INVASIVE SPECIES IN THE CONTEXT OF CLIMATE CHANGE: THE CASE OF *MAGALLANA GIGAS* (THUNBERG, 1793) IN THE BLACK SEA

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Abstract. The current climate changes are having a significant impact on species distribution. While some species are affected, others are thriving in these new conditions, expanding their range. This is also the case of some invasive species who seem to benefit from these changes. The invasive Pacific oyster *Magallana gigas* is among these species. The current situation of the Pacific oyster in the Black Sea is discussed, with new data from the Romanian waters.

Introduction

The constant global warming trend has a great impact on the distribution of species worldwide. Some native species spread their areal, while others are greatly affected and are faced with extinction. The warming climate is also a favourable factor in the dispersal and acclimatization of some invasive species to new habitats [4, 10].

Not many species can acclimate to the Black Sea conditions, but there are some species with a wide tolerance to salinity, temperature and pH that have been successful in these conditions. Among these species, the ones with the biggest impact on Black Sea ecosystems were the invertebrates *Mnemyopsis leidyi*, *Rapana venosa*, *Mya arenaria*, *Anadara kagoshimensis* etc. These species have managed to drastically impact the ecosystems on different levels: the ctenophore *M. leidyi* has seriously affected the zooplankton stock which led to the collapse of the planktivorous fish [11]; the veined rapana whelk *R. venosa* is the one responsible for the disappearance of the native flat oyster *Ostrea edulis* [6]; the softshell clam *M. arenaria* has produced major changes in the benthic ecosystem by replacing the native dominant species *Lentidium mediterraneum* [5].

The most recent invasive species settled in the Black Sea is represented by the Pacific oyster *Magallana gigas* (Thunberg, 1793). Here we present the past several years status of an established population discovered in the Romanian Black Sea.

Materials and methods

A small wild population of *M. gigas* was discovered in 2017, in Agigea harbor, near Constanța [8]. The population was assessed at least once a year since its discovery, during diving sessions. Individuals were measured and surface of the colony assessed using the same methods described in previous studies [8].

Results and discussion

The *M. gigas* colony found in the Romanian Black Sea is most likely the result of the off-shore attempts of acclimating the species to the Black Sea conditions for farming purposes. Since its discovery in 2017, there was no evident growth of the colony, but it has remained stable with living individuals growing. The largest specimen found in 2017 was of 18.6 cm in length, which suggested that the probable age of the colony was of about 5 years. Until now, no evidence of reproduction was observed in the colony. This year, however, small individuals of less than 5 cm in length were observed. This indicates that the colony is reproducing and, considering the growing rate of 4–5 cm in the first year, this shows that they are about one year old [3].

Figure 1. Small *M. gigas* individuals, of less than 5 cm in length, found in 2021 attached to other shells in Agigea colony (scale in cm)

In the context of the global climate change with higher average temperatures, *M. gigas* has fairly good chances of reproducing and forming stable colonies in the Black Sea. A recent study has also demonstrated that the range expansion of the Pacific oyster is driven by climate warming, predicting its presence all along the Northwest European Shelf [7]. Isolated individuals have been constantly found in the Black Sea even since 1989, and in the last 10 years, wild small populations have started to be found along the eastern, northern and western coasts of the Black Sea [9]. The species seems to follow the same trend in the Bulgarian Black Sea, where more and more specimens are beginning to be found, including small viable colonies of up to 20 individuals [9]. Recently, quite dense young colonies of *M. gigas* were discovered in the southern Black Sea, along the Turkish coast [1].

The status of *M. gigas* in the Black Sea is not yet clear, as it could fill in an ecosystem niche left empty by the disappearance of the native flat oyster *Ostrea edulis* or it could affect the present ecosystems in other positive or negative ways. At the moment, according to the framework proposed [2], *M. gigas* in the Black Sea falls into the C3 category with individuals surviving in locations where introduced with reproduction occurring, and some wild self-sustaining populations. Considering the current climate trends and the high reproductive potential and plasticity

of the species, *M. gigas* could easily start establishing secondary colonies in the future and transition to a fully invasive species. The possible impact of the Pacific oyster, with its highly adaptive potential, on the Black Sea ecosystems depends greatly on different complex factors and it is still unknown so far.

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