Journal of Sustainability Science and Management 2010 Volume 5 (1): 125-137

MALAYSIA AND THE BALLAST-WATER MANAGEMENT CONVENTION: AN ANALYSIS

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Introduction

Ballast water is essential for ships to maintain balance, stability and structural integrity, especially when sailing without cargo. Since the late 19th century, ships have used ballast water, which is pumped from surrounding water into clean tanks and potentially-dirty cargo holds (Carlton, 1985). IMO defines ballast water as 'water with its suspended matter taken on board a ship to control trim, draught, stability, or stresses of a ship'. Generally, ballast water is taken aboard when cargo is unloaded and is discharged at the port of destination before loading new cargo. Ballast also helps ferry, military and fishing vessels to manoeuvre, facilitate control during loading conditions and maintain stability. For tankers and dry-bulk carriers, ballast water is used in larger quantities to make up for weight loss after unloading the cargo they carry. Unfortunately, ballast water is now considered one of the major vectors for the transport of planktonic organisms (Lavoie *et al*., 1999). A wide diversity of organisms is known to occur in ships' ballast water and associated sediments (Smith *et al*., 1999; Zhang and Dickman, 1999; Drake *et al*., 2001; Bailey *et al*., 2003). The subsequent discharge of ballast water results in many organisms being released at ports-of-call and/or in transit, creating numerous opportunities to establish non-native populations. According to the World Conservation Union (IUCN) 2002, marine bio-invasion through ballast water is the second greatest threat to marine biodiversity after over-exploitation. It has also been identified as one of the four greatest threats to the world's oceans; the other three being land-sourced pollution, over-fishing and climate change. This concern is also recognised by the World Health Organisation (WHO) that fears not only the detrimental ecological impacts on the marine ecosystems and its economical repercussions, but also the threats posed on human health.

The problem of invasive species is largely due to the expanded trade and traffic volumes around the world. More than 80 per cent of the world trade is seaborne. The volume of seaborne trade continues to increase and it is envisaged that the problem is yet to reach its peak. The development of faster and larger ships, with the rapidly-increasing world trade, has enabled larger quantities of ballast water to be carried more quickly and more frequently to a greater number of destinations. As such, the numbers of species given the opportunity to invade new areas are further increasing as well. Catastrophic introductions of species have been documented worldwide, and the effects of most of them have been irreversible. Introduction of marine organisms alien to local ecosystems has serious consequences to native biota, fishery and ecosystems as a whole (Anil *et. al*., 2002). For example, Table 1 lists the ten most significant invasive species identified by the IMO around the world.

Table 1. Ten major examples of marine plants and microbes introduced around the world.

Organism	Native to	Introduced to	Impacts
Cholera (*Vibrio cholera*)	Various strains	South America, Gulf of Mexico, and other areas.	Some cholera epidemics appear to be directly associated with ballast water. For example, an epidemic began simultaneously at 3 separate ports in Peru in 1991 killing thousands of people. Prior to this, this strain was reported only in Bangladesh.
Cladoceran water flea (*Cercopagis pengoi*)	Black and Caspian Seas	Baltic Sea	Reproduces to form very large populations that dominate the zooplankton community, and clog fishing nets and trawls.
Mitten crab (*Eiocheir sinensis*)	Northern Asia	Western Europe, Baltic Sea and West Coast North America.	Undergoes mass migrations for reproduction. Preys on native fish and invertebrate species, hence causing local extinctions.
Toxic algae (red / brown / green tides)	Various species with broad ranges.	Several species have been transferred to new areas through cysts transfer in ships' ballast water and sediments.	Forms harmful algal blooms (HABs), causing massive kills of marine life through oxygen depletion and release of toxins, foul beaches and impact tourism & recreational activities. Some species may also contaminate filter-feeding shellfish. The consumption of contaminated shellfish by humans causes illness or death.
Round goby (*Neogobius melanostomus*)	Black, Asov and Caspian Seas	Baltic Sea and North America.	Highly adaptable and invasive. Competes for food and habitat with native fishes as well as preys on their eggs and young.
North America comb jelly (*Mnemiopsis leidyi*)	Eastern Seaboard of the Americas.	Black, Azov and Caspian Seas	Reproduces rapidly under favourable conditions. Causes the depletion in zooplankton stocks. As a result this condition causes the alteration of food webs and ecosystem functions. For example, had contributed significantly to the collapse of Black and Asov Sea fisheries in 1990s. Currently, imposing similar threats to the Caspian Sea.
North Pacific Seastar (*Asterias amurensis*)	Northern Pacific	Southern Australia	Reproduces in large numbers rapidly. Feeds on shellfish, as well as commercially-valuable scallops, oyster and clam species, causing economical repercussions.
Zebra Mussel (*Dreissena polymorpha*)	Eastern Europe (Black Sea)	Western and Northern Europe, including Ireland	Alters habitat, ecosystem and food web, besides causing severe fouling problems on infrastructure and vessels.

