Species in Fissurellidae (Gastropoda) from the North Atlantic with a focus on the Azorean seamounts

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Various reviews of families in Mollusca have indicated a large diversity and a high degree of endemicity on the Azorean seamounts. In this study, bathyal species in the gastropod family Fissurellidae have been investigated using material collected during the M151 cruise conducted by R/V Meteor in 2018 to seamounts south of the Azores. Additional records were incorporated from literature including a review of some species in the subfamily Fissurellinae from the cruise seamount 2 in 1997 and from northern Atlantic species in the collection at Senckenberg am Meer (Wilhelmshaven). Fourteen species are herein reported from the Azorean seamounts of which twelve species were found during M151; *Puncturella asturiana* (P. Fischer, 1883) and *Profundisepta alicei* (Dautzenberg & H. Fischer, 1897) were not recorded in this cruise. The distributions of the poorly-known, yet common, *Puncturella fornicata* Locard, 1898 and *Puncturella agger* R. B. Watson, 1883 are presented. *Profundisepta luciae* spec. nov. is proposed; this species is the only fissurellid endemic to the Azorean seamounts. The degree of endemism in Fissurellidae is much lower (7%) on the Azorean seamounts than in other recently reviewed species in Veti- and Caenogastropoda (40-100%). Nearly 50 % of the fissurellids have an amphi-Atlantic distribution. It is unclear how most species have distributed over large areas considering their direct or short lecitotrophic larval development. Their relatively large foot to body mass ratio possibly facilitated planktonic rafting and may have enabled long-distance migrations.

Key words: Mollusca, *Profundisepta luciae*, Atlantic Ocean, bathyal, biodiversity, endemism.

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INTRODUCTION

This study is part of a series of studies of upper-bathyal gastropod species from the seamounts south of the Azores and it reviews the species in the family Fissurellidae. Species in Fissurellidae are generally known as spongivores living in all Oceans on Earth from the intertidal zone to bathyal depths. The family currently has five subfamilies, 48 accepted genera and hundreds of species (MolluscaBase, 2022). Historic reviews of fissurellids were scattered in generic content and areal distribution.

Pérez Farfante (1943a, 1943b, 1947) reviewed the northwestern Atlantic species in the genera *Lucapina, Diodora, Lucapina, Zeidora, Nesta, Emarginula, Rimula* and *Puncturella*. Pérez Farfante (1947) introduced four new species and illustrated many poorly known taxa. McLean (1970) introduced one new genus and eight new species from the eastern Pacific Ocean. McLean & Geiger (1998) reviewed the genera and species having the *Fissurisepta* shell form; their study introduced three new genera and five new species. Simone & Cunha (2014) reviewed deep-water species in Fissurellidae from off SE Brazil. They proposed 20 new species in 9 different genera. Piani (1985) reviewed the Mediterranean species in *Emarginula* and introduced *Emarginula christiaensi*, a species commonly found in deep-water coral habitats. Cunha et al. (2017) provided an integrated analysis including molecular phylogeny of fissurellids from the Cape Verde Islands; a wide diversification of species in *Fissurella* and one species in *Diodora* was proven. Hoffman & Freiwald (2018) studied the fissurellids off Mauritania, and found live specimens of *Diodora tenuiclathrata* (Seguenza, 1863) and *Fissurisepta granulosa* Jeffreys, 1883 in coral-related habitats. The latter was hitherto solely known as fossil. Cunha et al. (2019) provided a molecular phylogenetic analysis of many genera in the family; their work formed the basis of the current generic allocations. They suggested that fissurellids firstly developed in the Tethys Sea (at about 175 Ma). The taxon *Rimula* has evolved early and forms a separate subfamily.

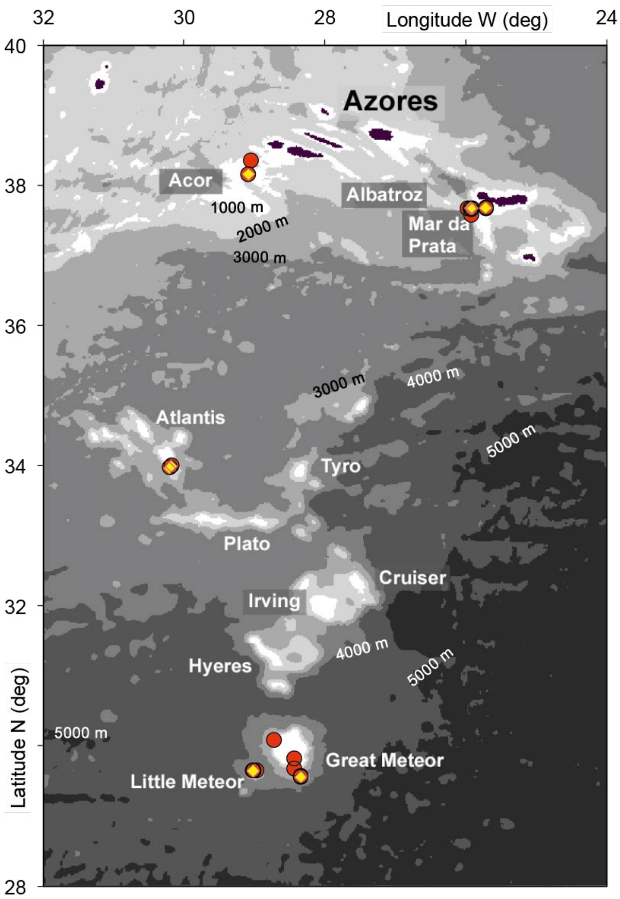


Fig. 1. Map of the Azores and the southern Azorean Seamounts with M151 locations where species in Fissurellidae (red dots) and the species *Profundisepta luciae* spec. nov. were found (yellow diamonds). Bathymetry GEBCO; isobaths 1000 m

The subfamily Zeidorinae now includes a wide variety of genera including *Zeidora* and *Puncturella* (the latter now includes *Cranopsis*) and the "sister" genera *Cornisepta* and *Profundisepta*. The genera *Emarginula, Diodora* and *Fissurella* are not monophyletic and are in need for further revision.

Barrio González (2015) issued her doctoral thesis on a review of some genera in the subfamily Emarginulinae from an area including the Azorean seamounts, some Lusitanian seamounts and the Galicia Bank. She did not review the genera *Diodora* and *Emarginula* but described three new species in *Cornisepta*, *Profundisepta* and *Cranopsis*. Unfortunately, she did not properly publish the results following ICZN Articles 8.5.3, 8.5.3.1 and 8.5.3.2 and her work is not available for taxonomic acts. The specific consequences of this omission will be dealt with in this paper.

