

New records of alien decapods (Crustacea) from the Mediterranean coast of Turkey, with a description of a new palaemonid species

Baki YOKES

Department of Molecular Biology & Genetics, Bogazici University,
Kuzey Kampus, Etiler, Istanbul (Turkey)
bakiyokes@turk.net

Bella S. GALIL

National Institute of Oceanography,
Israel Oceanographic & Limnological Research,
P.O.B. 8030, Haifa 31080 (Israel)
bella@ocean.org.il

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ABSTRACT

The marine biota of the southwestern coast of Turkey was studied by diving between 1996 and 2003. Nine alien decapod crustaceans of Red Sea origin have been noted. Four constitute new records for Turkey, for three we report significant range extensions within Turkey, and a new species of the widely distributed Indo-Pacific palaemonid genus *Urocaridella* Borradaile, 1915, is described, while the genus is reported for the first time from the Mediterranean. The main morphological characters used for differentiating *Urocaridella pulchella* n. sp. are the number and disposition of the rostral spines, the carpal/palmar length ratios of the first and second pereopods, the propodal/dactylar length ratios of the last three pereopods, the presence and shape of a dorsal ridge on the third abdominal segment, and the shape of the fifth pleuron.

KEY WORDS

Crustacea,
Decapoda,
Palaemonidae,
Urocaridella,
Mediterranean,
Turkey,
alien species,
new species.

RÉSUMÉ

Nouvelles occurrences de décapodes lessepsiens (Crustacea) de la côte méditerranéenne de la Turquie et description d'une nouvelle espèce de Palaemonidae.

Le milieu marin de la côte sud-ouest de la Turquie a été étudié en plongée entre 1996 et 2003. Neuf espèces lessepsiennes de crustacés décapodes originaires de la mer Rouge ont été découvertes. Quatre constituent des nouvelles occurrences

MOTS CLÉS

Crustacea,
Decapoda,
Palaemonidae,
Urocaridella,
Méditerranée,
Turquie,
espèces lessepsiennes,
espèce nouvelle.

pour la Turquie. Pour trois, l'aire de répartition en Turquie est significativement étendue et une nouvelle espèce du genre de Palaemonidae *Urocaridella* Borradaile, 1915, largement répandu dans l'Indo-Pacifique, est décrite, alors que ce genre est mentionné pour la première fois en Méditerranée. Les principaux caractères morphologiques utilisés pour distinguer *Urocaridella pulchella* n. sp. sont le nombre et la disposition des épines rostrales, les rapports de longueurs carpe/paume des premiers et seconds péréopodes, les rapports de longueurs propode/dactyle des trois derniers péréopodes, la présence et la forme d'une ride dorsale sur le troisième segment abdominal et la forme du cinquième pleuron.

INTRODUCTION

Alien decapods that had invaded the Mediterranean through the Suez Canal have long been known from the southern coast of Turkey: a recent publication (Galil *et al.* 2002) reported the occurrence of 27 Indo-West Pacific and Red Sea decapods along the Turkish Mediterranean coast. The main vector spreading those aliens is the Asia Minor Current that runs along the Anatolian coastline carrying westwards warm, salty water from the Levantine Sea and passing northward through the eastern Cretan Arc Straits. In 1991 the source of the Eastern Mediterranean Deep Water shifted to the southern Aegean Sea (Theocharis *et al.* 1992), and the augmented outflow of the newly formed denser water has been compensated for by inflowing Levantine surface and intermediate water (Wu *et al.* 2000). The increased inflow of Levantine waters and their biota may have contributed to the sudden influx of alien crustaceans into the southeastern Aegean in the past decade (Galil & Kevrekidis 2002).

The marine biota off the southwestern coast of Turkey, at depths between 3 and 26 m, was studied by diving between 1996 and 2003 (Fig. 1). The specimens were photographed *in situ* and some were collected and subsequently deposited in the National Collections, Tel Aviv University, Israel (TAU), and at the Muséum national d'Histoire naturelle, Paris (MNHN). Nine alien decapod species have been recorded: four constitute new records for Turkey, for three we report significant range extensions within Turkey, and a new species of the widely distributed Indo-Pacific palaemonid

genus *Urocaridella* Borradaile, 1915 is described, while the genus is reported for the first time from the Mediterranean.

