Exotic species in ballast water

The scientists are sampling the ballast water of the Berge Nord.

This is the first of two articles about ballast water research on Berge Nord, contributed by captain A.K. Pandey (Berge Nord), Kate Murphy and Melinda Bednarski (Smithsonian Environmental Research Center in Maryland, USA), Stefan Heinemann and Dr. Martina Doblin (Old Dominion University in Virginia, USA). The second article will appear in Horizon 4/2002.

Since the late 19th century, trading ships have transported ballast water containing exotic fish, algae and other organisms to ports around the world. It is estimated that on any given day, several million metric tonnes of ballast water are on the move in the world's oceans, while each year, some 10 billion tonnes are transported among domestic and international ports.

Usually, the port donating the ballast water is home to numerous native species, as well as the offspring of organisms, which previously spread from foreign ports. Many sea creatures normally reside on the seafloor, or are too large to enter a ship through its sea chest. However, since most marine species spend parts of their lives as tiny, floating or swimming organisms that are easily sucked into ballast tanks, even the young of large seafloor-dwelling species can be transported in this manner.

Diversity

Over the past 30 years, biologists around the world have encountered a diverse array of organisms in ballast water samples. Hundreds of animals and thousands of plant-like cells are found in a "typical" liter of ballast water. Numbers of bacteria and viruses are even higher. We might estimate that a mid-sized bulk carrier transporting 50,000 tonnes of ballast water could contain over 1,000 trillion organisms, some of which could establish and spread in a new environment – resulting in "biological invasions".

Although many have a limited effect on their new surroundings, some introduced species are ecologically and economically devastating. In the United States alone, the economic impacts of introduced species may exceed $100 billion per year. One well-known culprit is the European zebra mussel (dreissena polymorpha), which after first appearing in Lake St. Clair in 1986, has advanced steadily and dramatically throughout the Great Lakes, now spanning 22 American states and the eastern part of Canada. The zebra mussel fouls ships, pipes, marine structures and even other shellfish, forcing huge and expensive clean-ups while consuming much of the phytoplankton (microscopic algae) which sustains the aquatic food-web.

The European zebra mussel has visibly changed the lake ecosystems of North America, while its economic impact has exceeded a billion dollars since its first appearance in 1986. (Photo: courtesy of GLERL)

Effects on humans?

Of further concern is the discovery that bacteria and viruses that can affect human and ecosystem health, are also transported in ballast water. In one study, for example, the bacterium responsible for cholera was detected in 15 ships arriving to the US east coast. While no outbreaks of disease have been clearly attributable to ballast water, scientists are still unsure of the implications of such large-scale redistribution of microbes by shipping activities.

Mid-ocean ballast water exchange

The IMO Guidelines (1997) for the control and management of ships' ballast water list several ways that ships can reduce impact on world's oceans.

These include:

1. Avoid ballasting in shallow water, turbid water and in darkness, since more organisms are likely to be in the water column near the ballast intake pipes in these situations.
2. Remove sediments from the ballast tanks on a regular basis, since sediments can be a refuge for many organisms.
3. Avoid unnecessary discharge of ballast. Older ballast water typically contains far fewer organisms than recently ballasted water.
4. Where safety permits, undertake ballast water exchange in the open ocean, i.e. no less than 200 nautical miles from the nearest coast and in water deeper than 2,000 metres.

Ballast water exchange is currently the only accepted method of treating ballast water. During exchange, the vessel replaces the coastal water in its tanks with water from the deep open ocean. The species in the coastal waters do not survive well in the open ocean, and vice versa.

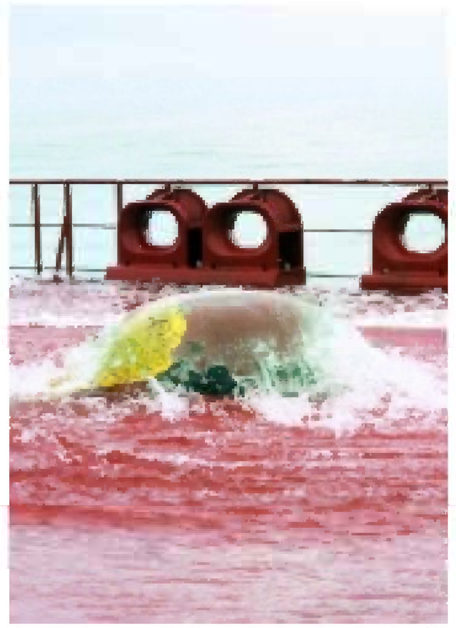
Mandatory or recommended

Ballast water exchange is recommended or mandatory in many parts of the world for foreign vessels intending to discharge ballast water. The practice is mandatory for vessels entering the Great Lakes of North America. Even before ballast water exchange became widespread at the end of the 20th century, vessels operating in cold climates, like Berge Nord, routinely exchanged ballast water to increase its salt content and temperature, preventing tanks from freezing.

Once or three times

The IMO recommends two types of ballast water exchange, either of which theoretically results in more than 95% replacement of the original ballast water. When ballast water is exchanged using the "100% empty-refill method", the tanks are first emptied of coastal water and then refilled with open-ocean water. When a ship uses the "300% flow-through method", ocean water is continuously pumped into the bottom of the tanks while the excess overflows through hatches on to the deck. To compensate for mixing between the two water types in the ballast tanks, flow-through exchange continues until three tank volumes of oceanic water have entered each tank.

Each ship's captain elects which method will be used to perform ballast water exchange. Usually, this decision is driven by design, safety or operational constraints. While the "empty-refill method" is usually the quickest and cheapest way to perform the exchange, it also places the most stress on the vessel structure. Consequently, many ships, including Berge Nord, prefer to exchange ballast water using the "flow-through method".



Ballast water exchange on Berge Nord is performed using the "300% flow-through method".