This paper reviews the diversity, distribution and endemicity of bathyal fissurellid species from the Azorean seamounts.

MATERIAL AND METHODS

The material studied was gathered during the R/V Meteor Cruise M151 in October 2018. The cruise investigated deep-water coral habitats on summits and slopes of six seamount areas that were sampled between the Azores and the Great and Little Meteor Seamounts (Fig. 1). Sampling was done using ROV (grab by remotely-operated vehicle), van Veen grabs and box cores (0.5 x 0.5 m^2). The recovered sediment was sieved on board retaining the fractions exceeding 0.5 mm. Not a single live fissurellid was found in the bottom samples. The sieved fractions were washed with fresh water to remove salt and dried at 40°C.

At the Senckenberg am Meer (SaM) institute in Wilhelmshaven, shells from the sieve fractions were hand-sorted using a low magnification Zeiss stereo-microscope. Selected specimens were colour photographed using a Keyence confocal stereo-microscope. Optical stacking of multi-focal images was performed using the Keyence processing software. Additional high-resolution images were taken using a VEGA3-Tescan Scanning Electron Microscope (SEM) using an incident energy of 10 KeV. The SEM samples were coated with gold to enhance image quality.

One holotype and two paratype sets are retained at the Museum national d'Histoire naturelle (MNHN) in Paris, France. One paratype is kept at the Senckenberg Museum in Frankfurt am Main (SMF), Germany. The remaining material from the R/V Meteor Cruise M151 is kept in the reference collection in SaM, Wilhelmshaven.

We used the reference collection at SaM as well as Atlantic literature records of fissurellids to establish distributions of the Azorean species. All examined material consists of material stored at SaM unless specifically stated otherwise. A particularly important reference is the doctoral thesis by Barrio González (2015) that includes some fissurellid records from the SEAMOUNT 2 expedition (Gofas, 1997) to the Southern Azorean Seamount Chain. Unfortunately, the material studied by Barrio González (2015) is currently not accessible.

Abbreviations. Morphological: H = height of shell in mm; L = length of shell in mm; W= width of shell in mm. Institutes: GeoB = Sample location indicator of University or Bremen, Germany; MNHN = Muséum national d'Histoire naturelle, Paris, France; NHMUK = Museum of Natural History of the United Kingdom, London, United Kingdom; RBINS = Royal Belgian Institute for Natural Sciences, Brussels, Belgium; RMNH = Rijksmuseum voor Natuurlijke Historie, now Netherlands Centre for Biodiversity – Naturalis, Leiden, the Netherlands; SaM = Senckenberg am Meer, Wilhelmshaven, Germany; SMF = Senckenberg Museum, Frankfurt am Main, Germany.

RESULTS

Nearly 1000 shells have been examined in this study. Live specimens have not been found during the M151 cruise. The abundance of empty shells in ROV samples, van Veen grabs and box core samples are common on seamounts where the sediment is largely biogenic with remains of foraminiferans, sponges, corals, planktotrophic and benthic gastropods and bivalves and in minor fractions hydroids, crustaceans and echinoderms. The probability for sampling live specimens on hard substrates or hosts (like for example sponges) is low in these types of sediment samples. Alternative sampling by dredging is nowadays hardly done in coral-related habitats to minimise damage to the invertebrate megafauna.

Twelve species were found during the cruise M151. *Puncturella asturiana* (P. Fischer, 1882) and *Profundisepta alicei* (Dautzenberg & H. Fischer, 1897) have been reported from off the Azores but these taxa were not found in our material. Additionally, *Puncturella* cf. *laxa* (Dall, 1927) was reported by Barrio González (2015: 299) but the species was also not encountered during M151. Hence, in total 15 species are currently known from the Azorean seamounts.