SYSTEMATICS

Metapenaeopsis aegyptia Galil, 1990
(Fig. 2D)

MATERIAL EXAMINED. — **Turkey.** Fakdere, Kaş, 4 m depth, night dive, 27.XI.2003, 1 ♂ carapace length (cl) 11.1 mm, 1 ♀ cl 8.1 mm (TAU).

REMARKS

Metapenaeopsis aegyptia was recently described from Rhodes I. (Kevrekidis *et al.* 1998; Galil & Kevrekidis 2002). Though the present report constitutes the first record of the species from the Turkish coast, the species is common near Tekirova and Üç Adalar, and might have been established much earlier.

Metapenaeopsis moigensis consobrina
(Nobili, 1904)

MATERIAL EXAMINED. — **Turkey.** Tekirova, 6 m depth, sand, night dive, 25.X.2003, 1 ♂ cl 10.1 mm, 2 ♀♀ cl 9.8, 13.5 mm (TAU).

REMARKS

Metapenaeopsis moigensis consobrina was only recently described from the Mediterranean, at once from

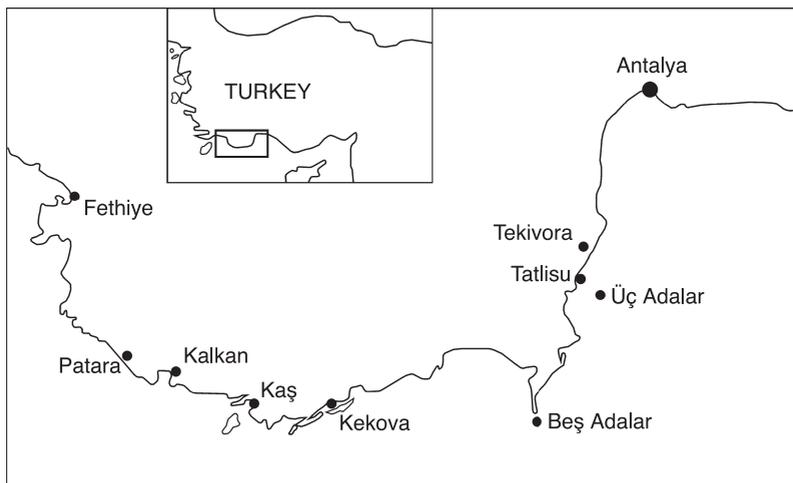


FIG. 1. — Map showing sampling sites, Kaş Peninsula, southwestern coast of Turkey.

Israel and Rhodes I. (Galil 1997; Kevrekidis *et al.* 1998; Galil & Kevrekidis 2002). The present report constitutes the first record of the species from the Turkish coast.

Trachysalambria palaestinensis (Steinitz, 1932)

MATERIAL EXAMINED. — **Turkey.** Tekirova, 5-6 m depth, sand, night dive, 25.X.2003, 1 ♀ broken (TAU).

REMARKS

Trachysalambria palaestinensis was recently described from Rhodes I. (Kevrekidis *et al.* 1998, as *Trachypenaeus curvirostris*; Galil & Kevrekidis 2002).

Urocaridella pulchella n. sp.
(Figs 2A, B; 3)

?*Leandrites cyrtorhynchus* – Holzberg 1971: 362, figs 1, 2.

?*Urocaridella antonbruunii* – Fransen 1994: 88, pl. 1B.

TYPE MATERIAL. — **Turkey.** Güvercin Ada, Kaş, 12 m depth, rocky bottom, night dive, 30.VIII.2003, 1 ♂ holotype cl 5.7 mm (MNHN); 1 juv. paratype cl 4.4 mm (TAU).

ETYMOLOGY. — From *pulchellus* (Latin): very pretty.

DISTRIBUTION. — Known only from type locality. This is the first record of this handsome genus from the Mediterranean.

