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Two new mathildids from the Mediterranean Sea (Gastropoda, Heterobranchia, Mathildidae)

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Based on shell characters, two new gastropod species of the family Mathildidae Dall, 1889, are herein described from the Mediterranean Sea. The new taxa are compared with the similar *Mathilda barbadensis* (Dall, 1889), an amphi-atlantic mathildid recently reported from the Mediterranean Sea. The new species are clearly distinguishable from *M. barbadensis*, as well as from the other Mediterranean and Eastern Atlantic members of the family on the base of their teleoconch shape and sculpture, and protoconch morphology. The occurrence of *M. barbadensis* in the Mediterranean basin is also critically discussed.

Key words: Gastropoda, Heterobranchia, Mathildidae, *Mathilda*, taxonomy, corals, Mediterranean Sea.

INTRODUCTION

Abbreviations, for institutions and collections: AP = Alen Petani, Zadar, Croatia; CS-PM = Carlo Smriglio and Paolo Mariottini, Rome, Italy; JP = Jakov Prkiæ, Split, Croatia; MCZ = Museum of Comparative Zoology, University of Harvard, Cambridge, USA; MZB = Laboratorio di Malacologia, Museo di Zoologia dell'Università di Bologna, Italy; NL = Neven Lete, Split, Croatia; RR = Romualdo Rocchini, Pistoia, Italy; RS = Rino Staniæ, Split, Croatia; SR = Stefano Rufini, Rome, Italy; USNM = National Museum of Natural History, Washington DC, USA.

Other abbreviations: CTS = central Tyrrhenian Sea; D = diameter; H = height; NTS = northern Tyrrhenian Sea; PD = protoconch diameter; TW = teleoconch whorls (number).

The family Mathildidae Dall, 1889, includes a small group of mostly deep-water, marine gastropods, morphologically characterized by a high-spired shell, generally with a hyperstrophic protoconch and a sculpture consisting of intersecting axial and spiral ribs. These molluscs are associated with cnidarians for feeding and their larval shell morphology suggests a long pelagic phase, usually associated to wide geographic distributions. In spite of the fact that this group of gastropods represents an interesting phylogenetic sub-

ject, being considered a "lower heterobranch" branching (Haszprunar, 1988; Bieler, 1992, 1995), mathildids have been rather poorly studied with most nominal species known from their types series only (Bieler, 1995). In the Mediterranean Sea the genus *Mathilda* Semper, 1865, is actually said to be represented by six species, viz. *Mathilda barbadensis* Dall, 1889, *Mathilda cochlaeformis* Brugnone, 1873, *Mathilda coronata* Monterosato, 1875, *Mathilda gemmulata* Semper, 1865, *Mathilda quadricarinata* (Brocchi, 1814) and *Mathilda retusa* Brugnone, 1873 (CLEMAM). *Mathilda barbadensis* was long considered an amphi-atlantic species (Fernandes & Rolan, 1994, and references therein), based on the erroneous identification of *M. canariensis* (?= *barbadensis*) (Oliverio & Nofroni, 1986, 1988). Its presence in the Northern East Atlantic (including the Mediterranean Sea) was first dismissed (Oliverio & Nofroni, 1988) and recently reinstated (Rocchini, 2004) based on records from the Tuscan Archipelago and Sicily. By revising this group in the Mediterranean Sea, we have found that the presence of *M. barbadensis* within the basin cannot be confirmed. Instead, in material recorded under this name we found three mathildids that are clearly separable from the Mediterranean nominal species of the genus. At least two species are new to science and are herein described: *Mathilda letei* spec. nov. and *Mathilda bieleri* spec. nov. A third species of the *letei/bieleri* group, *Mathilda* spec. A, is also reported based on a single specimen. We refrain from formal description, pending additional material for a definitive taxonomic assessment. Nevertheless, we prefer to mention it already now, to make the genus *Mathilda* better known in the Mediterranean Sea.

SYSTEMATICS

Family Mathildidae Dall, 1889

Genus *Mathilda* Semper, 1865.

Type species (by subsequent designation by De Boury, 1883: 112): *Turbo quadricarinatus* Brocchi, 1814; Pliocene, Italy.

Mathilda letei spec. nov. Prkiæ & Smriglio (figs 1-8, 20)

Description. – Shell rather small, high-spired, cone-shaped, slender, spire about one half total height.

Protoconch smooth, globular, transparent with a light brownish embryonic whorl, hyperstrophic, approximately diverging 40-45° from teleoconch axis; embryonic whorl exposed (the first whorl completely visible), multispiral consisting of 2½ whorls; protoconch diameter 640 ?m.

