

INVESTIGATION OF INDIGENOUS AND NON-INDIGENOUS PLANKTONS IN BALLAST WATER DISCHARGED IN PERSIAN GULF REGION AND TREATMENT OPTIONS

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(With the memory of Dr. Farhad Nadim who left us so soon.)

ABSTRACT

Ballast water is carried by ships under less than full cargo to ensure that the propeller is kept at optimum depth and to adjust trim and draft to suit prevailing sea and cargo conditions. ROPME has adopted the Regional Action Plan to control and lessen the transfer of harmful aquatic organisms and pathogens in ballast waters. One of the six pilot-scale demonstration sites initiated by the IMO/GloBallast phase 1 project has been set up in Kharg Island which is a large oil terminal in the Persian Gulf in Iranian territory.

A large amount of oil is spilled annually from the routine discharge of dirty ballast waters and tank washing, partly due to the lack of shore reception facilities in the region. In this study, the indigenous and non-indigenous planktons in discharged ballast water were investigated. Test results showed that about 500 non-indigenous planktons were recognized in different samples. Some treatment options were suggested to process the discharged ballast water in reception facilities.

Key Words: Plankton; Ballast Water; Persian Gulf; ROPME; Kharg Island.

INTRODUCTION

Studies carried out in several countries have shown that many species of bacteria, plants, and animals can survive in a viable form in the ballast water and sediment carried in ships, even after journeys of several months' duration.

The potential for ballast water discharge to cause harm has been recognised not only by the International Maritime Organization but also by the World Health

Organization, which is concerned about the role of ballast water as a medium for the spreading of epidemic disease bacteria (1).

Marine species are being carried around the world in ships ballast water. When discharged into new environments, they may become invasive and severely disrupt the native ecology, impact economic activities such as fisheries and cause disease and even death in humans. Invasive marine species are one of the four greatest threats to the world's oceans and the other three are land based sources of marine pollution, over exploitation of living marine resources and physical alteration and destruction of coastal and marine habitat. A problem may arise when ballast water taken by a ship contains unwanted marine organisms. Once established, it is virtually impossible to control an invasive marine species. Impacts are usually irreversible. International Maritime Organization (IMO) has joined forces with Global Environment Facility (GEF) and the United Nations Development Program (UNDP) to assist countries to reduce the transfer of invasive marine species in ballast water. The Global Ballast Water Management Program (GloBallast) is working through six initial demonstration sites (Brazil, China, India, Ir. Iran, South Africa and Ukraine) to prepare for the new International regulatory regime. Activities carried out under GloBallast include: education and awareness, ballast water risk assessments, port baseline surveys, ballast water sampling, training port and shipping personnel in ballast water management practices, assistance with laws and regulations and self financing mechanisms. An overview of this initiative is presented (2).

Some nonindigenous invasive species have had significant adverse effects on human, plant or animal health, local and regional economies, and on the ecosystems they invade.

Fortunately, many releases of nonindigenous species occur with little or no apparent adverse effect, primarily because the species do not become established (i.e., form a selfsustaining, reproducing population).

A general rule of thumb used by many scientists is that about 10% of all introduced nonindigenous species actually become established, and about 10% of those that become established also become invasive and harmful. Some estimates place these numbers closer to 15%. In spite of the small numbers of successful introductions of invasive species that might be expected by applying this "rule of thumb", there are thousands of invasive species in the US and Canada today, all of which have some degree of impact on the ecosystems they have invaded and on societal uses of those ecosystems, with commensurate economic costs and losses. Because of the regularity with which new species are being introduced throughout the world, some scientists are now heard to refer to our age as the 'homogecene' (3).

THE GLOBALLAST RISK ASSESSMENT SYSTEM

The GloBallast (Global Ballast Water Management Programme) risk assessment system was supported by GEF/UNDP/IMO (Global Environment Facility/ United Nations Development Program / International Maritime Organization). Pilot systems have been or are still in development in Brazil, China, India, Iran, South Africa, and Ukraine (globallast. imo.org). Development began in 2000 and is scheduled to continue until 2004. The final project report for the Iranian site has recently been published, and explains the methodology in detail.