DESCRIPTION

Rostrum slender, tapering, 1.5 as long as carapace, prominently upcurved. Antorse, falcate, epigastric tooth medially on dorsal margin of carapace; inner margin distally serrulate. Dorsal margin of rostrum bearing three pairs of antorse teeth. Basal pair of teeth, set above orbit, resembling epigastric tooth, distalmost tooth larger; row of three or four long plumose setae on rostrum underneath each curved tooth. Spinose, midrostral pair of teeth, smaller than first pair, set wider apart, lacking the fine serrulation distally on inner margin; two or three long plumose setae on rostrum underneath each tooth. Subterminal pair of teeth spinose, glabrous, non serrate. Ventral margin of rostrum bearing ten spinose, non serrate teeth, placed closer together distally; proximalmost ventral tooth situated posteriorly to midrostral pair, distalmost ventral tooth slightly posterior to subterminal dorsal teeth. Lower lateral margin of rostrum bearing row of long, antorse, plumose setae. Carapace laterally compressed, smooth. Eyes large, globular cornea separated from bulbous peduncle by distinct groove. Orbital angle produced, lobate. Basal antennular segment broad, anterior margin lobate,

outer lateral margin anteriorly spinose. Second and third antennular segments short, bearing plumose setae. Rami of upper antennular flagellum fused basally, free part of shorter ramus twice as long as fused part; longer ramus slender, longer than lower flagellum. Antennal scale broad, well-developed; anteriorly rounded, outer lateral margin anteriorly spinose. Antennal spine prominent, set on anterior margin of carapace. Branchiostegal spine smaller than antennal spine, its tip as far from margin as length of spine. Anterolateral margin of carapace rounded.

Third abdominal segment bearing prominent, rounded ridge medially, subrectangular in profile; ridge obsolescent in juvenile specimen. Pleura of three anterior abdominal segments broadly rounded; fourth and fifth pleura progressively produced, narrowing posteroventrally, leaf-like. Sixth abdominal segment elongate, nearly twice as long as fifth segment. Telson tapering, slightly shorter than sixth segment; bearing dorsally on distal half two pairs of minute spines; distal margin with produced, triangular process, and bearing three pairs of spines, lateral pair resembling dorsal telson spines, median pair prominent, robust, submedian spines third as long as median pair. Uropods exceed telson in length, outer lateral margin of exopod spinose.

First pereopod with fingers as long as palm, distally setose; inner margin of palm with long hooked setae, and short serrate setae. Carpus sub-cylindrical, longer than chela, with transverse row of short setae near inner distal margin; merus cylindrical, longer than carpus; ischium stout, third as long as merus. Second pereopod far exceeding length of first pereopod; chela more than twice as long as chela of first pereopod. Fingers as long as palm, distally hooked, spinose; tips crossing when closed. Carpus, 1.5 times as long as palm, distally thickened; merus and ischium slender, cylindrical, nearly as long as carpus. The last three pereopods filiform, sparsely setose, successively longer posteriorly; dactyls simple, curved; their propodi 7–8 times as long as dactylus.

Endopod of first pleopod short, narrow, outer margin bearing plumose setae; second pleopod with appendix interna more than half as long as endopod.

Carapace transparent, abdomen with small red spots, a red bar across third abdominal segment, uropodal exopods striped red and white, rostrum white, banded with red subterminally. Pereopods white, banded with red: first two pereopods with bright-red palms and carpo-propodal joints, last three pereopods with red carpi and propodi.

REMARKS

Urocaridella is a widely distributed Indo-Pacific palaeomonid genus (Chace & Bruce 1993), *U. urocaridella* (Holthuis, 1950) is known from the Maldives, Andamans, India (Orissa), Mergui Archipelago and Java Sea; *U. antonbruunii* (Bruce, 1967) from Île Mayotte, Comoros; and *U. cyrtorhynchus* (Fujino & Miyake, 1969) from Tanabe Bay, Kii Peninsula, Japan. However, *U. pulchella* n. sp. is not the first case an Indo-Pacific decapod species new to science is described from the Mediterranean, where it is obviously an alien: *Ixa monodi* (Holthuis & Gottlieb, 1956) was described from material collected in the Bay of Mersin, southeastern Turkey, and *Alpheus migrans* (Lewinsohn & Holthuis, 1978) was described from specimens collected in the southeastern Levantine Basin.