		and Baltic Sea, and eastern half of North America.	
Asian Kelp (*Undaria pinnatifida*)	Northern Asia	Southern Australia, New Zealand, west coast of USA, Europe and Argentina.	Grows and spreads rapidly causing alterations on habitats, ecosystems, and food webs.
European Green Crab (*Carcinus maenus*)	European Atlantic Coast	Southern Australia, South Africa, USA and Japan.	Highly adaptable and invasive. Resistant to predation due to its hard shell. Competes with and displaces native crabs. Consumes and depletes wide range of prey species.

Source: Adapted from the 'Ten of the Most Unwanted'. 2000. Global Ballast Water Management Programme (GloBallast) Poster. GEF-UNDP-IMO-UNEP.

Content

This paper focusses on the importance of the IMO convention for Malaysia by analysing the current status, issues and concerns involved in ships' ballast water control and management in the country. In achieving this, consultations were carried out with various stakeholders, including government departments and agencies, shipping companies and port authorities, to attain their views and position on the subject matter. Besides that, research was also focussed on the current international practices pertaining to the issue and the implications on the ship operators.

In general, this paper is organised into two parts. The first part of the paper provides a brief explanation on the international responses and initiatives taken around the world to address the matter. The second part of the paper focusses on the status, threats, basic concerns and issues that need to be considered for Malaysia regarding ballast-water control and management measures.

International Responses to Confront the Problem

It has been more than 18 years since Canada last drew the attention of the international maritime community, through the IMO, to the problems it was experiencing in the Great Lakes with an infestation of the European zebra mussel (Hinchliffe and Tongue, 2007). Since then, there has been an increasing awareness on the issue. However, considerable harm has already been done around the world worth billions of dollars. If actions are not taken, these impacts could worsen over time. As such, several major international conventions and forums, such as the United Nations Convention on the Law of the Sea (UNCLOS), the International Convention on Biological Diversity (CBD), and the World Summit on Sustainable Development (WSSD), have highlighted the significance of marine invasive-species issue and called upon governments and industries to act accordingly, even before the IMO convention was introduced.

As such, several countries such as Australia, Canada, New Zealand and the United States have acted proactively in enforcing stringent unilateral rules on voluntary and mandatory reporting and regulations on ships calling at their national ports to protect their national interests (Table 2). These countries have the authority to stop ships from entering their ports if vessels do not conform to their established standards.

Table 2. Examples of unilateral legislative requirements by countries on ballast-water control.

