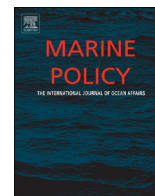




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Management strategies to prevent the introduction of non-indigenous aquatic species in response to the Ballast Water Convention in Taiwan

Ta-Kang Liu*, Chi-Hsin Chang, Ming-Li Chou

Institute of Ocean Technology and Marine Affairs, National Cheng Kung University, 1 University Road, Tainan City 70101, Taiwan

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ABSTRACT

The Convention for ballast water management is approaching the threshold of enforcement. Many countries around the world formulate national laws and regulations to mitigate the hazards of non-indigenous aquatic species (NIAS) brought about by the discharge of ballast water from ships. Taiwan's critical location as an important transportation hub in the Western Pacific Ocean makes it a hot spot for the invasion of NIAS. Therefore, devising strategies for the management of ballast water is urgently needed. This study explores the global trend in ballast water management, and discusses the possible strategies which Taiwan may adopt in response to the Ballast Water Convention, from the perspective of Taiwan's stakeholders in relation to the ballast water issue. Some of the proper actions that Taiwan should take in the future regarding the management of ballast water include: delineating the area for ballast water exchange, establishing the ballast water declaration system for incoming vessels, assisting shipping companies in installing ballast water treatment systems, determining risk priority for incoming vessels, and inspecting ballast water-related parameters by means of port state control (PSC). In this way, the invasion of NIAS may then be prevented in compliance with the global standards.

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1. Introduction

About 90% of international trade involves the transportation of goods as sea freight [1]. Non-indigenous aquatic species (NIAS) may be brought into another country during the shipping process by attaching them to ship hull, in the ballast water, or other parts, like propellers and anchors [2]. A ship may carry over 1000 t of seawater from the departing country as ballast water for a voyage, which will then be discharged in the destination country [3]. The process of transporting long-distance international freight by sea allows biological species to break through the natural geographical barriers, and constitutes an important channel for the transmission and invasion of NIAS [4–7]. The International Maritime Organization (IMO) officially adopted the “International Convention for the Control and Management of Ships' Ballast Water and Sediments” in 2004 (hereafter the Convention), with the aim of preventing, mitigating and eventually eradicating the hazards confronting the environment, health, property and resources, posed by harmful NIAS [8]. This Convention will be put into force upon the threshold of 30 countries' ratification and these countries' merchant ship tonnage represents over 35% of the world's tonnage. By May 2013, 36 countries had ratified the Convention,

representing 29.07% of the world's tonnage. The Convention is expected to come into force soon. The Convention provides recommendations regarding the management of ballast water and 14 technical guidelines [9]. Effective control over the discharge of ballast water to prevent or minimize NIAS transference and the related invasive risks is a major common challenge for all nations. Argentina, Australia, Canada, New Zealand, US, and countries in EU have legislation for the management of ballast water [10,11], which covers a number of control items, such as: stipulating the pre-arrival declaration of ballast water, designating the areas for ballast water exchange, and setting up the water quality standards for treated ballast water. These measures aim to protect the marine ecosystems. Taiwan is situated at the hub of southbound and northbound traffic in the Western Pacific Ocean; import/export shipping plays a critical role in Taiwan's economic development. Toxic algal blooms have been on the rise worldwide, with ever expanding affected areas; therefore, appropriate policies must be adopted to prevent, improve and restore the situation regarding the hazards of NIAS brought about by the discharge of ballast water [12–14]. In areas with busy sea traffic, the incidence of biological invasions in coastal ecosystems continues to increase. With Taiwan's policy goal of developing into the Asia-Pacific Regional Operations Center in the future, the country's share of the global sea-borne freight traffic is bound to rise, making it highly susceptible to invasions of NIAS. In compliance with the global trend, the formulation of strategies for the management of

* Corresponding author. Tel.: +886 6 2757575x31146; fax: +886 6 2753364.
E-mail address: tkliu@mail.ncku.edu.tw (T.-K. Liu).

ballast water to protect the domestic marine environment from the pollution of foreign ballast water and sediments is urgently required. By examining Taiwan's existing regulations covering ballast water and the current status of Taiwan's shipping industry in relation to the management of ballast water, this study probes into the possible strategies that Taiwan may adopt in response to the Convention. Developing a ballast water management system suitable for Taiwan is proposed among the recommendations offered by this study.

2. Approach and method

Through an analysis of the literature, this study explores the spirit behind the Convention and the actual situation of ballast water management around the world, and also discusses Taiwan's existing legal framework for the management of ballast water. In a qualitative study, the researchers visited various executives of port agencies and the Environmental Protection Administration, in order to determine the competent authority's needs and opinions concerning the management of ballast water. To understand the response of Taiwan's shipping industry to the Convention, in-depth interviews were also conducted with major global shipping companies headquartered in Taiwan, to obtain relevant expert opinions. Transit information on merchant vessels was collected as well, and the improvements that the shipping companies have made on their ship equipments were investigated, for example, the current status of ballast water treatment for incoming vessels to the ports of Taiwan, the percentage of vessels having installed the ballast water treatment equipment, and the attitude to use the on-shore ballast water treatment facilities. Subsequently, the researchers also invited stakeholders in the management of ballast water, including those involved in marine conservation, ecology, shipping, maritime affairs, port affairs, and legal regime, to a meeting to clarify the issues regarding the management of ships' ballast water in Taiwan. Finally, the administrative policy recommendations were made in the face of the possible challenges in ballast water management that may emerge in the future.

