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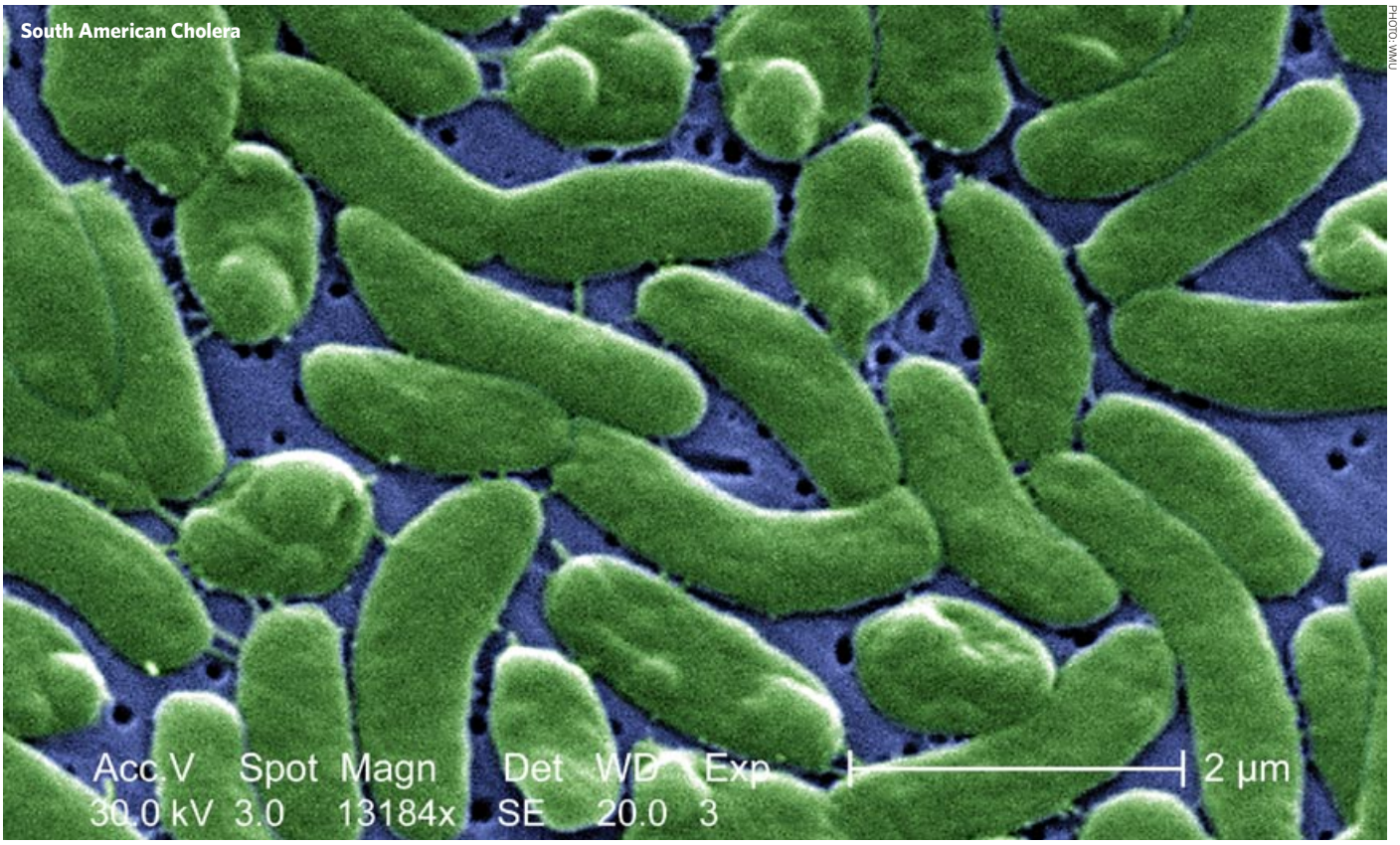

PHOTO: WMU

IMO still fighting invasive species

Ballast water contains stones, sediment and thousands of living species. Some of these species carried by ballast water are harmless while others are harmful.

The shipping industry has become the most important method for transporting goods all over the world due to the great growth in seaborne trade. According to the IMO, the shipping industry transports more than 90 per cent of the world's goods.

