

## ALIEN SPECIES AND THEIR IMPACTS IN THE BLACK SEA

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#### **Abstract**

The Black Sea, a unique fragile ecosystem, has been under the threat of pollution, climate change, invasive alien species and overfishing over many years. Combined impacts of these threats caused serious problems in the Black Sea ecosystem, fisheries economy and welfare of Turkish fishermen by reduction of the catch of commercial fish species, decrease in biodiversity, loss of habitats, increased food competition of endemic species and related problems in the food web by changes in various trophic levels. In this presentation the impacts of the alien invasive species will be explained on certain species basis in the Black Sea.

Unintentionally introduced new species to a certain area are known as invasive species. Alien species that become invasive are considered to be a main direct drive towards biodiversity loss across the globe. In addition, alien species have been estimated to cost global economies hundreds of billions of dollars each year (CBD, 2011).

Some of the alien species i.e. *Rapana venosa*, *Anadara inaequalis*, *Mnemiopsis leidyi*, *Beroe ovata*, *Mya arenaria*, *Balanus improvisus*, *Mugil soiyu*, *Potamopyrgus jenkinsi* caused significant impacts on the Black Sea ecosystem and fisheries. All kinds of impacts due to invasive species had a big effect on the reduction of total fish production in the Black Sea as predation, food competition and major destruction in the food web. There are many other species introduced to the Black Sea from phytoplankton to top predators. Some of the invasive alien species and their impacts in the Black Sea are summarized in Table 1.

Research studies on the impacts of alien species to the ecosystem and fisheries economy are very limited in the Black Sea. In order to support the ecosystem recovery in spite of all types of negative impacts for the sustainable management of the natural resources, it is very essential to understand, analyze and take urgent management

measures regarding all aspects of the ecosystem. New research studies in the Black Sea should be focused on prey-predator relationships, reproduction and growth rates of invasive species, relationship between their distribution and environmental factors, assessment of limiting factors, natural barriers and mechanisms, etc.

**Key words:** *Invasive species, impact, Black Sea, ecosystem, fisheries*

## INTRODUCTION

Alien species that become invasive are considered to be a main direct drive towards biodiversity loss across the globe. In addition, alien species have been estimated to cost global economies hundreds of billions of dollars each year (CBD, 2011). Unintentionally introduced new species to a certain area are known as invasive species. Annually, more than 3000 species from the oceans change their locations via ca. 10 billion tons of ballast waters discharged from the ships (IMO, 1998).

Nearly 87% of the water volume of the Black Sea is anoxic and contains high concentrations of hydrogen sulphide (Bronfman, 1995; Zaitsev and Mamaev, 1997).

Therefore, living space suitable for the majority of aquatic organisms makes up to 10% of the total volume of the Black Sea. Since the early 1970s, noticeable changes have taken place in the Black Sea ecosystem because of anthropogenic eutrophication (Kideys, 2002). In the period from 1981-2000 the intensity of alien species appearance increased to about two species per year. The principal vector of alien species during this period was ballast water (Alexandrov *et al.* 2004).

The Black Sea is a recipient area for non indigenous species (NIS) native to very different geographical donor areas, i.e. North Atlantic (35%), East Atlantic-Mediterranean (23%), West Pacific (13%), South-East Asia (8%), South-West Pacific (1%), Indo-Pacific (6%), and cosmopolitan species (15%) (Zaitsev *et al.* 2004).

Invasive species are evolving very well in new areas by switching from their natural areas due to ballast water discharges of ships, aquaculture activities and environmental changes in the ecosystem. These species are in equilibrium with the existing predators and under the control of ecosystem relations in their natural environment. Generally, invasive species that occupy new ecosystems that are poor in biodiversity cause negative economical, environmental and ecological changes by competing with the local species in their transitional or new regions. Intentionally or unintentionally access of invasive species to the Black Sea ecosystem has started in the 19th century and significant effects to the ecosystem have emerged at present.

Zaitsev (1991) reported that more than 30 foreign aquatic plant and animal species were introduced to the Black Sea in 20th century. Some of these species (*Rapana venosa*, *Anadara inaequalis*, *Mnemiopsis leidyi*, *Beroe ovata*, *Mya arenaria*, *Balanus improvisus*, *Mugil soiyu*, *Potamopyrgus jenkinsi*) caused significant impacts on the Black Sea ecosystem and fisheries. All kinds of impacts due to invasive species had been very effective on the reduction of total fish production in the Black Sea as predation, food competition and major destruction in the food web. Some of the invasive alien species in the Black Sea are given in Table 1.

