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First record of the isopod *Idotea hectica* (Pallas, 1772) (Idoteidae) and of the brachyuran crab *Matuta victor* (Fabricius, 1781) (Matutidae) in the Hellenic waters

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Abstract

The presence and the establishment of *Idotea hectica* is reported for the first time in the Hellenic seas on the basis of three adult specimens and a juvenile collected from *Posidonia oceanica* meadows close to the main town of Rhodes Island, Aegean Sea. Common and contrasting characters between this and other species of the genera *Idotea* and *Pentidotea* are briefly discussed. Furthermore, following a westward expansion along the eastern Mediterranean coasts, *Matuta victor* was discovered for the first time in Hellenic waters on the basis of a single specimen from the northeast of Rhodes Island.

Keywords: Isopoda; Idoteidae; *Synischia*; *Idotea*; *Pentidotea*; Brachyura; *Matuta victor*; *Posidonia oceanica*; non-indigenous species; Mediterranean Sea.

Introduction

Isopoda in the Mediterranean Sea account for more than 165 species (Coll *et al*., 2010; Castelló, 2017) of which nine species are considered as non-indigenous (Zenetos *et al*., 2010; Marchini *et al*., 2014). At least 74 isopod species occur in the Hellenic Aegean waters (Chintiroglou *et al*., 2005; Zenetos *et al*., 2005) and, up to date, five non-indigenous isopods are known (Zenetos *et al*., 2018).

Among the Idoteidae reported from the Mediterranean, the genus *Idotea* is represented by at least seven species, *I. chelipes* (Pallas, 1766)*, I. linearis* (Linnaeus, 1766), *I. balthica* (Pallas, 1772)*, I. hectica* (Pallas, 1772), *I. emarginata* (Fabricius, 1793), *I. metallica* (Bosc, 1802), and *I. granulosa* (Rathke, 1843) (Argano & Campanaro, 2010; Bedini *et al*., 2014; Leal Natal, 2015). The Atlanto-Mediterranean species *I. hectica* was transferred to the genus *Synischia* (Hale, 1924) by Poore and Ton (1993) and moved again to *Idotea* by Charfi-Cheikhrouha (2000). However, the phylogenetic analysis performed by Leal Natal (2015) "support the removal of *hectica* from the genus *Idotea*, but doubt remains on whether the placement into the genus *Synischia* was correctly made". Although, according to Boyko *et al*. (2008 onwards), the accepted name for this species is *Synischia hectica* (Pallas, 1772), in the present work it is referred as *I. hectica* (Pallas, 1772). Currently, in Mediterranean basin, the genus *Pentidotea* lists only one species, *Pentidotea panousei* (Daguerre de Hureaux, 1968) (Daguerre de Hureaux, 1968), also known in the eastern Atlantic, while all other ten species of *Pentidotea* occur in the Pacific Ocean (Leal Natal, 2015; Boyko *et al*., 2008 onwards).

The purpose of this work was to report the first record for the Hellenic waters of the isopod *Idotea hectica*, emphasising some characters that may lead to misidentification with other isopods belonging to Idoteidae.

Furthermore, the occurrence of the non-indigenous crab of Indo-Pacific/Red Sea origin *Matuta victor* (Fabricius, 1781) is documented for the first time in the Hellenic seas. This record adds a new non-indigenous crab to the 17 species already recorded in the Hellenic waters (see Zenetos *et al*., 2018), the majority of Indo-Pacific/Red Sea origin introduced into the Mediterranean via the Suez Canal. In Greece, most of these species have been recorded for the first time and are today established in the region around Rhodes Island.

Both the above species have been found in Rhodes, southeastern Aegean Sea, eastern Mediterranean, a marine region of great zoogeographical significance but still not well known and heavily affected by biological invasions (Corsini-Foka *et al*., 2015).

Fig. 1: The collection sites in Rhodes island (A: Kritika Bay, B: Zefyros Bay) for *Idotea hectica* (A, B) and *Matuta victor* (B).