Country	State practices
Australia	On the 1st July 2001, the Australian Quarantine and Inspection Service (AQIS) introduced mandatory ballast-water management requirements that prohibit the discharge of 'high-risk' ballast water from ships anywhere inside Australia's territorial seas (12 nm limit). Ballast water that has been exchanged at sea is acceptable for discharge in Australian ports / waters. Besides that, vessels must also retain all ballast-water records and any relevant logbooks, and make these available to quarantine officers on request. In addition, all ships from international waters are required to submit a Quarantine Pre-Arrival Report (QPAR) to AQIS. This report includes the reporting of ballast-water management procedures undertaken. The ship's master is required to send the QPAR to AQIS between 12-48 hours prior to arrival in Australia, usually through the ship's local agents. Effective from the 1st July 2004, the State of Victoria introduced legislation intended to complement the AQIS legislation. The legislation also allows the charging of fees and fines in relation to ballast water applicable to all ships entering Victorian ports. Additional requirements apply to Victoria State's coastal traffic that stipulates ballast water must be exchanged at a minimum of 3 nm offshore.
Canada	Effective 8th June 2006, new regulation was introduced, intended to be harmonised with the requirements of the IMO convention. The regulation requires vessels carrying ballast water taken outside Canadian waters to either: • exchange ballast water more than 200 nm from land in a water depth greater than 2000 m; or • if during its voyage they have not navigated to an area more than 200 nm from shore with a water depth of 2000 m, to exchange ballast in an area at least 50 nm from land with a water depth at least 500 m. If a ship is unable to exchange ballast water due to stability or safety concerns, then the authorities must be notified at least 96 hours before entering Canadian waters, or as soon as it is practical. As such, alternative exchange zones may be designated or the ship may be required to retain the ballast on board. Besides that, when a ship is destined for a Canadian port, the master of the vessel must submit a fully-completed Ballast-Water Report Form by an approved method detailing whether the vessel has a Ballast-Water Management Plan (BWMP) appropriate to that ship.[1]
New Zealand	Effective 1st April 2004, legislation requires mid-ocean ballast-water exchange (>200 nm offshore) and prohibiting the discharge of sediments into New Zealand's territorial waters (12 mile territorial limit). Any sediment must be disposed off by the use of an approved landfill. Vessels discharging ballast must record in their logs where the ballast water was loaded together with the volumes, location and dates of all exchanges undertaken.

	Before arriving in New Zealand, vessels must complete a New Zealand ballast-water declaration form. In addition, a quarantine officer's permission to discharge ballast must also be obtained prior to any discharge at the port.
USA	Federal legislation proposed in Congress recently conforms to the IMO convention requirements, except that the regulation D-2 biological efficacy standard is some 100x more stringent.[2] However, it may be anticipated that this proposed regulation will be subjected to further amendment prior to a final acceptance.

Source: Adapted from the International Chamber of Shipping (ICS) and International Shipping Federation (ISF). Updated summary of existing and proposed regional ballast-water legislation (as at October 2006). The other countries and states that also impose their own unilateral legislation on the subject matter include Argentina, Brazil, California, Chile, Egypt, Israel, Panama, Peru, Russia, United Kingdom, Ukraine, Michigan, Oregon; to name a few.

The IMO *International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004*

Due to the complexity and transboundary nature of the ballast-water control and management issue, the IMO proposed the *International Convention for the Control and Management of Ships' Ballast Water and Sediments,* which was adopted by consensus at a Diplomatic Conference in February 2004. The convention builds on the complementary roles of coastal, port and flag States as well as the shipping industry in protecting the marine environment by embracing effective ballast-water management measures (IMO, 2005). The convention will eventually come into force with the adequate number of countries (30 countries representing 35 percent of the world's merchant shipping tonnage) ratifying the Convention. As at 31 March 2008, there are 13 contracting countries to the convention (IMO website) and several other countries have announced their preparedness to ratify the convention soon (communication with IMO representatives).

Besides, the present different sets of international laws and regulations make it difficult and complex for ship operators to comply with requirements at different parts of a voyage, making it increasingly important for a uniform enforcement internationally. As such, the IMO resolution requires countries to adopt the international standards in reducing or eliminating problems caused by ballast water. Following to that, the IMO have come up with several initiatives to introduce international standards on ballast-water control and management as listed below:

Six pilot countries (India, South Africa, Ukraine, Iran, China and Brazil) have been successfully involved in the demonstration port survey and management plan to minimise the risk of transfer of alien species in ballast water through the IMO-GloBallast Programme (2000-2004)[3]. Through this programme, technical assistance is extended to these countries to get them prepared before the coming into force of the convention. These include education and awareness building, port

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1 BWMP is designed to minimise the transfer of aquatic nuisance species. This plan normally includes guidance for the ship and operating company. The shipping community [for example, the International Chamber of Shipping (ICS) and the International Association of Independent Tanker Owners (INTERTANKO)] has demonstrated their support to tackle the issue by producing a model BWMP for the IMO.

