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New molluscan records from the eastern Mediterranean bathyal

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Twenty-eight mollusc species were collected by Israel Oceanographic and Limnological Research during a 2011 pollution monitoring survey of a deep waste-dumping site (1264–1325 m), in the Levantine Sea, 45 km off the coast of Israel. Three species, Odostomia silesui, Ledella marisnostri*, and* Katadesmia cuneata *are new records to the Eastern Mediterranean. The depth records of the first two species considerably extend their known bathymetric ranges.* Roxania monterosatoi *and* Alvania subsoluta *are new records for the Levantine Basin and the additional two species are new records for the Israeli coast. The finding of additional specimens of* Diaphana marshalli*, recently reported for the first time in the Mediterranean Sea, confirms the presence of an established population of the rare species. The exploration and production of the extensive sub-salt natural gas fields recently discovered off the coast of Israel may all too soon impact this barely explored region.*

Keywords: Mollusca, Mediterranean, bathyal, *Odostomia silesui*, *Roxania monterosatoi*, *Katadesmia cuneata*, *Ledella marisnostri*, *Diaphana marshalli*

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INTRODUCTION

The research on the Levantine bathybenthic molluscs began auspiciously with the voyages of the 'Pola' in the late 19th Century (Sturany, 1896), but was followed by a century-long hiatus (Janssen, 1989). Thus, when discussing the Mediterranean deep sea gastropod fauna Bouchet & Taviani (1992) rightly declared 'the Eastern Mediterranean is the least adequately sampled region'. During a series of cruises conducted by Israel Oceanographic and Limnological Research (IOLR) in the 1990s, a total of 4580 specimens identified to 43 species were collected off the coast of Israel at depths ranging from 734 to 1558 m (Bogi & Galil, 2004).

The specimens described in the present study were obtained from samples collected during a cruise by IOLR conducted in 2011 as part of a pollution-monitoring survey of a bathyal waste-dumping site. The species were collected at stations located at depths between 1264 and 1325 m. Twenty-eight species were identified, of which three, *Odostomia silesui*, *Ledella marisnostri* and *Katadesmia cuneata* are new records to the eastern Mediterranean, whereas *Roxania monterosatoi* and *Alvania subsoluta* are new records for the Levantine Basin and an additional two species are new records for the Israeli coast. The material examined consisted of empty shells.

Recently, extensive sub-salt natural gas fields were discovered in the Levant Basin, off the coast of Israel, in waters deeper than 1500 m. The US Geological Survey estimates that one field alone, Leviathan, holds approximately 600 million barrels of recoverable oil and 17 trillion cubic feet of recoverable gas (www.offshore-technology.com). To evaluate the likely impacts of exploration and production, knowledge about the biology, ecology and biogeography of the fauna is needed, and as this short survey attests—we know but little.

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MATERIALS AND METHODS

The samples were collected on 25–26 July 2011, during a cruise aboard the RV 'Shikmona', using a 0.062 m² box-corer with an effective penetration of 40 cm (Ocean Instruments model 700 AL) (Table 1). The samples were preserved in 10% buffered formalin aboard ship. In the laboratory, samples were washed and sieved through a 250 μm mesh, preserved in 70% ethanol, stained in rose Bengal and sorted. The shells are in an excellent state of freshness. The specimens are deposited in the collection of the senior author (C.B.), Livorno, Italy (Table 2).

Table 1. Details of the sampling stations.

Station number	Coordinates	Depth	Date
14 (A, B, C)	32°57.322′N 034°35.994′E	1325 m	25/07/2011
15 (A, B, C)	32°56.028′N 034°34.378′E	1312 m	25/07/2011
16 (A, B, C)	32°55.816′N 034°38.018′E	1268 m	25/07/2011
17 (A, B, C)	32°54.628′N 034°35.996′E	1264 m	25/07/2011
18 (A, B, C)	32°56.082′N 034°38.523′E	1265 m	26/07/2011

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Table 2. List of species and number of specimens per station. v., single valve; *, new record for the Eastern Mediterranean; **, new record for the Levantine Basin; ***, new record for Israel.