Materials and Methods

During an experimental survey, four specimens of the isopod *Idotea hectica* were collected from meadows or debris of *Posidonia oceanica* (Linnaeus) Delile in the waters of Rhodes, with the use of a prototype epibenthic sledge, dredged with an 8 m hired vessel. The sledge employed a conical net with a mesh eye of 1 mm. All specimens are deposited at the Hydrobiological Station of Rhodes (HSR) collection, preserved in ethanol 70 %.

One ovigerous female (Catalogue number HSR 553) was collected during the night hours of the 18 June 2018 at Kritika, Ialysos Bay, northwest Rhodes from 36°25'46.86"N and 28°11'44.64"E to 36°25'56.40"N and 28°11'54.66"E (Fig. 1A). Two male adults and an unsexed juvenile (Catalogue numbers HSR 552-1/552-2/552-3) were collected during the night hours on the 21 June 2018 from 36°24'13.92"N and 28°14'15.12"E to 36°24'22.92"N and 28°14'08.64"E), off Zefyros Bay, northeast of Rhodes (Fig. 1B). Both locations are well-known fishing grounds for small-scale fisheries (trammel and gill nets, boat-seining). Within a depth range of 6-16 m, the substrate in the Ialysos Bay and off Zefyros Bay is characterized by patches of *P. oceanica* and sand, clear or covered by dead phanerogam leaves. Temperature and salinity were approximately 24 °C and 39.2 ‰, respectively.

The adults and juvenile specimens of *I. hectica* were identified based on the description of Charfi-Cheikhrouha (2000), while Stimpson (1857), Richardson (1905), Menzies & Waidzunas (1948), Naylor (1955), Brusca & Wallerstein (1977), and Stebbins (2012) were also consulted. The total body length of the isopod samples was measured from the middle of the frontal margin to the central point of the pleotelson distal margin and the body width was measured at the point of maximum width (sixth thoracic segment).

A single male specimen of *Matuta victor* (was collected during a snorkelling survey in the evening of the 3 July 2018 at Zefyros bay, northeast coast of Rhodes, close to the harbours of Rhodes city (36° 25' 47.33'' N, 28° 14' 12.71'' E) over a sandy bottom, at a depth of 1.5-2 m (Fig. 1B). Temperature and salinity were approximately 25°C and 39.2 ‰, respectively. The specimen, preserved in ethanol 70 %, is deposited at the Hydrobiological Station of Rhodes collection with the Catalogue number HSR 554.

The crab species was identified using the descriptions of Milne Edwards (1837), Galil & Clark (1994), and Ng & Huang (1997). The length of *M. victor* was taken from rostrum notch to posterior edge of carapace and the width with and without the lateral spines.

Diagnostic features were observed under a stereoscope and measurements were taken with a digital caliper on 70% alcohol preserved samples.

Results

The total length of the four *I. hectica* specimens ranged from 8.9 mm to 34.7 mm and the ratio between length and width ranged from 5.1 to 5.6 (Table 1).

Main morphological characters

Body of all specimens elongated with a medio-dorsal ridge extending from the cephalon to the pleon. Thorax

Table 1. Selected characters and measurements (mm) of *Idotea hectica* from Rhodes (MPp: maxillipedal palp, l: Left, r: Right, * 4th segment cut, ** a suture in 4th segment).