2 The IMO regulation D-2 specifies the allowable content of indicator microbes in the water after ballast- water treatment process is undertaken.

3 The Global Ballast-Water Management Programme (GloBallast) is a cooperative initiative of the Global Environment Facility (GEF), United Nations Development Programme (UNDP) and the International Maritime Organisation (IMO) to assist countries to reduce the transfer of harmful organisms in ships' ballast water (Anil *et al.*, 2004).

baseline surveys, ballast-water sampling to assess high-risk ships calling at their ports, training of port and shipping personnel in ballast-water management practices, and assistance with local laws and regulations, to name a few.

The IMO-GloBallast Partnership Initiative (2007) is further aimed at expanding government and port-management capacities, investigating legal, policy and institutional reforms at country level, developing mechanisms for sustainability, and driving global and regional coordination and cooperation.

The IMO has also developed ballast-water guidelines [*Assembly Resolution A.868(20)*]. Among others, the guidelines stipulate that ships should carry out ballast-water exchange at sea. The purpose of this is to minimise the transfer of nonindigenous species in ballast water of ships, and reduce the risk of exotic species invasions associated with the release of ballast water. However, ballast-water exchange is limited by safety considerations, making a ship especially vulnerable to rough conditions, posing serious threat to the crew and cargo of ships in heavy seas. As such, ballast-water treatment is now one of the main focusses of the IMO convention. A number of countries are currently carrying in-depth research on ballast-water treatment technologies in accordance to the IMO guidelines.

Importance of the IMO convention on ballast-water management

Due to the transboundary nature of the issue, successful ballast-water control and management would only be possible through cooperation at global and regional levels with uniform enforcement. This is definitely a challenge for the States, but it is also important to acknowledge the consequences of not doing so. One foreseeable effect is on the trade using national commercial vessels to overseas ports that impose strict rules and regulations on the ballast-water discharge. The proliferation of different sets of laws and regulations governing shipping makes compliance extremely difficult and complex for ship operators. Uncoordinated country-specific management complicates the conduct of worldwide trade. Moreover, if ports or countries act in isolation of each other, there arises the danger of unfair economic competition between ports, especially when some have less stringent management systems than others. Furthermore, these states could also stop ships from entering their ports if vessels do not conform to their established standards, leading to undue delay and financial implications to ship operators. In addition, actions taken at national level sometimes only temporarily reduce the risk of species introductions in the respective country's ports as it might lead to the establishment of alien species in some of the neighbouring countries due to lacking of enforcement and lower level of environmental protection practiced. As such, it is envisaged that the shipping industry could benefit from the IMO convention, as it will provide greater international consistency regarding ballast-water requirements.

However, the costs implication would be one of the most undesirable results that the stakeholders will have to bear when the global convention comes into force. These include *inter alia* cost implications in adopting new ballast-water treatment technologies, undertaking control and eradication measures, regulation and compliance monitoring and enforcement, and others.

The Situation in Malaysia

Besides the global initiatives on ballast-water management, it is also important to look at the status of the issue in Malaysia. It is pertinent to understand the present situation and requirements as a basis to better respond to the international initiatives and in particular to protect Malaysia's marine environment and the shipping industry.

Threats to Malaysia

Magnitude of Shipping

As one of the world's top twenty trading nations, the importance of the maritime sector to Malaysia cannot be underestimated.[4] An estimated 95 percent of the country's goods traded are transported by sea. There are more than 100 landing facilities in the country, ranging from major ports to small jetties, either under federal or state control. An estimated 80 minor ports or jetties are under the control of the Marine Department. There are also some of the world's major ports, maritime hubs and trans-shipment harbours in Malaysia (Ports World Sdn Bhd). These include Port Klang, Penang Port, Bintulu Port, Johor Port, Pasir Gudang Port, Port of Tanjung Pelepas, Kuantan Port, Kemaman Port, Bintulu Port, Kota Kinabalu Port, to name a few.