Teleoconch with rounded whorls, and distinct suture. Pattern of spiral (more prominent) and axial ribs (29 on last whorl) intersecting at approximately right angles forming nodules. Spacing of the axial and spiral ribs regular, their crossing form a well ordered arrangement of rectangles, the bigger created between the two primary spiral ribs. Spiral sculpture consisting of four ribs ("2+2" pattern), the two on the upper part of the whorl weaker, the two lowermost stronger, with the third one more prominent. An additional fine spiral thread is visible between the third and fourth ribs starting from the sixth whorl, a fifth spiral rib almost fully covered, barely visible at the suture and exposed at the base of shell, forming an evident double keel. Six fine spiral threads are visible on the basal

area, umbilicus closed. Colour of the live-collected holotype shell brownish with white spiral ribs. Horny operculum flat, concentric and multispiral, translucent.

Table 1. Measurements and collecting data for *M. letei*

	H (mm)	D (mm)	H/D	TW	Locality	Depth	Collection
Holotype	6.4	2,6	2.46	6.7	[type loc.]	60-90 m	MZB29749
Paratype A[1]	5.5	2.6	2.11	5.8	[type loc.]	60-90 m	CS-PM
Paratype B[1]	2.9	1.6	1.81	4.3	[type loc.]	60-90 m	CS-PM
Paratype C[1]	9.7	3.6	2.69	8.3	[type loc.]	60-90 m	JP
Paratype D[1,2]	9.5	3.4	2.79	8.4	[type loc.]	60-90 m	JP
Paratype E	6.5	2.8	2.32	6.8	[type loc.]	60-90 m	NL
Paratype F	5.9	2.6	2.26	6.4	[type loc.]	60-90 m	NL
Paratype G[1]	4.2	2.0	2.10	5.1	[type loc.]	60-90 m	AP
Paratype H	5.0	2.3	2.17	5.7	[type loc.]	60-90 m	RS
Paratype I	5.3	2.5	2.12	5.7	[type loc.]	60-90 m	SR
Paratype J	6.1	2.7	2.25	6.4	CTS , 41°51'N 11°28'E	450-600 m	CS-PM
Paratype K	7.8	3.4	2.29	6.2	NTS, off Gorgona Island	300-450 m	RR

[1] With soft parts and operculum.

[2] Non canonical pattern of secondary spiral ribs.

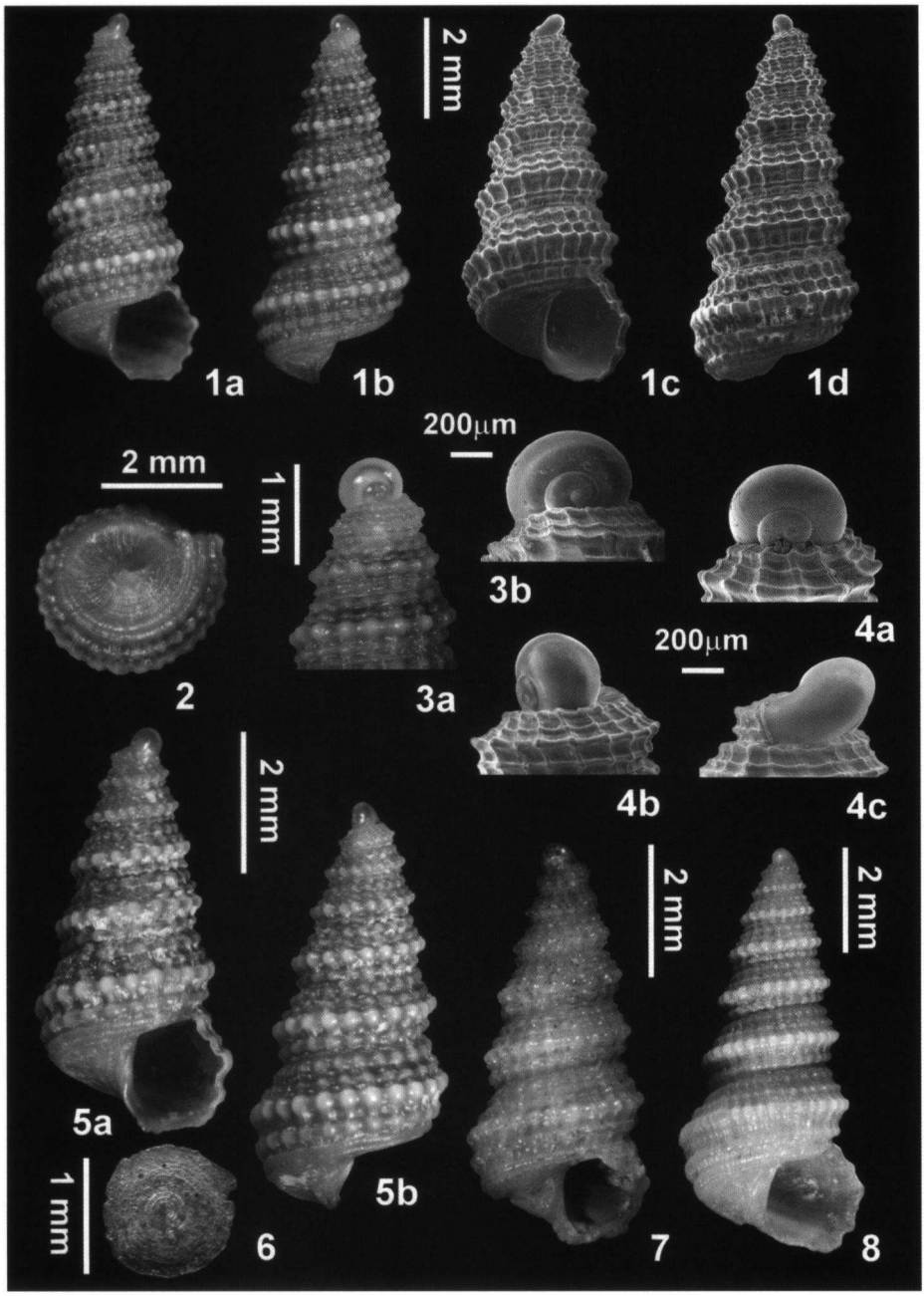
Type material. – Holotype and paratypes A-I, Croatia, Island of Mljet, 42°41'N 17°30'E, Southern Adriatic Sea, 60-90 m depth [type locality]. Paratype J, Central Tyrrhenian Sea (41°51'N 11°28'E , coast of Latium), deep-sea coral bank (biocoenosis CB, sensu Pérès & Picard, 1964) at 450-600 m. Paratype K, Northern Tyrrhenian Sea, off Gorgona Island (Tuscan Archipelago) at 300-450 m, inside an amphora.

