

***Clementia papyracea* (Gmelin, 1791) (Mollusca: Bivalvia: Veneridae): its established status in the Mediterranean Sea and the first record from Greece**

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Abstract: The biodiversity of the Mediterranean Sea is threatened by an ever increasing pressure from alien species, among which Mollusca are playing a leading role with more than 200 species enumerated. Within the Bivalvia, *Clementia papyracea* (Gmelin, 1791) is amongst one of the least recorded Mediterranean invaders, only known on the basis of one living specimen from Egypt and few additional empty shells and loose valves. We here first report both the overlooked presence of this species from Greece (Kriti Island) and the first fresh samples from Israel. Our unpublished records may therefore contribute to the suggestion that this taxon is established in the Mediterranean Sea.

Résumé : *Clementia papyracea* (Gmelin, 1791) (Mollusca: Bivalvia: Veneridae): son statut en Mer Méditerranée et la première signalisation en Grèce. La biodiversité de la Mer Méditerranée est menacée par la pression croissante des espèces non natives, parmi lesquelles les mollusques jouent un rôle prépondérant avec plus de 200 espèces recensées. Parmi elles, le bivalve *Clementia papyracea* (Gmelin, 1791) fait partie des envahisseurs méditerranéens les moins signalés, connu par un seul spécimen vivant d’Egypte et par quelques coquilles vides et valves libres. Nous rapportons ici pour la première fois la présence sous-estimée de cette espèce en Grèce (île de Crète) et les premiers échantillons frais en Israël. Nos enregistrements inédits pourraient donc contribuer à la suggestion que ce taxon est établi dans la mer Méditerranée.

Keywords: Mollusca • Mediterranean • Alien species

Introduction

Since the opening of the Suez Canal, the Mediterranean basin has been invaded by an high number of Lessepsian species (Zenetos et al., 2012), which is expected to increase with the widening of the Canal (Galil et al., 2015). This ongoing phenomenon soon attracted the attention of scientists, along with the production of a massive literature culminated and summarized in the series of atlases of exotic species published by CIESM, covering fish, crustaceans, molluscs and macrophytes (CIESM website). Among alien Lessepsian species, Mollusca play a leading role (Gofas & Zenetos, 2003; Mienis, 2004; Zenetos et al. 2010 & 2012). Originally confined to the Levantine Basin, several species have now reached the central Mediterranean Sea, often becoming established. Sporadic records of Lessepsian species are also occasionally reported from the Adriatic and the western Mediterranean, although these two areas are more prone to invasions by alien species which entered by other pathways/vectors (e.g. transport - stowaway and escape from confinement, among the others) (Nunes et al., 2014).

Among Lessepsian molluscs, *Clementia papyracea* (Gmelin, 1791) is one of the least known invaders, whose recent distribution in Mediterranean was never reviewed. This recently led to the publication of some uncorrect statements - e.g. van Aartsen et al. (2015) only reported it from Gaza area (Palestine Authority) and Turkey. Recorded long ago from the Suez Canal (Moazzo, 1939 as *Clementia cumingi* Deshayes, 1854 [sic! for 1855]), it was then mentioned from Egypt, Palestine Authority, Israel and Turkey (Haas, 1948; Barash & Danin, 1973; Enzeross et al., 1990; Engl, 1995; Mienis, 2002; Edelman-Furstenberg, 2008; Leshno et al., 2015), where specimens and shells were found in the littoral zone and down to 90 m on different soft bottoms (Zenetos et al., 2004). However, despite its relatively large size and unmistakable shell shape, the extreme fragility of its valves makes it substantially more difficult to find than the majority of alien species, especially as beached or trawled material. This resulted in few published records from the Mediterranean Sea, most of which are based on empty shells or loose valves, and a single one of a living specimen from Egypt (Barash & Danin, 1973). Moreover, Zenetos et al. (2010) considered it as established in the Mediterranean Sea, although the only published record of a living specimen had been collected 47 years ago, making its established status in the basin potentially questionable. We here first report both fresh recent samples from Israel and the first overlooked presence of this species from Greece (Kriti Island). This may overall suggest that this taxon is established in the Mediterranean Sea.

Material and Methods

Alien status, pathway and taxonomy

Clementia papyracea (Gmelin, 1791) is considered an alien species in the Mediterranean in accordance with the definition proposed by the European Commission (EC, 2008). Pathway nomenclature follows the Convention on Biological Diversity (CBD, 2014). The taxonomy has been updated following the World Register of Marine Species (WoRMS Editorial Board, 2015).