Malaysia is also strategically located along the Straits of Malacca, which is one of the busiest shipping lanes in the world (Table 3). This Strait is a maritime superhighway that hosts a tremendous amount of maritime activities and seaborne trade that facilitates a high volume of vessel traffic. For example, on any given day, thousands of vessels of all types ply the Straits of Malacca (Figure 1). These range from small boats owned by fishermen earning subsistence living off its resources and barter traders, to giant container ships owned by major shipping lines as well as supertankers carrying crude oil. For instance in 2007, over 70,000 movements of ships were reported in the Straits of Malacca, making it the world's busiest shipping lane for merchant shipping traffic. In addition, it has been projected that annual traffic in the strait will increase to above 100,000 vessels by 2020.[5] As such, the growing size and number of ships traversing the Straits of Malacca would increasingly add to the challenge for ballast-water management in order to protect our marine environment.

Table 3. Number of ships passing the Straits of Malacca compared to other chokepoints in the world.

Chokepoints around the Globe	Usage (ships / day, 2003)
Malacca	600
Bosphorus	135
Hormuz	50
Suez	38
Panama	35

Source: Adapted from Assoc. Prof. Anthony Chin. National University of Singapore. The Economic Impact of the Strait of Malacca. Paper presented at the IMO-KL Meeting on the Straits of Malacca and Singapore. [Kuala Lumpur, Malaysia: 18 - 20 September 2006].

[4] For example, Port Klang is Malaysia's major seaport and the world's 18th busiest container port in 2006 by way of throughput handled. A dramatic surge of 13 percent increase in the volume of containers handled by local ports totalling 15.0 million TEUs in 2007 has contributed to further raising the profile of Malaysian ports and strengthening their role in the international port system. Besides that, the national shipping line (MISC) which is the world's single largest owner operator of LNG tankers continued to support the country's economy as well.

[5] Estimate made by the Chairman of the Nippon Foundation, Mr. Yohei Sasakawa, in his speech at the 'Symposium on the Enhancement of Safety of Navigation and the Environmental Protection of the Straits of Malacca and Singapore' held in Kuala Lumpur, Malaysia on the 13-14 March 2007.

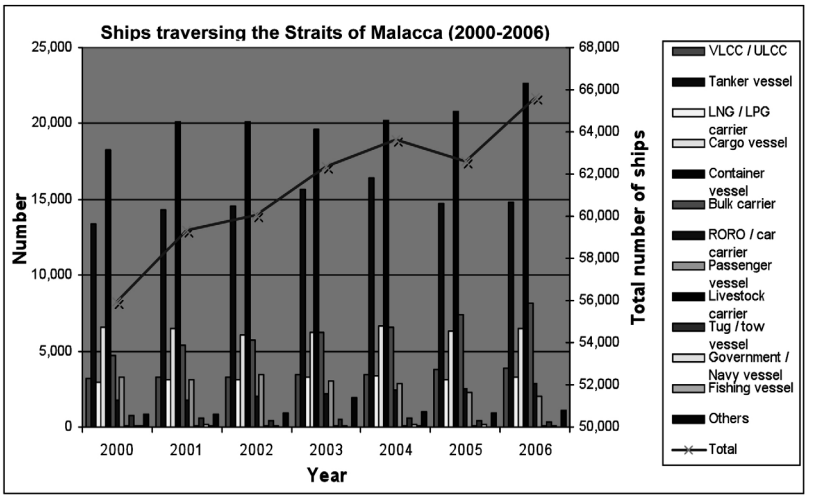

Figure 1. Total number of ships passing through the Straits of Malacca (2000 – 2006)[6]
(Source: Data from the Marine Department of Malaysia)

Besides that, a boost in the number and sizes of ships calling to Malaysian ports has also been recorded over the years. For instance, total number of ships calling by some of the major ports in Malaysia, which stood at just 57,156 ships (277,734 GRT) in 1996, has drastically increased to 65,499 ships (503,963 GRT) in 2006. A more detailed comparative distribution for ships calling to the major ports in Malaysia between year 2000 to 2006 is shown in Figure 2 and 3, illustrating a general increase pattern in the number of ships calling as well as their sizes.

