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Two alien venerid bivalves from the Eastern Mediterranean

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We report the first record in the Mediterranean Sea of the minute Indo-Pacific venerid bivalve Costellipitar chordatum. *The species has recently established a small population off the central coast of Israel. Numerous live specimens of* Gouldiopa consternans, *at several locations off the Israeli coast, confirm the presence of a fast growing population. This is the first record of the species from Israel, following a recent report from Turkey.*

Keywords: *Gouldiopa consternans*, *Costellipitar chordatum*, Veneridae, alien, invasive, new record, Mediterranean

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INTRODUCTION

The Veneridae (Rafinesque, 1815) is the most speciose family of heterodont bivalves, comprising more than 800 species (Chen *et al*., 2011). Some species are of considerable commercial value and support both wild and farmed fisheries, such as the quahog *Mercenaria mercenaria* (Linnaeus, 1758) and the Manila clam *Ruditapes philippinarum* (Adams & Reeve, 1850) – both widely introduced for culture purposes. These species have also been introduced into the Mediterranean: *M. mercenaria* to France and Italy (Bascheri, 1965; Bini, 1983), and *Ruditapes philippinarum* to France, Italy, Tunisia and Turkey (Bodoy *et al*., 1981; Cesari & Pelizzato, 1985; Albayrak, 2001; Ben Souissi *et al*., 2005). Yet, of the dozen alien venerid bivalves recorded in the Mediterranean, ten have been introduced through the Suez Canal. The first records date back over a century: *Dosinia erythraea* Römer, 1860 and *Gafrarium pectinatum* (Linnaeus, 1758) were collected in Port Said, Egypt (Tillier & Bavay, 1905). These species illustrate the prevailing patterns of invasion: whilst the former species was not recorded again in the Mediterranean, the latter spread to Israel, Lebanon, Syria, Turkey and Cyprus (Lindner, 1987; Bitar & Kouli-Bitar, 1999; Mienis, 1999; Zenetos *et al*., 2009; Albayrak, 2010, 2011). Five additional species are known from a single record: *Antigona lamellaris* Schumacher, 1817 (Engl & Çeviker, 1999), *Callista florida* de Lamarck, 1818 (Moazzo, 1939), *Circenita callipyga* (von Born, 1778) (Mienis, 2000), *Redicirce sulcata* Gray, 1838 (Mienis, 2004) and *Timoclea marica* (Issel, 1869) (Bogi & Galil, 1999); *Clementia papyracea* (Gray, 1825) was recorded from Gaza and Turkey (Haas, 1948; Enzenross *et al*., 1990) and *Paphia textile* (Gmelin, 1791) is known to occur in the Levant (Haas, 1948; Enzenross *et al*., 1990; Kucheruk & Basin, 1999; Lakkis & Novel-Lakkis, 2005; Zenetos *et al*., 2009). However, the purported record of this species from the northern Adriatic Sea (Kellner, 2003) is erroneous.

In the course of a long-running study of the benthic biota off the Mediterranean coast of Israel, specimens of two more alien venerid species were collected. Upon examination, they were determined as *Costellipitar chordatum* (Römer, 1867) and *Gouldiopa consternans* (Oliver & Zuschin, 2001).

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MATERIALS AND METHODS

During survey efforts of the shallow soft bottoms along the Mediterranean coast of Israel, sediment samples were collected, preserved in 4% formalin and, within days, sieved on a 250 mm mesh. The retained material was preserved in 70% alcohol, tinted with rose Bengal, and sorted. Specimens were deposited in the Steinhardt National Collections of Natural History, Tel Aviv University, Israel, and the balance retained in the private collections of C. Bogi, Livorno, Italy and J. van Aartsen, Dieren, the Netherlands. Abbreviations used.

RESULTS

SYSTEMATICS

Superfamily VENEROIDEA Rafinesque, 1815
Family VENERIDAE Rafinesque, 1815
Genus *Gouldiopa* Iredale, 1924
Gouldiopa consternans (Oliver & Zuschin, 2001)
(Figure 1A–E)

Gouldia minima var. triangularis Montagu – Moazzo, 1939: 90, Figure 4.
Microcirce sp. – Zuschin & Hohenegger, 1998, pl. 56, Figures 4 & 5.
Pauliella miliacea Issel – Hoenselaar & Dekker, 1998: 206, Figures 1–6.