The new species differs from *U. urocaridella* in having two rather than four spines medially on the upper margin of rostrum, and carpi of first and second pereopods longer than palm; it differs from *U. vestigialis* (Chace & Bruce, 1993), in having the third abdominal segment bearing prominent, rounded ridge medially, subrectangular in profile, rather than simply rounded, the fifth pleuron not as acute posteroventrally, and in the number and disposition of rostral spines. Though Chace & Bruce (1993) synonymized *Leandrites cyrtorhynchus* Fujino & Miyake, 1969, with *Urocaridella antonbruunii* (Bruce, 1967), Okuno (1994) and Hayashi (2000) consider it a distinct species, *U. cyrtorhyncha*. Comparing our specimens with the holotype of *U. antonbruunii* (USNM 127358, ♀, postorbital carapace length 2.2 mm) revealed that it differs from *U. pulchella* n. sp. in possessing a triangular hump on the third abdominal segment, the fifth pleuron posteroventrally rounded rather than prominently produced, and in the number and disposition of the rostral spines. The Mediterranean specimens

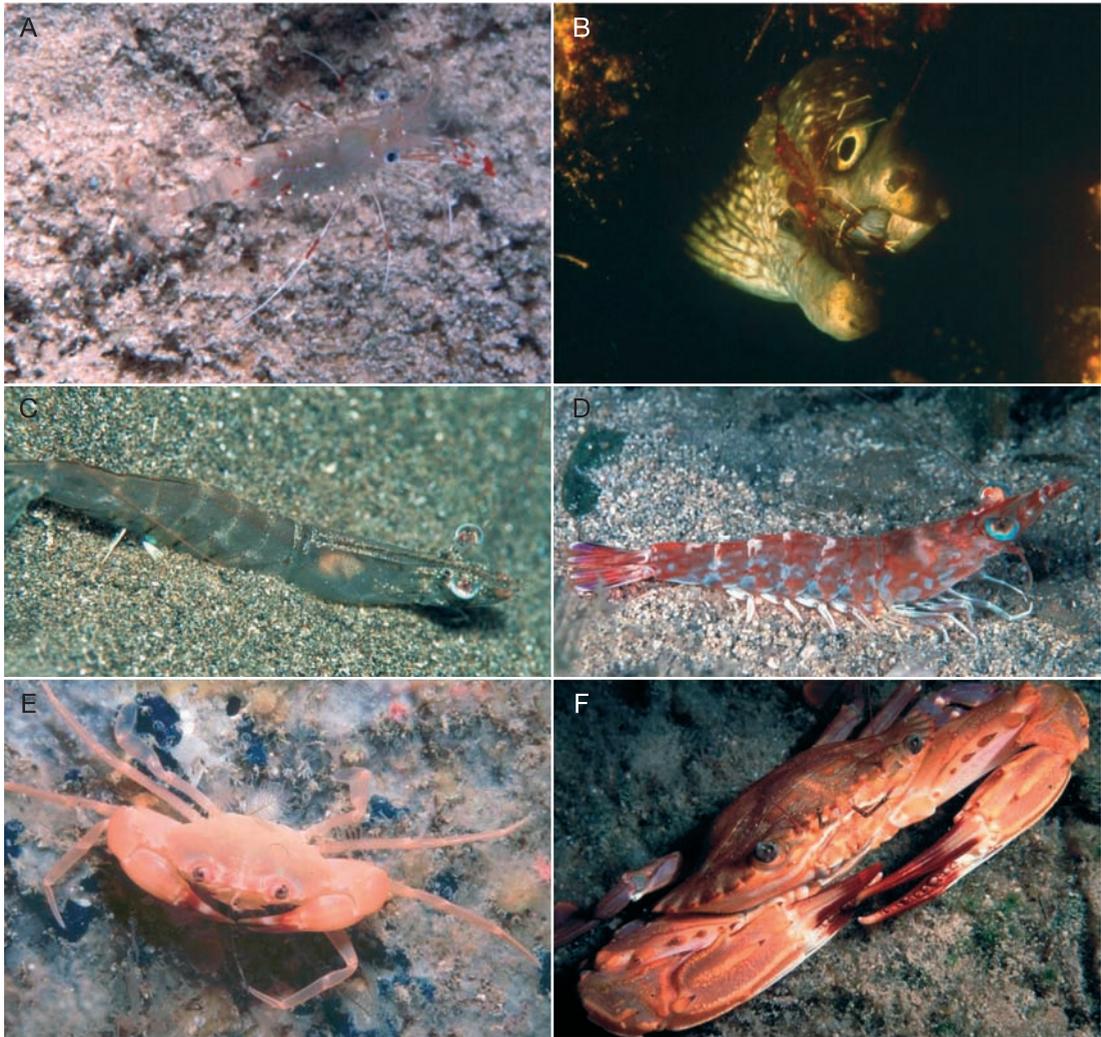


FIG. 2. — **A, B**, *Urocaridella pulchella* n. sp.; **A**, Güvercin Ada, Kaş, 12 m depth, rocky bottom, night dive, VIII.2003; **B**, Kaş, 10-15 m depth, rocky bottom, night dive, XI.2003; **C**, *Melicertus hathor* (Burkenroad, 1959), Tatlısu Limanı, 4 m depth, sand, night dive, IX.2002; **D**, *Metapenaeopsis aegyptia* Galil, 1990, Fakdere, Kaş, 4 m depth, *Posidonia* meadow, night dive, IX.2002; **E**, *Carupa tenuipes* Dana, 1851, Dalyan, Muğla, 8 m depth, in a cave, night dive, 30.X.1996; **F**, *Charybdis (Charybdis) hellerii* (A. Milne-Edwards, 1867), Tekirova, 7 m depth, rocky bottom, night dive, VIII.2001.

most closely resemble *U. cyrtorhyncha*, though they differ in having the carpus of the second pereopod slim, 1.5 times longer than the palm, rather than robust, and “equal to the palm in length” (Fujino & Miyake 1969: 147, fig. 1). Hayashi’s illustrations (2000: figs 401, 402, d) of the pereopods of *U. cyrtorhyncha* agree in their length and thickness with our specimens, but his illustrations lack the

