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First and additional records of alien crustacean decapods in the Aegean Sea, Turkey

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Abstract: The present paper includes report of the three alien decapod crustaceans collected from surveys performed on Gökova Bay, Turkey, southern Aegean Sea. Two of which, alien penaeid shrimps, *Farfantepenaeus aztecus* and *Trachysalambria curvirostris*, are here reported for the first time while a xanthid species, *Atergatis roseus*, is reported for the second time from the Turkish coast of the Aegean Sea. The findings show that their distributions are expanding northwards, along the Anatolian coasts of the Aegean Sea, approaching the colonization of the whole south basin.

Résumé : *Nouveaux signalements de crustacés décapodes exotiques en Mer Egée, Turquie*. Le présent document présente le rapport de trois crustacés décapodes exotiques récoltés au cours de prélèvements réalisés dans la Baie Gökova, Turquie au sud-est de la Mer Egée. Deux d'entre eux, des crevettes pénéides exotiques, *Farfantepenaeus aztecus* and *Trachysalambria curvirostris,* sont ici signalées pour la première fois alors qu'une espèce de xanthidé, *Altergatis roseus*, est signalée pour la seconde fois sur la côte turque de la Mer Egée. Les résultats montrent que leurs distributions sont en expansion vers le nord, le long des côtes anatoliennes de la Mer Egée, indiquant la colonisation de l'ensemble du bassin sud.

Keywords: Gibraltar Strait ● Suez Canal ● Alien species ● Decapod Crustaceans ● Turkey

Introduction

The Mediterranean Sea and adjacent seas are considered to be the main hotspots of marine bioinvasion due to increasing rates of tropical and/or sub-tropical origin marine organisms (Rilov & Galil, 2009; Edelist et al., 2012; Zenetos et al., 2012). The rate of influx of alien species into the Mediterranean is directly linked to several vectors: Atlantic influx, lessepsian migration, introductions by humans, water circulation patterns and present-day sea warming (Bianchi, 2007).

The general dispersal direction of alien species in the Mediterranean previously suggested that they are dispersed northwards by using the inner shelf and wave-induced currents, and then spread westwards by the way of the Asia Minor Current (AMC) that runs along the southern Turkish coast (Yokes & Galil, 2006); furthermore, the SST gradient

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of whole Aegean sub-basin is significantly controlled by water exchange between cold/fresh Black Sea water entering through the Dardanelles Strait and warm/saline Levantine basin water entering through the Cretan Arc Straits (Poulain et al., 2012). However, a change in the source of the Eastern Mediterranean Deep Water, caused by an increase in the average SST of the Mediterranean, has been increased inflow of Levantine waters into the southeastern Aegean through the Cretan Arc Straits in the past decade, thereby it has provided favourable conditions for invasion of alien crustaceans, whether Atlantic and/or Erythrean origin (Yokes & Galil, 2006)

To date, the marine arthropods on the Turkish coasts currently consists of 1531 species, including 7 classes: Malacostraca (766 species), Maxillopoda (437 species), Ostracoda (263 species), Pycnogonida (27 species), Arachnida (26 species), Branchiopoda (7 species), and Insecta (5 species); 75 of these species have been reported as alien species for Turkish coasts (Bakır et al., 2014).

Recent surveys between 2014 and 2015 along the Gökova Bay have revealed the presence of *Farfantepenaeus aztecus* (Ives, 1891), *Trachysalambria curvirostris* (Stimpson, 1860) and *Atergatis roseus* (Rüppell, 1830) in the South Aegean Sea. This study presents the first records of Erythraean and Atlantic alien penaeid shrimps and additional record of Erythraean alien crab for the Aegean coasts of Turkey.

Materials and Methods

Farfantepenaeus aztecus

On 28 August 2014, a female specimen was caught by gillnet, which had a 22 mm mesh size, at a depth of 25-30 m on a sandy-mud bottom in Gökova Bay (37°01.946'N-28°16.652'E). The specimen was identified and described following the instructions of Pérez Farfante & Kensley (1997) and Tavares (2002).