Habitat.– Holotype and paratypes A-I hand-collected by professional divers at 60-90 m depth, on bottoms dominated by the Mediterranean red coral *Corallium rubrum* (L., 1758). A specimen from the Central Tyrrhenian Sea dredged at 450-600 m depth, on bottoms dominated by a deep-sea coral bank (biocoenosis CB).

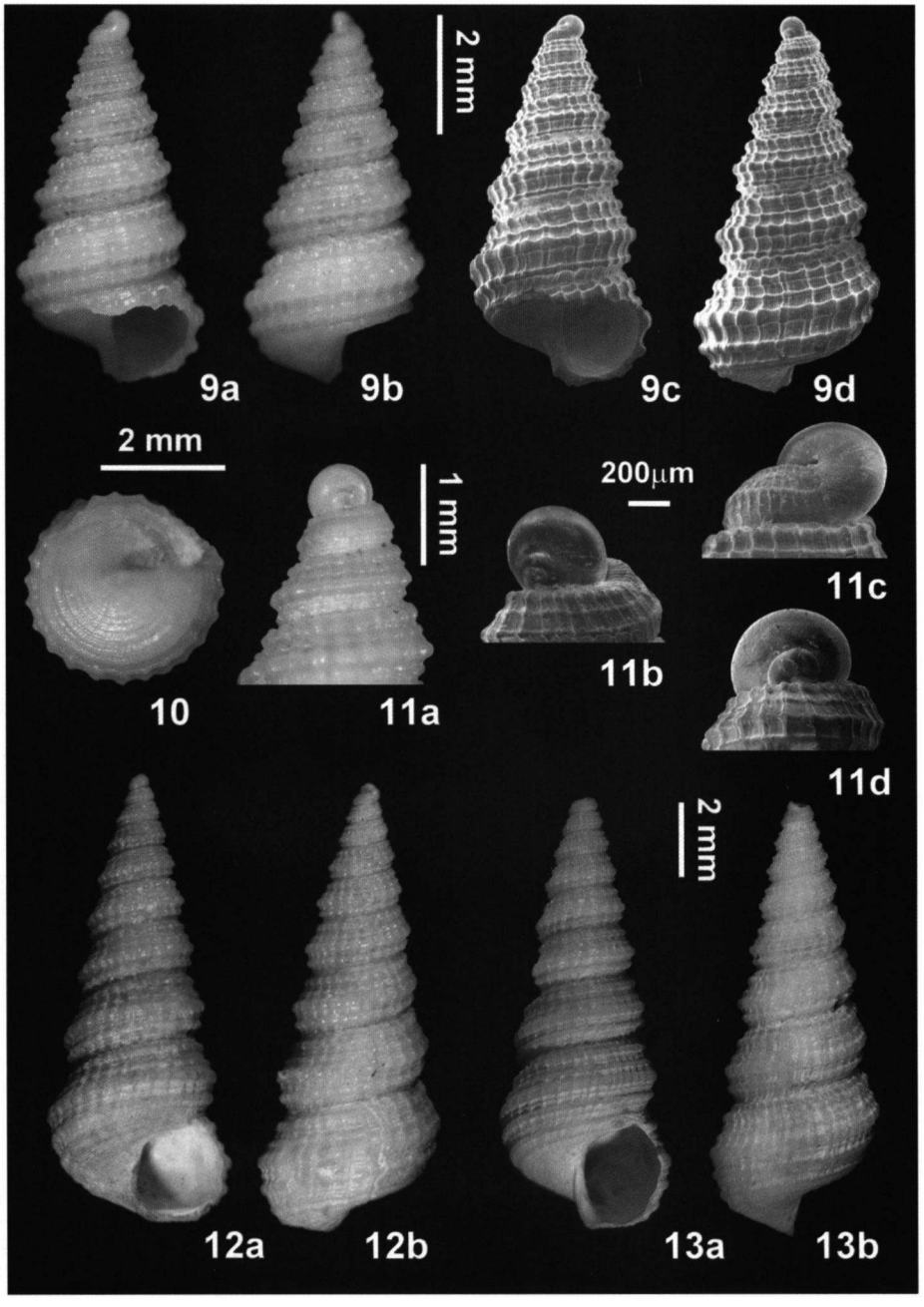
Distribution. – The species is known from the type locality in the southern Adriatic Sea, the central Tyrrhenian Sea (41°51'N 11°28'E, coast of Latium) and the northern Tyrrhenian Sea (Gorgona Island, Tuscan Archipelago).