prominent ridge on the third abdominal segment, possibly because it depicts a juvenile specimen (cl 4.1 mm). The colour photographs of *Urocaridella* sp. A from Japan (Hachijo-jima, Ryukyu Is.) (Okuno 1994: 4; Takeda & Okuno 2000; Kato & Okuno 2001; Kawamoto & Okuno 2003) bear close similarity to the colour pattern of *U. pulchella* n. sp. The specimens photographed by Holzberg (1971: 362,

figs 1, 2) and Fransen (1994: 88, pl. 1B) from the Red Sea and the Seychelles respectively, too resemble the colour pattern of *U. pulchella* n. sp.

These nocturnal cleaner shrimps are quite common, occurring in small groups of five to six individuals in the *Posidonia* and *Cymodocea* meadows. On occasion they were observed cleaning moray eels. Similar behaviour was observed by Okuno (1994: fig. 2). Holzberg (1971) noted them in Eilat, Red Sea, where they form cleaning guilds of five to 10 individuals by rocky overhangs, regularly visited by the groupers *Aethaloperca rogae* (Forskål, 1775) and *Cephalopholis argus* Bloch & Schneider, 1801.

Leucosia signata Paulson, 1875

MATERIAL EXAMINED. — Turkey. Tekirova, 5-6 m depth, 25.X.2003, 1 ♂ cl 25.8 mm, 1 ♀ cl 26.3 mm (TAU).

REMARKS

Specimens of *Leucosia signata* have been collected off the Mediterranean coast of Turkey (Grippa 1982; Galil *et al.* 2002: 90, 186). Since the likelihood of encountering a stray incursion from the Red Sea is diminishingly small, recorded alien species are considered as “established” species that have self-maintaining populations of some duration in the Mediterranean Sea; subsequent records, like the present one, confirm the existence of a long-established population in the region.

Carupa tenuipes Dana, 1851
(Fig. 2E)

MATERIAL EXAMINED (exoskeletons). — Turkey. Kakalak I., Üç Adalar, 7 m depth, rocky bottom, 5.IV.2002, cl 7.4 mm (TAU). — Panorama Reef, Kalkan, 9 m depth, rocky bottom, 13.VII.2002, cl 13.8 mm (TAU). — Ince Burun, Kaş, 5 m depth, rocky bottom, 21.VII.2002, cl 8.4 mm (TAU). — Çoban Burnu, Kaş, 6 m depth, rocky bottom, 24.VII.2002, cl 11.2 mm (TAU). — Siçak Peninsula, Kekova, 26 m depth, rocky bottom, 12.VIII.2002, cl 6.1 mm (TAU). — Devecitaşı I., Beş Adalar, 17 m depth, rocky bottom, 24.VIII.2002, cl 10.9 mm (TAU). — Tatlisu Limani, 3 m depth, 2.IX.2002, cl 9.9 mm (TAU) — Tekirova, 5-6 m depth, 25.X.2003, 1 juv. cl 6.9 mm (TAU).