The specimen was preserved in the 4% formaldehyde solution and deposited in Muğla Sıtkı Koçman University Faculty of Fisheries Museum (MUSUM/CRU/2014-4).

Trachysalambria curvirostris

On 02 December 2014, a female specimen was caught by gillnet, which had a 22 mm mesh size, at a depth of 8-15 m on a sandy-mud bottom in Gökova Bay (37°02.212'N-28°17.033'E). The specimen was identified following the instructions of Galil et al. (2002).

The specimen was preserved in the 4% formaldehyde solution and deposited in Muğla Sıtkı Koçman University Faculty of Fisheries Museum (MUSUM/CRU/2014-1).

Atergatis roseus

On 14 August 2014, a female specimen was caught by gillnet, which had a 22 mm mesh size, at a depth of 18-25 m on a sandy-mud bottom in Gökova Bay (37°02.053'N-28°16.127'E). The specimen was identified following the instructions of Galil et al. (2002) and Corsini-Foka & Pancucci-Papadopoulou (2010). The specimen was preserved in the 4% formaldehyde solution and deposited in Muğla Sıtkı Koçman University Faculty of Fisheries Museum (MUSUM/CRU/2014-5).

Results

Class Malacostraca Latreille, 1802
Suborder Dendrobranchiata Spence Bate, 1888
Family Penaeidae Rafinesque, 1815
Genus Farfantepenaeus Burukovsky, 1997
Farfantepenaeus aztecus (Ives, 1891)
(Fig. 1)

Diagnostic characteristics

Carapace smooth. Rostrum armed with nine teeth and one epigastric tooth on dorsal margin and 2 teeth on ventral, adrostral sulcus and carina long, extending almost to hind margin of carapace, sulcus long and wide posteriorly; postrostral carina well developed, gastrofrontal carina present. Antennae short, more than the body length. First three pairs of pereiopods terminate with a chela; first pereiopod with a spine on ischium and basis and second pereiopod with a spine only on basis; three short well-defined cicatrices on the sixth abdominal somite and one small on the fifth abdominal somite; dorsolateral sulcus on the sixth abdominal somite and telson unarmed.

Colour

Body brown, sometimes with an orange or yellowish tinge, occasionally reddish or greenish; pereiopods and tail fan darker, uropods often with a purple edge. No dark lateral spot at junction of third and fourth abdominal segments.

Measurements (mm)

Total length 156, carapace length 36.98, rostrum length 19.62

Distribution

It was firstly reported from the eastern Mediterranean Sea, Turkey (Deval et al., 2010) and thereafter recorded from: Levant (Gökoğlu & Ozvarol, 2013), Adriatic (Marković et

