2017-02-08

Ten years of Brazilian ballast water management

Trindade de Castro, Maria Cecilia

http://hdl.handle.net/10026.1/8515

10.1016/j.seares.2017.02.003
Journal of Sea Research
Elsevier BV

This is the author's accepted manuscript. The final published version of this work (the version of record) is published by Elsevier in *Journal of Sea Research* available on 10 February 2017 at: http://dx.doi.org/10.1016/j.seares.2017.02.003. This work is made available online in accordance with the publisher's policies. Please refer to any applicable terms of use of the publisher.

Ten years of Brazilian ballast water management

Maria Cecilia Trindade de Castro[a,b,c] , Jason M. Hall-Spencer[d,e], Cecília Fonseca Poggian[c] , Timothy W. Fileman[f]

[a] School of Marine Science and Engineering, University of Plymouth, PL4 8AA, UK. Email: cdc@pml.ac.uk Tel: +44(0)1752 633 100.

[b] Plymouth Marine Laboratory (PML), Prospect Place, Plymouth, PL1 3DH, UK.

[c] Directorate of Ports and Coasts, Navy of Brazil. Rua Teófilo Otoni, nº 4, CEP 20090-070, Rio de Janeiro/RJ, Brazil.

[d] Marine Biology and Ecology Research Centre, University of Plymouth, PL4 8AA, UK.

[e] Shimoda Marine Research Centre, University of Tsukuba, Japan.

[f] PML Applications Ltd, Prospect Place, Plymouth, PL1 3DH, UK.

Abstract

In 2005, Brazil addressed the environmental challenges posed by ballast water through a unilateral regulation, called the Maritime Standard Nº 20 (NORMAM-20), applied to all shipping in her waters. This world-leading decision was the culmination of a process that started during the 1990's. Here, we summarize how these ballast water regulations were brought in and adopted and present the findings of 10 years of enforcement (2005-2015) in 39 ports along the Brazilian coast. We show that compliance with the Brazilian standard has increased significantly since the regulations were implemented ($p<0.001$). After five years of implementation, non-compliance decreased probably reflecting an increase in awareness of the Brazilian Standard and a shift in the shipping industry commitment to minimize and control the spread of invasive species through ballast water. The Brazilian experience shows that very high levels (97%) of compliance with ballast water management regulations can be made to work in a region of global importance to the maritime industry. In the last decade, the rules governing ballast water in Brazil have evolved to address the demands from the maritime community and to provide updates such as imminent requirements for the use of ballast water management systems on board ships. These regulations are rarely cited when ballast water regulations are discussed internationally, yet there is much to learn from the proactive approach taken by Brazil such as what is feasible and enforceable.

Keywords: Shipping, Biosecurity, Invasive Species, Marine Biology, International Trade.

Introduction

Today, about 80% by volume of international trade is carried by sea along shipping routes that connect coastal regions worldwide (UNCTAD, 2014). The shipping industry has played a very important role in the development of economies around the world; increasing industrialization and changes in the world economies have fuelled the trade and set a growing demand for consumer products and advances in shipping technology mean that has become an increasingly efficient and a swift method of transport (IMO, 2012). However, shipping activities need environmental controls to help avoid accidents, to curb pollution and inhibit the transfer of organisms across biogeographic boundaries (Leal-Neto, 2007).

Ballast water is taken on board ships to improve manoeuvrability, stability and safety and is of major environmental importance since when it is discharged it can spread pathogens that cause disease and can have major ecological and economic impacts if invasive and harmful species are introduced. Descriptions of alien species associated with shipping date back to the 16th Century with a scientific focus on the problem building up through the 1970s leading to Canada and Australia raising the risks posed at meetings of the International Maritime Organization (Galil et al., 2009).

Shipping is the main source of unintentional transfer of organisms, including pathogens, via ballast water discharges and biofouling (Ruiz et al., 2000; Bax et al., 2003; Coutts &Taylor, 2004; Drake & Lodge, 2007; Takahashi et al.; 2008). International initiatives have been taken to avoid the transference of non-native species through ballast water, initially with the adoption of voluntary guidelines which recommended the ballast water exchange in mid-ocean as a management option (International Maritime Organization (IMO) Marine Environment Protection Committee Resolution MEPC.50(31), IMO Assembly Resolution A.774(18), IMO Assembly Resolution 686(20)). In 2004, the International Convention for the Control and Management of Ships Ballast Water and Sediments (BWM Convention) (IMO, 2004) was adopted by consensus. After more than 12 years, in September, 2016 the IMO BWM Convention finally reached the 35 per cent of world merchant shipping tonnage as provided in Article 18 and will enter into force on 8th September 2016. Apart from this international regulation and its guidelines, many management practices have been developed to deal with the problem; ballast water exchange in mid-ocean (already mentioned), risk assessment and modelling, technologies to treat the ballast water on board, shipping routes optimization and new ship designs are among them. Management practices ashore like reception and storage facilities, as well as mobile solutions in a form of dedicated ships or container size units are also possibilities that enable in-port ballast water treatment (Gregg et al., 2009; Jing et al., 2012; Balaji et al., 2014). Moreover, since Australia has been a pioneer on the matter, it seems appropriate to mention that recently this Country has changed their regulation initially adopted in 2001. In terms of management practices the Biosecurity Act 2015, adopted on 16/06/2016, included as exceptions (and then subject to discharge): ballast water managed with IMO Type Approved Ballast Water Management System listed in the regulation; discharges from ballast water exchanged in defined areas as well as derived from freshwater ballast.