The assessment is semi-quantitative. It identifies the riskiest trading routes for each recipient site, but does not identify the specific risk associated with an individual ballast tank. The major question that is addressed is: "Which ballast water sources and destinations need more vessel monitoring and management?" (4).

Core activities of the GloBallast Programme are being undertaken at Demonstration Sites in six Pilot Countries. These sites are the ports at Khark Island (I.R. Iran), Dalian (China), Mumbai (India), Odessa (Ukraine), Saldanha (South Africa) and Sepetiba (Brazil). Activities carried out at the Demonstration Sites will be replicated at additional sites in each region as the programme progresses This report describes and presents the results of the first Ballast Water Risk Assessment (BWRA) carried out for the Port of Khark Island, Islamic Republic of Iran This GloBallast Demonstrate Site is a major oil export terminal which is located in the north-west part of the ROPME Sea Area

MITIGATION MEASURES

When loading ballast, every effort should be made to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms. The uptake of ballast water should be minimized or, where practicable, avoided in areas and situations such as:

Removing ballast sediment on a timely basis

Where practicable, routine cleaning of the ballast tank to remove sediments should be carried out in mid-ocean or under controlled arrangements in port or dry dock, in accordance with the provisions of the ship's ballast water management plan.

Avoiding unnecessary discharge of ballast water

If it is necessary to take on and discharge ballast water in the same port to facilitate safe cargo operations, care should be taken to avoid unnecessary discharge of ballast water that has been taken up in another port.

Ballast water management options

Near-coastal (including port and estuarine) organisms released in mid-ocean, and oceanic organisms released in coastal waters, do not generally survive.

Non-release or minimal release of ballast water

In cases where ballast exchange or other treatment options are not possible, ballast water may be retained in tanks or holds. Should this not be possible, the ship should only discharge the minimum essential amount of ballast water in accordance with port States' contingency strategies.

Discharge to reception facilities

If reception facilities for ballast water and/or sediments are provided by a port State, they should, where appropriate, be utilized.

Emergent and new technologies and treatments

If suitable new and emergent treatments and technologies prove viable, these may substitute for, or be used in conjunction with, current options. Such treatments could include thermal methods, filtration, disinfection including ultraviolet light, and other such means acceptable to the port State.

Results concerning the application and effectiveness of new ballast water management technologies and associated control equipment should be notified to the Organization with a view to evaluation and incorporation, as appropriate, into these Guidelines (5).

Heat treatment of ballast water to reduce aquatic invasive species has been proposed and tested in large ocean going ships where time in ballast and available energy is such that sufficient rise in temperature of the ballast water can be achieved (6).

KHARG ISLAND, IRAN

Kharg Island is located on the Persian Gulf and is Iran's and the Gulf's largest port facility. The Sea Island Terminal is located on the West side of the island with two berths for vessels up to 500 000 dwt. The depth alongside these berths is 32.3 m at MLW. The terminal also provides two berths for vessels up to 300 000 dwt with a depth alongside of 29.8 m at MLW.

The management of the terminal and the operation of vessels are the responsibility of National Iranian Oil Company (NIOC), which is also in charge for the cargo storage and handling. In addition to the loading and discharging facilities the terminal provides pilotage, tug services and antipollution services. The maintenance of the terminal and the

other essential facilities of a port (hospital, fire protection etc) are also responsibilities of the NIOC. The main functions of maritime administration are the responsibility of the Ports & Shipping Organisation (PSO). Vessel Traffic Control and Port State Control is performed by PSO inspectors.

The selection of Kharg Island as a demonstration site, aside from its general Gulf location and by virtue of its being the largest oil terminal in the Gulf, is due to the sensitive environmental nature of the Gulf. Gulf waters are shallow, have substantial marine biodiversity, high water temperature, and experiences little exchange of water



with surrounding marine areas through the Ormuz Strait (7).

Figure 1. Location of Kharg Island and other ports in the ROPME Sea Area (7)

The aims of the GloBallast BWRA for the Port of Kharg Island were to:

1. Assess and describe as far as possible from available data, the risk profile of invasive aquatic species being both introduced to and exported from Kharg Island in ships' BW, and to identify the source ports and destination ports posing the highest risk for such introductions.