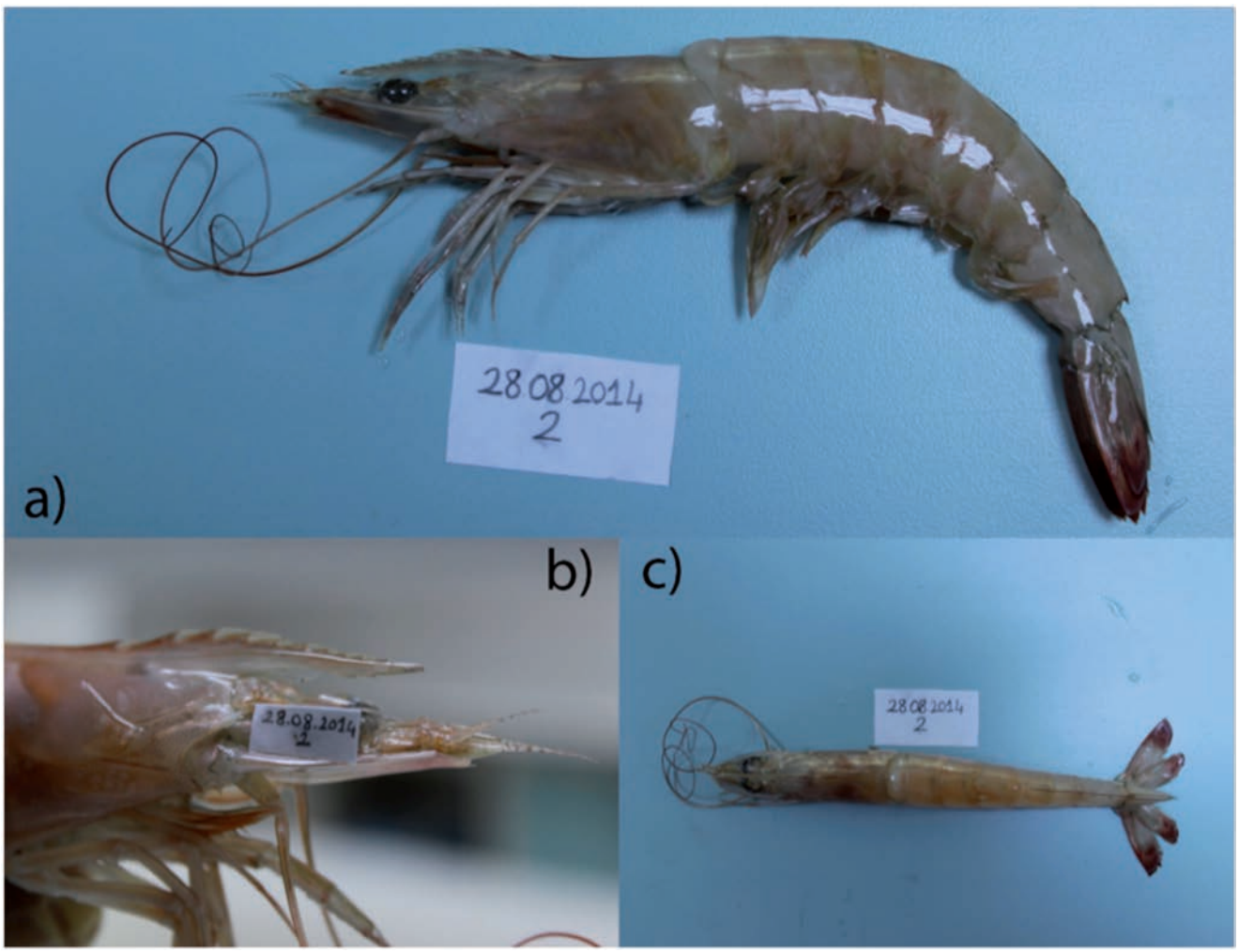

Figure 1. *Farfantepenaeus aztecus*. **A.** General view. **B.** Lateral view of armed rostrum. **C.** Dorsal view of whole body.

al., 2014), Thermaikos Gulf, Greece (Nikolopoulou et al., 2013; Minos et al., 2015), Ionian Sea (Kapiris & Apostolidis, 2014; Zenetos & Giavasi, 2015).

Class Malacostraca Latreille, 1802
Suborder Dendrobranchiata Spence Bate, 1888
Family Penaeidae Rafinesque, 1815
Genus *Trachysalambria* Burkenroad, 1934a
Trachysalambria curvirostris (Simpson, 1860)
(Fig. 2.)

Diagnostic characteristics

Entire body densely pubescent; rostrum armed with 8 dorsal teeth and no ventral teeth; hepatic groove discernible; telson armed with small movable lateral spines sub-equal in size; longitudinal suture short.

Colour

Body pink to reddish–brown, sometimes whitish on sides; abdominal crest whitish; pereiopods white with some pink; pleopods White with red or reddish–brown patches; uropods bright red to reddish–brown, sometimes dark brown with distinct white margins.

Measurements (mm)

Total length 83, carapace length 18.6, rostrum length 11.14.