From a national perspective, there have been many major environmental and economic problems associated with the introduction and spread of the golden mussel (*Limnoperna fortunei*) during the 1990's (i.e. agglomeration and clogging inside cooling systems and discharge pipes, deterioration and obstruction of filters at Itaipu binacional hydroelectric power plant) (Mansur et al., 1999; Danrigran & Drago, 2000). This led Brazil to unilaterally adopt her own ballast water management regulations to minimize the threat posed by invasive species.

Brazilian maritime administration and ballast water management

The Brazilian Maritime Authority enforces, under naval command, national and international regulations in waters under national jurisdiction and carries out inspections for the protection of human life, the safety of navigation and the prevention of environmental pollution. The Maritime Authority has a main Directorate of Ports and Coasts that oversees the implementation and enforcement of maritime regulations carried out by Port State Control Officers (PSCO).

National regulations on ballast water began in 2000 with the adoption of the Brazilian Maritime Authority's Standard nº 08 (NORMAM 08), superseded by reviews in 2013 and 2015 (Brazil, 2015). This required that each vessel in Brazilian territorial waters to send a completed Ballast Water Form to the local Port Captaincy and that a copy was shown during Port State Control inspections. In 2001, the Brazilian National Health Surveillance Authority imposed a similar requirement (Resolution RDC nº 217) (Brazil, 2001) to limit public health problems associated with ballast water with epidemiological surveillance and vector control at Sanitary Control Ports. This followed the occurrence of a small cholera outbreak in Paranaguá Bay, southern Brazil, in 1999, where the disease had never previously been reported (Riviera et al., 2013). Already at that time, regulations for health surveillance made the Ballast Water Form mandatory for granting entry to ships into Brazilian ports. The resolution raises the possibility of sampling of ballast water tanks for identifying the presence of pests and pathogens and to verify physical and chemical parameters, at the Sanitary Authority's discretion (article 28). In December, 2009, this sanitary rule was updated by Resolution RDC nº 72 (Brazil, 2009).

In 2005, after a period of discussions with the Brazilian maritime community, the Director of Ports and Coasts adopted the Brazilian Maritime Standard for ballast water management (NORMAM-20) which stipulates obligations to ships and/or their agents including filling out and sending the Ballast Water Form and providing information about the ballast water handled by the ship and its management, mainly through the mid-ocean exchange (Castro et al., 2010). In 2014 the rule was revised and providing information about ballast water management systems has become compulsory (Brazil, 2014).

Taking into account the additional task on ballast water and considering the nature of the inspection (not merely documental), during the period between the adoption of the Brazilian Standard (June, 2005) and its entry into force (October, 2005), PSCO located along the coast were trained by specialists on ballast water, senior inspectors and ship's masters. Moreover, informative material and presentations on the new requirements were also delivered to ship owners and maritime agents, with a view to discuss and clarify any aspects associated with the adoption of the new ballast water requirements.

Inspection of ballast water is generally conducted during ordinary inspections by Port State Control officers and is based on documents required by the Brazilian ballast water regulations, like the Ballast Water Management Plan and the Ballast Water Reporting Form (see Appendix*). The exchange of ballast water in the mid-ocean is also required by Brazilian regulation. Ballast Water Management Plan minimum requirements are identical to those provided in the BWM Convention whereas the Ballast Water Reporting Form is a variation of the IMO Resolution A.686(20), from 1997. The ballast water history of each ship is usually checked as the form is sent prior to arrival and this is checked again during the inspection on board. This is to verify whether the ship exchanged water in the mid-ocean and where it was conducted. Further analysis is conducted in the Brazilian Navy's Research Institute (IEAPM) located in Arraial do Cabo, Rio de Janeiro, where an ongoing project has taken place since the regulation was adopted. Finally, at PSCO's discretion or when national campaigns are applied, ballast water samples are taken and a refractometer is used to verify the salinity of the water. At this stage, a further indication of the mid-ocean exchange is desirable. In 2014, a new field was added to the Form regarding the existence of a certified ballast water management system already installed. Therefore, data verified and collected by Port State Control officers are mainly related to the ballast water management practices adopted by the ship. Additional provisions are also requested when ships are navigating between national ports/terminals located in different hydrographic basins. In this case, ships must exchange their ballast water to avoid the spread of invasive species as they are operating within similar water bodies. Rules on ballast water exchange in Brazil apply to domestic shipping when rivers from different hydrographic basins are crossed. Exemptions from ballast water management practices are provided in the regulation and are similar to those provided in the BWM Convention; however, in some cases, a valid Exemption Certificate issued by the Directorate of Ports and Coasts is required.