Therefore, the size and the weight of ships has increased as ship builders are designing huge new ships. The ballast tanks become bigger and the amount of ballast water needed to ensure the stability is also increased. Around three billion tonnes of ballast water is transferred around the world annually.

Transporting this huge amount of ballast water means transporting around 7 000 species of harmful aquatic organisms per day worldwide with devastating results to the global ecosystem. According to the IMO, the transfer of invasive species is considered one of the top four threats to the world's oceans, due to the negative impacts on both the environment and human life. This article will discuss the impacts of invasive species transferred through ship's ballast water from different perspectives: ecological, economic and human health. Also, the article will present the solutions considered by the IMO to solve the problem and the methods proposed to decrease the transfer of invasive species.

»Around three billion tonnes of ballast water is transferred around the world annually.«

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According to the IMO, ballast is known as "any solid or liquid placed in a ship to increase the draft, to change the trim, to regulate the stability or to maintain stress loads within acceptable limits". To fully understand the issues of ballast water, this definition will be elaborated to include in more detail what ballast water is, where ballast water is taken from and the function of ballast water in the ship.

Ballast water can be salt water when it is loaded in the ship's ballast tanks from the sea at a port located on the coast, or fresh water when it is loaded from a port located in a river or a lake. Secondly, ballast water is taken in separate tanks, designed especially for this use, to prevent mixing with other types of water or fuel to avoid pollution. Thirdly, ballast water has more than one function in the ship. The basic function is to ensure and maintain the stability of the ship, especially when the ship is on ballast.

Another function of ballast water is to load it while the ship has cargo to increase the draft to ensure the safety of the ship, especially in bad weather, and to ensure the efficiency

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of the rudder in the water to maintain good steering for the ship under these conditions. The last function of ballast water is to help in adjusting the stability of the ship while loading or discharging by loading more ballast water in one side than the other, or to load ballast water in the forward or aft parts in the ship to adjust the trim. Figure 1 shows the circulation of ballast water during the ship's voyage.

Ballast water contains stones, sediment and thousands of living species. Some of these species carried by ballast water are harmless while others are harmful. To be considered an invasive species, the following four criteria must be met: to be in a new region where they were not before, the spread of the species must be connected to direct or indirect human activity, there must be a geographical pause between the new region and the old region of the invasive species and "new generations of the non-native species are born in situ without human assistance". According to that definition, the Asian kelp is considered to be an invasive species because it has appeared in a new area and has spread unaided in big numbers as a result of indirect human activity.

This Asian kelp was transferred a long distance from northern Asia to the west coast of the USA, Europe and Argentina where it is now a problem. In addition, cholera is also an invasive species since it meets the four criteria. Cholera was transferred from different places to South America and the Gulf of Mexico and it swept all over South America affecting millions of people, killing more than ten thousand in 1994. Finally, the North Pacific seastar, which was transferred from the Northern Pacific to the South part of Australia, is considered an invasive species because it has rapidly reproduced unaided in the new areas and continues to thrive.

Since the issue of harmful invasive species was discovered, the impacts of this problem and how dangerous these impacts are have been discussed. To show the threat caused by this problem of invasive species, the United Nations Environment Programme has identified invasive species in general as the second greatest threat to global biodiversity after habitat loss.

First of all, to show the great impact of invasive species on the environment and the ecosystems it is useful to compare it to another major threat to the environment, such as oil pollution. To begin with, when an oil spill happens in the sea, it can be spotted easily and the position of the oil spill can be fixed and surrounded. But as for invasive species, which come into the sea via ballast water, it is impossible to see the threat because the species are often invisible to the naked eye. In addition, when an oil spill happens it can be cleaned and/or contained, but for invasive species when they are transferred to a new area they are almost impossible to contain because they spread in large numbers and move quickly from the place where the ballast water was discharged to the rest of the ecosystem.