REMARKS

The specimen photographed off the Kaş Peninsula is similar to the single specimen collected off the Mediterranean coast of Israel (Galil 2004). The carapace and pereopods of the specimen are of nearly uniform pale orange colour. The fingers were dark brown distally and along their inner margins, the dactyl bearing a pale round spot medially on upper margin. The species, of nocturnal habits, was collected on biogenic rubble and rocky bottoms in the Mediterranean though it is known to inhabit coral reef and coral rubble bottoms in the Indo-West Pacific. A new record for Turkey, where it has been established as far back as 1996 (pers. obs.), and the number of the shed exoskeletons collected point to its apparent abundance between Kalkan and Tekirova.

Thalamita poissonii (Savigny, 1817)

MATERIAL EXAMINED. — Turkey. Tekirova, 5-6 m depth, 25.X.2003, 2 juv. cl 7.1, 6.8 mm (TAU). — Fakdere, Kaş, 4 m depth, night dive, 27.XI.2003, 1 ♂ cl 16.1 mm (TAU).

REMARKS

Thalamita poissonii was first collected in Turkey in 1959 at Selimiye, just east of the peninsula (Holthuis 1961). It was later collected off the Aegean coast of Greece (Kalopissis & Kalopissis 1984, as *Thalamita admete* (Herbst, 1803)), and off the western coast of Crete (d’Udekem d’Acoz 1994).

NEW RECORDS ESTABLISHED ON THE
BASIS OF PHOTOGRAPHED MATERIAL

Melicertus hathor (Burkenroad, 1959)
(Fig. 2C)

MATERIAL PHOTOGRAPHED. — Turkey. Tatlisu Limani, 4 m depth, sand, night dive, IX.2002.

REMARKS

Melicertus hathor is easily distinguished from other Mediterranean penaeids by the vertical brown stripes on the margins of the abdominal pleura. It