In case of non-compliance the local Maritime Authority can apply fines or warn, detain or prohibit the vessel's entry and/or discharge its ballast water, request the vessel to leave the port or terminal in order to discharge or exchange its ballast water prior to operations in the port/terminal. Sanctions are applied depending on the seriousness of the violation and its potential threat to the aquatic environment, varying from educative measures to fines in most cases.

This is an exploratory descriptive study to evaluate the status of adherence to the Brazilian regulation on ballast water in a 10 years period; here we consider the Brazilian experience of ballast water management over the past decade, based on inspections' reports. During the period, Brazilian port State control officers verified vessel compliance to the national standard and reported back the results to the Brazilian Maritime Authority. Additional important initiatives taken concerning ballast water issues within the country are also reported.

Methodology

Design and Area of study

We considered 11,183 vessels in 39 ports / terminals (ANTAQ, 2016) aboard which naval inspections were carried out by the Brazilian Port State Control Officers during the period between 2005 and 2015. These ports / terminals are distributed along seven (of nine) Naval Districts according to the criteria adopted by the Brazilian Navy. Areas 1 to 7 cover the following ports and/or terminals:

Area 1: Ports / terminals of Rio de Janeiro, Angra dos Reis / Itacuruçá, Itaguaí / Sepetiba, Vitória, Praia Mole / Tubarão, Ponta de Ubu, Barra do Riacho / Portocel;

Area 2: Ports / terminals of Aracaju, Salvador;

Area 3: Ports / terminals of Fortaleza, Recife, Natal / Termisa, Suape, Pecém, Paracuru, Mucuripe, Maceió, Cabedelo, Areia Branca;

Area 4: Ports / terminals of Itaqui, Alumar, Belém, Ponta da Madeira, Fazendinha / Santana, Vila do Conde, Macapá;

Area 5: Ports / terminals of Rio Grande, Imbituba, Itajaí, São Francisco do Sul, Paranaguá, Antonina, Navegantes, Porto Alegre, Tramandaí, Santa Clara;

Area 6: Ports / terminals of São Sebastião, Santos;

Area 7: Port of Manaus.

Data collection

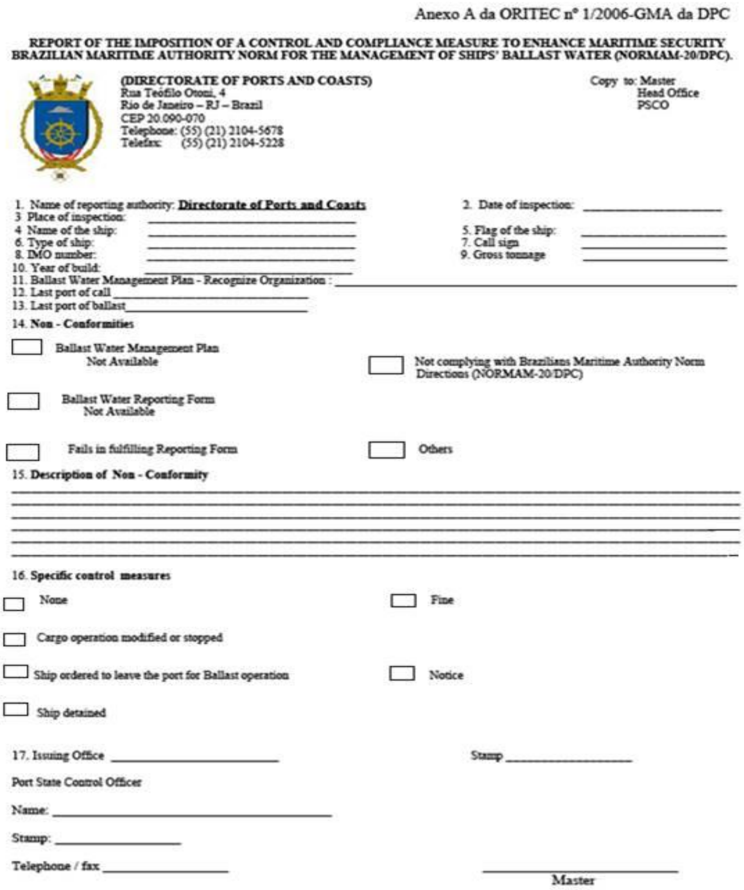
Data used in the present study were collected from Port State Control reports on ballast water, which is divided into 17 fields, where general information about the ship and description of non-conformities are required. We analysed data related to ship compliance with the Brazilian standard, mainly reported in fields 14 and 15 (Figure 1).

