

**THE DISTRIBUTION OF THE ALIEN SPECIES
PENAEUS AZTECUS IVES, 1891 (DECAPODA, PENAEIDAE)
IN THE MEDITERRANEAN SEA**

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ABSTRACT

The present paper is based on the literature review and the recent information about the distribution range of the alien brown shrimp *Penaeus aztecus* Ives, 1891 in the Mediterranean Sea. This alien species has spread throughout the Mediterranean Sea (especially the eastern part) mainly through ship/ballast water introductions and has presently been reported by eight countries (27 localities). Introduction pathways and chronological distribution patterns of the alien brown shrimp species are discussed. *Penaeus aztecus* forms dense populations along the coast of the Turkish Mediterranean Sea, and it has a potential for colonising the native habitats of autochthonous species.

ZUSAMMENFASSUNG: Die Verbreitung der fremdländischen Art *Penaeus aztecus* Ives, 1891 (Decapoda, Penaidae) im Mittelmeer.

Vorliegende Arbeit stützt sich auf eine Erfassung der Fachliteratur und auf rezente Informationen betreffend die im Mittelmeer eingebürgerte Art *Penaeus aztecus* Ives, 1891. Diese adventive Art hat sich im gesamten Mittelmeer, vor allem in dessen östlichem Teil vorwiegend durch Ballastwasser der Schiffe ausgebreitet und wurde bereits aus acht Ländern insgesamt an 27 Orten gemeldet. Ebenso wurden die Verbreitungswege und das chronologische Verbreitungsmodell der Art dargestellt. *Penaeus aztecus* bildet dichte Populationen entlang der türkischen Mittelmeerküste und hat unter den invasiven Garnelenarten das Potential die Lebensräume der einheimischen Arten zu besiedeln.

REZUMAT: Distribuția speciei străine *Penaeus aztecus* Ives, 1891 (Decapoda, Penaidae) în Marea Mediterană.

Prezenta lucrare se bazează pe o trecere în revistă a literaturii și pe informații recente referitoare la distribuția speciei adventive *Penaeus aztecus* Ives, 1891 din Marea Mediterană. Această specie adventivă s-a răspândit în întreaga Mediterană (în special în partea estică) în principal introdusă prin apa de balast a navelor și a fost semnalată în opt țări (27 de localități). Am prezentat de asemenea, căile de introducere și modelul cronologic de distribuție al acestei specii. *Penaeus aztecus* formează populații dense de-a lungul coastei Turcie a Mării Mediterane. Între speciile invazive de creveți, *Penaeus aztecus* are potențial de colonizare a habitatelor native ale speciilor autohtone.

INTRODUCTION

The alien species invasions are one of the most important conservation issues around the world (Welcomme, 1988; Lodge et al., 1998; Strahm and Rietbergen, 2001; Lansdown et al., 2016; Anastasiu et al., 2017; *, GISD). Biological invasions of alien species constitute a significant environmental problem and one aspect of global change in the marine environment (Özcan et al., 2010; Katsanevakis et al., 2014; Galil et al., 2018). According to Galil et al. (2018) 726 alien marine species were listed in the Mediterranean Sea. An average of 10 alien species per year has penetrated in this sea (Galil, 2009).

The Mediterranean Sea is affected by invasive marine species by means of the Suez Canal. Most of pathways for the introduction of exotic species are via hull fouling and/or ballast water from ships (Özcan et al., 2010).

The brown shrimp *Penaeus aztecus* Ives, 1891 is commonly distributed throughout the north-western Atlantic Ocean (from Massachusetts to the Gulf of Mexico and the north-western Yucatán) (Perez Farfante, 1969; Tavares, 2002).

The species was first recorded from the Antalya Bay, Levantine Sea coast of Turkey and it was hypothesized its introduction to the eastern Mediterranean Sea was due to ballast water (Deval et al., 2010). Then, it has been reported from the coast of Egypt (Sadek et al., 2018), Greece (Nikolopoulou et al., 2013), Montenegro (Marković et al., 2014), Italy (Cruscanti et al., 2015; Zava et al., 2018), Israel and France (Galil et al., 2017). *Penaeus aztecus* has also been reported from different localities of the Mediterranean Sea (Gökoğlu and Özvarol, 2013; Kapisir and Apostolidis, 2014; Zenetos and Giavasi, 2015; Minos et al., 2015; Bakır and Aydın, 2016; Kapisir and Minos, 2017; Kampouris et al., 2018; Zava et al., 2018). The economic importance of the zoogeographical distribution of this species in the Mediterranean Sea and its distribution in the İskenderun and Mersin Bays where areas of important shrimp fisheries are present.