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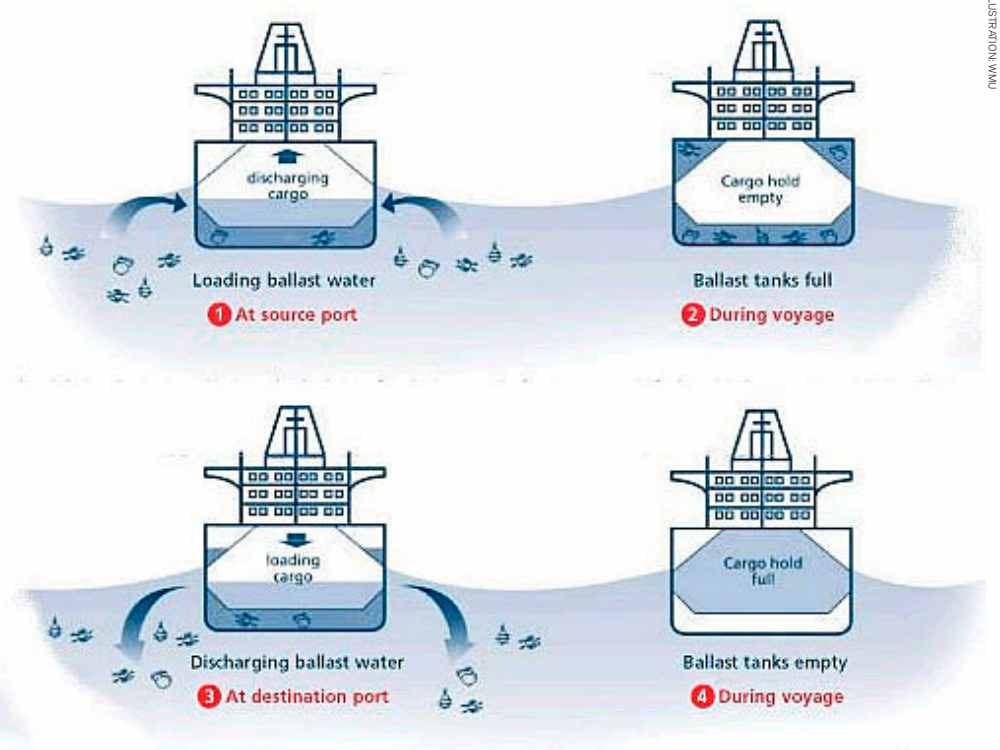

Figure 1: The circulation of the ballast water during the ship's voyage.

PHOTO: WMU

Figure 2: The invasive species North Pacific seastar.

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As mentioned before, invasive species initially have an invisible impact on the environment, but once they are detected, the economic impact is apparent quite quickly because the species can cause damage to existing infrastructure. The most famous example of an economic impact due to invasive species is the impact of the European zebra mussels on the Great Lakes in USA.

These zebra mussels caused huge problems by blocking the water supply pipes of city industry facilities and the cooling system of a nuclear power plant, which could have lead to a disaster. The average cost of the damage done by the European zebra mussels is around USD 360 000 per year for affected cities and industries, USD 825 000 per year for nuclear power plants, USD 600 000 for a shipping company, USD 1.5 million for a single factory, USD 3.7 million for water treatment facilities and USD 6 million for a power plant. The total cost for ten years is a staggering USD 5 billion, USD 3.1 billion of which is a direct cost for the power industry.

PHOTO: WMU

Figure 3: The invasive species European zebra mussels.

There are many examples showing the negative impacts of invasive species on human health, such as South American cholera (vibrio cholerae).

In 1991, it was discovered that the bacterium that caused cholera was found in oysters and fish in Mobile Bay, Alabama, USA. Many samples taken by the US Food and Drug Administration from the ballast water of 19 ships arriving in the Gulf of Mexico ports from Latin American found that five of the ships were carrying a strain of South American cholera. It was believed that the original strain may have been transported from Asia to South America through ballast water. The outbreak of the disease caused one million reported cases of cholera and over 10 000 deaths.

In addition, in some parts of the world there are frequent outbreaks of red tides, another invasive species that produces neurotoxins which can accumulate in shellfish and cause illness and sometimes death to people eating them. Studies have shown that some of the toxic dinoflagellates were introduced in the sediments transported through ballast water.