Compliance data were defined as the outcome variable and were categorized as a binary variable (compliant and non-compliant). This variable was distributed considering two periods of time (T): T1 from 2005 to 2010 and T2 from 2011 to 2015.

Data analysis

Chi-Square tests were applied to assess differences in compliance between T1 and T2. Then, a binary-logistic regression (not adjusted) was conducted to test the effect of T1 and T2 on compliance with the Standard. A p-value <0.05 was adopted as the statistical significance.

All analysis were fitted with IBM SPSS Statistics software (Version 22).



Anexo A da ORITEC nº 1/2006-GMA da DPC

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

Figure 1: Port State Control report on ballast water.

Results

Port State control reports

Overall compliance with Brazilian ballast water regulations is shown in Table 1. These data were collected aboard 11,183 ships inspected in Brazilian waters between 2005-2015.

Table 1: Ships' compliance with the Brazilian Maritime Standard between 2005 and 2015 (per area of study).

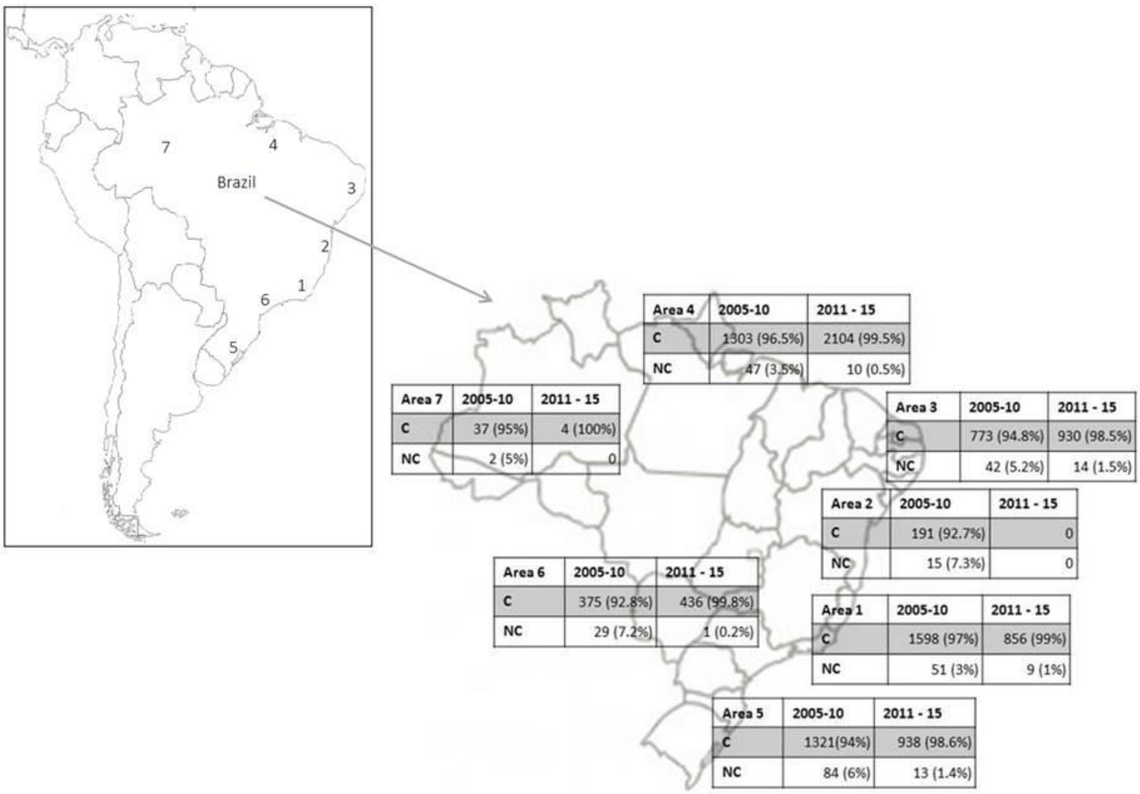
Area	Compliant Ships (C)	Non-compliant Ships (NC)	Total
1	2454	60	2514
2	191	15	206
3	1703	56	1759
4	3407	57	3464

5	2259	97	2356
6	811	30	841
7	41	2	43
Total	10866	317	11183

From the total of ships inspected during the period (Table 1), a clear predominance of inspections occurred in area 4 (31%) followed by areas 1 (22.5%) and 5 (21%); Port of Manaus, Amazonas had the lowest rate of inspection (0.4%).