Distribution

It was reported firstly as *Metapenaeus* sp. in Palestine (Steinitz, 1929) and thereafter recorded from: Mediterranean coasts of Turkey (Geldiay & Kocatas, 1968; Yokes & Galil, 2004); Egypt (Dowidar & Ramadan, 1976);

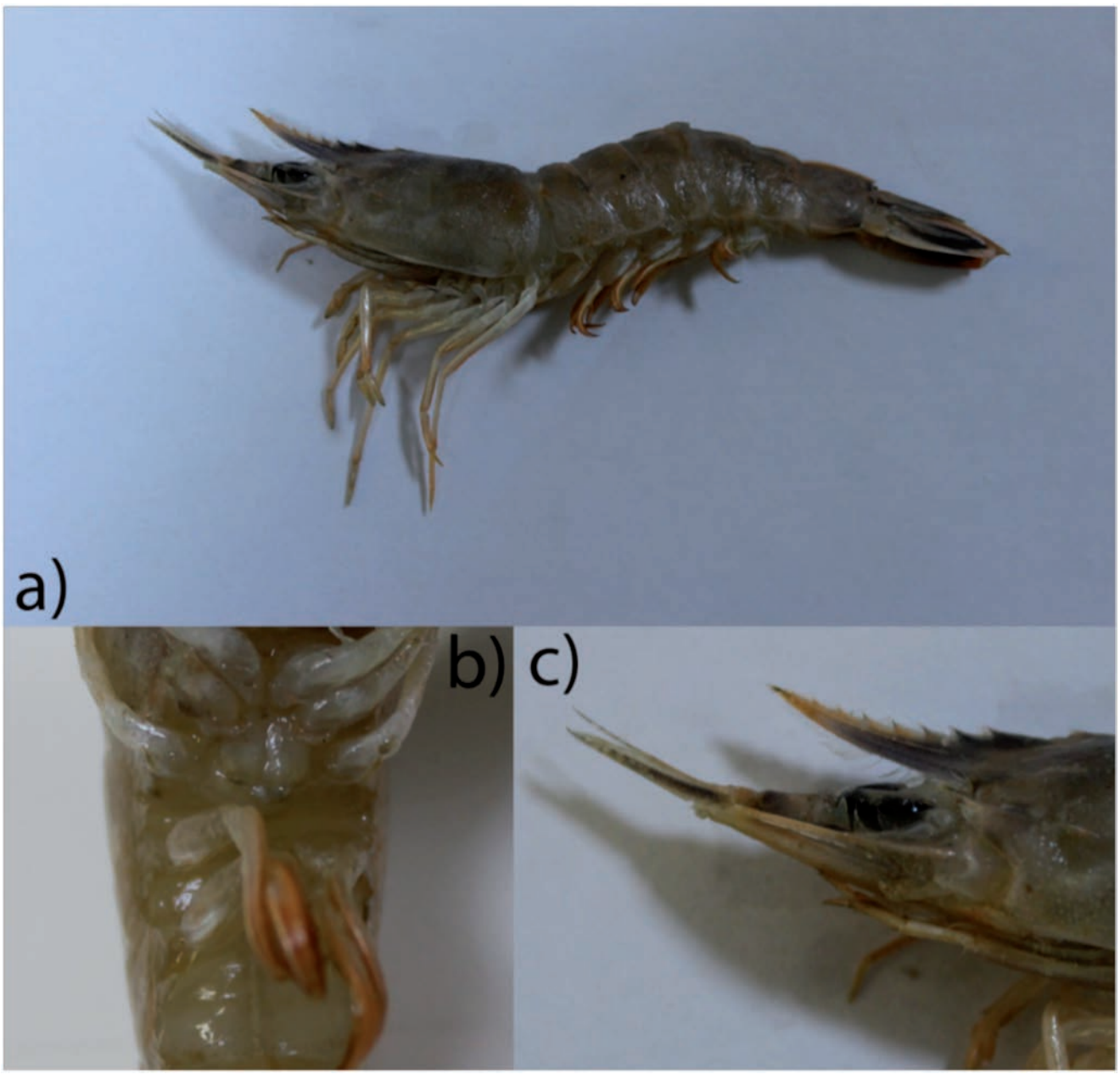

Figure 2. *Trachysalambria curvirostris.* **A.** General view. **B.** Thelycum. **C.** Lateral view of armed rostrum.

southern Tunisia (Zaouali, 1993); Syria (Saker & Farah, 1994, Hasan et al., 2008); Greece, Rhodes Island (Kevrekidis et al., 1998).

