EFFECTS OF BALLAST WATER ON THE BLACK SEA ECOSYSTEM

Muhammet Boran*

Karadeniz Technical University, Faculty of Marine Sciences, Trabzon/Turkey
E-mail: mboran@ktu.edu.tr

ABSTRACT

The ballast water is called the water taken aboard with the suspended materials control the vessel for a suitable draft and trim and reduce stresses and improve stability. It may contain a variety of harmful substances, including in certain cases oil contaminants non-native marine animals and plants. Organisms that are carried by ballast water into a new environment can cause major ecological and economic damage to the ecosystem. Approximately 50 000 vessel transits through the Strait to the Black Sea each year. Ship traffic has led to the introduction of new species to the Black Sea that altered the ecosystem of this Sea.

Key-Words: Black Sea, ship-sourced pollution, ballast water, American Comb Jelly, Mollusc

AIMS AND BACKGROUND

Important changes have taken place in the Black Sea ecosystem over the last thirty years.The factors causing the change of the Black Sea ecosystem are pollution, over and illegal fishing, introduction or spread of non-indigenous species, changes in water regime, habitat damage (abrasion, other physical damage, removal of substratum) and habitat loss (habitat change to another substratum, to land). These changes in the Black Sea ecosystem have caused significant damage to the regional fisheries.

Ballast water contains a variety of biological materials, including plants, animals, bacteria and viruses. Therefore ballast water includes non-native and exotic species that can cause extensive ecological and economic damage to aquatic ecosystem when they interact with new environment. Mollusks and other organisms whose habitat includes marine substrate also attach to the surfaces of ocean-going

vessels at the point of departure and then fall into the water at the destination. Non-native species affect adversely commercial fisheries and water-based recreation and cause degradation of wildlife habitat, the reduction of biodiversity, and the alteration of natural ecosystems. Invasive species can also impact human health. Invasive zebra mussels accumulate toxins in their tissues like PCB's and PAH's. When other organisms prey on these mussels, the toxins are passed up the food chain and can also enter animals consumed by humans. Ballast water from ships also sometimes contains harmful bacteria like cholera. Invasive animals can also be vectors for disease (White and Molloy, 2001; Thayer, 2016). In addition ships can carry varying amount of sediments in their ballast tank.

It is estimated that the transfer of ballast water is annually about 10 billion tons by world shipping fleet and is containing hundreds of species (Elcicek *et al*., 2013). The aim of this study is to introduce effect of ballast water on the marine ecology of the Black Sea.

EXPERIMENTAL

This manuscript reviews available studies on the effects of ballast water to the Black Sea ecosystem.

RESULTS AND DISCUSSION

Black Sea connects central and eastern Europe to the near and the middle east and farther on to central Asia. It is both starting and finishing traffic point worldwide (Urucu and Buza, 1999). The Black Sea has 41 ports and harbors in six countries. Under the Montreux Treaty signed in 1936, navigation through the Turkish Straits is unrestricted for commercial vessels without any restriction on flag and cargo type. Since then, traffic density on Turkish Straits has increased significantly. In 1936 the number of ships passing through Bosporus was only 4500. In 2016, 42 553 ships passed through the Bosporus and 26050 of them are transit passing ships. So ship-source pollution especially sewage, bilge water, ballast water and solid waste that are formed during normal activities of ship, have an important role in pollution of the Black Sea (Ozturk, 2005; UDHB, 2016).

Ballast tanks come in various sizes and shapes, and are located in different areas of ship, depending on the type of vessels involved. Although many ships take ballast water to their ballast tanks, vessels carrying liquid chemical loads are taking sometimes ballast water into their tanks after discharging their cargoes. Then the ballast water is contaminated with toxic liquids. For this reason, both tank wash water and ballast of these ships are polluted with toxic liquids. But the biggest problem that caused by ballast waters is the transfer of organism from one sea to the another (Deacutis, 2002). This introduction of non-native species is considered to be one of the five major threats to marine biodiversity identified in the Convention of Biodiversity. The introduction of non-native species from ships' ballast water, in addition to other sources, is a matter that is causing increasing concern and is a potentially serious, but highly unpredictable problem, in all coastal marine ecosystems (Carlton, 1996). The International Maritime Organization (IMO) has

developed Ballast Water Management Convention (BWMC) 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. The Convention provides two ballast water discharge performance standards. The first provides a standard for ballast water exchange and the second based on ballast water treatment (Elcicek *et al*., 2013; Meer, 2016).