With a view to recognizing whether compliance with the Brazilian standard had varied in the first decade of implementation, we analysed the data in two time periods. Regional variations are shown in Figure 2 whilst a decrease in the proportion of non-compliant ships in T2 is shown in Figure 3.

Figure 2: Regional variation in compliance with Brazilian ballast water regulations between 2005-10 and 2011-15.



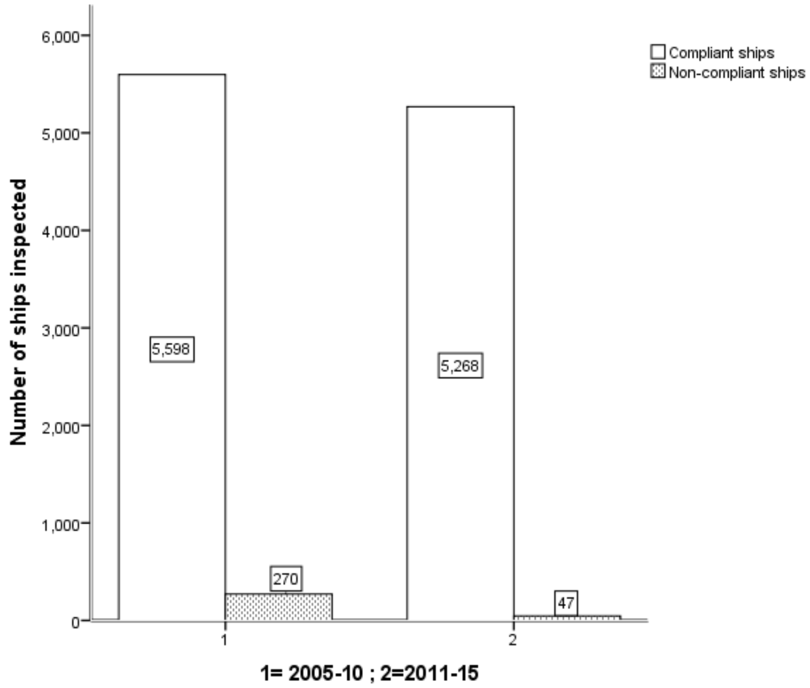


Figure 3: Decrease in non-compliance with Brazilian ballast water regulations between 2005-2010 and 2011-2015.

Chi-Square tests ($p<0.001$) revealed a significant decrease in the overall proportion of non-compliant ships, and these differences were also significantly different in all areas ($p\leq0.001$) except 2 and 7 where few inspections were conducted. Results from a binary-logistic regression (not adjusted) showed a negative association between time and the number of non-compliant ships ($Exp(\beta)= 0.185$; $SE= 0.159$ and $p< 0.001$).

Discussion

The first results of Port State Control enforcement procedures in Brazilian Jurisdictional Waters were presented in 2009 (Castro & Poggian, 2009). After that, a more recent evaluation of Naval Inspection reports showed that from October 2005 to May 2012, the number of non-compliant vessels had decreased gradually, reaching values below 5% of the total number of inspected ships (Poggian, 2014). Here we investigated how compliance with the Brazilian standard has changed and show a significant fall in noncompliance between 2005-10 and 2011-15 ($p< 0.001$) across all areas in Brazil, except for ports in Aracaju, Salvador and in Manaus where few inspections took place. Results obtained with the logistic regression confirmed this decrease, highlighting the positive effect of time over the number of compliant ships inspected in Brazilian ports / terminals. From the regression model, the odds of inspecting a non-compliant ship is 80% lower in 5 years.

Discrepancies in the number of inspections within the Country (as clearly shown in Table 1) revealed a clear predominance of inspections in areas 4, 1 and 5 in both periods of study,

from 2005-10 and from 2011-15. These results are mainly due to the number of ports / terminals selected per region, their engagement / importance in the shipping industry, and in a smaller proportion to the lack of local inspectors and logistic arrangements to implement the inspection in some areas. Nevertheless, a further analysis might show a relationship between these areas and their economic importance in Brazil, mainly for areas 1 (Southeast region where Itaguaí/Sepetiba ports/terminals in Rio de Janeiro State and Praia Mole/Tubarão and Ponta Ubu ports/terminals in Espírito Santo State are located) and 5 (South of Brazil, where Paranaguá port in Paraná State is located). These areas are crucial ones for the production's outlet, where mainly mineral ore, grains, fertilizers and bulk liquid are handled. Area 4, despite not being considered as developed as areas 1 and 5, is a strategic region for the exportation of mineral ore. Its importance is reflected in the massive number of inspections primarily conducted in Ponta da Madeira terminal, Maranhão State, where almost 13 percent of the total inspection effort occurred. Santos port/terminals are in area 6 and are also very important for the flow of the production of the aforementioned commodities and might require more attention in terms of number of inspections.
We opted to categorize the outcome variable in compliant / not compliant based on the questionnaire used by the PSCO. The non-adherence to at least one of the requirements provided in the Brazilian regulation not intended to explore reasons for non-compliance. Here, non-conformities that were found were mainly related to the Ballast Water Management Plan.