	14(A)	14(B)	14(C)	15(A)	15(B)	15(C)	16(A)	16(B)	16(C)	17(A)	17(B)	17(C)	18(A)	18(B)	18(C)
Alvania subsoluta (Aradas, 1847)**							4								
Alvania testae (Aradas & Maggiore, 1844)							1								
Benthonella tenella (Jeffreys, 1869)	4	2	1	2		1	4		1				1		
Atlanta brunnea J.E Gray, 1850				1											
Oxygyrus inflatus Benson, 1835										1					
Benthomangelia macra (Watson 1881)	1	1		2			1		1				1		
Odostomia silesui Nofroni, 1988*													1		
Turbonilla micans (Monterosato, 1875)						1									
Eulimella ventricosa (Forbes, 1844)				1											
Crenilabium exile (Jeffreys, 1870)	4	1													
Raxania monterosatoi Dautzenberg & Fischer, 1896**	1												1		
Diaphana marshalli (Sykes, 1904)	1	1													
Heliconoides irflata (d'Orbigny, 1834)							3	1	1		3		1		
Limacina trochiformis (d'Orbigny, 1834)	2			2			2			1					
Cavolinia gibbosa (d'Orbigny, 1834)	1			1									1		
Peracle reticulata (d'Orbigny, 1834)		1													
Entalina tetragona (Brocchi, 1814)							1								
Ennucula aegeensis Forbes, 1844***	2	lv.		1		lv.	lv.								
Katadesmia cuneata Jeffreys, 1876*		l + 2v.													
Yoldiella philippiana (Nyst, 1845)	1v.	lv.					lv.								
Yoldiella wareni La Perna, 2004	11	2	1			1	18 + 8v.	2		1 + lv.	4		5	2	4
Ledeila marisnostri La Pema, 2004*	1														
Bathyarca pectunculoides (Scacchi, 1834)	2v.						5v.				1		1		
Notolimea crassa (Fabes, 1844)***							lv.								
Thyasira eumyaria (Sars M., 1870)					2		5v.								
Thyasira oblonga (Montercsato, 1878)		2	2			2	2	2						3	
Kelliella abyssicola (Montagu, 1803)	2v.	1					3 + 9v.	1	1	1	1	1		2	
Cardiomya costellata (Deshayes, 1835)							lv.				lv.				

TAXONOMY

SYSTEMATICS

Class BIVALVIA Linnaeus, 1758
Order NUCULANOIDA Carter, Campbell & Campbell, 2000
Family MALLETIDAE Adams H.&A., 1858
Genus *Katadesmia* Dall, 1908
Katadesmia cuneata (Jeffreys, 1876)
(Figure 1.4, 5)

MATERIAL EXAMINED

A single shell (9.3 mm), two valves (10.1 mm and 7.6 mm), Station 14B.

DIAGNOSIS

Valves slightly convex, rostrated posterior part three times as long as rounded anterior, ventral margin curved. External ligament well developed, internal ligament lacking. Size 10 mm.

REMARKS

Widely distributed Atlantic species, recorded off the Atlantic coast of the Iberian Peninsula (as *Malletia cuneata*, Salas, 1996) at great depths (890–1523 m). As nuculanoid bivalves possess short-lived non-planktotrophic larvae, it was believed that the shallow sill at Gibraltar precludes their crossing into the Mediterranean Sea (La Perna, 2003). Though its shells were recorded in the southern Tyrrhenian Sea (Di Geronimo *et al.*, 2001), thus far no living specimens were recorded from the Mediterranean (La Perna, personal communication). First record for the eastern Mediterranean.



Fig. 1. 1, *Diaphana marshalli* height 1.7 mm; 2, *Roxania monterosatoi* height 2.4 mm; 3, *Odostomia silesui* height 2.1 mm; 4–5, *Katadesmia cuneata*, right valve, length 9.3 mm; 6–7, *Ledella marisnostri*, right valve, length 2.3 mm.

Family NUCULANIDAE Adams H. & A., 1858
Genus *Ledella* Verril & Bush, 1897
Ledella marisnostri La Perna, 2004
(Figure 1.6, 7)

MATERIAL EXAMINED

A single shell in excellent condition with traces of fresh and shiny periostracum (antero-posterior diameter 2.30 mm, umbo-ventral 1.65 mm), Station 14A.

DIAGNOSIS

Shell ovate, moderately convex, elongate, thin-walled. Umbo rather large. Antero-dorsal margin slightly convex, curving into a well-rounded anterior margin. Postero-dorsal margin curving into a moderately developed blunt rostrum at shell height midline. Ventral margin wide, evenly rounded except for posterior sinuosity marking out rostrum. Hinge, making a 130° angle, with rows of similar length. Dentition taxodont, seven teeth anteriorly, six posteriorly. Ligamental pit rather deep, triangular. Periostracum thin, shiny, yellowish. Its congener, *L. messanensis* (Jeffreys, 1870), is larger, its hinge composed of a greater number of teeth, the concavity at its postero-ventral margin is more pronounced and its beak is pointed.

REMARKS

Ledella marisnostri has been recently described from the southern Adriatic Sea, at 976 m (La Perna, 2004), and subsequently reported off Fiumicino, the Tyrrhenian coast of Italy, at 400 m depth (Campani & Spanu, 2007). First record for the eastern Mediterranean, and a significant extension of its known bathymetric range.