Etymology. – The species is named after Mr Neven Lete, a keen amateur collector from Split and good friend of one of the authors (JP), who provided us with some shells of the type lot.

Remarks. – This new species shares the typical mathildid pattern of two pairs of primary spiral ribs on the exposed part of the whorls ("2+2" pattern, fig. 20) as defined by Bieler (1995), but its sculpture is distinguishable from all the other Mediterranean and eastern Atlantic members of the family. In particular, *M. cochlaeformis* has a sculpture formed by four primary spiral ribs, the two lowermost very strong, the two uppermost weak, particularly the second one which sometimes is missing; the shell is uniformly brownish, including the protoconch; *M. coronata* shows a marked lowermost spiral rib that in the initial whorls is positioned very close to the suture, giving to the shell a crowned (=*coronata*) aspect, it has three primary spiral ribs, the shell is brownish with transparent-whitish protoconch which differs from that of *M. letei* because its embryonic whorl is only



Figs **1-8**. *Mathilda letei* spec. nov. **1a-3b**, holotype (MZB27749); **1a-d**, optical and SEM (uncoated) frontal and dorsal views; **2**, basal view; **3a-b**, optical and SEM (uncoated) details of the protoconch; **4a-6**, paratype A; **4a-c**, details of the protoconch; **5a-b**, frontal and dorsal views; **6**, operculum, internal view; **7**, paratype J from the Central Tyrrhenian Sea (41°51'N 11°28'E, coast of Latium), frontal view; **8**, paratype K from the Northern Tyrrhenian Sea (Gorgona Is., Tuscan Archipelago), frontal view.



Figs 9-13. *Mathilda bieleri* spec. nov. **9a-11d,** holotype (MZB27748); **9a-d,** optical and SEM (uncoated) frontal and dorsal views; **10,** basal view; **11a-d,** optical and SEM (uncoated) details of the protoconch; **12a-b,** paratype A, frontal view; **13a-b,** paratype B, frontal view.

partially visible; *M. gemmulata* has four primary spiral ribs, the second one is the weakest, but it shows a very typical slender shell, almost cylindrical; the much larger *M. quadricarinata* shows four marked spiral ribs, only slightly granulose; *M. retusa* has three major spiral ribs with stronger nodules.

This mathildid is similar to *Mathilda bieleri* spec. nov., *M. barbadensis* and the allied *Mathilda* spec. A (see the remarks on these three mathildids below). Interestingly, the habitat of *M. letei* includes both red- and white-coral biocoenosis; its bathymetric range is from 60 to 600 m. It can be postulated that for feeding *M. letei* is associated with a single host, that has a wide bathymetric range and lives in both red- and white-coral communities. Alternatively, this mathildid can feed on several cnidarians that are specific of the two biocoenosis. Remarkably, unusually rich deep water coral communities (including red, white and yellow corals) have recently been found in the Mediterranean (Hermes Newsletter n. 9: http://www.eu-hermes.net/).