2. Help determine the types of management responses that are required, and provide the foundation blocks for implementing a more sophisticated BW management system for the Port of Kharg Island.

3. Provide training and capacity building to in-country personnel, resulting in a fully trained risk assessment team and operational risk assessment system, for ongoing use by the Pilot Country, replication at additional ports and use as a demonstration tool in the region (8).

MATERIAL AND METHODS

Samples have been collected from gate between ballast water tank and ship surface and also from ballast water tank from bottom to surface. Zooplankton sampling has been done by 100 μ mesh net. Also 20 μ mesh net has been used for phytoplankton sampling. Formalin has been used for fixing the samples. After fixing each sample, number of planktons has been counted.

RESULTS

Some of the zooplanktons and phytoplanktons, which have been counted in this research, have been listed in tables (1) and (2).

Table (1): some of the zooplanktons in ballast water of Kharg Island

FAMILY	SPECIES	GENUS
Coelenterata	<i>Diphyes</i>	<i>sp.</i>
	<i>Obelia</i>	<i>larvae</i>
Gastropoda	<i>Creseis</i>	<i>virgula</i>
	<i>Limacina</i>	<i>sp.</i>
	<i>Euclio</i>	<i>Sp.</i>

Arthropoda (Ostracoda)	<i>Conchoecia</i>	<i>sp.</i>
	<i>Euconchoecia</i>	<i>sp.</i>
Copepoda (Acartiidae)	<i>Acartia</i>	<i>bispinosa</i>
	<i>Acartia</i>	<i>copepodites</i>
Paracalanidae	<i>Acrocalanus</i>	<i>gibber</i>
	<i>Parvocalanus</i>	<i>crassirostris</i>
	<i>Paracalanus</i>	<i>parvus</i>
	<i>Paracalanus</i>	<i>Aculeatus</i>
Pontellidae	<i>Labidocera</i>	<i>copepodites</i>
	<i>Labidocera</i>	<i>sp. *</i>
	<i>Pontellid</i>	<i>Nauplii</i>
Candaciidae	<i>Candacia</i>	<i>bradyi copepodite</i>
Centropagidae	<i>Centropages</i>	<i>Furcatus</i>
	<i>Centropages</i>	<i>Orsinii</i>
Tortanidae	<i>Tortanus</i>	<i>Forcipatus</i>
Oithonidae	<i>Oithona</i>	<i>nana</i>
	<i>Oithona</i>	<i>plumifera</i>
Oncaeidae	<i>Oncaea</i>	<i>clevei</i>
	<i>Onacea</i>	<i>conifera</i>
Harpacticoida	<i>Euterpinna</i>	<i>acutifrons</i>

	<i>Microsetella</i>	<i>norvegica</i>
Polychaeta	<i>Setigerous</i>	<i>larvae</i>
Chaetognatha	<i>Sagitta</i>	<i>Sp.</i>

Table (2): some of the phytoplanktons in ballast water of Kharg Island

FAMILY	SPECIES	GENUS
<i>Coscinodisceae</i>	<i>Coscinodiscus</i>	<i>jonesianus</i>
<i>Coscinodisceae</i>	<i>Thalassionema</i>	<i>nitzschiodies</i>
<i>Chaetocereae</i>	<i>Chaetocerus</i>	<i>diversicurvatus</i>
<i>Rhizosoleniaceae</i>	<i>Rhizosolenia</i>	<i>Sp.</i>
<i>Hemiaulaceae</i>	<i>Eucampia</i>	<i>Sp.</i>
<i>Ceratiaceae</i>	<i>Ceratium</i>	<i>Sp.</i>

CONCLUSION

A large amount of oil is spilled annually from the routine discharge of dirty ballast waters and tank washing, partly due to the lack of shore reception facilities in Kharg Island. In this study, the indigenous and non-indigenous planktons in discharged ballast water were investigated. Test results showed that about 500 non-indigenous planktons were recognized in different samples. In order to minimize the impacts of indigenous planktons, strategies, which are explained in mitigation measures, could be implemented.

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