Every day, every hour, an estimated 7 000 marine and coastal species travel unnoticed across the world's oceans, silently stowed away in ships' ballast water tanks. When released in a new environment, these unwanted travelers can become invasive, outcompeting and changing native flora and fauna and resulting in irreversible ecological change and economic loss. Some of invasive species introduced to the new environments are Zebra Mussel (*Dreissena polymorpha)*, American Comb Jelly (*Mnemiopsis leidyi*), Cholera, Toxic Alga. Zebra Mussel have drastically altered the ecosystem of Great Lakes. American Comb Jelly collapse of the anchovy and sprat fisheries in the Black and Azov Sea. Vibrio cholera was released and infected the drinking water in Peru. Toxic Algae introduced into a new area, algae may form algae blooms. Additionality, some species may contaminate filter feeding shellfish (WWF International, 2009; NOAA, 2011).

Several vessels operate exclusively within the Black Sea area, such as tankers, ro-ro ships, bulk carrier and fishing vessels. The Black Sea is a semi enclosed sea and its ecosystem has experienced substantial changes since the 1960s, such as nutrient enrichment and large population growth of gelatinous and opportunistic species. The Black Sea was regarded as an area in which the impact from the introduction of non-indigenous species is high. To many non-indigenous species have been identified in Black Sea (Acomi and Acomi, 2015). Some of these species have caused significant changes in the black sea ecosystem. These are two members of the scyphozoan phylum *Rhizostoma pulmo, Aurelia aurita,* a lobate ctenophore *Mnemiopsis leidyi* three mollusc species, the gastropod *Rapana thomasiana,* the bivalves *Mya arenaria* and *Scapharca inaequivalvis***.** *R. pulmo* fed on zooplankton plus the eggs and larvae of fish and shellfish, this jellyfish was not formerly considered a big player in the Black Sea's animal community. It was suggested that *A. aurita* was consuming 62% of all zooplankton produced in body of Black sea water. After the introduction of a new species a lobate ctenophore, *Mnemiopsis leidyi* into the Black Sea the major changes of its ecosystem became evident. Around the end of the 1980s- beginning of the 1990s, the Black Sea ecosystem underwent changes: a decrease in mesozooplankton stock, severe changes in zooplankton composition, an extraordinary bloom of the introduced ctenophore Mnemiopsis leidy, appears to be the most important reasons for the sharp decrease of anchovy and other pelagic fish stocks in the Black Sea. It affected the ecosystem at all levels, from top predators to plankton-fed fish, to zooplankton, to phytoplankton and from picoplankton to detritus (Kideys, 1994; Bahya, 2001; Nierman, 2004). The largest changes in the Black Sea bottom biota resulting from exotic animals are associated with the introduction of the mollusk that mentioned above. Introduced *Rapana thomasiana* had the greatest influence on populations of large bivalve mollusc, decreasing their densities at many sites (Zolotarev, 1996). Black Sea marine ecosystem was helped by another ctenophore invasion:

carnivorous *Beroe ovata* came here from Mediterranean in the 1990s. *Beroe* eats *Mnemiopsis,* only *Mnemiopsis*, swallowing it as a whole with a wide mouth-slot (Bahya, 2001).

CONCLUSIONS

The ballast water from ships carries marine organisms that have invasive potential. This invasive species has negative impacts: it reproduces rapidly under favorable conditions, it feeds excessively on zooplankton, it depletes zooplankton stocks, altering the food web and the ecosystem functionality, and contributed significantly to the collapse native species. Biodiversity and the abundance of native species change significantly as a result of introduced species. Invasive species impacted directly the biota and ecosystem of the Black Sea especially in years end of the 1980s- beginning of the 1990s.

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