Published and unpublished data

Indexed and grey literature was surveyed for published Mediterranean records, particularly that concerning faunistics, taxonomy and biogeography. Only literature reporting unpublished data from the Mediterranean Sea is listed below in "Mediterranean records". Unpublished data reported in the present paper are based on specimens, shells and loose valves collected both manually (by snorkelling) and from the analysis of the by-catch of scientific and commercial trawling. Published and unpublished data were used to built an updated distribution map.

Abbreviations used

HUJ - Hebrew University of Jerusalem (Jerusalem, Israel);
LT - Lionello Tringali private collection (Rome, Italy);
SMNH MO - The Steinhardt Museum of Natural History and National Center for Biodiversity Studies, Tel Aviv University (Tel Aviv, Israel).

Results and taxonomy

Class BIVALVIA Linnaeus, 1758
Order VENEROIDA J.E. Gray, 1854
Family VENERIDAE Rafinesque, 1815
Genus *Clementia* J.E. Gray, 1842
Clementia papyracea (Gmelin, 1791)

Mediterranean confirmed records

Clementia papyracea Gray [sic! for (Gmelin, 1791) - see Gmelin (1791: 3257)] – Haas, 1948: 142 [1: Palestine Authority]; *Clementia papyracea* (Gmelin, 1791) – Barash & Danin, 1973: 326 (figure 22), 341 [2: Egypt, Israel]; Mienis, 2002: 75 [3: between Hadera and Palmahim, Israel, trawled 40 m depth, 1992]; *Clementia papyracea* (Gmelin) – Enzeross et al., 1990: 291 [4: Turkey]; *Clementia papyracea* Gray, 1825 [sic!] - Engl, 1995: 46, 48 (figure 8) [5: Turkey]; *Clementia papyracea* (Gray, 1842) – Edelman-Furstenberg, 2008: 10, 22, 25, 34, 36, 52-53 (figures 39a-b) [6: Israel]; *Clementia papyracea* - Leshno et al., 2015: 52 [7: Israel].

Mediterranean excluded records

A record of *Clementia papyracea* from Syria, published in Saker et al. (2008: figure 33), was excluded as based on a misidentification for *Digitaria digitaria* (Linnaeus, 1758).

In addition, Engl & Çeviker (1999) reported the presence of a single valve in Çeviker's collection, but with no locality data. Therefore, we have excluded also this potential record from our map.

Unpublished material examined

Israel, Haifa Port, 7 July 1937, 1 small shell (SMNH MO 61781), *legit* A. Wirszubski [8]; Israel, Haifa Bay, <1940, dredging, 1 right valve (HUJ 11330), *legit* A. Wirszubski [8]; Israel, off Tantura, 55 m depth, 25 July 1967, 1 broken left valve (SMNH MO 39498), *legit* E. Gilat [9]; Israel, off Dor, 22 m depth, sand, 6 May 1968, 1 right valve (SMNH MO 39499), *legit* E. Gilat [10]; Israel, off Palmahim, 35 m depth, 24 January 1977, 1 damaged right valve (SMNH MO 39500), *legit* Ch. Lewinsohn [11]; Greece, Palaiochora, 12 m depth, 14 July 1985, sandy bottom, 2 complete shells with intact ligament (LT private collection), *legit* R. Villa (Figure 1) [12]; Israel, off Nizzanim, 35 m depth, 28 February 1987, 1 left valve (SMNH MO 39502), *legit* Ch. Lewinsohn [13]; Israel, off Jaffa, 40 m depth, trawled by local fishermen, 4 April 2008, 1 left valve still with remains of the hinge (HUJ 51880) [14]; Israel, off Jaffa, trawled by local fishermen, 17 September 2009, 1 left valve (HUJ 54093) [14]; Israel, off Nizzanim, 25 m depth, 17 June 2012, 1 large specimen preserved with soft parts (SMNH MO 76394), *legit* N. Stern [13]; Israel, off Tel Aviv, <30 m depth, trawled by local fishermen, 12 December 2014, 1 fragment of the anterior part of a left valve (HUJ 54225) [15].

Description

Bivalve species with a medium-sized shell (maximum length ~70 mm), thin, inflated, equivalve, inequilateral,



Figure 1. *Clementia papyracea* (Gmelin, 1791) from Palaiochora (Kriti, Greece). Scale bar: 1 cm.

subovate, with a large and well protruding umbo close to the anterior margin. Anterior margin subacute; posterior dorsal margin longer, sloping and gradually curving. Marginal sculpture of broad and rippled undulations closer on the umbonal area and close-set lines of variable strength, well evident on the whole surface; under low magnification (5-10 x), undulations rippled by crossing lines, very weak, irregular, fragmented and with a direction difficult to define. Lunule lacking. Pallial sinus acute, V-shaped, deep, reaching beyond the midline. Whitish in colour, occasionally faint yellowish near the umbo or along the concentric sculpture.