Mathilda bieleri spec. nov. Smriglio & Mariottini (figs 9a-13b, 21)

Description. – Shell rather small, high-spired, cone-shaped, slender, spire about one half total height.

Protoconch smooth, globular, hyperstrophic, approximately diverging 40-45° from teleoconch axis; embryonic whorl exposed (the first whorl completely visible), multispiral consisting of 2½ whorls; protoconch diameter 570 ?m.

Teleoconch with rounded whorls, and distinct suture. Pattern of regular spiral crossing weaker and slightly arcuate axial ribs (24 on last whorl), intersecting at approximately right angles forming nodules. Spacing of the axial ribs regular, the crossing of spiral and axial ribs form a well ordered arrangement of rectangles, the bigger created between the two lowermost spiral ribs. Spiral sculpture consisting of four ribs ("2+2" pattern), the first uppermost and the middle third one stronger, the second on the upper part of the whorl and the fourth lowermost weaker; the third rib is the most prominent. Four additional fine spiral threads are visible among the major spiral ribs starting from the seventh whorl; in the last whorl, a fifth spiral rib almost fully covered, barely visible at the suture and exposed on the base of shell, forming a clear double keel. Eight fine spiral threads are visible at the basal area, umbilicus closed. Colour of the dead-collected holotype shell whitish. Operculum unknown.

Table 2. Measurements for *M. bieleri*

	H(mm)	D(mm)	H/D	TW
Holotype	6.1	2.9	2.10	6.7
Paratype A	12.4	4.6	2.61	8.8
Paratype B	13.7	5.4	2.53	8.4*
Paratype C	6.5	3.1	2.09	6.3*

* apical whorls missing

Type material. – Holotype (MZB29748); paratypes A-C (CS-PM); central Tyrrhenian Sea (41°51'N 11°28'E , coast of Latium).

Habitat. – Holotype and paratypes dredged at 450-600 m depth, on bottoms dominated by a deep-sea coral bank (biocoenosis CB).

Distribution. – The species is only known from the type locality.

Etymology. – This species is named in honour of Dr Rüdiger Bieler (The Field Museum of Natural History, Chicago), an eminent scientist who greatly contributed to malacology, and particularly to the knowledge of the Mathildidae.

Remarks. – This new taxon shows the typical mathildid "2+2" pattern (fig. 21), it is similar to *M. letei* but it can be separated on the base of some shell diagnostic features: larger size, lower TW/H (in the adult specimens), protoconch diameter (PD) smaller (570 ?m versus 640 ?m), spiral rib arrangement different in relative intensity and spacing of ribs (compare diagrams of figs 20 and 21), spiral threads at the basal area more numerous (8 versus 5-6), white colour. Furthermore, the spiral ribs of *M. bieleri* show less marked nodules than the ones of *M. letei*. *Mathilda bieleri* is very similar to *Mathilda* spec. A, the differences between these two shells are discussed below. For a comparison with the sculpture of the other species see the remarks on *M. letei*. This new taxon was collected on a bathyal bottom under investigation (Smriglio & Mariottini, 2002), which is dominated by deep-sea coral communities (biocoenosis CB). The analysis of the sediment dredged from this marine site has yielded many fragments of the azooxanthellate corals *Desmophyllum cristagalli* Milne Edwards & Haime, 1848, and *Dendrophyllia cornigera* (Lamarck, 1816).

Mathilda spec. A (figs 14a-16d, 22)