National Port State ballast water inspections are ongoing and the data this generates are being used to assist Port Captaincies Authorities with cases of non-compliance, and are part of an ongoing research project conducted by the Brazilian Navy's Marine Research Institute Admiral Paulo Moreira. Furthermore, the ongoing task of enforcement allows the ratification and rectification of adopted procedures and their updates. Currently, the implementation of a uniform procedure of ballast water sampling and analysis along the Brazilian coast is being developed.

Other relevant national ballast water management initiatives were taken in the period, mainly actions taken by Governmental stakeholders, some of them included in the present study with a view to contextualising the proactive way that Brazil is dealing with the ballast water issue. One of the first important ballast water initiatives came from Petrobras, the Brazilian Oil Company, during the 1990's, with the development of the Brazilian Dilution Method proposed as a variation of the flow-through method recommended by the International Maritime Organization (IMO). The method was adopted as one of the three recommended methods to exchange ballast water in mid-ocean. Results from the tests conducted by Petrobras were presented in many IMO papers (MEPC 38/13/2, MEPC 42/8/3, MEPC 42/INF.14, MEPC 53/2/24, MEPC 53/INF.18 and DE 42/11/1) Mauro et al., 2002; Castro, 2008).

The Brazilian Health Surveillance Agency undertook a 6-month campaign in 2001/2002 with a view to investigating the possible presence of pathogenic organisms in ballast waters reaching Brazilian ports. Furthermore, training was given on sampling and analysis of ballast water among local health surveillance agents working in Brazilian ports. More recently, as aforementioned, the Agency update its regulation on the matter and has started working with other Ministries / National Authorities with a view to combine efforts to have a broader control over the spread of unwanted species along the coast.

In December 2003 the Minister of State for the Environment officially established the Golden Mussel National Task Force which was composed of many entities from Federal, State and Municipal Governments, energy companies like Furnas, Itaipú and Eletrobrás and was supported by an Expert Group. Through the Golden Mussel National Task Force an Emergency Action Plan was launched, with the involvement of State and local institutions on the control of the golden mussel. The main purpose of the Emergency Action Plan was to control the golden mussel spread in the river basins of Guaíba, Alto Paraguay and Alto Paraná and also in developing outreach activities, by means of public awareness, training and monitoring activities (Castro, 2008). The Brazilian Environment Ministry was the Leader Agency regarding the implementation of the IMO Global Ballast Water Programme (GloBallast) – phase 1 in Brazil, during 2000 and 2004.

Also supported by the Brazilian Environment Ministry, a National Report on Invasive Alien Species within the country was started in mid-2003, with a view to systematizing and disseminating existing information on the subject. Reports on actual or potential invasive species affecting the marine environment, inland waters, human health and agriculture were produced. Results from each subproject were summarized in two main documents: "Diagnosis of Current and Potential Invasive Species" and "Existing Structure for the Prevention and Control". A comprehensive report concerning the marine environment was officially launched in 2009.

During 2007 and 2009, Petrobras undertook research at some of their marine terminals known to be ballast water importers taking into account the cargo loading/unloading rate. The research applied the GloBallast risk assessment methodology in the selected terminals. Results did not show significant risks, except for two shipping routes that had been identified as important paths because the ports of origin had environmental similarity with some of the national terminals studied (personal communications).

Conclusions

The Brazilian experience shows that very high levels (97%) of compliance with ballast water management regulations can be made to work in a region of global importance to the maritime industry. Results showed a positive effect of time over the compliance; however, results also showed discrepancies in the inspection regime along the coast. The decrease in non-compliance probably reflects an increase in awareness of the Brazilian Standard and increased industry commitment to minimizing the spread of invasive species.

Since the adoption of ballast water management in Brazil the main goal of the Maritime Authority has been to prevent and minimize impacts associated with the spread of non-native species through ballast water. The Port State Control efforts illustrate Brazilian commitment to marine environment protection and to international laws such as the United Nations Convention on the Law of the Sea, the Convention on Biological Diversity and the Ballast Water Management Convention itself. Moreover it represents, in our view, the best approach to verify the standard's implementation and to comply with IMO recommendations.

Brazil signed the Ballast Water Management Convention on 25th January 2005 and adopted its own NORMAM-20 regulations after open discussion within the Brazilian maritime community. Notwithstanding the adoption of a national legislation and the implementation of an inspection regime, the work on the subject is far from over, requiring further scientifically validated data for evaluation of its efficacy, besides monitoring and surveys campaigns to control the spread of non-native species (Lehtiniemi et al., 2015).