Table 1. Major alien species in the Black Sea and their impacts on the ecosystem

Species	From	Native to	Way of Introduction	Impact	First discovered in	Reference
Rapa whelk <i>Rapana venosa</i>	Gastropoda	Sea of Japan	Attach hulls Ballast UI*	Mussel banks, oysters and native bivalves collapsed	1947 Novorossiysk	Drapkin, 1953
Comb jelly fish <i>Mnemiopsis leidyi</i>	Cephore	NW Atlantic	Ballast UI	Anchovy, horse mackerel and sprat stocks collapsed	1982 Black Sea 1988 Azov Sea	Vinogradov <i>et al.</i> , 1989
Ctenophore <i>Beroe ovata</i>	Cephore	Mediterranean	I, UI?	Sharp decrease <i>M. leidyi</i> , recover small pelagics	1997, Northern Black Sea, 1999, Azov Sea	Shiganova <i>et al.</i> , 2001
Pacific mullet <i>Mugil so-iuy</i>	Mugilidae	Amur river estuary and Japan Sea	I**	Food competition with local mullet species which are disappeared	1972-1980, Azov Sea and the Black Sea	Zaitsev, 1991
Soft shell clam <i>Mya arenaria</i>	Myidae	Baltic Sea	Ballast UI	Formed new communities	1960	Strasser, 1999
Invasive Blood cockle <i>Scapharca (=Anadara) inaequivalvis</i>	Arcidae	Indo-Pacific	Ballast UI	Depleting with mussels as a new filter feeder	late 1970s Black Sea	Zolotarev & Zolotarev, 1987
Bay barnacle <i>Balanus improvisus</i>	Balanidae	Atlantic, Pacific, Mediterranean	Ballast UI	Formed new communities	1844	Gomoiu & Skolka, 1996
New Zealand mud snail <i>Potamopyrgus jenkinsi</i>	Littoridinidae	New Zealand	Ballast UI	Formed new communities	1952, Razelm-Sinoe Lagoon 1960, Azov Sea	Bank, 2007
Common starfish <i>Asterias rubens</i>	Asteridae	Atlantic	Mediterranisation UI	Predating on mussels, baby clams, rapa whelk	2003, Bosphorus entrance	Karhan <i>et al.</i> , 2007

I: Intentionally, UI\*: Unintentionally

There are many other species introduced to the Black Sea from phytoplankton to top predators. When the food web was destroyed dramatically in late 1980's in line with collapse of anchovy stocks due to predation of comb jelly fish, a lot of other fish species from higher trophic levels, feeding on anchovies and other small pelagics, have also declined. After the intentionally or unintentionally introduction of *Beroe ovata*, that is still unclear, population of *Mnemiopsis leduyi* sharply declined and the anchovy fisheries started to recover.

The other ecological disaster was due to alien species *Rapana venosa*. After the first introduction in 1947 to Novorossiysk Bay, it has spread all over the Black Sea due to lack of predators, mainly sea stars. It destroyed all commercial mussel banks which are essential filter feeders acting as a fuse to control nutrient increase via river discharges. After the collapse of mussels, it started to feed on other mollusks like oysters, baby clams and carpet shells.

At present, the growth rate of rapa whelk considerably decreased due to lack of food but recruitment of the population is out of control and its impact continues at maximum level.

Pacific mullet *Mugil so-iuy* is one of the new introduced species in the eastern Black Sea. It was intentionally carried to the cages in the Azov Sea for aquaculture. However, it was accidentally released to the sea and has well adapted to the Black Sea since 1980. Recently it reached to the Mediterranean. It prefers the southeastern Black Sea coasts especially in the reproduction season starting in May and June. During spawning migration, it is harvested by gill nets all over the Black Sea coasts. Size of this fish is bigger than the local mullet species.

There were 5 endemic mullet species before its introduction. At present, all the native species almost disappeared due to high food competition. Fishermen also were obliged to change their gill nets to catch bigger sized Pacific mullet.

## RECOMMENDATIONS

Research studies on the impacts of alien species to the ecosystem and fisheries economy are very limited in the Black Sea. In order to support the ecosystem recovery in spite of all types of negative impacts for the sustainable management of the natural resources, it is very essential to understand, analyze and take urgent management measures regarding all aspects of the ecosystem. New research studies in the Black Sea should be focused on prey-predator relationships, reproduction and growth rates of invasive species, relationship between their distribution and environmental factors, assessment of limiting factors, natural barriers and mechanisms, etc.

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