	HSR 553 ♀	HSR 552-1 ♂	HSR 552-2 ♂	HSR 552-3
Total Length	34.7	32.6	30.0	8.9
Width	6.5	6.0	5.9	1.6
Length of MPp (l-r)	1.5-1.4	1.4-1.3	1.3-1.3	0.5-0.5
Number of MPp segments (l-r)	4-4	4-4*	4*-4**	4-4

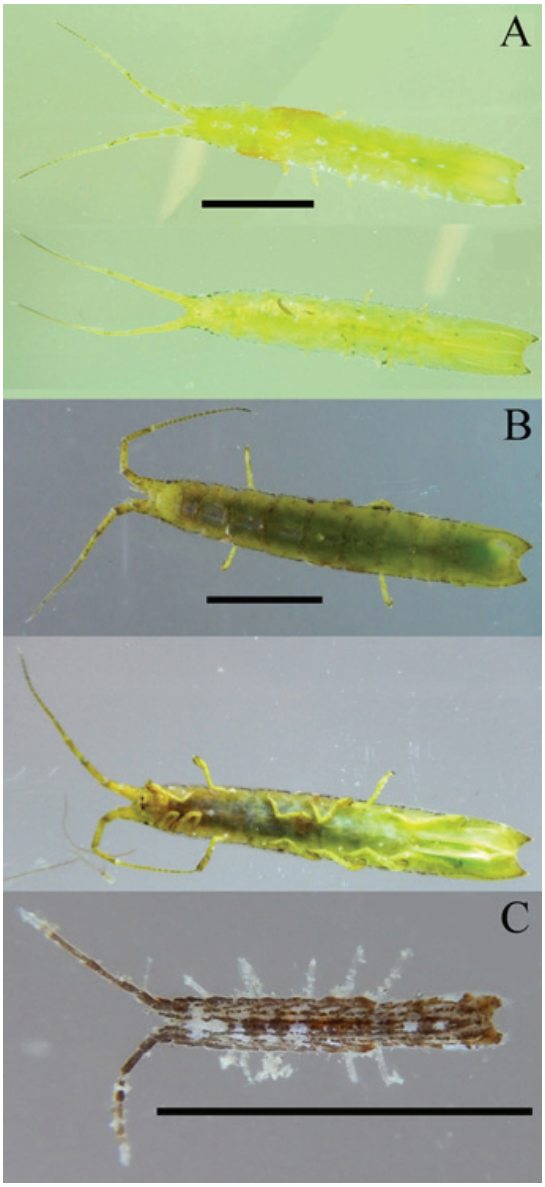

Fig. 2: Specimens of *Idotea hectica* from Rhodes: (A) Live ovigerous female (HSR 553), 34.7 mm total body length, dorsal and ventral view; (B) preserved male (HSR 552-1), 32.6 mm total body length, dorsal and ventral view; (C) live juvenile (HSR 552-3), 8.9 mm total body length, dorsal view. Scale bars 10 mm.

Fig. 3*:* Left maxillipeds (from above) of *Idotea hectica*: female HSR 553 (A), male HSR 552-2 (B).

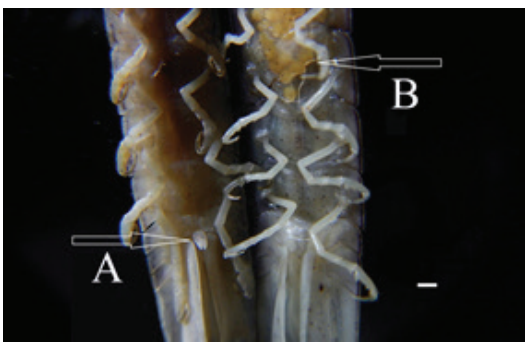

Fig. 4: *Idotea hectica* genital appendages in male (A) (HSR 552-1) and eggs in the marsupium of female HSR 553 (B). Scale bar 1 mm.