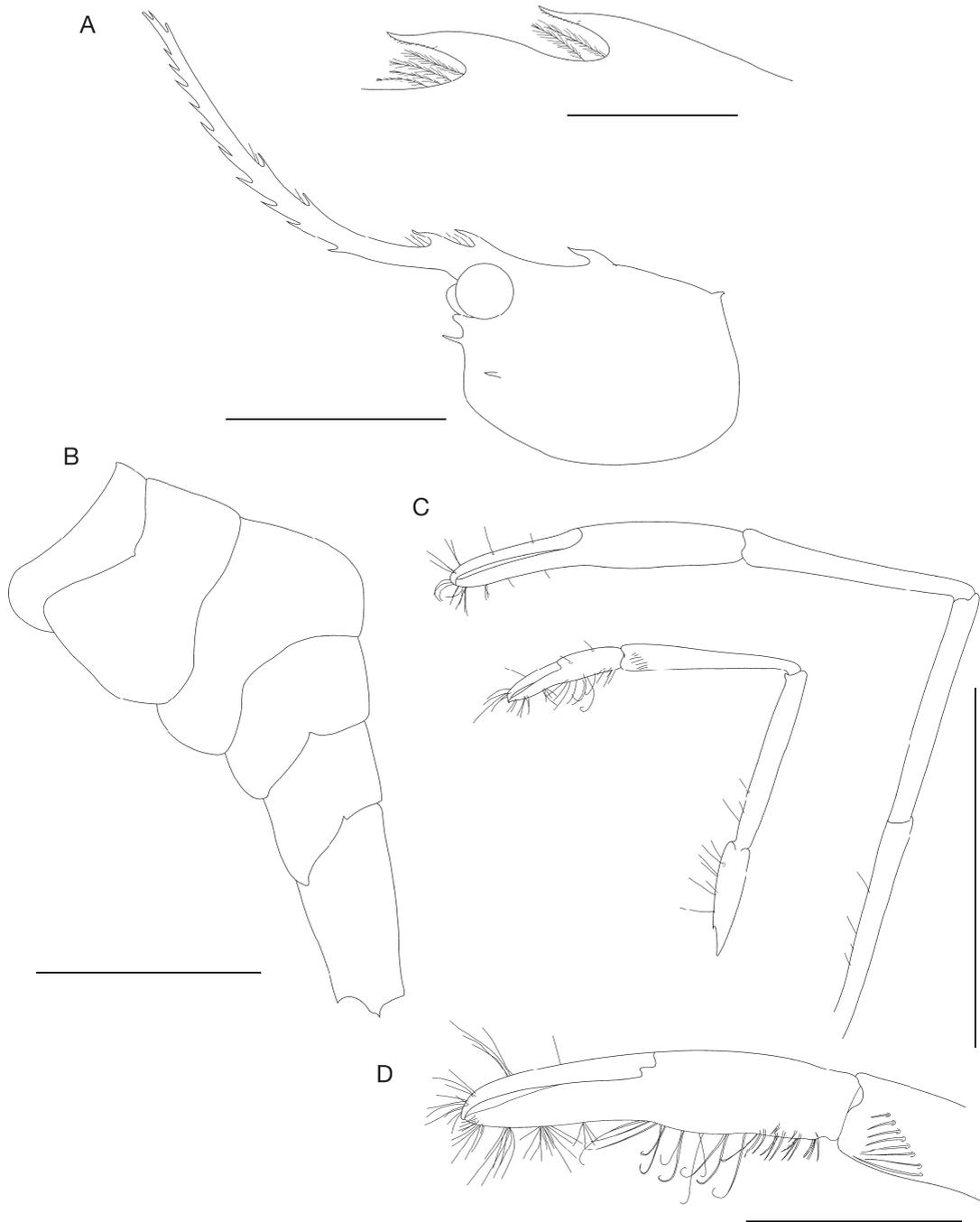


FIG. 3. — *Urocaridella pulchella* n. sp., Güvercin Ada, 1 ♂ holotype cl 5.7 mm: **A**, carapace, lateral aspect and detail of upper margin, (scale bar of the latter: 1 mm); **B**, abdomen, lateral aspect; **C**, first and second pereopods; **D**, chela of first pereopod. Scale bars: A-C, 5 mm; D, 1 mm.

was collected from the coast of Israel 70 years after it had been reported from the Suez Canal (Galil 1999). In May 2002 it was collected in Yumurtalik bight, SE Turkey (M. Kumlu, O. T. Eroldogan, M. Aktas and M. Gocer pers. comm.), but this record is a remarkable extension of its range.

Charybdis (Charybdis) hellerii

(A. Milne-Edwards, 1867)

(Fig. 2F)

MATERIAL PHOTOGRAPHED. — Tekirova, 7 m depth, rocky bottom, night dive, VIII.2001.

REMARKS

Charybdis hellerii is easily differentiated from the congeneric Erythrean invasive *C. longicollis* Leene, 1938 in its prominently cut teeth on frontal margin of carapace, large spines on anterior margin of cheliped merus, and chela bearing four spines on superior surface, and a single spine near the carpal articulation. A westward extension of its range, as it was reported before only from southeastern Turkey (Kocataş 1981). The species is quite common off Tekirova.

Atergatis roseus (Rüppell, 1830)

MATERIAL PHOTOGRAPHED. — Turkey. Konyaalti, 3-4 m depth, X.2001. — Üç Adalar, 2002.

REMARKS

Atergatis roseus is distinguished from the Mediterranean xanthid species in its transversely oval, punctate carapace, with nearly entire, crested anterolateral margins. The carapace is a bright reddish-brown, and in younger specimens, it is rimmed with white. This record constitutes a westward extension of its range, as it was reported before only from southeastern Turkey (Enzenross *et al.* 1990).