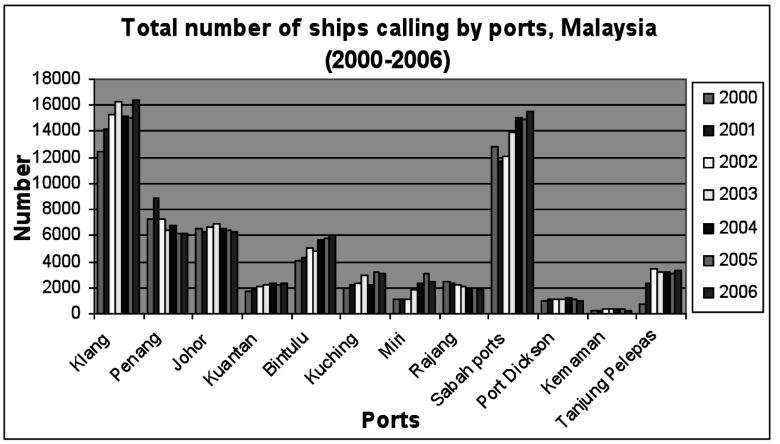

Figure 2. Total number of ships calling to the major ports in Malaysia (2000 - 2006).
(Source: Data from the Ministry of Transport, Malaysia)

[6] Type and total number of vessels reported to the Klang Vessel Traffic Monitoring System (VTS). VTS provides active monitoring and navigational advice for vessels in particularly confined and busy waterways. The service is implemented by the Marine Department of Malaysia designed to improve the safety and efficiency of navigation, safety of life at sea and the protection of the marine environment. The system captures vessels of 300 GRT and more of size passing through the Strait.

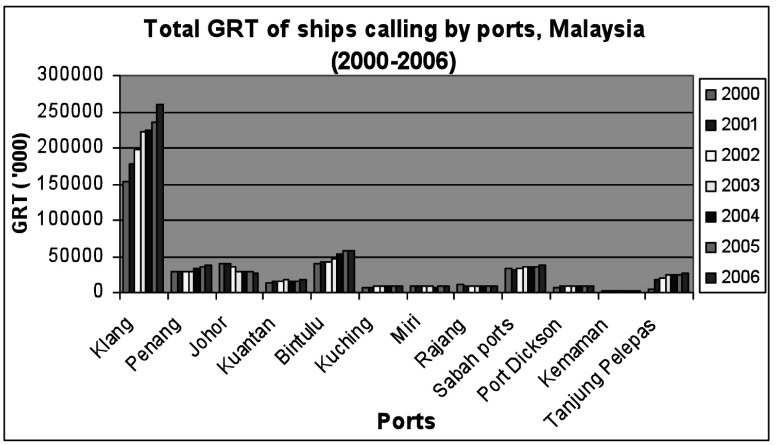

Figure 3. Total GRT of ships calling to the major ports in Malaysia (2000 - 2006)
(Source: Data from the Ministry of Transport, Malaysia)

All these factors represent a huge challenge for Malaysia to manage the ballast-water issue. Moreover, the problem could be further compounded as any introductions of exotic species could be spread domestically by coastal vessels passing the area. It has been well documented that domestic movement of ballast water has the potential to move marine invasive species outside their normal ranges and expand the range of established transoceanic invaders (Lavoie *et al*., 1999).