Class Malacostraca Latreille, 1802
Suborder Pleocyemata Burkenroad, 1963
Family Xanthidae MacLeay, 1838
Genus Atergatis De Haan, 1833
Atergatis roseus (Rüppell, 1830)
(Fig. 3)

Diagnostic characteristics

Carapace transversely suboval, convex, minutely punctate, regions undefined. Front narrow, deflexed, somewhat projecting. Antennulae folding transversely, inter-antennular septum broad. Orbital margin finely tri-sutured, eyestalk short, thickened. Antero-lateral margin prominently arched, bluntly carinate. Postero-lateral margin strongly convergent, straight. Underside of carapace concave laterally. Chelipeds subequal, superior margin of chela bluntly crested, fingers fluted. Walking legs dilate, distally crested.

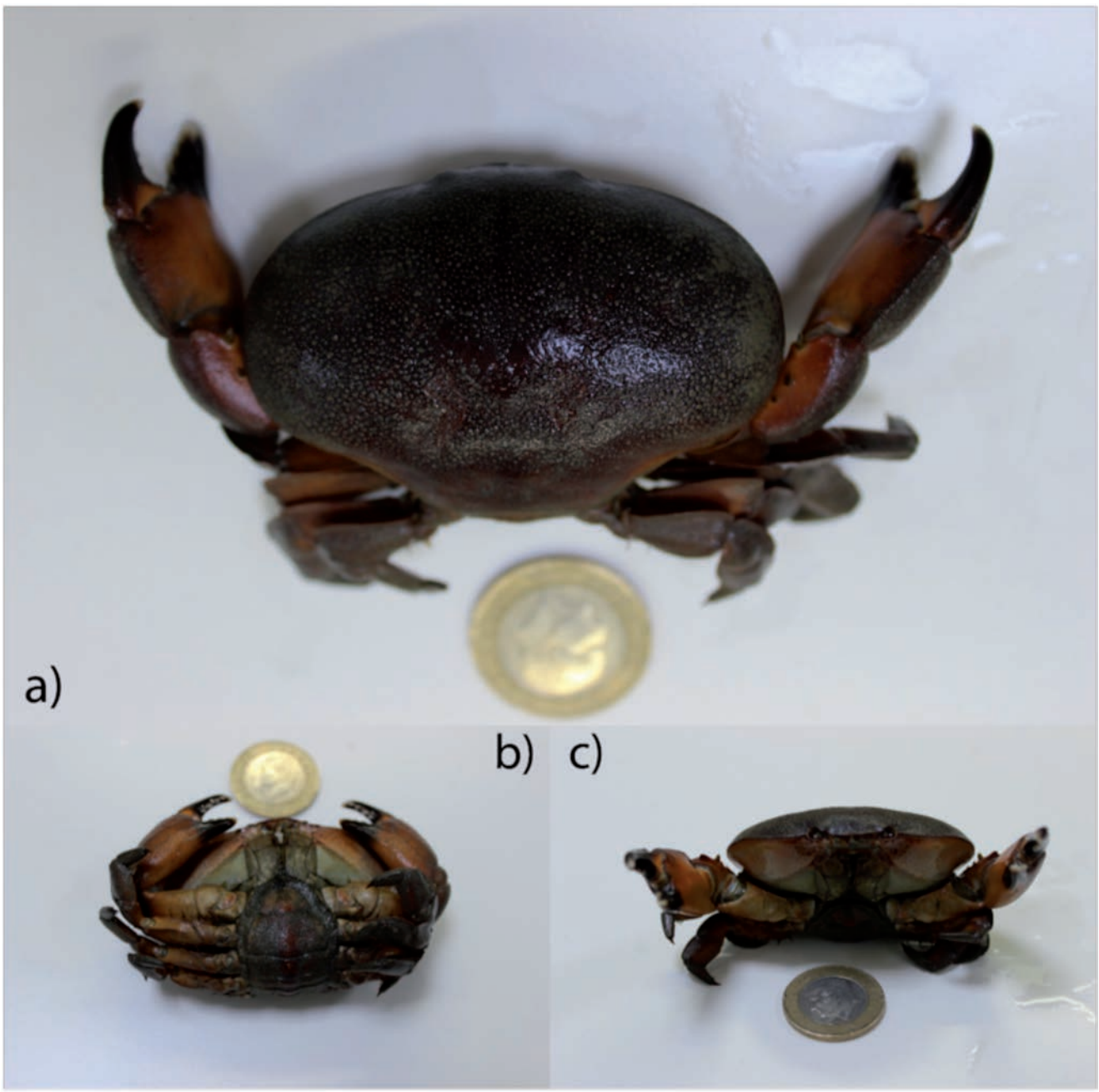

Figure 3. *Ategatis roseus.* **A.** Female specimen. **B.** Ventral view. **C.** Frontal view.