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REFERENCES

- CHACE F. A. & BRUCE A. J. 1993. — The caridean shrimps (Crustacea: Decapoda) of the *Albatross* Philippine Expedition, 1907-1910, Part 6: Superfamily Palaemonoidea. *Smithsonian Contributions to Zoology* 543: i-vii + 1-152.
- ENZENROSS L., ENZENROSS R. & NIEDERHÖFER H. J. 1990. — Wissenschaftlich interessante Funde aus der Sammlung Enzenross (Marine Invertebraten). *Jahreshefte der Gesellschaft für Naturkunde in Württemberg*, Stuttgart 145: 283-294.
- FRANSEN C. H. J. M. 1994. — Marine palaemonid shrimps of the Netherlands Seychelles Expedition 1991-1993, in VAN DER LAND J. (ed.), Results of the "Oceanic Reefs" Expedition to the Seychelles (1992-1993), Volume 1. *Zoologische Verhandelingen* 297: 85-152.
- FUJINO T. & MIYAKE S. 1969. — On two new species of palaemonid shrimps from Tanabe Bay, Kii Peninsula, Japan (Crustacea: Decapoda, Palaemonidae). *Publications of the Seto Marine Biological Laboratory* 17 (3): 143-154.
- GALIL B. S. 1997. — Two lessepsian migrant decapods new to the coast of Israel. *Crustaceana* 70 (1): 111-114.
- GALIL B. S. 1999. — *Melicertus bathor* Burkenroad, 1959 – a Red Sea penaeid prawn new to the Mediterranean. *Crustaceana* 72 (9): 1226-1228.
- GALIL B. S. 2004. — *Carupa tenuipes* Dana, 1851: an Indo-Pacific swimming crab new to the Mediterranean (Decapoda, Brachyura, Portunidae). *Crustaceana* 77 (2): 249-251.
- GALIL B. S. & KEVREKIDIS K. 2002. — Exotic decapods and a stomatopod off Rhodes Island (Greece) and the Eastern Mediterranean Transient. *Crustaceana* 75 (7): 925-930.
- GALIL B., FROGLIA C. & NOËL P. 2002. — *CIESM Atlas of Exotic Species in the Mediterranean* (F. Briand ed.). Volume 2. *Crustaceans: Decapods and Stomatopods*. CIESM Publishers, Monaco, 192 p.
- GRIPPA G. 1982. — First record of *Leucosia signata* Paulson, 1875 from South Western Turkey (Decapoda, Brachyura, Leucosidae). *Quaderni del Laboratorio di Tecnologia della Pesca*, Ancona 3 (2-5): 335-338.
- HAYASHI K. 2000. — Prawns, shrimps and lobsters from Japan (115). Palaemonidae, subfamily Palaemoninae – Genus *Urocaridella* and subfamily Pontoniinae – genus *Paratypton*. *Aquabiology* 22 (6): 570-574.
- HOLTHUIS L. B. 1961. — Report on a collection of

- Crustacea Decapoda and Stomatopoda from Turkey and the Balkans. *Zoologische Verhandelingen*, Leiden 47: 1-67.
- HOLZBERG S. 1971. — Beobachtung einer Putzsymbiose zwischen der Garnele *Leandrites cyrtorhynchus* und Riffbarschen. *Helgoländer wissenschaftliche Meeresuntersuchungen* 22 (3-4): 362-365.
- KALOPISSIS J. & KALOPISSIS V. 1984. — *Thalamita admete* Herbst dans les eaux du golfe de Saronique. *Biologia Gall-Hellenica* 11 (1): 133-136.
- KATO S. & OKUNO J. 2001. — *Shrimps and Crabs of Hachijo Island*. TBS-Britannica Co., Tokyo, 160 p.
- KAWAMOTO T. & OKUNO J. 2003. — *Shrimps and Crabs of Kume Island, Okinawa*. Hankyu Communication, Tokyo, 174 p.
- KEVREKIDIS K., GALIL B. S. & KEVREKIDIS T. 1998. — Three Lessepsian migrant penaeids (Decapoda) in Rodos island (Greece). *Crustaceana* 71 (4): 474-478.
- KOCATAŞ A. 1981. — Liste préliminaire et répartition des crustacés décapodes des eaux turques. *Rapports et Procès-verbaux des Réunions, Commission internationale pour l'Exploration scientifique de la Mer Méditerranée*, Monaco 27 (2): 161-162.
- OKUNO J. 1994. — Notes on the shrimps of the genus *Urocaridella* Borradaile, 1915 from Japan. *I.O.P. Diving News* 5 (10): 4-5.
- TAKEDA M. & OKUNO J. 2000. — *Marine Decapods and Stomatopod Crustaceans Mainly from Japan*. Ryo Minemizu, Tokyo, 344 p.
- THEOCHARIS A., GEORGOPOULOS P., KARAGEVREKIS A., IONA L., PERIVOLIOTIS I. & CHARALAMBIDIS N. 1992. — Aegean influence in the deep layers of the eastern Ionian Sea. *Rapports et Procès-verbaux des Réunions, Commission internationale pour l'Exploration scientifique de la Mer Méditerranée*, Monaco 33: 235.
- UDEKEM D'ACCOZ C. D' 1994. — Contribution à la connaissance des crustacés décapodes helléniques 1 : Brachyura. *Bios (Greece)* 1 (2): 9-47.
- WU P., HAINES K. & PINARDI N. 2000. — Toward an understanding of deep-water renewal in the eastern Mediterranean. *Journal of Physical Oceanography* 30: 443-458.

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