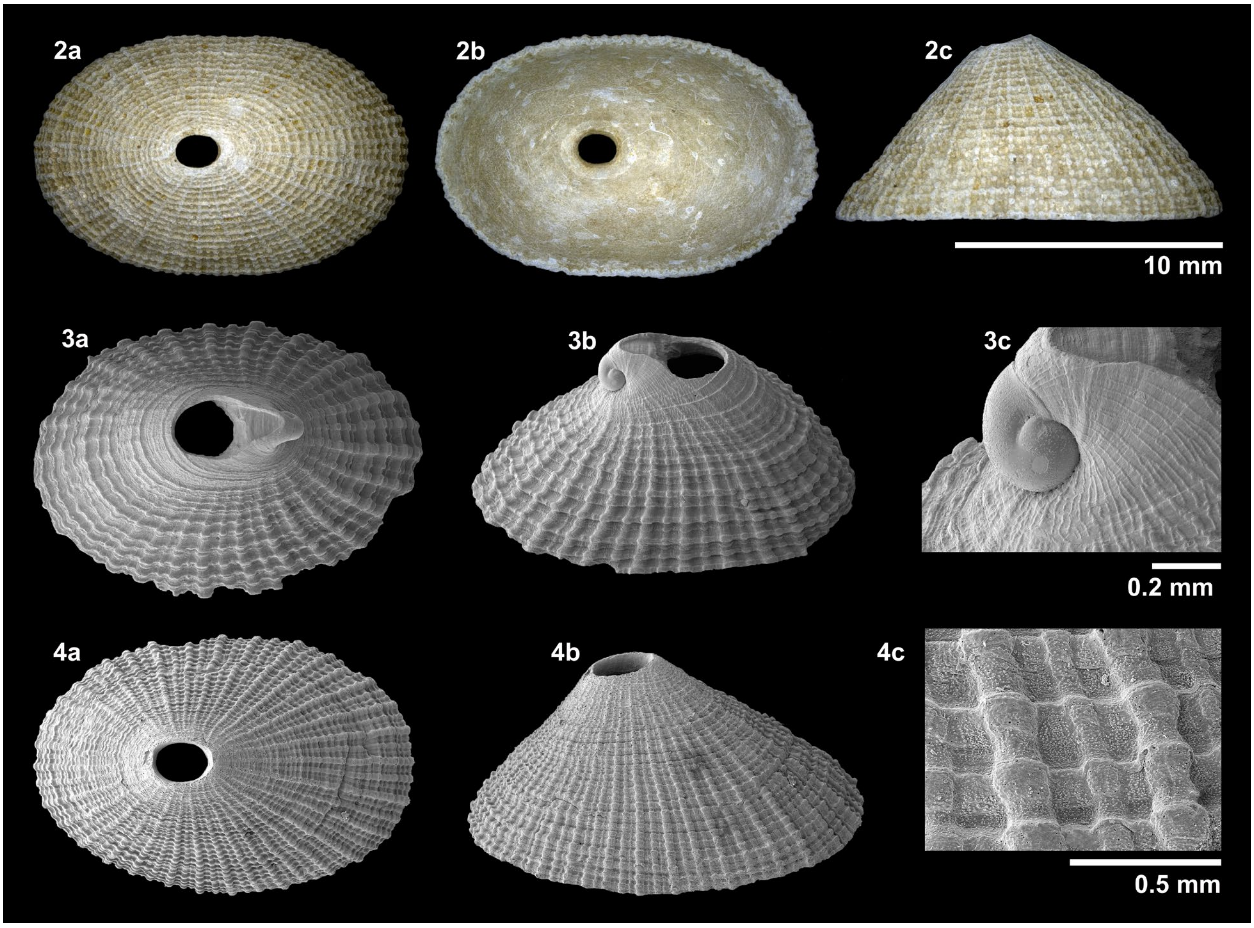
SYSTEMATICS

Class Gastropoda Cuvier, 1795
Subclass Vetigastropoda Salvini-Plawen, 1980
Superfamily Fissurelloidea J. Fleming, 1822
Family Fissurellidae J. Fleming, 1822

Genus *Diodora* Gray, 1828
Type species (by monotypy): *Patella graeca* Linnaeus, 1758.

Diodora tenuiclathrata (Seguenza, 1863)
(Figs 2-4)

Material examined (145 shells, 1 specimen). — **Azorean seamounts**. Mar da Prata. • 1 shell; 37.669°N, 25.926°W; 834 m; M151-GeoB23109. • 11 shells; 37.673°N, 25.925°W; 595 m;



Figs 2-4. *Diodora tenuiclathrata* (Seguenza, 1863). **2a-c.** Azores, Mar da Prata, M151-GeoB23111, L 15 mm, W 9 mm, H 7 mm. **3a-c.** Mauritania, Banda Mound Complex, POS346-GeoB11567, juvenile shell: (a-b) external view, L 3.7 mm, W 2.6 mm; (c) protoconch, L 0.40 mm. **4a-c.** Mauritania, Tamxat Mound Complex, MSM16/3-GeoB14905, subadult shell: (a-b) external view, L 9 mm, W 6 mm; (c) sculpture.

M151-GeoB23111. • 10 shells; 37.661°N, 25.918°W; 599 m; M151-GeoB23112. Great Meteor Seamount. • 1 shell; 29.565°N, 28.339°W; 944 m; M151-GeoB23425R6. **Rockall Bank**. Haas mounds. • 3 shells; 55.503°N, 15.786°W; 667 m; HERMES2005-23. Kiel Seamount. • 5 shells; 56.696°N, 17.523°W; 863 m; M61-1-300. **Porcupine Basin.** Challenger Mound. • 1 shell; 51.438°N, 11.740°W; 916 m; POS316-528. • 1 shell; 51.460°N, 11.700°W; 670 m; POS292-606. Castor Mound. • 3 shells; 51.430°N, 11.794°W; 1029 m; M61-1-223. • 3 shells; 51.441°N, 11.787°W; 1059 m; M61/1-221. • 2 shells; 51.430°N, 11.794°W; 1029 m; M61/1-223. Galway Mound. • 3 shells; 55.536°N, 15.656°W; 889 m; POS292-541. Propeller Mound. • 30 shells; 51.449°N, 11.753°W; 837 m; M61/3-551. **Moroccan Slope.** • 1 shell; 35.367°N, 6.903°W; 685 m; 64PE284-GeoB12712-1. **Mauritania.** Arguin South 3 Canyon. • 12 shells; 19.708°N, 17.117°W; 370 m; POS346-GeoB11509. Banda Mounds Complex. • 1 shell; 17.650°N, 16.668°W; 441 m; POS346-GeoB11566. • 6 shells; 17.658°N, 16.668°W; 428 m; POS346-GeoB11567. • 6 shells; 17.664°N, 16.673°W; 514 m; POS346-GeoB11568. • 2 shells; 17.667°N, 16.672°W; 440 m; POS346-GeoB11569. • 2 shells; 17.675°N, 16.670°W; 458 m; POS346-GeoB11578. • 3 shells; 17.679°N, 16.668°W; 450 m; POS346-GeoB11579. • 7 shells; 17.684°N, 16.668°W; 481 m; POS346-GeoB11580. Timiris Mound Complex. • 2 shells; 18.98325°N, 16.86558°W; 482 m; POS346-GeoB11587. • 9 shells; 18.9832°N, 16.86363°W; 474 m; POS346-GeoB11588. Tanoudert Canyon. • 2 shells; 20.243°N, 17.668°W; 490 m; MSM16/3-GeoB14799. Timiris deep coral mound chain. • 4 shells; 18.962°N, 16.870°W; 548 m; MSM16/3-GeoB14876. • 6 shells; 18.963°N, 16.869°W; 498 m; MSM16/3-GeoB14877. Tamxat Mounds. • 2 shells; 17.548°N, 16.662°W; 414 m; MSM16/3-GeoB14903. • 1 shell; 17.541°N, 16.667°W; 486 m; MSM16/3-GeoB14905. • 1 live specimen; 17.670°N, 16.681°W, 574 m; MSM16/3-GeoB14908. • 4 shells; 17.483°N, 16.694°W; 535 m; MSM16/3-GeoB14910.

Literature records. — Dautzenberg & Fischer (1896: 189, pl. XXII figs 6-7) described the synonymous *Glyphis edwardsi* from SE of Flores, 39.027°N, 30.256°W; 454 m; Hirondelle (1888) sta. 70. Gofas et al. (2021) reported *Diodora tenuiclathrata* from the Galicia Bank: 42.867°N, 11.850°W; 985-1000 m; SEAMOUNT 1-DW116.

Remarks. — *Diodora tenuiclathrata* is the only present day deep-water species in the genus *Diodora* from the NE Atlantic. It is known from the Azorean seamounts and from the Rockall Bank south to the Mauritanian upper slope in 370-1000 m. It is likely extinct in the Mediterranean Sea.

The species is distinguished by its perfectly oval foramen (Figs 2a-b, 4a), its sculpture of radial flattened ribs with alternating strengths with overlying flattened commarginal cords of equal strength (Fig. 4c). The outline of the margin is oval when young turning oblong-oval in adult shells (Figs 2a-b, 3a, 4a); the anterior-dorsal margin is convex, the posterio-dorsal margin is nearly straight (Fig. 2c). Young specimens show a protoconch posterior of the foramen; the protoconch has a length of 0.4 mm, a faintly dotted sculpture and a flexuous thickened lip (Figs 3a-c).