MATERIAL AND METHODS

According to the existing literature (Web of Sciences, Google Scholar, Researchgate etc.) the zoogeographic distribution and expansion of *Penaeus aztecus* was attempting to be presented. In Turkey, the samplings were carried out in İskenderun and Mersin Bays between December 2010 and March 2017. The specimens of *Penaeus aztecus* were captured by means of trawl hauls on the sandy muddy seabed at depths of 20-35 m (Fig. 1). The specimens were identified using the keys in Perez Farfante (1969, 1988) and Tavares (2002). The specimens were preserved in 4% formalin and deposited at the Faculty of Marine Sciences and Technology of the Iskenderun Technical University, Turkey (collection of Dr. T. Özcan).

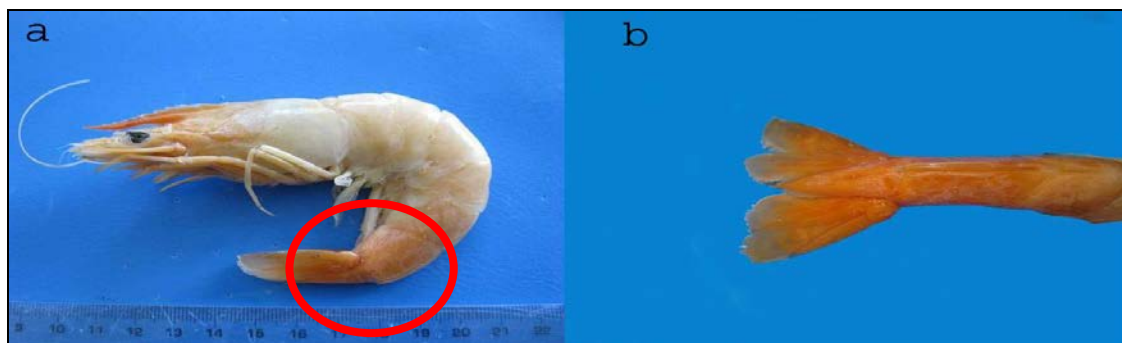


Figure 1: *Penaeus aztecus* a: Lateral view, ♀ mm;
b: Dorsal view of sixth abdominal somite, telson and uropods.

RESULTS AND DISCUSSION

Recently, *Penaeus aztecus* has been one of the species that has rapidly entered in the Mediterranean Sea (Zava et al., 2018). The distribution area of this species in this sea has expanded. Previous local records of *Penaeus aztecus* on the Turkish Mediterranean coast were given from the Bays of Antalya, Mersin, and İskenderun (west side: Yumurtalık Bight) (Gökoğlu and Özvarol, 2013). *Penaeus aztecus* is denser in the Yumurtalık-Karataş region within the Iskenderun Bay and it is predicted to be evaluated economically in terms of its population size. After one year, the species first reported in Turkey has expanded to the Finike coast and the Iskenderun Bay increasing its expansion area by approximately 500 km (Gökoğlu and Özvarol, 2013). *Penaeus aztecus* was reported on the shores of Damietta Egypt (Sadek et al., 2018) and Thermaikos Gulf, Greece (Nikolopoulou et al., 2013) after one year due to introduction by ship ballast waters. The expansion between 2013 and 2018 are as follows; Boka Kotorska Bay, Adriatic Sea, Montenegro (Marković et al., 2014), Corfu Island, Ionian Sea, Greece (Kapiris and Apostolidis, 2014), Thermaikos Gulf (Kevrekidis, 2014) and Nestos estuaries, Aegean Sea, Yunanistan (Minos et al., 2015), Castiglione della Pescaia, Tyrrhenian Italy (Cruscanti et al., 2015), Kyllini (Zenetos and Giavasi, 2015) and Chalki Island, Greece (Kondylatos and Corsini-Foka, 2015), Gulf of Lion (France), Israeli coast (Galil et al., 2017), Sicily between Porto Empedocle and Mazara del Vallo, Italy (Scannella et al., 2017); Vivari Lagoon, Argolikos Gulf-Greece, Aegean Sea (Kapiris and Minos, 2017); Çandarlı and Ildır Bay, Aegean Sea, Turkey (Bakır and Aydın, 2016); Chieti, Ortona, Mola di Bari and Termoli, Adriatic Sea (Zava et al., 2018) and Vlora Bay-Albania, Adriatic Sea and Marzamemi, Ionian coast of Sicily (Kampouris et al., 2018) (Fig. 2 and Tab. 1).