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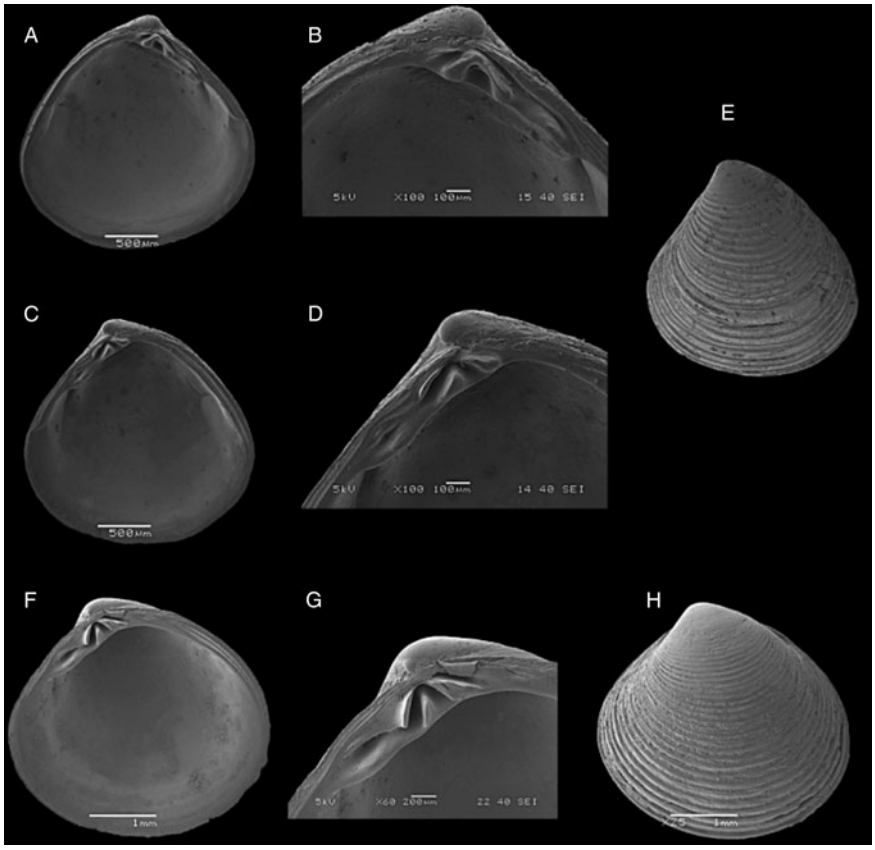


Fig. 1 A–E: *Gouldiopa consternans* Soreq. A: Left valve (LV), internal view; B: LV, detail of the hinge; C: Right valve (RV), internal view; D: RV, detail of the hinge; E: LV, external view. F–H: *Costellipitar chordatum* Hani South. F: RV, internal view; G: RV, detail of the hinge; H: LV, external view.

Microcirce consternans Oliver & Zuschin, 2001: 225, Figures 17A–B, 18A–F, 19A–D & 20A–D; Zuschin & Oliver, 2003: 150. *Gouldiopa consternans* – Ovalis & Mifsud, 2013: 9, Figure 1.

MATERIAL EXAMINED

Mediterranean Sea. Israel, Haifa Bay, 32°54′N 35°04′E, 2 August 2011, 11.2–15 m, four specimens; 9 September 2013, 10.6–13.5 m, four specimens. Soreq, 31°56′N 34°41′E, 6 June 2012, 18–22.5 m, 16 specimens; 11 October 2012, 18.6–25.4 m, 89 specimens; 15 October 2013, 17–22.3 m, 82 specimens; 31°56′N 24°41′E, 20 May 2014, 17.3–25 m, 56 specimens (one specimen, TAU M 79747). Ashdod, 31°51′N 34°39′E, 21 May 2012, 9.5–27 m, 11 specimens; 10 October 2012, 13.4–26.6 m, 105 specimens; 30 August 2013, 10.7–16 m, three specimens. All the specimens were collected live.