Genus *Emarginula* Lamarck, 1801

Type species (by monotypy): *Emarginula conica* Lamarck, 1801 (= *Patella fissura* Linnaeus, 1758).

Emarginula adriatica O. G. Costa, 1830
(Figs 5-7)

Material examined (109 shells). — **Azorean seamounts.** José Gaspar Seamount. • 4 shells; 37.674°N, 25.717°W; 337 m; M151-GeoB23105-2. • 6 shells; 37.675°N, 25.717°W; 311 m; M151-GeoB23161. Mar da Prata. • 13 shells; 37.673°N, 25.925°W; 595 m; M151-GeoB23111. • 1 shell; 37.669°N, 25.906°W; 406 m; M151-GeoB23114. Açor Seamount. • 1 shell; 38.359°N, 29.051°W; 648 m; M151-GeoB23135. • 16 shells; 38.156°N, 29.084°W; 339 m; M151-GeoB23139. Atlantis Seamount. • 1 shell; 33.971°N, 30.206°W; 677 m; M151-GeoB23404. Great Meteor Seamount. • 2 shells; 29.816°N, 28.433°W; 300 m; POS397-106-3. • 1 shell; 29.568°N, 28.340°W; 855 m; M151-GeoB23425R9. Little Meteor Seamount. • 2 shells; 29.654°N, 29.015°W; 852 m; M151-GeoB23436. • 4 shells; 29.655°N, 29.003°W; 464 m; M151-GeoB23438. • 4 shells; 29.645°N, 28.975°W; 284 m; M151-GeoB23440. **Bay of Cadiz.** Hesperides Mud Volcano. • 1 shell; 36.182°N, 7.306°W; 676 m; SO175-GeoB9022. **Canary Islands**. Banco d'Amanay. • 3 shells; 28.282°N, 14.763°W; 120 m; VH97-196. **Madeira.** Porto Santo. • 3 shells; 33.01°N, 19.21°W; 370 m; CANCAP-3.032. **Cape Verde Islands.** Razo Island. • 1 shell; 6.60°N, 24.62°W; 208 m; CANCAP-7.120; RMNH.MOL.133828. **Mediterranean Sea.** • 1 shell; Greece, Corfu, Kontokali; 1 m. • 1 shell; Italy, Lampedusa; 20 m. • 20 shells; Italy, Lecce, Santa Caterina; 25 m. • 25 shells; Italy, Terracina; 80-120 m.

Literature records. — Piani (1985: 200-203, figs 13-25) appointed the neotype and recorded many specimens from the Mediterranean Sea.

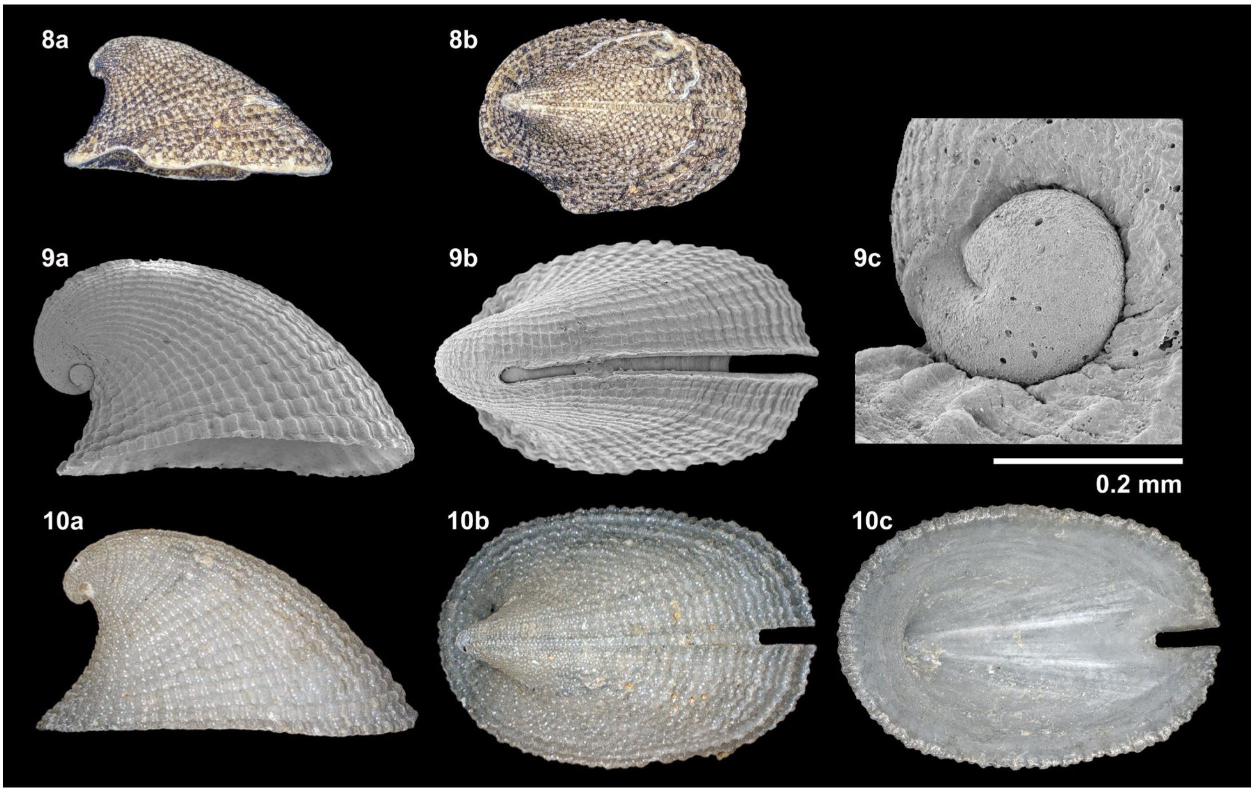
Remarks. — Shells have been found in the Mediterranean Sea, on the Azorean seamounts, and on the upper slope of NW Africa, Madeira, Canary Islands and the Cape Verde Islands from the sublittoral to 855 m.

Emarginula adriatica is identified by its overturned apex above the posterior margin; the sculpture has narrow regular radial ribs with regular tubercles.

