; Other = O

IF EXCHANGES WERE NOT CONDUCTED, STATE OTHER CONTROL ACTION(S) TAKEN:_____
IF NONE STATE REASON WHY NOT:_____

5. INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004 ON BOARD? YES_____ NO_____
IMO BALLAST WATER GUIDELINES ON BOARD (RES. A.868(20))? YES_____ NO_____
RESPONSIBLE OFFICER'S NAME AND TITLE (PRINTED) AND SIGNATURE: _____

ANNEX 2

INTERNATIONAL MARITIME ORGANIZATION
4 ALBERT EMBANKMENT
LONDON SE1 7SR

Telephone: 020 7735 7611
Fax: 020 7587 3210

IMO

E

Ref. T5/1.22

BWM.2/Circ.1*
22 September 2005

INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004

Communication received from the Administration of Brazil

A communication has been received from the Administration of Brazil concerning the mandatory national legislation pertaining to requirements for ballast water exchange.

At the request of the Administration of Brazil, the above-mentioned communication annexed hereto is circulated to Member States for their information and future action as appropriate.

***

* To facilitate prompt identification, circulars related to the status of BWM Convention will be issued under the symbol (BWM.1/Circ.…) and circulars related to technical aspects of ballast water management will be issued under the symbol (BWM.2 /Circ.….).

ANNEX

SUMMARY OF BRAZILIAN NATIONAL LEGISLATION ON BALLAST WATER MANAGEMENT FOR SHIPS

The Brazilian national legislation on Ballast Water Management for Ships was developed using as a basis the provisions of IMO's Resolution A.868(20) and the International Convention for the Control and Management of Ship's Ballast Water and Sediments, 2004, adopted by the Organization in February 2004.

This legislation will be applicable to all ships that carry out ballast water discharge in Brazilian jurisdictional waters and shall enter into force as from 15 October 2005.

This legislation stipulates, as a mandatory requirement, that all ships intending to discharge ballast water in Brazilian jurisdictional waters shall:

- Conduct ballast water exchange at least 200 nautical miles from the coast and in water at least 200 metres in depth.

In cases where the ship is unable to conduct ballast water exchange as stipulated above, it shall be done as far as possible from the nearest land and in all cases at least 50 nautical miles from the coast and in water at least 200 metres in depth.

In cases where the ship is unable to carry out ballast water exchange, ballast water shall be retained on board and only a minimum amount may be authorised for discharge, with the consent of the Maritime Authority Agent. In such cases the master should notify the Maritime Authority in advance.

The three methods for ballast water exchange – sequential, flow-through and dilution - will be accepted. When the flow-through or dilution method is used, at least three times the tank's volume should be pumped. Ballast water exchange should be carried out with an efficiency of at least 95% volumetric exchange.

Ballast water exchange will also be required for ships engaged in commercial navigation between distinct hydrographical basins and between maritime and fluvial ports.

Special provisions apply to ports of the Amazon Basin, where an additional exchange will be required in order to reduce the ballast water salinity, and should take place between the isobathic of 20 metres and Macapá. For ships with a ballast capacity of less than 5000m^3 the additional exchange should be carried out at the mouth of the river Jari. For this additional exchange the tank's volume only needs to be pumped once. The same applies to the River Pará, for which the additional exchange should be conducted at least sixty nautical miles from Salinópolis up until the lighthouse of Ponta do Chapéu Virado (Mosqueiro Island).

Monitoring of the above provisions will be done through the inspection of the Ballast Management Plan and the Ballast Water Reporting Form. The Ship must send a copy of the Ballast Water Reporting Form to the relevant agency twenty-four hours prior to the estimated time of arrival.

Monitoring may also include the collection and analysis of a ballast water sample.

Violations of these provisions will be sanctioned according to the national law, which may include warnings, fines, detention or prohibition of the ship's entry in the port or terminal.