composed of seven pereonites with posterior margin concave or biconcave and sub-parallel lateral margins. Ratio between width and length of 2nd to 7th thorax segments ranged from 1.8 to 2.0 in the two males, from 1.7 to 2.0 in the juvenile and it was 1.9 in the female. Coxal plates not dorsally visible (Fig. 2A, B). Pereopods with setae on anterior margins of distal articles in all adult specimens**.** Pleon composed of two complete pleonites and one incomplete pleonite. Posterior margin of pleotelson strongly concave, with rather acute post-lateral angles, in particular in the adult specimens. Antennules composed of three articles. Antennae with a peduncle composed of five articles and a flagellum composed of 17 articles in the three adult specimens, at right and left, and 7 articles in juvenile specimen, at right and left (Fig. 2A, B, C). Maxilliped formed by an endite, with apical setation and a single coupling hook, and a palp composed of four articles (Fig. 3A, B); a suture-like line faintly present in the distal portion of 4th segment of right maxilliped palp of male HSR 552-2 (Table 1); inner margin of three distal articles of palp with setae. Epipodite inserted on outer coxopodite reaching the distal margin of the 3rd article of maxilliped palp. Length of maxilliped palp ranged from 0.5 mm to 1.5 mm (Table 1). Pleopods consist of five pairs of bilobed lamellar structures. Two lobes of pleopods 1 and 2 provided with longer setae distally, shorter along external border of outer lobe (exopodite). The 2nd pleopod of male bears a stylet (appendix masculinus) placed at proximal internal border of endopodite. Adult male 552-1 stylets extending well beyond tip of endopodite, whereas stylets of 552-2 extending up to tip of endopodite. Appendix masculinus rounded distally, terminating to a slightly pointed apex. Paired penes separated but contiguous at base, arising from first abdominal segment and projecting towards bases of pleopods (Fig. 4A). Marsupium of female almost full of eggs (approximate eggs diameter 0.3-0.5 mm) (Fig. 2A, 4B). Adult overall col-

Fig. 5: The male of Matuta victor (defrosted) from Rhodes, dorsal view (carapace length 28.6 mm). Scale bar 10 mm.

oration yellowish green to olive green, similar to that of *P. oceanica* (Fig. 2A, B), juvenile prevalently brownish with whitish stripes along body (Fig. 2C).

The carapace length of *M. victor* was 2.86 cm and the width with and without the lateral spines was 43.7 mm and 27.2 mm, respectively (Fig. 5).

Among the most striking characteristics of the species is the transversely serrate ridge on the dactylus of the palm, the arrangement of tubercles and spines on carpus and palm of chelipeds, and the yellowish overall coloration with scattered reddish to brown dots on the carapace which do not form continuous lines.

Discussion

Idotea hectica has been recorded, although as a rare occurrence, from the North Atlantic Ocean (Junoy & Castelló, 2003), Mediterranean Sea including Tunisia (Charfi-Cheikhrouha, 2000), Italy (Argano & Campanaro 2010), Spain (Junoy & Castelló, 2003), and Turkey from the Sea of Marmara to the northeastern Aegean Sea (Geldiay & Kocataş, 1972), often on *Posidonia oceanica*, the same habitat observed in the present work. The species has probably been overlooked for a long time in the Hellenic waters or it is extending its distribution to the southern waters of the eastern Mediterranean, since it was reported for the first time from the Levant coasts of Turkey in 2008 (as *Synischia hectica*, Kirkim *et al*., 2017).

One of the main features used to separate the genera *Pentidotea* and *Idotea* was the five-segmented palp of maxilliped in the first and the four-segmented palp in the second (Menzies & Waidzunas, 1948; Brusca & Wallerstein, 1977; Stebbins, 2012). In some of the Rhodes samples, the maxillipedal palps appeared five-segmented, due to a probably false suture we observed initially in their 4th segments. This feature, and also the evidently concave posterior margin of pleotelson, conduced us to confuse our specimens with the eelgrass isopod *Pentidotea resecata* (Stimpson, 1857) (cf. Menzies & Waidzunas, 1948: 112, Plate III; Stebbins, 2012), a species native to the western North American coasts from Alaska to the southern edge of Baja California and across to Mazatlan, Mexico (Richardson, 1905; Miller, 1968; Iverson, 1974; Brusca & Wallerstein, 1977). However, the number of articles of maxillipedal palp, as well as the number of segments of the flagellum of the second antennae and the shape of the posterior margin of the telson, change with growth and should not be considered basic distinguishing characters between *Idotea* and *Pentidotea* genera (Menzies & Waidzunas, 1948; Stebbins, 2012). Finally, our specimens' shape and morphological features agreed with those described for *I. hectica* by Charfi-Cheikhrouha (2000) and the initial identification of our samples as *P. resecata* was rejected on the base of other characters matching with *I. hectica* and also because the eastern Pacific native range of *P. resecata* and the absence of signs of its invasiveness constitute its introduction into the Mediterranean currently improbable.