Emarginula christiaensi Piani, 1985
(Figs 8-10)

Material examined (98 shells, 2 specimens). — **Azorean**

Figs 5-7. *Emarginula adriatica* O. G. Costa, 1830. **5-6.** Azores, Mar da Prata, M151-GeoB23111: (5) L 11 mm, W 8 mm, H 5 mm; (6) L 10 mm, W 7 mm, H 5 mm. **7.** Terracina, Italy, 80-120 m, L 8 mm, W 6 mm, H 3 mm.



Figs 8-10. *Emarginula christiaensi* Piani, 1985. **8.** Great Meteor Seamount, M151-23425R9, old shell, L 8 mm, W 6 mm, H 4 mm. **9.** SE Rockall Bank, HERMES2006-56, juvenile shell: (a-b) external view, L 2.1 mm, W 1.1 mm, H 1.1 mm; (c) protoconch, W 0.23 mm. **10.** Porcupine Seabight, Galway Mound, POS316-524, L 11 mm, W 8 mm, H 6 mm.

seamounts. Mar da Prata. • 1 shell; 37.673°N, 25.925°W; 595 m; M151-GeoB23111. • 1 shell; 37.661°N, 25.918°W; 599 m; M151-GeoB23112. Great Meteor Seamount. • 1 shell; 29.565°N, 28.339°W; 944 m; M151-GeoB23425R6. • 1 shell; 29.568°N, 28.340°W; 855 m; M151-GeoB23425R9. **Rockall Bank.** Logachev Mounds. • 1 shell; 55.545°N, 15.658°W; 687 m; M2001-29. • 3 shells; 55.436°N, 16.116°W; 784 m; Moundforce2004-41C. • 7 shells; 55.500°N, 15.798°W; 593 m; HERMES2005-15. • 1 shell; 55.503°N, 15.786°W; 667 m; HERMES2005-23. • 6 shells; 55.445°N, 16.076°W; 767 m; HERMES2005-34. • 1 shell; 55.496°N, 15.810°W; 578 m; HERMES2006-56. • 11 shells; 55.500°N, 15.799°W; 578 m; HERMES2006-23A. Franken Mound. • 4 shells; 56.507°N, 17.310°W; 656 m; M61/3-615. **Porcupine Basin.** Propeller Mound. • 1 shell; 51.455°N, 11.752°W; 857 m; M61/3-553. Castor Mound. • 1 shell; 51.441°N, 11.787°W; 1059 m; M61/1-221. Pollux Mound. • 5 shells; 51.416°N, 11.762°W; 912 m; M61/1-225. • 2 live specimens, 2 shells; 51.497°N, 11.702°W; 845 m; M61/1-234. Galway Mound. • 2 shells; 55.540°N, 15.653°W; 839 m; POS292-539. • 4 shells; 55.543°N, 15.671°W; 690 m; POS292-540. • 1 shell; 51.451°N, 11.752°W; 810.2 m; M61/3-552. • 3 shells; 51.455°N, 11.752°W; 857.2 m; M61/3-553. • 1 shell; 51.451°N, 11.757°W; 920 m; M61/3-566. • 1 shell; 51.454°N, 11.733°W; 860 m; POS316-524. **Moroccan Slope.** • 1 shell; 35.367°N, 6.903°W; 685 m; 64PE284-GeoB12712-1. **Mauritania.** Timiris Mound Complex. • 3 shells; 18.983°N, 16.866°W; 482 m; POS346-GeoB11587. • 1 shell; 18.983°N, 16.864°W; 474 m; POS346-GeoB11588. • 7 shells; 18.963°N, 16.869°W; 498 m; MSM16/3-GeoB14877. • 3 shells; 18.966°N, 16.868°W; 493 m; MSM16/3-GeoB14878. Mauritania. Banda Mound Complex. • 2 shells; 17.658°N, 16.668°W; 428 m; POS346-GeoB11567. • 3 shells; 17.667°N, 16.672°W; 440 m; POS346-GeoB11569. • 8 shells; 17.679°N, 16.668°W; 450 m; POS346-GeoB11579. • 2 shells; 17.684°N, 16.668°W; 481 m; POS346-GeoB11580. • 2 shells; 17.482°N, 16.692°W; 450 m; MSM16/3-GeoB14911. Tamxat Mound Complex. • 1 shell; 17.548°N, 16.662°W; 414 m; MSM16/3-GeoB14903. • 1 shell; 17.543°N, 16.663°W; 510 m; MSM16/3-GeoB14904. • 2 shells; 17.541°N, 16.667°W; 486 m; MSM16/3-GeoB14905. • 2 shells; 17.483°N, 16.694°W; 535 m; MSM16/3-GeoB14910.

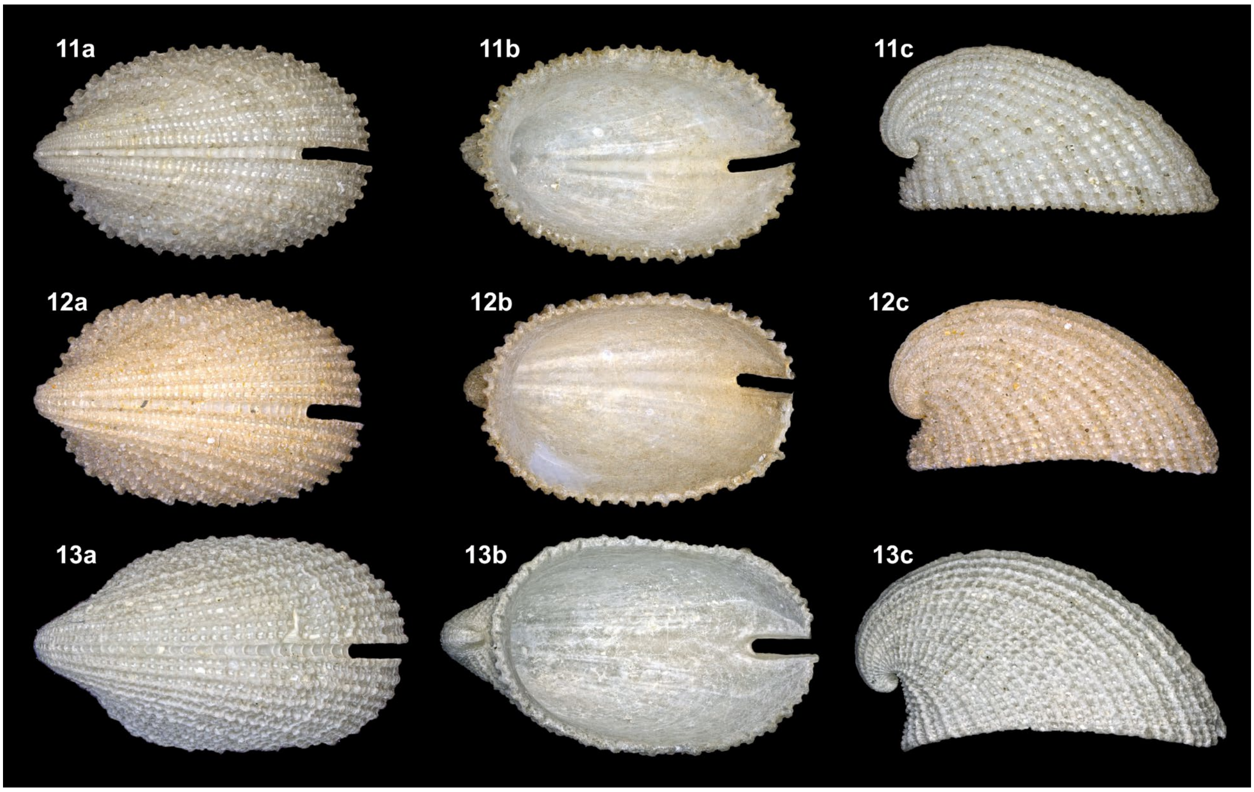
Literature records. — Locard (1898: 82–83, pl. 4 figs 16–18) described *Emarginula elata* non *E. elata* Libassi, 1859 from a single specimen from off Western Sahara, 365 m, Travailleur (1883) sta. 64. Piani (1985: 217-220, figs 65-71) provided the replacement name *E. christiaensi* and gave several records of the species in the Adriatic and western Mediterranean Sea. Hoffman et al. (2011: 92-93, figs 61-63) reported the species from the Rockall Bank. Hoffman & Freiwald (2018: 117-118, figs 11-14) provided records from off Mauritania. Gofas et al. (2021: 12, figs 4I-J) indicated several shells from the Galicia bank.

