An Assimilated Loom on Considerations for Design of a National Action Plan on Ballast Water Management in Iranian Territorial Seas

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ABSTRACT
This study reviews the necessary considerations for design of national action plan on ballast water management in Iranian territorial seas. Introduction of harmful aquatics and different kinds of pathogens into the new environments through the ships' ballast water is one the four greatest threats to the world's oceans and seas. Therefore, studying the harmful ecological, economic impacts of these organisms entrances into the marine environments and studying the reason(s) of theirs entrances has been observed as a major issue for scientist and international societies' attention. The purpose of this study is inspecting environmental and ecological impacts of ships' ballast water discharges into the Southern waters of I.R. Iran seas, which in turn causes the introduction of alien species and finally presenting reasonable and practical solutions for minimizing undesirable impacts and offering solutions for managing, treating and controlling ballast water according to the international conventions, regulations and treaties. Herein, we review the necessary marine ballast management strategies and legislation that have to be implemented nationally and locally. It is recommended that regular and emergency ballast water exchange zones and to be defined in framework of D1-guideline observance and notification on economically important resources, respectively.

Key words: Ballast water, management, Persian Gulf, Oman Sea, Caspian Sea

INTRODUCTION
Transfer of harmful non native aquatics caused by discharging the ships' ballast water into the sea has created a global difficulty and solving this problem has exceeded from national plans and needs international cooperation and a global action.

Approximately 3 to 5 billion tons of ballast water are transferred internationally each year by 8500 ships (Raaymakers, 2002) and it is estimated that almost 7000 different species are being carried in ships' ballast tanks around the world every day (Cartlon, 2001).

The Persian Gulf is one of the most important marine areas economically, politically and militarily. According to the statistics presented by the Port and Maritime Organization of I.R. Iran, 40000 vessels transit the Persian Gulf and Hormuz Strait every year. In spite of the fact that the petroleum release into this marine environment is estimated to be about 120186 tons year⁻¹ (Eghtesadi-Araghi and Farzadnia, 2011), the petroleum related pollution in Northern coasts of Iran is in moderate level (Eghtesadi et al., 2002). But this fact would not cancel the treat by ballast water released by huge oil tankers in this area for this region which provide half of the world oil demand releasing 1 to 2 million barrels of oil through ballast water into this region (Heilman et al., 2008). Both Iranian marine environments including the Persian Gulf and the Caspian Sea has special temperature and environmental conditions (Heilman et al., 2008; Zaker and Araghi, 2009)
making them special zones for survival of important habitats like coral reefs (Maghsoudlou and Eghtesadi-Araghi, 2008) and other organisms e.g., mollusks (Sajjadi et al., 2009; Salimi et al., 2009). Thus, we can comprehend the gravity of the situation at a glance. Even the International Maritime Organization (IMO) announced this region as a special marine area in 2007. Having the widest shoreline of the region and numerous islands in this water mass, Islamic Republic of Iran has special privileges. Thus, studying the bio-ecology of this important water body for the purpose of utilization and protection of national benefits is inevitable.

Iranian Southern Marine Seas has experienced different biological tragedies which as recent incidences one can refer to infestation of Crambionella orsini in the shores of Oman Sea (Daryanabard and Dawson, 2008) and Chabahar Bay and the occurrences of red tide in the Persian Gulf. Red tide phenomenon caused vast fish fatalities and coral reef bleaching in the coastal areas.

**Conventional regulations:** Responding to the increasing invasive species entrances through ballast water discharges in recent decades, Marine Environment Protection Committee (MEPC) of International Maritime Organization (IMO) adopted a guideline for preventing the entrance of non native species in 1991. In 2004, IMO passed the international convention on controlling and managing the ships’ ballast water to confront this issue. The convention requires the member countries to give effect to the provisions of the mentioned convention. According to the convention, the member governments considering their situation and their abilities should adjust and enforce their policies, strategies and national plans in respect to managing the ships’ ballast water in their ports and waters (www.imo.org).

Nowadays, different methods are used for treating and controlling ballast water and preventing invasive species entrances in different countries especially the ones which have high marine traffics (Australia, United States of America, Brazil). In these methods the IMO’s standards especially the D-1, D-2 and D-3 guidelines shall be met.