Class GASTROPODA Cuvier, 1795
Order HETEROSTROPHA Fischer P., 1885
Family PYRAMIDELLIDAE Gray, 1840
Genus *Odostomia* Fleming, 1813
Odostomia silesui Nofroni, 1988
(Figure 1.3)

MATERIAL EXAMINED

A single shell (2.1 mm), Station 18A.

DIAGNOSIS

Odostomia silesui is characterized by a heterostrophic protoconch (type B: Aartsen, 1987), forming an angle of approximately 135° with the axis of teleoconch, and an arcuate columellar lip lacking a tooth or a fold (unique in the genus *Odostomia*). The growth lines on the teleoconch whorls are clearly opisthocline and slightly flexuous. The last whorl is about 2/3 of the total height, the mouth is thin lipped, a small and narrow umbilical groove. The present specimen bears a fine spiral striation over the entire surface of the teleoconch whorls.

REMARKS

A rare species, described from two specimens collected off southern Sardinia (800/950 m) (Nofroni, 1988), and off Civitavecchia, the Tyrrhenian coast of Italy (550 m)

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(Tringali & Ardovini, 1992). First record for the eastern Mediterranean, a significant extension of its bathymetric range.

Order CEPHALASPIDEA P. Fischer, 1883
Family DIAPHANIDAE Odhner, 1914
Genus *Diaphana* Brown, 1827
Diaphana marshalli (Sykes, 1904)
(Figure 1.1)

MATERIAL EXAMINED
Two adult shells (1.8, 1.7 mm), Stations 14A, B.

DIAGNOSIS
Transparent oval shell, with an umbilicus. Spire flat with projecting protoconch with more than 1.5 whorls. Rhinophores simple, triangular flaps in front corners of headshield.

REMARKS
Diaphana marshalli, a rare Atlantic bathyal diaphanid gastropod, has been recently reported off the coast of Israel at depths of 1227–1454 m (Campani *et al.*, 2011). The present finding of shells in excellent condition confirms the presence of a population of this rare species in the eastern Mediterranean. The size of its larval shell indicates planktotrophic larval development (Bouchet & Warèn, 1979), which may have facilitated its passage to the Levantine Sea.

Family CYLICHNIDAE Adams H.&A., 1854
Genus *Roxania* Leach in Gray, 1847
Roxania monterosatoi Dautzenberg & Fischer H., 1896
(Figure 1.2)

MATERIAL EXAMINED
An adult shell (2.8 mm), Station 14A; an adult shell (2.4 mm), Station 18A.

DIAGNOSIS
Shell globular, rounded, outer lip simple, overlooking plane of spire, columella straight and evident umbilicus, opening wider at the bottom. Shell porcelain white, surface entirely crossed by thin spiral incisions, closer at poles.

REMARKS
Roxania monterosatoi was first recorded off the Azores (1165–2102 m) (Dautzenberg & Fischer, 1896), and subsequently in the Mediterranean Sea from the Aegean at 2300 m (Parenzan, 1970), and in the Gulf of Taranto, Italy (210–1958 m) (Di Geronimo & Panetta, 1973). First record for the Levantine Basin.

DISCUSSION

The deep water fauna of the Levantine Sea had long been considered the most impoverished in the Mediterranean Sea (Fredj, 1974; Fredj & Laubier 1985). Yet, each survey adds to the list of Levantine bathyal biota (Galil, 2004). A comprehensive study of the bathyal molluscs off the Israeli coast listed 43 species, of which five were new records for the eastern Mediterranean and 8 newly recorded from the Levantine Basin (Bogi & Galil, 2004). The present collection, consisting of merely 15 box core samples, resulted in 28 species being recorded, three new records for the eastern Mediterranean, and two new records for the Levant Basin (Table 2). Two species are newly added records for the Israeli coast: *Ennucula aegeensis* Forbes, 1844, previously recorded from Greece (Sturany, 1896; Koutsoubas *et al.*, 2000) and Turkey (Demir, 2003); and *Notolimea crassa* (Forbes, 1844), previously recorded from Crete, Greece (Koutsoubas *et al.*, 2000). The growing list of bathybenthic mollusc species, owing to expanding research efforts, challenges the conventional view of the Levant deep-sea biodiversity.

Marenzeller (1893) reported that species occur deeper in the Levant than elsewhere in the Mediterranean. Recent studies (Ben Eliahu & Fiege, 1996; Goren & Galil, 1997, 2002; Sorbe & Galil, 2002; Bogi & Galil, 2004), as well as the present one, confirm his findings: bathymetric parcelling of the Levantine populations differs from those of the western Mediterranean deep water assemblages.

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