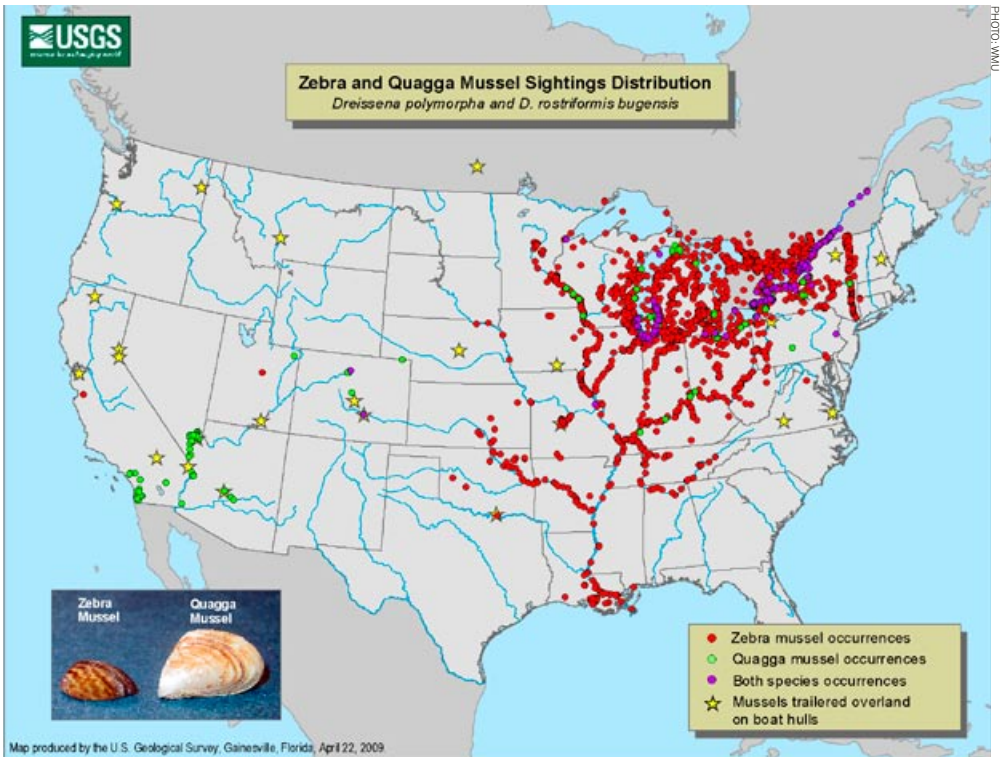

PHOTO: WMU

Figure 4: The invasive species European zebra mussel's distribution map all over the USA.

Canada brought the problem of invasive species transferred through ballast water to the world's attention in 1988. At that time, Canada introduced a study outlining the impact of strange organisms in ship's ballast water that was discharged to the Great Lakes. Furthermore, in 1990, Australia supported Canada by announcing the problem of invasive species by citing another study on toxic invasive species that came into Australian waters via ballast water. As a result of these two studies, the IMO took very quick action one year later through the Marine Environment Protection Committee (MEPC) and adopted the Guidelines for Preventing the Introduction of Unwanted Organisms and Pathogens from Ships' Ballast Waters and Sediment Discharges. After two years of discussion, the IMO Assembly, in 1993, adopted the first Resolution A.774 (18) on Guidelines for Preventing the Introduction of Unwanted Organisms and Pathogens from Ships' Ballast Waters and Sediment Discharges. Later, the IMO put together working groups to draft regulations to fight this problem, which adopted the Resolution A.868 (20) Guidelines for the control and management of ships' ballast water to minimize the transfer of harmful aquatic organisms and pathogens, cancelling and updating Resolution A.774 (18).

As a result of these IMO guidelines, seven years later the MEPC offered to adopt the International Convention for the Control and Management of Ships' Ballast Water and Sediment on February 13, 2004. The main focus of the convention is to "prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments". In addition, to make this convention effective and for it to enter into force, it must be ratified by more than thirty member states representing more than thirty-

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PHOTO: WWW

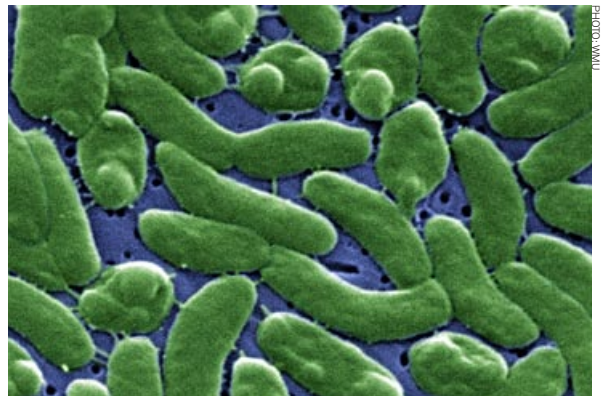

PHOTO: WWW

Figure 5: The invasive species South American cholera.