Among the present methods, exchanging ballast water in the open ocean area is the most approved one by IMO. This method is carried out in 2 ways: Empty-Refill (ER) and Flow-Through (FT).

**Under regulation D-1 ballast water exchange standard of IMO:**

- Ships performing ballast water exchange shall exchange with an efficiency of 95% volumetric exchange of ballast water and it is assumed that this efficiency shall be met after 3 times of ballast water pumping through the tank
- Whenever possible, ballast water exchange is conducted at least 200 nautical miles from the nearest land and in water at least 200 m in depth. In cases where, the ship is unable to conduct ballast water exchange as above, this should be as far from the nearest land as possible and in all cases at least 50 nautical miles from the nearest land and in water at least 200 m in depth
- It allows the countries to specify their ballast water exchange zone

**Under regulation D-2 ballast water exchange standard of IMO:**

- Ships conducting ballast water management shall discharge less than 10 viable organisms per cubic meter greater than or equal to 50 microns
Ships conducting ballast water management shall discharge less than 10 viable organisms per mL less than 50 microns.

3 indicator microbes for discharging include:

- Virus with less than 1 colony forming unit (cfu) per 100 mL or less than 1 cfu per 1 g zooplankton samples
- *Escherichia coli* less than 250 cfu/100 mL
- Intestinal Enterococci less than 100 cfu/100 mL

The systems which make use of chemicals or biocides must be approved by the administration in accordance with IMO guidelines

**Iranian national status:** In designation of Iranian national appropriate response to the ballast water issue, national existing regulatory and institutional frameworks, nature and value of resources at risk and the source and extent of the ballast water problem should be accounted. The risk posed by ballast water depends on a variety of factors, including the volume of ballast water discharges which is governed by the frequency of discharges (which in turn determines the risk produced by entering organisms) and environmental similarity between the ports of origin (source ports) and the Iranian ports.

Therefore, it is important to have an estimation of role and weight of all these factors. The characteristics of ballast water discharges are determined by the Iranian national trading patterns predominantly. Hence, the contents of the cargo and the kind of vessel in which it is carried by, has an important role in characterizing the patterns and volumes of ballast water uptake and discharge e.g., specific cargoes of this region such as petroleum which are carried in bulk are generally transported in tankers or bulk carriers. Such big ships or tankers, overall load or unload all of the cargo at specific few port therefore, although they can carry huge amounts of ballast water, each load of ballast water is likely to come from a single source port, i.e., simplifies determining the risk it poses.

Conversely, ships carrying usual cargo tend to stop at numerous Iranian ports, with partial loading or unloading of cargo at each one. Consequently, when the amount of ballast water are low, the composition of species in the ballast water is probably far more complex and the risk assessment is more complex. Because the IMO has recommended a ballast water reporting form (BWRF), it is important that all ROPME countries release their data on ballast water discharges in regional meetings. But, if this reports are not available, we should search for specific studies data on the different kinds of cargo and vessels going through any particular harbor. Although it would not be easy but these data can be used to prepare a preliminarily, estimation of the volumes of ballast water being discharged in Iranian waters.

Hence, it is of great importance to publish national data according to the above mentioned items. In order to have an estimation of the national efforts that has been made in this regard, we review these projects/efforts on marine based organizations in Iran.

Considering the above mentioned guidelines and considering the sensitivity of Iran's marine ecosystems, Ports and Maritime Organization of I.R. Iran in cooperation with national and international organizations including IMO and UNDP had carried out a project entitled Removing Obstacles and Efficient Control and Management of Ballast water in the Developing Countries from 2004 to 2008.
Moreover, Iranian Ports and Maritime Organization consulted with international administrations of Regional Organization for the Protection of Marine Environment (ROPME) to make this study practical and pave the way for enhancing regional cooperation between the Persian Gulf bordering countries. The I.R. Iran held the first regional conference on Control and Management of Ships Ballast Water in the presence of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates. In the conference, regional strategic action plan was presented and it was assigned to try to enforce the action plan and to form a working group of eminent officials in 2003. In this direction, the project of Global Management Ballast Water was carried out and Khark Island oil terminal was chosen as the location for research activities. It should be noted that Islamic Republic of Iran is a member of the Globalballast (Global Ballast Water Program) (Pughuic, 2001). According to the permanent direction of seawater movement in the Persian Gulf and Oman Sea (Reynolds, 1996), it is of great importance for Iran to start regional collaborations in the ROPME Sea Area as many of the marine ballast dilemmas are to be considered in a trans-boundary manner.