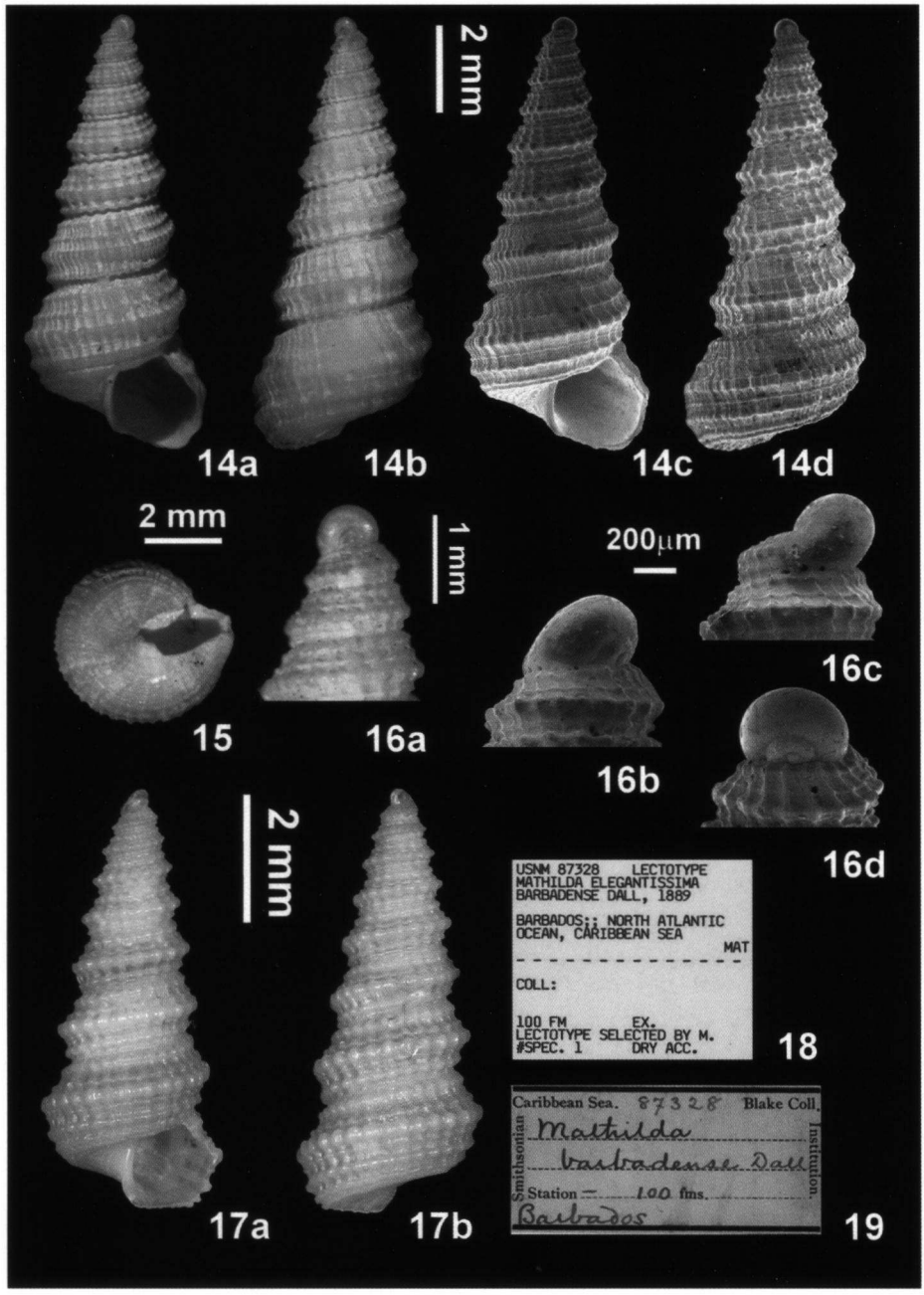
Description. – Shell rather small, 9.9×4.6 mm, high-spired, cone-shaped, slender, spire about one half total height.

Protoconch smooth, globular, hyperstrophic, approximately diverging 40-45° from teleoconch axis; embryonic whorl exposed (the first whorl completely visible), multispiral consisting of 2½ whorls; protoconch diameter 580 ?m.

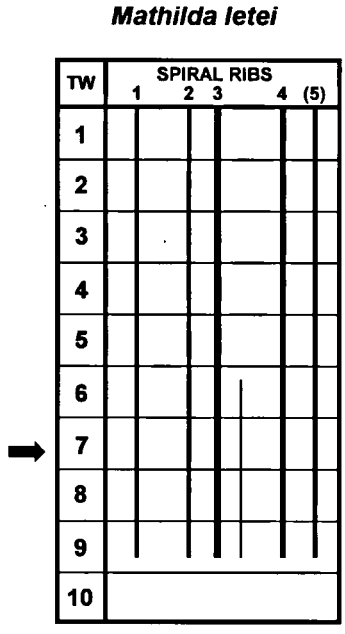
Teleoconch with rounded whorls, and distinct suture, about 8 TW. Pattern of regular spiral and weaker prosocline axial ribs (44 on last whorl), intersecting at approximately right angles forming nodules. Spacing of the axial and spiral ribs regular, their crossing form a well ordered arrangement of rectangles, the bigger created between the two primary spiral ribs. Spiral sculpture consisting of four ribs ("2+2" pattern), the first and second on the upper part of the whorl and the lowermost fourth weaker; the middle third rib is the most prominent. Three additional fine spiral threads are visible: two between the third and fourth spiral ribs and starting from the fourth whorl; the third between the fourth and the fifth spiral ribs and starting from the seventh whorl. The fifth spiral rib almost fully covered, barely visible at the suture and exposed at the base of shell, forming an evident double keel. Eight fine spiral threads are visible on the basal area, umbilicus closed. Colour of the dead-collected shell whitish-brownish. Operculum unknown.