As underlined by Charfi-Cheikhrouha (2000) and according also to Naylor (1955), *I. hectica* is distinguished from other *Idotea* species for the aspect of the body with sub-parallel lateral margins, the medio-dorsal ridge and for the coxal plates not dorsally visible. Two species of *Idotea* known in the Mediterranean show a concave posterior margin of pleotelson like specimens described in this work: *I. linearis* and *I. emarginata*. The first, *I. linearis*, presents a slender body, lateral margins of thorax segments not sub-parallel, small coxal plates never extending to posterior border of any segment, sides of pleotelson slightly concave anteriorly and its posterior border concave, armed with a small median spine in younger specimens (Naylor, 1955). *I. hectica* differs from *I. emarginata* mainly for its oblong oval body, body length less than five times the width, coxal plates visible dorsally (Naylor, 1955).

Further investigations including genetic analysis and comparisons between Atlantic and Mediterranean populations will help to clarify the today controversial systematic position of the isopod species under study, as assessed by Charfi-Cheikhrouha (2000) and Leal Natal (2015).

The brachyuran *Matuta victor* (Matutidae) is the only known species of the genus in the Mediterranean. In its natural range it shows an Indo-West Pacific distribution, occurring from the Gulf of Suez, Red Sea to Gulf of Oman, Arabian Sea, East Africa (Sudan, Somalia, Tanzania, Zanzibar, Mozambique, Madagascar, Mayotte and Reunion, South Africa), Pakistan, India, Southeast Asia (Thailand, Malaysia, Singapore, Indonesia, Philippines, Vietnam, Taiwan) China, Japan, Australia to New Caledonia, New Hebrides, Fiji, Wallis and Futuna Islands (Galil & Clark, 1994; Apel, 2001; Galil & Mendelson, 2013). In the Mediterranean it was first recorded from Haifa Bay, Israel in 2012 (Galil & Mendelson, 2013). Later it was reported from Lebanon at Batroun, in 2013 and Tyr and Saida, in 2014 (Crocetta *et al*., 2015), from the Mediterranean coasts of Turkey, at Phaselis, Gulf of Antalya, in 2015 (Gökoğlu *et al*., 2016), and from the southeastern Aegean waters of Turkey, at İztuzu Beach, Muğla, in 2017 (Ateş *et al*., 2017).

The identification of the moon crab may be puzzling

as the species can be easily misidentified for *Ashtoret lunaris* (Forskål, 1775) (Galil & Clark, 1994; Ateş *et al*., 2017). Its occurrence was expected in Greek waters (Karachle *et al*., 2017) and its record in Rhodes is not surprising, since the last finding comes from the area of Muğla (Turkey), close to Rhodes (Ateş *et al*., 2017). Apparently, since its initial discovery in Haifa Bay, Israel in 2012 (Galil & Mendelson, 2013), the species follows a north and westward expansion, on a "classic" route for aliens entering the Mediterranean Sea through the Suez Canal.

The crab *M. victor* is an omnivorous predator and a voracious scavenger, exhibiting intraspecific feeding competition and an aggressive behaviour (Innocenti *et al*., 2017). Its establishment success is further assisted by its reproductive plasticity and the production of numerous eggs. Could its presence in the Aegean Sea exert pressure on the already altered biodiversity?

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