DIAGNOSIS

Shell minute (average shell height 2.5 mm), equivalve, not compressed, generally slightly higher than long, subovate-trigonal. Anterior and posterior margins sloping steeply, with rounded ventral margin. Posterior margin more curved than lunule margin, lunule weakly defined. Ventral margins smooth. Sculpture consists of low concentric ridges. The hinge on the right valve comprises three cardinal teeth: anterior narrow, laminar and parallel to the shell margin and in line with upper lateral, forming a pseudo-lateral socket with median cardinal, posterior and median large, triangular. The hinge on left valve consists of three cardinal teeth, posterior small, laminar, median large and triangular, anterior long, laminar; anterior and median teeth dorsally joined, forming deep triangular socket; anterior lateral tooth large and in the line with anterior cardinal. Marginal grooves and ridges present. Valves similar, but anterior with a groove and posterior with a ridge. Adductor scars not well defined. Shell colour white, tinged pale orange or pink. The adult specimens collected off the Israeli coast are smaller than those collected in the Red Sea. Like Oliver & Zuschin (2001), we noted an intraspecific variability in the shape of the apical angle (forms trigonal and subovate), and in the rugosity of the sculpture on the external surface of the valves.

REMARKS

Gouldiopa consternans was recorded in Singapore (Huber, 2010), the Arabian Sea, the Persian Gulf and the Red Sea (Safaga, Egypt), but is possibly widely distributed in the Indo-Pacific Ocean (Oliver & Zuschin, 2001). It was reported from the Suez Canal (Moazzo, 1939, as *Gouldia minima var. triangularis* Montagu, 1803). Oliver & Zuschin (2001) noted that the species was collected at depths of 20–30 m, on shell gravel, muddy-sand and sand bottoms, whereas, off Taşucu, Turkey, it was collected at a depth of 10 m (Ovalis & Mifsud, 2013). Off the Israeli coast specimens were collected at depths ranging from 9.5 to 26.8 m, on sandy and sandy-mud bottoms, and occurred in highly eutrophic and polluted sites adjacent to Haifa port and the Kishon estuary, and the outfall of the Dan Region Wastewater project, which discharges 14,000 m^3 day^{-1} excess sewage sludge.

The first specimens were collected in Haifa Bay in August 2011, the following year a couple of specimens were collected in Turkey (Ovalis & Mifsud, 2013). Since the Israeli sites are

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subject to annual or biannual sampling as part of long-running surveys of the shallow soft bottoms, we may assume that this is a very recent introduction. The large number of specimens, including numerous juveniles, collected in October 2012 and 2013 may signify this species as likely 'invasive'.

Genus *Costellipitar* Habe, 1951
Costellipitar chordatum (Römer, 1869)
(Figure 1F–H)

Caryatis chordate Römer, 1869: 125.
Costellipitar chordatum – Habe, 1977, pl. 53, figs 14–16.

MATERIAL EXAMINED

Mediterranean Sea. Israel, Nitzanim, 31°44′N 34°34′E, 10 May 2012, 25 m, two specimens; 31°49′N 34°35′E, 10 May 2012, 37 m, two specimens. Soreq, 31°56′N 34°41′E, 6 June 2012, 18–22.5 m, five specimens. Mikhmoret, 32°24 ′N 34°51′E, 7 August 2014, 13 m, one specimen (TAU M79746). All the specimens were collected live.

DIAGNOSIS

Shell shape trigona, fragile, equivalve, inequilaterale, with prominent umbos nearly central, turned anteriorly. Generally as wide as high, with rounded ventral margin. The sculpture consists of concentric ribs rounded, equidistant and regular, most evident along the ventral margin. Interior ventral margins smooth. Lunula large, oval, heart-shaped. A much coarser co-marginal ribbing is present. Hinge with three cardinal teeth on each valve; those in the right valve (Figure 1F–H) are divergent, the anterior lateral teeth are small and at a clear angle to each other, the second tooth is stronger and the third oblique and incised on the top. Colour white opaque. The maximum size of our specimens was 4.5 mm wide and 4 mm high, which corresponds to the size of the species type.

REMARKS

Costellipitar chordatum is distributed in the Indo-Pacific Ocean, from Japan and East China Sea to Safaga, Egypt and the Red Sea (Habe, 1977; Bernard *et al*., 1993; Dekker & Orlin, 2000; Oliver & Zuschin, 2000). This is the first record of the species in the Mediterranean Sea. Though the specimens are few in number, they were collected 90 km apart. It is quite likely that the species is already established along the southern and central Mediterranean coast of Israel.

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