

Marine Bioinvasion: An Overview

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Marine environment is a reservoir of resources, both living and non-living and is extensively used for connecting the different economies of the world through shipping. It is important for us to care for the health of this environment, which provides so much to the well being of mankind. It is apparent that this environment is threatened by human activities.

Shipping is the backbone of global economy and facilitates transportation of 90% of commodities. A single bulk cargo ship of 200,000 tones can carry up to 60,000 tones of ballast water. It is estimated that 12 billion tones of ballast water are carried around the world each year. Translocation of organisms through ships is considered as one of the important issue that is threatening the naturally evolved biodiversity and consequences of such invasions is realised increasingly in the recent years

Mnemiopsis leidyi, an opaque comb jellyfish around 10 centimeters long, is reported to have entered the Black Sea in early 1980s as a stowaway in ballast water on a ship from the United States. *M. leidyi*, which had until then lived in bays along the eastern seaboard of the United States, encountered no predators in the Black Sea but food in plenty. It devoured the eggs and larvae of a wide variety of fish that lead to collapse of fishing industry. The fish catch fell by 90 % in six years. By 1990, the total biomass of *M. leidyi* in the Black Sea had reached an estimated 900 million tones; 10 times the total annual fish catch from all the worlds' oceans. The zebra mussel, *Dreissena polymorpha*, was first discovered in North America in Lake St. Clair, Michigan in 1988. This species is native to Europe and is believed to have been introduced in 1983 or 1984 from transoceanic ships, which discharged freshwater ballast containing planktonic larvae or young adults. It has now spread to infest more than 40% of the United States water ways, fouls the cooling water intakes of industry and may have cost US\$ 5 billion in control measures since 1984. Black striped mussel *Mytilopsis sallei* has been reported from Mumbai and Visakhapatnam. This species is a native of tropical and sub tropical Atlantic waters and is reported to have invaded the Indian waters sometime during 1960's. It has also spread to Hong Kong and threatened Australia. Green crab - *Carcinus meanas*, a native of Europe, is found in Sri Lankan waters. The molluscs and crustacean population on which this crab preys upon can, therefore, be affected. *Vibrio cholerae* 01 and 0139 is the causative bacteria for the human epidemic cholera can be transported through ballast water. Strong evidence linking cholera epidemics and climate has also been made. As this bacterium is capable of forming associations with plankton, their survival and sojourn in the ballast water tanks are much more easier.

The introduction of new species can have a direct impact on the society and human health by affecting the fisheries and causing health hazards. The health hazards are generally caused by build up of toxins in the food chain caused by Harmful Algal Blooms (HAB). Incidence of HAB is popularly referred as Red Tides and their incidences have been raising world over. Ballast water has been considered as one of the important vectors for the spread of these organisms. The toxic effects of these

harmful algae can lead to fatality in human beings through Paralytic Shellfish Poisoning (PSP) and cause health concerns through Diarrhetic Shellfish Poisoning (DSP). Human death due to PSP has been recorded in India.

The Global Environment Facility of the United Nations Development Program has initiated through International Maritime Organisation a program that looks at marine bioinvasion mediated through ballast water carried by the ships. The first phase of this global ballast water management program has the participation of six countries (Brazil, China, India, Iran, South Africa and Ukraine). In India, Mumbai and Jawaharlal Nehru Ports have been chosen for this program.

The management measure recommended under the existing IMO ballast water guidelines is ballast exchange at sea (three times the volume). It is widely recognized that this approach has many limitations, including serious safety concerns and the fact that translocation of species can still occur even when a vessel has undertaken complete ballast exchange. Yet another concern is the location at which such exchange is undertaken. The surface currents can transport the organisms to the nearby coasts. In the Indian context it is important to note that the seas around India act as corridors for the oil tanker route and such mid ocean exchange practices can negate the principle of limiting bioinvasion.

Research related to ballast water treatment is underway in many countries and the options include, heating, filtration, Ozonation, Deoxygenation, Gas super saturation, ultraviolet radiation, biocides. So far none of these have been able to address the issue in totality and scope for research and technology development is ample. Molecular tools that can identify the organisms in ballast water and markers that can substantiate the effectiveness of mid ocean exchange has potential implication in quarantine procedures and needs to be pursued. Simultaneously, it would be interesting to weigh the option of self-certification by using molecular techniques to declare No Risk Species in Ballast. This can also lead substantial cuts in the cost of ballast water treatment and management. Identification of suitable ballast discharge sites by each of the ports might become a necessity; hence ballast water dispersion models need to be in place.

India is dotted with 12 major ports and a number of minor ports. These serve as gateways for marine bioinvasion. In addition to introduction of alien species in these marinas, the threat of its spread to neighbouring environments and the coral reefs of Andaman, Nicobar and Lakshadweep Islands is a distinct possibility. In light of this it is essential to monitor all the ports simultaneously to delineate the already invaded species, carry out risk assessment and adopt suitable measures to check future invasions and their proliferation.