Discussion

Clementia papyracea (Gmelin, 1791) is a species widely distributed in the Indo-Pacific from the Red Sea to Japan (Oliver, 1992; Huber, 2010). After having been reported from the Suez Canal (Moazzo, 1939), it presumably entered the Mediterranean Sea in a step by step process (corridor spread *sensu* CBD, 2014), and continued its spread in the semi-enclosed Levantine basin up to Greece due to natural dispersal of larvae - unaided spread *sensu* CBD (2014) (see Fig. 2). However, as mentioned before, sightings from the invaded area were scarce. Indeed the exceedingly fragile valves makes it substantially more difficult to find than the majority of alien species, and this may be why records from Lebanon are still missing despite recent fieldwork in the area (Crocetta et al., 2013). Though, also the general decline in taxonomic knowledge (see Boero, 2001; Boero & Bernardi, 2014) may be responsible for the few data

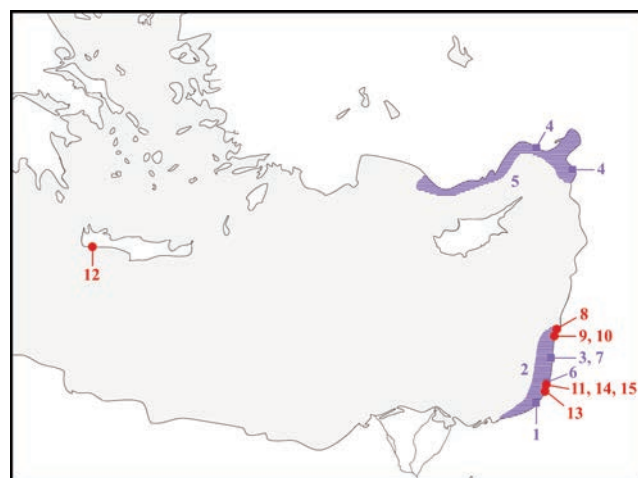


Figure 2. *Clementia papyracea*. The eastern Mediterranean and the known distribution. Blue squares: published data. Red dots: present records. Numbers in the map corresponding to numbers in square brackets as reported in “Mediterranean confirmed records” and “Unpublished material examined”.

published. However, the very recent presence in Israel of specimens with soft parts may suggest the establishment of *C. papyracea* in the basin. In fact, even if both published and unpublished records are often based on single or a few specimens or shells, a continuous ingression of single larvae from the Suez Canal seems very unlikely. Since so far Greek records are based on two empty shells only, we consider it among “casual” or “not established” taxa for Greek waters, pending further field researches in the area that may reveal the presence of established populations. The bulk of material analyzed here was preserved in institutional museums, which again confirms the utility of such formal repositories of biological material for subsequent studies (Ojaveer et al., 2014). However, as already highlighted in several articles (e.g. Zenetos et al., 2013; Crocetta et al., 2015 among others from Greece), citizen scientists and in particular amateur shell collectors constitute an invaluable additional source of information when it comes to reporting newly introduced species. The finding reported in the present article of unpublished specimens of *C. papyracea* (Gmelin, 1791) from Greece, stored in an Italian private collection, confirms the importance of such input.

Acknowledgements

Raimondo Villa (Anaguillara Sabatia, Rome, Italy) kindly provided data on *Clementia papyracea* (Gmelin, 1791) from Kriti (Greece). Nicholas Xentidis (Athens, Greece) prepared the map. Bilal Öztürk (Bornova/İzmir, Turkey) kindly provided requested papers. The study of the alien species from Greece was partially funded by the East and South European Network for Invasive Alien Species - a tool to support the management of alien species in Bulgaria (ESENIA-TOOLS) (EEA funded - Contract No. Д-33-51/30.06.2015) (FC and AZ), the DEVOTES (DEVELOPMENT OF innovative TOOLS for understanding marine biodiversity and assessing Good Environmental Status, funded by the European Union under the seventh Framework Programme, ‘The Ocean of Tomorrow’ Theme - grant agreement no. 308392; www.devotes-project.eu) (AZ) and the COST (European Cooperation in Science and Technology) Action TD1209 Alien Challenge (FC) projects.

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