Moreover, Transportation Research Institute of I.R. Iran in cooperation with Iranian National Institute for Oceanography (INIO) carried out a project entitled Study of Ecological Impacts of Ship’s Ballast Water Discharges on Waters of I.R. Iran (the present study). The project was carried out to collect and analyze all data in relation to the different fields of marine trafics including the assessment of undesirable ecological, economic impacts of discharging ballast water. In this study, Khark Island and Shahid Rajaii port were chosen as sampling location to collect primary information of the species in ship’s ballast water since, these areas have high marine traffics. Although, the sampling in these ports was not extensive, making the field and laboratory sampling methods operational, recognizing the obstacles and different scenarios for undesirable species entrances as well as the volume of ballast water discharges in the Persian Gulf and Oman Sea were very important.

CONCLUSIONS

According to the recent surveys, most countries (esp. Australia and United State of America) use Mid Ocean Exchange (BWE) as the main solution for the issue of discharging ballast water. There are also other methods which are under tests such as UV Radiation, Filtration-Dioxidation, using sound waves, electric and magnetic pulses .

According to the Mid Ocean Exchange method, due to the differences between the salinity of the open ocean area and of the coastal areas, the species which enter to the tanks during the discharging of ballast water will die in the coastal waters. Considering this theory, port control officers can solve the issue of entering new species into the Iranian ports by measuring the salinity of the ballast water in the tanks and comparing it with the open ocean salinity.

Nowadays, two methods for ballast water exchange at sea are used:

- The Empty-Refill (ER) method, in which ballast tanks are pumped out and refilled with clean water
- The Flow-Through (FT) method, in which ballast tanks are simultaneously filled and discharged by pumping in clean water

In each method, 95% of Ballast Water is exchanged. Although, using tracers proved that 3 times of pumping in the FT method will exchange less than 95% of ballast water. For
substantiating the water ballast exchange in the ports, measuring the natural tracers in the environment is very important. For this purpose, we should take two things into account. First, it should be noted that there are differences between the tracer’s concentrations in the water tanks and in the ocean. Second, the necessary guidelines for using these tracers should be made available for ship's operators.

The countries that had accepted the convention, use different methods for examining, discharging and exchanging ships’ ballast water including comparison of chemical tracer's concentrations of the ballast water in the tanks and in the open ocean. Another method is inspecting the concentration of organic materials solutions especially the organic materials of chromorphic solution. The newest study by the University of New South Wales, Australia (Murphy et al., 2008) showed Barium, Manganese and Phosphor can be used as efficient tracers for controlling ballast water exchange. The Barium and Phosphor concentrations are more important than of other tracers since the concentration of these chemicals in the ballast water tankers changes and can be used as chemical tracers (Murphy et al., 2004).

From the above mentioned discussions, it is recommended to implement a programme on ship’s ballast water management in I.R. Iran. This important matter needs integrated organizational and legal actions as well as the cooperation of scholars and officials. Fortunately, using the valuable experiences of Ports and Maritime Organization of I.R. Iran and the achievements of the present study, we expect to implement a programme on ship’s ballast management water soon.

RECOMMENDATIONS
Considering the IMO standards, practical solutions should be presented too. For this purpose, at the first step, the ballast water exchange zone in the Persian Gulf should be specified. This zone should be defined as at least 200 nautical miles from the nearest land and in water at least 200 m in depth by the countries in the region of the Persian Gulf. It seems that for the first step and for enforcing the D-1 standard of IMO, it is better to conduct the ballast water exchange in the open ocean area. This action paves the way for implementation of the ballast water management programme in I.R. Iran. Therefore, it is recommended that regular ballast water exchange zones to be defined in framework of D1-guideline observance. About the emergency ballast water exchange zones and it is recommended that a notification to be done on economically important resources with a precise look on resources at risk.

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REFERENCES