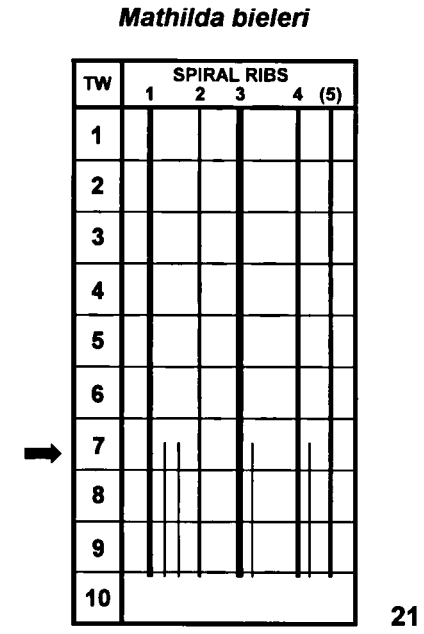
Locality and habitat. – Central Tyrrhenian Sea (41°51'N 11°28'E , coast of Latium). Deep-sea coral bank (biocoenosis CB) at a depth of 450-600 m.

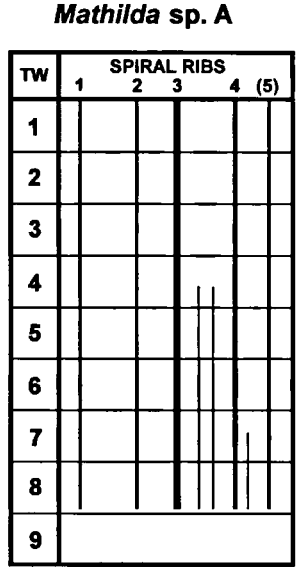
Remarks. – This mathildid shows the typical "2+2" pattern; it is similar to *M. bieleri*, but it can be separated on the base of a diverse spiral rib arrangement, since it shows different relative intensity and spacing of ribs (compare diagrams of figs 21-22). Furthermore, it has a smaller size, a higher TW/H and the axial ribs are prosocline (slightly arcuate in *M. bieleri*). *Mathilda* spec. A differs from *M. letei*, since it has a spiral rib arrangement different in relative intensity and spacing of ribs (compare diagrams of figs

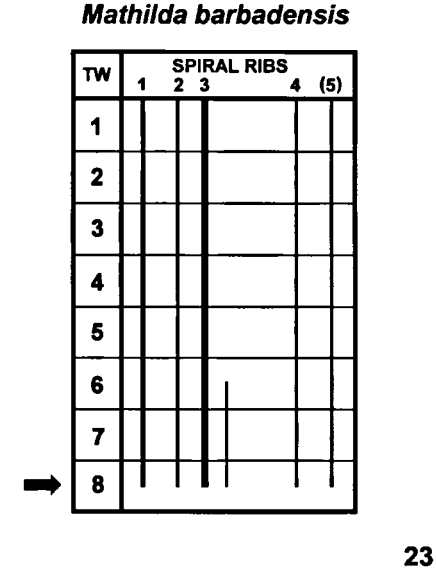


Figs **14-19**. Shells and museum labels of *Mathilda* spp. **14a-16d**, *Mathilda* sp. A; **14a-d**, optical and SEM (uncoated) frontal and dorsal views; **15**, basal view; **16a-d**, optical and SEM (uncoated) details of the protoconch; **17a-19**, *Mathilda barbadensis* Dall, 1889; **17a-b**, lectotype (USNM87328), frontal and dorsal views; **18-19**, USNM labels.









Figs 20-23. Diagrams of spiral sculpture of the four mathildids analysed, showing relative position and strength of exposed spiral ribs of teleoconch whorls (TW). Rib number in parenthesis indicates primary spiral rib serving as attachment of subsequent whorl. Arrow indicates holotype/lectotype positions. 20, *M. letei*; 21, *M. bieleri*; 22, *Mathilda* sp. A; 23, *M. barbadensis*.