Although Brazilian authorities have stated that having international standards are the most effective way to enforce ballast water regulations the pressing to protect the marine environment led to the adoption of unilateral rules. Nevertheless, since the Ballast Water Management Convention only recently reached the combined tonnage of contracting States and will enter into force on 8 September 2017, the decision taken more than ten years ago appears to have been the right one for biosecurity in Brazilian waters.

This study did not aim to evaluate the relationship between the requirements provided in the regulation and their potential impacts on the Brazilian coast. The authors believe that further, more detailed, studies would be required in order to assess more accurately the reasons for non-compliance and the most noticeable impacts resulting from them.

Acknowledgements

This study is part of a PhD research funded by the National Council for Scientific and Technological Development (grant award 200026/2015-1), an agency linked to the Ministry of

Science and Technology, in charge of the “Science without Borders Programme” with support from the Secretary of Science, Technology and Innovation / Directorate of Ports and Coasts of the Brazilian Navy.

We thank Professor Maria Beatriz T. de Castro who helped with the statistics and whose valuable comments improved this paper.

References

1. Bax, N., Williamson, A., Aguero, M., Gonzalez, E. & Geeves, W. 2003. Marine invasive alien species: a threat to global biodiversity. Marine Policy, 27, 313-323.
2. Brazil. 2016. Agencia Nacional de Transportes Aquaviarios (ANTAQ): http://www.antaq.gov.br/Portal/Informacoes_Geograficas_Mapas.asp. Access on 03/07/2016.
3. Brazil. Resolução RDC Nº 72, 29/12/2009. Dispõe sobre o Regulamento Técnico que visa à promoção da saúde nos portos de controle sanitário instalados em território nacional, e embarcações que por eles transitem. Agência Nacional de Vigilância Sanitária (ANVISA).
4. _____. Resolução RDC nº 217, 21/11/2001. Aprova o Regulamento Técnico, anexo a esta Resolução, com vistas à promoção da vigilância sanitária nos Portos de Controle Sanitário instalados no território nacional, embarcações que operem transportes de cargas e ou viajantes nesses locais, e com vistas a promoção da vigilância epidemiológica e do controle de vetores dessas áreas e dos meios de transporte que nelas circulam. Agência Nacional de Vigilância Sanitária (ANVISA).
5. _____. Portaria Nº 49/DPC, 10/03/2015. Altera as Normas da Autoridade Marítima para Tráfego e Permanência de Embarcações em Águas Jurisdicionais Brasileiras - NORMAM-08/DPC.
6. _____. Portaria Nº 26 /DPC, 27/01/2014. Aprova a Norma da Autoridade Marítima para o Gerenciamento da Água de Lastro de Navios – NORMAM-20/DPC (1st Review).
7. Castro, M.C.T. 2008 O Porto do Rio de Janeiro sob o enfoque da água de lastro. Master of Scence dissertation. Rio de Janeiro: Universidade do Estado do Rio de Janeiro (UERJ).
8. Castro M.C.T., Rosso T.C.A, Fernandes F.C. 2010. Characterization of Rio de Janeiro Port in Terms of Ballast Water. Naval Engineers Journal 122: 61-72.
9. Castro M.C.T. & Poggian C.F. 2009. Análise das inspeções navais da água de lastro em portos da costa brasileira.In: Anais do I Congresso Brasileiro de Bioinvasao “Espécies Exóticas Invasoras e seus Impactos”, São Luís: Universidade Federal do Maranhão.
10. Coutts, A. D., & Taylor, M. D. 2004. A preliminary investigation of biosecurity risks associated with biofouling on merchant vessels in New Zealand. New Zealand Journal of Marine and Freshwater Research, 38(2), 215-229.
11. Danrigran, G. & De Drago, I. E. 2000. Invasion Of The Exotic Freshwater Mussel Limnopema Fortunei (Dunker, 1857)(Bivalvia: Mytilidae) In South America. *The Nautilus,* 114, 69-73.
12. Drake, J. M., & Lodge, D. M. 2007. Hull fouling is a risk factor for intercontinental species exchange in aquatic ecosystems. Aquatic Invasions, 2(2), 121-131.
13. Galil BS, Gollasch S, Minchin D, Olenin S. 2009. Alien Marine Biota of Europe. Pages 93-104. Handbook of Alien Species in Europe, vol. 3 Springer Netherlands.
14. International Maritime Organization (IMO). Maritime Knowledge Centre. (MKC/IMO). 2012. International Shipping Facts and Figures – Information Resources on Trade, Safety, Security, Environment. London: International Maritime Organization Report.
15. ____. 2004. International Convention for the Control and Management of Ships' Ballast Water and Sediments.
16. Leal Neto A.C. 2007. Identificando similaridades: Uma aplicação para a avaliação de risco de água de lastro. PhD thesis. Rio de Janeiro: Universidade Federal do Rio de Janeiro (UFRJ).
17. Lehtiniemi M, Ojaveer H, David M, Galil B, Gollasch S, McKenzie C, Minchin D, Occhipinti-Ambrogi A, Olenin S, Pederson J. 2015. Dose of truth-Monitoring marine non-indigenous species to serve legislative requirements. Marine Policy 54: 26-35.
18. Mansur, M., Richinitti, L. & Santos, C. D. 1999. Limnoperna fortunei (Dunker, 1857) molusco bivalve invasor na bacia do Guaíba, Rio Grande do Sul, Brasil. *Biociências,* 7**,** 147-149.