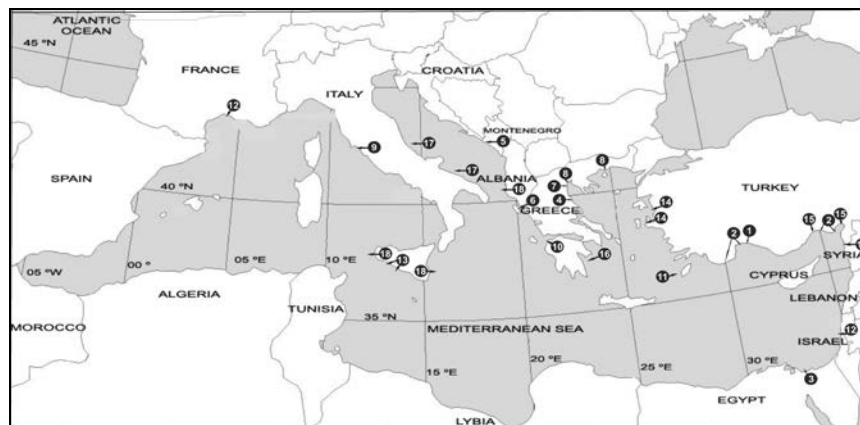


Figure 2: Current map showing distribution locations of records of *Penaeus aztecus* in the Mediterranean Sea, in chronological order: 1: (Deval et al. 2010); 2: (Gökoğlu and Özvarol 2013); 3: (Sadek et al. 2017); 4: (Nikolopoulou et al. 2013); 5: (Marković et al. 2013); 6: (Kapiris and Apostolidis, 2014); 7: (Kevrekidis 2014); 8: (Minos et al. 2015); 9: (Cruscanti et al. 2015); 10: (Zenetos and Giavasi, 2015); 11: (Kondylatos and Corsini-Foka, 2015); 12: (Galil et al., 2016); 13: (Scannella et al., 2017); 14: (Bakır and Aydın, 2016); 15: (Present study); 16: (Kapiris and Minos, 2017); 17: (Zava et al., 2018); 18: (Kampouris et al., 2018). For details see table 1.

According to Deval et al. (2010), *Penaeus aztecus* was captured with native and lessepsian species in the İskenderun and Mersin Bay. After *Penaeus aztecus* was reported for the first time in Antalya Bay, in eight years, its distribution in the Mediterranean was expanded.

Table 1: Chronological distribution of *Penaeus aztecus* found in the Mediterranean Sea.

No.	Authors	Region	Date reported
1.	Deval et al., 2010	Antalya, Turkey	24 December 2009
2.	Gökoğlu and Ozvarol, 2013	Finike, İskenderun Bay, Turkey	June 2011
3.	Sadek et al., 2018	Damietta, Egypt	2012
4.	Nikolopoulou et al., 2013	Thermaikos Gulf, Greece	2012
5.	Marković et al., 2014	Boka Kotorska Bay, Montenegro	19 September 2013
6.	Kapiris and Apostolidis, 2014	Corfu Island, Greece	November 2013
7.	Kevrekidis, 2014	Thermaikos Gulf, Greece	22 November 2013
8.	Minos et al., 2015	Thermaikos Gulf and Nestos estuaries, Greece	November 2013 to March 2014
9.	Cruscanti et al., 2015	Castiglione della Pescaia, Italy	6th August 2014
10.	Zenetos and Giavasi, 2015	Kyllini, Greece	October 2014
11.	Kondylatos and Corsini- Foka, 2015	Chalki Island, Greece	1st November 2014
12.	Galil et al., 2017	Le Grau du Roi, Gulf of Lion, France and Israel	30 April 2015
13.	Scannella et al., 2017	Sicily between Porto Empedocle and Mazara del Vallo, Italy	3rd November 2015
14.	Bakır and Aydın, 2016	Çandarlı Bay and Ildır Bay, Turkey	December 2015 to February 2016
15.	Present study	Mersin Bay, İskenderun Bay, Turkey	December 2010 to March 2017
16.	Kapiris and Minos, 2017	Vivari Lagoon, Argolikos Gulf-Greece, Aegean Sea	–
17.	Zava et al., 2018	Chieti, Ortona, Mola di Bari, Adriatic Sea Termoli, Adriatic Sea	2015, December 2016, November 2017
18.	Kampouris et al., 2018	Vlora Bay-Albania, Adriatic Sea; Marzamemi, Ionian coast of Sicily; Mazara del Vallo to Pozzallo	21 May and 2nd June 2018 24 March 2018

CONCLUSIONS

Recent studies reported that *Penaeus aztecus* which extends the distribution area in the Mediterranean, may have a potential negative effect on the native species of the Mediterranean such as *Penaeus kerathurus* (Kevrekidis, 2014). Consequently, it is likely that the existing shrimp species will start to compete with other shrimp species in the Mediterranean Sea. It is known, *Penaeus aztecus* prefers the coastal areas so many bays and estuaries in the Mediterranean ecosystem are suitable habitats for this species. *Penaeus aztecus* competes with many native and exotic species in the eastern Mediterranean (Kevrekidis, 2014).

The eastern Mediterranean Sea (particularly Iskenderun Bay) is affected by invasion of exotic shrimps via Suez Canal and hull fouling and/or ballast water from ships. Due to that, most of scientific surveys should be performed in Iskenderun Bay to have a detailed understanding about the impact exotics have on native species or competition between native and exotic species. Yet, we need to carry out the surveys in areas economically affecting shrimp fisheries in the Iskenderun Bay and Mediterranean Sea.

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