Remarks. — The species is identified by the elevated outline and a high pointed apex near the posterior margin; it has a regular reticulated sculpture, occasionally with regular dominant radial ribs. Gofas et al. (2021) suggested that the differences with the northern *Emarginula crassa* (Sowerby, 1813) need to be confirmed. It has been found in the NE Atlantic Ocean from the Rockall Bank to Mauritania and on the Azorean seamounts in 414-1059 m and in the Mediterranean Sea in 60-600 m. On the Azorean seamounts all shells were either old or juveniles.

Emarginula tuberculosa Libassi, 1859
(Figs 11-13)

Material examined (161 shells). — **Azorean seamounts.** Mar da Prata. • 7 shells; 37.669°N, 25.926°W; 834 m; M151-GeoB23109. • 7 shells; 37.673°N, 25.925°W; 595 m; M151-GeoB23111. • 93 shells; 37.661°N, 25.918°W; 599 m; M151-GeoB23112. • 1 shell; 37.579°N, 25.914°W; 925 m; M151-GeoB23156. Açor Seamount. • 1 shell; 33.996°N, 30.177°W; 617 m; M151-GeoB23408. Atlantis Seamount. • 29 shells; 33.971°N, 30.206°W; 677 m; M151-GeoB23404. • 1 shell; 38.359°N, 29.051°W; 648 m; M151-GeoB23135. Great Meteor Seamount. • 1 shell; 30.086°N, 28.726°W; 906 m; M151-GeoB23429R8. Little Meteor Seamount. • 2 shells; 29.654°N, 29.015°W; 865 m; M151-GeoB23434R4. • 2 shells; 29.654°N, 29.015°W; 852 m; M151-GeoB23436. • 1 shell; 29.654°N, 29.0138°W; 811 m; M151-GeoB23437. **Hatton Bank.** • 1 shell; 58.781°N, 18.590°W; 788 m; HERMES2008-59. **Rockall Bank.** Logachev Mounds. • 1 shell; 55.195°N, 15.650°W; 834 m; M2001-45. • 1 shell; 55.540°N, 15.653°W; 839 m; POS292-539. • 1 shell; 55.500°N, 15.799°W; 587 m; HERMES2006-10C. • 1 shell; 55.500°N, 15.799°W; 578 m; HERMES2006-23A. **Porcupine Basin.** Galway Mound. • 1 shell; 51.454°N, 11.733°W; 860 m; POS316-524. Porcupine Bank. • 1 shell; 53.787°N, 13.958°W; 809 m; M2001-26. **Morocco.** • 2 shells; 35.367°N, 6.903°W; 685 m; 64PE284-GeoB12712-1. **Lusitanian Seamounts.** Coral Patch Seamount. • 1 shell; 34.967°N, 11.956°W; 1050 m; VH97-91. **Mauritania.** Arguin South 3 Canyon. • 3 shells; 19.708°N, 17.117°W; 370 m; POS346-GeoB11509. Timiris Mound Complex. • 5 shells; 18.963°N, 16.869°W; 498 m; MSM16/3-GeoB14877. Banda Mounds Complex. • 1 shell; 17.646°N, 16.666°W; 442 m; POS346-GeoB11564. Tamxat Mound Complex. • 2 shells; 17.548°N, 16.662°W; 414 m; MSM16/3-GeoB14903. **Cape Verde Islands.** Sao Tiago Island. • 1 shell; 4.900°N, 23.633°W; 510 m; CANCAP-7.003; RMNH.MOL.133835. **Gulf of Mexico.** SW Florida Slope. • 1 shell; 26.337°N, 84.760°W; 507 m; MSM20/4-GeoB16337-2.

Literature records. — Libassi (1859) described the species from outcrop near Altavilla, Palermo, Sicily. Pérez Farfante (1947: 101-102, tab. 14 figs 1-7) reported the species from the western Atlantic from Georgia to Brazil. Piani (1985: 214-215, figs 46-48) and Cossignani & Ardovini (2011: 10, 94)



Figs 11-13. *Emarginula tuberculosa* Libassi, 1859. **11.** Little Meteor Seamount, M151-GeoB23434R4, L 8 mm, W 6 mm, H 4 mm. **12.** Azores, Mar da Prata, M151-GeoB23111, L 8 mm, W 6 mm, H 4 mm. **13.** Rockall Bank, HERMES2006-23, L 10 mm, W 6 mm, H 5 mm.

reported various records from the Mediterranian Sea. Hoffman et al. (2011: 92-93, figs 51-53) indicated shells from the Rockall Bank. Gofas et al. (2021: 12, figs 4F-H) recorded 2 shells from the Galicia Bank.

Remarks — The species can be identified by its broadly curved apex projecting beyond the posterior margin and the aligned tubercles on the spiral cords. The amphi-Atlantic and Mediterranean species has been recorded in 370-1050 m.