20-22), a different H/D ratio (2.15 vs 2.69-2.79 of the largest specimens of *M. letei*), a smaller PD (580 ?m versus 640 ?m), more numerous spiral threads at the basal area (8 versus 5-6). Finally, the fifth spiral rib exposed at the base of shell is much thinner than the ones of both *M. letei* and *M. bieleri*. *Mathilda* sp. A is sympatric with *M. bieleri*, since it was collected on the same locus typicus of the latter. See the remarks on *M. bieleri* for habitat data and putative coral association. In spite of the fact that this mathildid shows a peculiar "2+2" pattern with no resemblance to any other *Mathilda* from the Mediterranean and Atlantic, it is based on a single specimen, so additional material is needed for a more detailed taxonomic assessment. For a comparison with the sculpture of the Mediterranean nominal species see the remarks on *M. letei*.

Mathilda barbadensis Dall, 1889 (figs 17a-19, 23)

Mathilda (*elegantissima* var.?) *barbadense* Dall, 1889: 266, pl. 26 fig. 10.

Original description. – "Shell resembling *M. elegantissima* Costa, but proportionally more elongatd, with a nucleus only about one fourth as large as that of the Mediterranean species; with the peripheral spiral so large and sharp compared with the others as to carinate the whorls; and with the disk of the base covered with small spirals and proportionally smaller. Shell brownish with seven whorls, exclusive of the nucleus, the anterior edge of the peristome somewhat produced, columella simple without any chink behind it. Max. lon. of shell, 6.2; of last whorl, 2.7; max. lat. of shell, 2.5 mm. Habitat. Barbados, 100 fms. This is perhaps a variety of *elegantissima*, but I doubt their identity."

Type material. – Lectotype USNM 87328, initially regarded as holotype by Oliverio & Nofroni (1986), since it was assumed that there was only a single specimen [considered a lectotype designation by inference of "holotype" before 1999 (ICZN Art. 74.6)]; paralectotype MCZ 745; Barbados, Caribbean Sea, North Atlantic Ocean.

Distribution. – Amphi-atlantic, from the central western (Florida, Texas, Colombia, Northern Brazil, Barbados) to the central eastern (Spain, Morocco) Atlantic Ocean.

Remarks. – *Mathilda barbadensis* is a small mathildid (up to 8 mm in length) originally described from Barbados, with a collecting depth ranging from a few down to 200 m. Its distribution was previously discussed by Fernandes & Rolan (1994) and most recently by Rocchini (2004), who reported for the first time this species from the Mediterranean Sea. The record of the Mediterranean *M. barbadensis* is based on two empty shells collected in the Tuscan Archipelago (Gorgona Island, 300-450 m depth) and Sicily (S. Alessio Cape, 210 m depth). Rocchini (2004) was pointing out the need to find living specimens of this species to undoubtedly accept it as part of the living malacofauna of the Mediterranean basin. The Tuscan shell was kindly provided by Mr Rocchini for comparative study, and after its examination we conclude that this specimen is *M. letei*. *M. barbadensis* can be easily separated from *M. letei* because its typical "2+2" pattern strongly differs from the one of *M. letei*, as well as from the ones of both *M. bieleri* and *Mathilda* sp. A (compare diagrams of figs 20-23). In particular, *M. barbadensis* shows a spiral sculpture consisting of four ribs, the first uppermost and the middle third ribs stronger, the second on the upper part of the whorl and lowermost fourth rib weaker; the middle third rib is the most prominent. Only an additional fine spiral thread is visible on the lectotype between the third and fourth spiral ribs and starting from the sixth whorl. This secondary

thread is slightly granulose and stronger than the one of *M. letei*. Furthermore, *M. barbadensis* has a smaller protoconch and a larger aperture, whereas the teleoconch whorls are less convex and smaller than in *M. letei*. The lectotype of *M. barbadensis* is translucent white (in the original description the colour is brownish!); *M. letei* shell is also brownish but with clearly white spiral ribs. We like to recall that the shell of *M. barbadensis* shows a typical fifth spiral rib almost fully covered, barely visible at suture and exposed at the base of shell, forming a clear double keel. For a comparison with the sculpture of the Mediterranean species see the remarks sub *M. letei*. The occurrence of *M. barbadensis* in the Mediterranean remains uncertain, since we could examine only the Tuscan specimen reported by Rocchini (2004). We guess that also the Sicilian specimen could be *M. letei*. In our opinion, the Mediterranean distribution of *M. barbadensis* needs to be confirmed by other records.

DISCUSSION

The morphological features ("2+2" sculpture patterns) of the four mathildids dealt with here are summarised in figures 20-23. Obviously, a detailed observation of the spiral and axial sculpture arrangement can allow an easy separation of these shells. On the base of shell similarity, we assume a closer relationship in *letei/barbadensis* and in *bieleri/Mathilda* sp. A. couples.

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