Concerns for Malaysia

There are many different stakeholders in various disciplines, skills and industries that can be either involved in the process or be affected by the process of ballast-water uptakes and discharges in Malaysia. Some of the main concerns involve the shipping sector, fisheries, mariculture, marine biodiversity, tourism, human health, as well as constitutional right to environmental protection. For example, many marine protected areas (MPAs), tourist spots and resorts are located along the major ports and shipping lanes. This sector plays a role as a drawcard for economic revenue generation for the country. For example, Penang, Langkawi, Pangkor, and Port Dickson are some of the tourists islands located adjacent to the Straits of Malacca attracting huge economical prospects for the country annually. As such, it is feared that any introduction of invasive species would have the potential to not only jeopardise the marine environment, but also the economy.

In addition, the sea is also a source of livelihood for our people. For example, there was a total of 90,702 fishermen working on licensed fishing vessels in Malaysia in 2005 alone. It is also worth reflecting on our marine resources, which could be unintentionally threatened by ballast-water discharges. For example, the fisheries sector is also one of the main economic contributors in Malaysia. More than 380,000 tonnes of fish estimating at RM1.2 billion per year is landed from the Straits of Malacca, catered by almost 70 per cent of the fishermen located along the coast and on the islands in Peninsular Malaysia. In addition, the estimated wholesale value of brackish water aquaculture production in Malaysia in 2005 alone was reaching a towering sum of RM 902,709.86, with a total of 20,642 aquaculturists in Malaysia. Some of the more significant aquaculture production values are illustrated in Table 4.

These are only some of the many potential threats of bio-invasions from ballast water that could affect the country. These are some of the many areas which need to be taken into consideration

when addressing the ballast-water issue and its potential ecological, economical and human health repercussions on the country.

Table 4. Significant aquaculture area of brackish water / marine ponds and cages, cockles, mussels, oysters and seaweeds and number of culturists by culture system as well as its estimated wholesale value of production in year 2005.

Types	Among the highest recorded values, 2005	No. of culturists involved	Estimated wholesale value (RM ' 000)
Brackish water/marine ponds	1,341.15 ha (Sabah) 1,265.08 ha (Perak) 1,158.37 ha (Sarawak)	184 235 324	72,210.01 115,894.16 171,123.00
Brackish water/marine cages	362,376 m^2 (Penang) 305,503.14 m^2 (Johor)	175 210	34,656.72 58,949.30
Cockles	5,220.83 ha (Perak)	210	29,932.58
Mussels	126,930.55 m^2 (Johor)	78	2,671.13
Oysters	70,000.00 m^2 (Johor)	10	96.45
Seaweeds	2,368.89 ha (Sabah)	583	15,713.10

Source: Fisheries Department of Malaysia Annual Fisheries Statistics 2005 (Volume 1).

Issues of ballast-water control and management in Malaysia

It is apparent that, although ballast water is necessary to maintain safety and stability at sea, it also represents one of the major factors for the translocation of organisms to new areas around the world due to the shipping activities. As such, some of the main issues identified that need to be considered for Malaysia are as listed below.

Ballast water is not regarded as a pollutant in Malaysia. As such, ballast-water movements within Malaysia are currently unmanaged and unregulated. No guidelines have been formulated and no rules have been gazetted to specifically address the control of ballast-water discharges in Malaysian ports. At present, provisions of the Environmental Quality Act and the Federation Port Rules are only applied if ballast-water discharge contains oil residue. There is also an inadequate penalty of not exceeding RM250.00 for unlawful ballast-water discharge stipulated in the Merchant Shipping Ordinance 1952.

The Marine Department of Malaysia has been following the development of this issue under the IMO very closely. However, it is also important to acknowledge the fact that the problem of harmful organisms and pathogens in ship's ballast water is not a confined problem and its solution depends on the initiatives of the government as a whole within its separate ministries, departments and organisations. As such, the cooperation from all related agencies is crucial to address the matter.

Although our shipping companies are aware that ballast water in many ways is a cumulative and chronic problem, some of these companies (ships traversing in local waters only) are reluctant to react to the issue, due to the fact that the global enforcement of the IMO convention has not come into effect and that Malaysia has yet to promulgate its own legislative position on this issue. However, the major national shipping lines are currently adhering to the regulation and requirements on ballast-water control and management when calling at foreign ports.