3. Relevant legal instruments for ballast water management in Taiwan

The Convention stipulates two-stage management of ballast water on ships: the D-1 ocean ballast water exchange standard and the D-2 performance standard. The D-1 standard regulates the methods and principles for the exchange of ocean ballast water by ships. It specifies that the exchange of ballast water shall take place at a distance of at least 200 nautical miles from the nearest land and at a water depth of at least 200 m or above. When this is not possible, the port state may designate the Alternate Ballast Water Exchange Zone (ABWEZ) for ships to exchange the ballast water, but the designated ABWEZ should not affect ships' routes or delay the shipping schedules [10,15]. The D-2 standard, on the other hand, imposes restrictions on the concentration of selected organisms in the ballast water to be discharged. Individual standards are set for *Vibrio cholera*, *Escherichia coli* and intestinal *enterococci*; however, for the other organisms, only an aggregate concentration is specified. As the risk of an invasion of NIAS cannot be completely eliminated by the D-1 ocean exchange standard, ships must achieve the D-2 standard for the discharge of water by using a ballast water treatment system to ensure that the organism concentration in ballast water does not affect the marine environment. The D-1 ocean exchange standard is a transitional measure to be applied before the onboard treatment equipment or the on-shore ballast water reception facilities are installed.

Depending on the year of construction and the ballast capacity level, the less stringent D-1 standard may be applied during the transitional period for existing ships that were built earlier; however, all ships must fulfill the D-2 performance standard after 2016 [8].

Taiwan has not taken any specific action for the management of ballast water, mainly because the relevant laws, such as the "Marine Pollution Control Act", "Commercial Port Law" and "The Law of Ships" under the existing regime, have not provided the appropriate legal basis for the management of ballast water. The objective of the "Marine Pollution Control Act" is to prevent marine pollution, protect the marine environment, maintain the marine ecosystem and ensure national health, as well as the sustainable use of marine resources. A section in this Act is dedicated to the "prevention of marine pollution by ships", which should be the most relevant regulation governing ballast water pollution of the marine environment. This section includes articles regarding the installation of pollution-prevention equipments on ships, the relevant authority's entitlement to examine the marine pollution prevention certificate, or other supporting documents. However, as ballast water is not explicitly identified as one of the pollutants referred to in this Act, whether the Marine Pollution Control Act is applicable to the management of ships' ballast water is disputable. Recognition of marine pollution caused by ships and the relevant discharge restrictions mentioned in the Marine Pollution Control Act are laid down in accordance with The Law of Ships, Commercial Port Law, relevant regulations imposed by the shipping competent authority, and international conventions and practices [16].

The Commercial Port Law is formulated for the planning, establishment, management, operation, safety and pollution prevention of commercial ports. The Act specifically states that the port administration authority is required to manage the pollution from ships only in the "area within the commercial ports." Therefore, polluting behaviors outside the commercial ports are not subject to the control of the Commercial Port Law. Subject to the designation of areas for ballast water exchange in the coastal areas near Taiwan, and in compliance with the spirit of the Convention, the Commercial Port Law will have no legitimate power over the designated areas for ballast water exchange outside the commercial port. The Law of Ships is concerned primarily with the regulation of ship technology and administration, not with the control of pollution of the marine environment caused by ships. A section in this Act is about the regulation of the "drainage equipment", but the ballast water treatment equipment currently under discussion is not covered. Moreover, the Act is applicable only to domestically registered ships regarding the requirement to meet the standard for ballast water treatment equipment onboard; it does not apply to ships registered overseas.

For the implementation of the D-2 standard, Taiwan has to lay down criteria for the ballast water treatment and sample analysis according to the Convention's content, in order to ensure the safety of the ballast water discharged in various commercial ports and neighboring waters. The D-1 standard is dependent on the surrounding marine environment. As the D-1 standard stipulates that the exchange of ocean ballast water has to be done at a location at least 200 nautical miles away from land, the marine environment surrounding Taiwan cannot fulfill this requirement; hence, an ABWEZ must be designated. Nonetheless, designation of ABWEZ is not easy as there is busy traffic of merchant ships and fishing boats across Taiwan's sea areas. In addition, there is no clear law regarding the competent authority in charge of the management of ballast water. The port administration authorities have jurisdiction only over "pollution within the port areas" pursuant to the Commercial Port Law, while the Environmental Protection Administration is unable to control the ballast water on

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