Colour

Carapace dark reddish-brown, cheliped fingers black. Carapace of young reddish orange rimmed with white.

Measurements (mm)

Carapace length 16.5, width 25.6, frontal border 6.7, orbit diameter 1.4, frontorbital width 9.6, posterior border 4.8, left chela length 11.2, height 6.3, right chela length 10.8, height 6.2. Chelipeds length (maximum opening) left 20.9, right 19.

Distribution

It was recorded firstly from Israel (Lewinsohn & Holthuis, 1964 [1961]) and thereafter reported from Lebanon (Shiber, 1981); Mediterranean coasts of Turkey (Enzenross et al., 1990; Özcan et al., 2005; Yokes & Galil, 2006; Karhan et al., 2013) and Syria (Saker & Farah, 1994; Hasan et al.,

2008), Greece, Rhodes Island (Corsini-Foka & Pancucci-Papadopoulou, 2010).

Discussion

The Gibraltar Strait and Suez Canal, which are formed in natural and artificial respectively, have contributed to Mediterranean biodiversity by the introduction of Atlantic/Erythrean fauna and flora (Coll et al., 2010; Lasram et al., 2010). However, these phenomenons, called as Atlantic and Lessepsian influx, associated with anthropogenic actions have changed drastically biota of Mediterranean in the last century (Bianchi & Morri, 2003).

Marine and estuarine crustaceans have invaded mostly by way of seven categories of human-mediated vectors/corridors. They are vessels(shipping), other maritime activities, the movement of living organisms, contaminated maritime equipment and footwear, and marsh restoration, floating marine debris and canals. Although shipping and canals mostly enable all crustacean taxa to invade, decapods come to the forefront among these because they could spread via all vectors/corridors. Apart from human-mediated vectors/corridors, the range expansion of certain zoobenthic species, as such in fishes, mainly depends upon several vectors (e.g. global warming, temperature regime, substrate, currents, structure of the continental shelf, thermal tolerance of the colonizing species, food availability, competition with indigenous species, resistance to local pathogens, and extension of the spawning season) (Mavruk & Avsar, 2007; Yapici et al., 2015).

As a known fact, biological invasions are defined as synergistic processes which are influenced by the characteristics of the invader species and by the effects of the transport vector and the conditions of recipient environment. In the marine environments, a successful invader is characterized by primary features: fast growth, longevity, high fecundity, planktonic dispersal, adaptability to live a wide range of enviromental conditions and different habitats, broad food preferences and a large size (Brockerhoff & McLay, 2011). Based on recent literature, these specimens, which are common throughout the Levant have not yet established population in the southeastern Aegean, probably due to the difficulties in overcoming one or more of the aforementioned biotic/abiotic factors. It may indicate that distribution of *F. aztecus* and *T. curvirostris* is not documented in the Aegean Sea of Turkey. However, it should not be forgotten that repetitive anthropogenic effects, such as intense maritime traffic, offer repeatedly opportunities for establishment (propagule pressure).

F. aztecus and *T. curvirostris* are not considered as target species for small-scale fisheries in the SE Aegean Sea of Turkey because their abundance is not adequate for the moment at least. On the other hand, there are commercial shrimp species (e.g. Genus: Melicertus, Penaeus) morphologically similar to *F. aztecus* and *T. curvirostris*; accordingly, their introduction and distribution could be overlooked. Therefore, species identification should be more carefully and sensitively and also contact meeting about alien species with local fisherman is required for monitoring of introduction and distribution alien decapod crustaceans.

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