Genus *Cornisepta* J. H. McLean & Geiger, 1998

Type species (by original designation): *Fissurisepta antarctica* Egorova, 1972.

Cornisepta rostrata (Seguenza, 1863)

(Figs 14-15)

Material examined (47 shells). — **Azorean seamounts.** Mar da Prata. • 9 shells; 37.669°N, 25.9269°W; 834 m; M151-GeoB23109. Great Meteor Seamount. • 2 shells; 30.086°N, 28.726°W; 906 m; M151-GeoB23429R8. Little Meteor Seamount. • 5 shells; 29.654°N, 29.01494°W; 865 m; M151-GeoB23434R4. • 12 shells; 29.654°N, 29.015°W; 852 m; M151-GeoB23436. **Rockall Bank.** Logachev Mound Province. • 9 shells; 55.422°N, 15.611°W; 1443 m; Moundforce2004-29. **Porcupine Basin.** Galway Mound. • 1 shell; 51.448°N, 11.763°W; 982 m; M61/3-556. **Penmarc′h Bank.** • 1 shell; 46.904°N, 5.443°W; 610 m; VH97-321. **Galicia Bank.** • 5 shells; 42.874°N, 11.823°W; 1080 m; VH97-61. **Lusitanian Seamounts.** Coral Patch Seamount. • 1 shell; 34.967°N, 11.956°W; 1050 m; VH97-91. **Mediterranean Sea.** Reggio di Calabria. • 2 shells; 600 m.

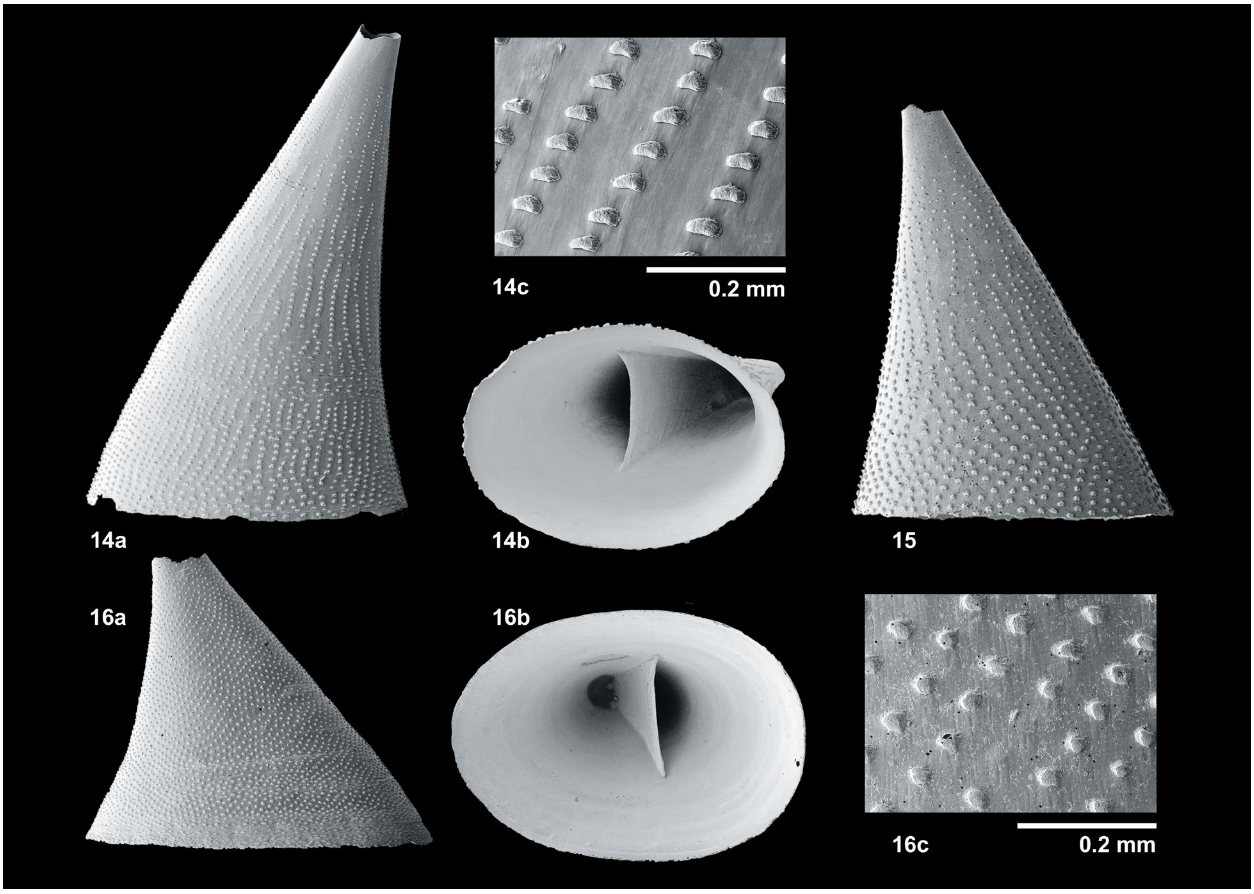
Literature records. — Seguenza G. (1863: 84-85, figs 3-3c) reported the type material from off Trapani, Sicily; these types are assumed lost during the 1908 earthquake in Messina (Ceragato and Tabanelli, 2006). Dautzenberg & Fischer (1896: 492, pl. 12 fig. 15) reported the syntypes of the synonymous *Cornisepta crossei* from South of Terceira: 37.767°N, 27.425°W; 1385 m; Princesse-Alice (1895) sta. 46 and between Flores and Faial: 38.795°N, 30.620°W; 1022 m; Princesse-Alice (1895) sta. 109. Barrio González (2015: 165) reported from SEAMOUNT 2: Hyères Seamount: DW200 (21 shells), DW203 (53 shells); Irving Seamount: DW238 (3 shells); Atlantis Seamount: DW261 (86 shells). Barrio González (2015: figs 49A-C) also figured 3 syntype shells from the Museum Oceanographique de Monaco (MOM 22 5747, shell figured by Dautzenberg & Fischer 1896: pl. 22 fig. 15; MOM 22 5748, 2 shells). Gofas et al. (2021: 13, pl. 2 fig. 6) recorded 1 shell from the Galicia Bank.

Remarks — The taxon can be identified by its fine axially aligned tubercles and its highly elevated outline. It has been recorded from the Azorean seamounts, from the Rockall Bank in the North to the Lusitanian seamounts and into the Mediterranean.