In addition, there is also a lack of local marine biological-diversity baseline data and records of possible introductions of species associated with ballast water to the local waters. Moreover, in many groups of marine organisms, there is currently insufficient knowledge on the existing native organisms to enable assessment of possible alien species. As such, it is difficult to

assess the extent of the problem associated with ballast-water discharges in Malaysian waters. Lack of continuous monitoring is a major impediment to detect any introduction of invasive alien species. Therefore, sampling is a critical element to develop an understanding of the risks posed by ballast water, besides contributing towards establishing a baseline database for species recording (David and Perkovic, 2004).

In line with that, one area of concern for the country is the increased occurrence and distribution of toxic algae/red tide in the country, which has been causing fish mortalities, paralytic shellfish poisoning and human-health problems over the years. This is also highlighted in the '*ten most unwanted organisms'* lists of the IMO in Table 1. For instance, HABs which were once confined to the waters of Sabah, are now being discovered at Peninsular Malaysia as well. Some of the species of concern include *Pyrodinium bahamense* Plate *var. compressum, Prorocentrum minimum, and Cochlodinium polykrikoides.* It is envisaged that the dinoflagellates' cysts might have been transported into new areas through ballast water (Fisheries Department of Malaysia, 2006).

Studies have documented that the dinoflagellates have strong survival techniques where it forms cysts in sediments and becomes activated when the ballast water is discharged at the port of destination and forms a bloom with adequate level of nutrients (Hallegraeff and Bolch, 1991). It has been therefore predicted that the cysts of these algae might have been transported into new areas through ballast water, causing blooms with the availability of suitable environmental conditions. However, this is still subject to further detailed research.

Advantages and disadvantages of ratifying the IMO convention

Basically, there are pros and cons for the country to ratify the IMO convention. The advantages for Malaysia would include the prevention of the spread of invasive species in the country's waters, which would contribute towards the protection and conservation of Malaysia's marine biological diversity. This would also be economically viable as eliminating introduced organisms has been proven to be almost impossible. Besides that, this would also illustrate that the country is trying to fulfill her international obligations under international treaties such as MARPOL 73/78, the Convention on Biological Diversity, and the Agenda 21. Furthermore, it could also assist in protecting valuable fisheries resources, tourism, mariculture, marine biodiversity, human health, and the ecosystems as a whole.

However, the most important disadvantage of ratifying the convention would be its potential cost implications, which ship-owners and the local authorities would have to bear. To commit to the convention would mean that Malaysia has to be prepared to fulfill her obligations as stipulated under the convention. This would also increase to some extent the burden of adhering to the convention's requirements for the related authorities as well as the ship operators.

Recommendations

From the analysis provided, it is apparent that Malaysia is susceptible to the threats of bio-invasions from ships' ballast water. However, there are several gaps in addressing the issue in Malaysia. In order to address all the concerns, there is the need to get prepared nationally. A range of issues that need to be taken into consideration include policy, management, regulation, research, as well as information dissemination. For example, some of the actions taken could be:

Designate a national task force involving the various related ministries, departments and organisations to coordinate the national response to the issue.

Address the gaps in the national laws and regulations. One important aspect that needs to be tackled.

Establish ballast-water control measures in Malaysia. Should include training and provision of information, scientific and technical assistance such as port and ballast-water sampling and monitoring programmes, strengthening the ability to enforce the national laws, as well as promote regional cooperation and information exchange on the matter.

Replicate the best practices from the pilot countries of the GloBallast Programme to facilitate the development and implementation of ballast-water management.

Conclusion and Future Direction

From the analysis given, there are various gaps that need to be addressed for ballast-water control and management in our waters, especially for the protection of our marine biodiversity and resources. By becoming a party to the Convention, as well as enacting national legislation and implementing proper guidelines and rules, Malaysia will be putting into place one more significant international tool to protect the marine environment from vessel-based pollution. However, the costs implication of putting in the required treatment technology as well as for monitoring activities would be the major undesirable result which the stakeholders would have to bear when the IMO convention comes into force.

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