19. Mauro C.A. *et al*. 2002. The Brazilian Dilution Method for Ballast Water Exchange. Bol. téc. Petrobras 45 (3/4). Rio de Janeiro: Centro de Pesquisa e Desenvolvimento Leopoldo A Miguez de Mello (Petrobras Research Centre).
20. Poggian CF. 2014. Prevention of Bioinvasion: Analysis of International Regulation and the Brazilian Participation. Paper presented at ICBWM2014 -7th edition of the International Conference on Ballast Water Management, 05-07 November 2014. Singapore.
21. Rivera I.N.G., Souza K.M.C., Souza C.P., Lopes R.M. 2013. Free-Living and Plankton-Associated Vibrios: Assessment in Ballast Water, Harbor Areas, and Coastal Ecosystems in Brazil. Frontiers in Microbiology 3: 443.
22. Ruiz GM, Rawlings TK, Dobbs FC, Drake LA, Mullady T, Huq A, Colwell RR. 2000. Global spread of microorganisms by ships - Ballast water discharged from vessels harbours a cocktail of potential pathogens. Nature 408: 49-50.
23. Takahashi, CK, Lourenço, NGGS, Lopes, TF, Rall, VLM, & Lopes, CAM. 2008. Ballast water: a review of the impact on the world public health. Journal of Venomous Animals and Toxins including Tropical Diseases, 14(3), 393-408. https://dx.doi.org/10.1590/S1678-91992008000300002
24. United Nation Conference on Trade and Development (UNCTAD). 2014. Review of Maritime Transportation 2014. Geneva: UNCTAD. Report.

Appendix

BALLAST WATER REPORTING FORM

☐ Ballast Water Exchange ☐ Rectifier Ballast Water Exchange ☐ Ballast Water Treatment System ☐ Rectifier Ballast Water Treatment System

1. SHIP INFORMATION

Vessel Name:	Arrival Port:
IMO Number / Call Sign:	Arrival Date at the Port:
Flag:	Previous Port and Country:
Type of Vessel / Gross Tonnage:	Next Port and Country:
Owner:	Agent:

2. BALLAST WATER AND TANKS INFORMATION

Total Number. of Ballast Tanks on Board:	Number of Tanks in Ballast:
Number of Tanks with Ballast Water Exchange:	Number of Tanks without Ballast Water Exchange:
Total Ballast Water on Board (m^3):	Total Ballast Water Capacity (m^3):

3. BALLAST WATER HISTORY (Register all tanks that will discharge ballast water on the arrival port – If none go to item 5)

Tanks **(*)** (List multiple sources per tank separately)	BALLAST WATER SOURCE INFORMATION					BALLAST WATER EXCHANGE INFORMATION						BALLAST WATER DISCHARGE INFORMATION			
	Date dd/mm/yy	Port or Lat/Long	Volume (m^3)	Temp. (ºC)	Salinity	Date dd/mm/yy	Lat/Long (Endpoint)	Volume (m^3)	% Exchange	Local Depth (m)	Exchange Method **(**)**	Date dd/mm/yy	Port or Lat/Long	Volume (m^3)	Salinity

(*) Codes for Ballast Water Tanks: Forepeak = FP / Aftpeak = AP / Double Bottom = DB / Wing = WT / Topside = TS / Cargo Hold = CH / Other – O
(**) Exchange Method: Dilution (1) / Flow Through (2) / Empty/Refill (3)

3.1. OTHER INFORMATION OF BALLAST WATER EXCHANGE

If exchanges were not conducted, state other control action(s) taken:
If no action was taken, state why not:

4. INFORMATION ON BALLAST WATER TREATMENT SYSTEM

System's Trade Name:	Installation Date:
Manufacturer:	International Certificate's Expiration Date:

5. ADDITIONAL INFORMATION:

Is There a Ballast Water Management Plan on Board? ( )YES ( ) NO	Is There the International Convention on Board? ( ) YES ( ) NO
Was the Ballast Water Management Plan Implemented? ( ) YES ( ) NO	Is There the IMO Resolution A.868 (20) on Board? ( ) YES ( ) NO

____
RESPONSIBLE OFFICER'S NAME AND TITLE (CAPITAL LETTER)

____
SIGNATURE