The requirements of these provisions shall not apply to:

- the uptake or discharge of ballast water and sediments necessary for the purpose of ensuring the safety of the ship in an emergency situation or saving life at sea;
- The accidental discharge or ingress of ballast water and sediments resulting from damage to the ship or its equipment;
- The uptake and discharge of ballast water and sediments when being used for the purpose of avoiding or minimizing pollution incidents from the ship; and
- The discharge of Ballast Water and Sediments from a ship at the same location where the whole of that Ballast Water and those sediments originated and provided that mixing with un-managed ballast water and sediments from other areas has not occurred.

The following ships are exempt from these provisions: war ships or ships owned or operated by a Estate and employed in non-commercial voyages, ships with sealed ballast tanks not subject to discharge, maritime and port support vessels, ships whose design characteristics do not allow ballast exchange, and recreational and search and rescue vessels, with less than 50 metres in length and with a maximum ballast capacity of eight cubic metres.

More detailed information about these provisions can be obtained from secom@dpc.mar.mil.br.

BRAZILIAN NAVY

BRAZILIAN PERMANENT REPRESENTATION TO THE INTERNATIONAL MARITIME ORGANIZATION
170 Upper Richmond Road, Putney
London – SW15 2SH
Tel: 0208 246 4431/88/86, Fax: 0208 246 4495
E-mail: BrazilianRepresentation.IMO@mar.org.uk

28 July 2005

The Secretary-General
International Maritime Organization
4 Albert Embankment
London
SE1 7SR

Sir,

The Brazilian Permanent Representation presents its compliments and, with reference to the issue of Ballast Water Management, has the honour to inform you that, as part of Brazil's efforts to preserve the marine environment and to implement the provisions of the International Convention for the Control and Management of Ship's Ballast Water and Sediments, 2004, Brazil has recently adopted mandatory national legislation pertaining to requirements for Ballast Water Exchange.

This legislation shall apply to all ships intending to discharge ballast water in Brazilian jurisdictional waters and shall enter into force as from 15 October 2005.

I enclose at annex a summary of the main requirements of this legislation and would be grateful if you could kindly arrange for this information to be circulated to all IMO Member States.

I avail myself of this opportunity to renew to you, Sir, the assurance of my highest consideration.

Luis Fernando Resano
Captain
Acting Permanent Representative to IMO

ANNEX 3

MAIN BRAZILIAN PORTS

Available in: http://www.antaq.gov.br/Portal/default.asp# . Accessed on 18th of July, 2012

ANNEX 4

REPORT OF THE IMPOSITION OF A CONTROL AND COMPLIANCE MEASURE TO ENHANCE MARITIME SECURITY BRAZILIAN MARITIME AUTHORITY NORM FOR THE MANAGEMENT OF SHIPS' BALLAST WATER (NORMAM-20/DPC).

(DIRECTORATE OF PORTS AND COASTS)

Rua Teófilo Otoni, 4
Rio de Janeiro – RJ – Brazil
CEP 20.090-070
Telephone: (55) (21) 2104-5678
Telefax: (55) (21) 2104-5228

Copy to: Master
Head Office
PSCO

1. Name of reporting authority: **Directorate of Ports and Coasts** 2. Date of inspection: _____

3 Place of inspection: _____
4 Name of the ship: _____ 5. Flag of the ship: _____
6. Type of ship: _____ 7. Call sign _____
8. IMO number: _____ 9. Gross tonnage _____
10. Year of build: _____
11. Ballast Water Management Plan - Recognize Organization : _____
12. Last port of call _____
13. Last port of ballast_____

14. **Non - Conformities**

Ballast Water Management Plan
Not Available

Not complying with Brazilians Maritime Authority Norm Directions (NORMAM-20/DPC)

Ballast Water Reporting Form
Not Available

Fails in fulfilling Reporting Form

Others

15. **Description of Non - Conformity**

_____
_____
_____
_____
_____
_____

16. **Specific control measures**

None

Fine

Cargo operation modified or stopped

Ship ordered to leave the port for Ballast operation

Notice

Ship detained

17. Issuing Office _____ Stamp _____

Port State Control Officer

Name: _____

Stamp: _____

Telephone / fax _____

_____
Master