Figure 6: The invasive species red tides.

five percent of the world's fleet. Moreover, the convention will enter into force twelve months after the date of ratification. According to the IMO status of conventions, as of March 31, 2009, eighteen member states had singed the convention representing 15.36 per cent of the world's fleet.

The IMO, from the time of adopting the convention, started to change its way of thinking. The IMO started to find ways and methods to not only stop transferring these harmful invasive species, but also to kill these living organisms which may survive during the long voyage in ship's ballast water to be sure that no harmful invasive species are transferred. Therefore, the MEPC in July 2005 adopted Guidelines for uniform implementation of the International Convention for the Control and Management of Ships' Ballast Water and Sediments. Moreover, the IMO set up the Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) whose duty is to approve the proposals submitted to the IMO for ballast water management systems and to be sure that these systems pose no harm to the environment or human health.

In fact, the Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) did a great job in developing and approving various proposed ballast water management systems.

On the one hand, there are some proposals that have been introduced to the IMO that show many advantages, so some shipping companies have used them since they have been shown to be effective. First, the IMO approved the proposed method of ballast water exchange in deep ocean water to minimize the risk of transferring harmful invasive species. The composition of deep ocean water is different from the water in which the organisms in the ballast tanks came from, so these organisms cannot survive in these new conditions once they are released in the open ocean. Second, the GESAMP approved the proposal of a ballast water heating system which is very useful as it uses heat developed to kill the harmful invasive species by increasing the temperature of the ballast water to a temperature of 36–38°C for 2–6 hours. Thirdly, the group approved the proposal of the ultra violet radiation system, where the ballast water passes through ultra violet radiation which kills the harmful invasive species in the ballast water. Moreover, the electrochemical system proposed by Sweden electrochemically oxidizes the ballast water to rid it of harmful invasive species.

Finally, in October 2006, the MEPC,

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Figure 7: The electrochemically oxidizes system.

with the help of the GESAMP, adopted new guidelines containing ballast water reception facilities in which the ships have to discharge their ballast water into reception facilities in the port to control the discharge of invasive species.

On the other hand, not all proposed ballast water treatment methods approved by the IMO have been shown to be advantageous; the IMO has also approved proposals for ballast water treatment that show some disadvantages. For example, the non-release of ballast water is not suitable for all types of ships because some ships, such as bulk carriers and tankers, must release the ballast water to load cargo. In addition, the use of chlorine to treat ballast water is effective, but it has a negative impact on the environment when discharging the highly toxic chlorinated ballast water. For a comprehensive list of ballast water treatment methods and the advantages/disadvantages of these treatment methods, see Ballast water treatment methods and their advantages/disadvantages (IMO, 1999).

»This opens up a huge global market for ballast water treatment in the next few years.«

In conclusion, there is an agreement among the maritime industry, international organizations and non-governmental organizations that the transportation of harmful invasive species through ships' ballast water causes sever negative impacts on the environment, economy and human health due to their rapid invasion and destructive tendencies. In order to make sure any work being done is effective, urgent actions should be taken globally, such as the GloBallast Programme.

Even if international standards and procedures are developed, there are still number of factors to consider such as enforcement, effectiveness and cost. Currently, there are a few approved ballast water treatment methods on the market. The methods are not required to be applied on ships because the convention does not have power since it has not yet entered into force. Regarding costs, shipowners usually argue about installing the treatment technology on board because they have to pay the equipment to treat the ballast water and train the crew to operate the equipment.

All of these factors need to be taken into consideration when responding to the problem of invasive species. Since an approved ballast water treatment method still needs to be developed, ballast water exchange will therefore remain the primary method for dealing with the threat of invasive species for some time. This opens up a huge global market for ballast water treatment in the next few years, which will give the IMO and the GESAMP the incentive to undertake more research and development in order to find more ballast water treatment methods which comply with current standards in terms of safety, environmental friendliness, practicality and cost effectiveness. *

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