Cornisepta microphyma (Dautzenberg & H. Fischer, 1896)
(Figs 16)

Material examined (56 shells). — **Azorean seamounts.** Santa Maria. • 2 shells; 36.917°N, 25.117°W; 620 m; CANCAP-5.051; RMNH.MOL.133802. Mar da Prata. • 2 shells; 37.669°N, 25.926°W; 834 m; M151-GeoB23109. • 1 shell; 37.579°N, 25.914°W; 925 m; M151-GeoB23156. Atlantis Seamount. • 3 shells; 33.971°N, 30.206°W; 677 m; M151-GeoB23404. • 17 shells; 33.996°N, 30.177°W; 617 m; M151-GeoB23408. Great Meteor Seamount. • 2 shells; 29.565°N, 28.339°W; 945 m; M151-GeoB23425R4. • 2 shells; 29.565°N, 28.339°W; 944 m; M151-GeoB23425R6. • 3 shells; 29.568°N, 28.340°W; 855 m; M151-GeoB23425R9. Little Meteor Seamount. • 4 shells; 29.654°N, 29.015°W; 865 m; M151-GeoB23434R4. • 6 shells; 29.654°N, 29.015°W; 852 m; M151-GeoB23436. **Galicia Bank.** • 1 shell; 42.874°N, 11.823°W; 1080 m; VH97-61. **Cape Verde Islands.** Razo Island. • 3 shells; 6.600°N, 24.617°W; 400-430 m; CANCAP-6.093; RMNH.MOL.133805. Cima Island. • 8 shells; 14.933°N, 24.633°W; 590-610 m; CANCAP-7.039; RMNH.MOL.133790.

Literature records. — Barrio González (2015: 187) reported from SEAMOUNT 2: Hyeres Seamount: DW185 (1 shell), DW200 (62 shells), DW203 (9 shells); Irving Seamount: DW208 (4 shells), DW237 (1 shell), DW238 (18 shells); Plato Seamount: DW242 (83 shells); Atlantis Seamount: DW263 (60 shells), DW261 (26 shells, Barrio González, 2015: 201-226, as *Cornisepta corrali* nomen nudum, a synonym of *C. microphyma*). Barrio González (2015: 188, figs 61A-C) also figured the single type specimen reported by Dautzenberg & Fischer (1896: 492-493, pl. 22 fig. 14) stored at the Museum Oceanographique de Monaco (MOM 22 5751, 1 shell, 1888-78, 861 m). Gofas et al. (2021: 13, pl. 2 fig. 6) recorded 1 shell from the Galicia Bank.



Figs 14-16. *Cornisepta* J. H. McLean & Geiger, 1998. **14-15.** *Cornisepta rostrata* (Seguenza, 1863). **14a-c.** Little Meteor Seamount, M151-GeoB23436: (a) external view, H 5.1 mm, L 3.4 mm, W 2.4 mm; (b) internal view with septum; (c) external sculpture. **15.** Rockall Bank, Kiel Seamount, M61/1-300, side view, H 4.5 mm, L 3.4 mm. **16.** *Cornisepta microphyma* (Dautzenberg & H. Fischer, 1896), Little Meteor Seamount, M151-GeoB23436: (a) external view, H 3.4 mm, W 4.0 mm, L 2.9 mm; (b) internal view with septum; (c) external sculpture.

Remarks. — The taxon can be identified by its fine tubercles in quinqunx arrangement and its curved conical outline. It has been recorded from the Azorean seamounts, from the Rockall Bank in the North to the Lusitanian seamounts and into the Mediterranean.

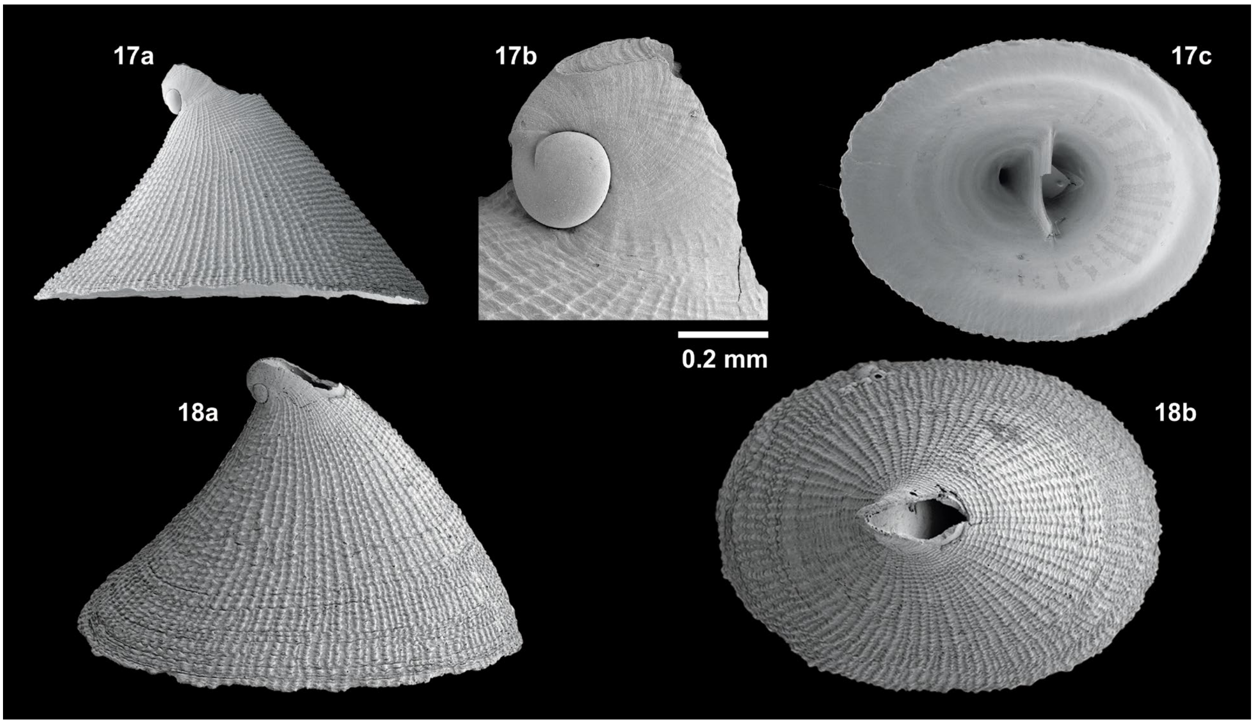
Genus *Profundisepta* J. H. McLean & Geiger, 1998

Type species (by original designation): *Puncturella profundi* Jeffreys, 1877.

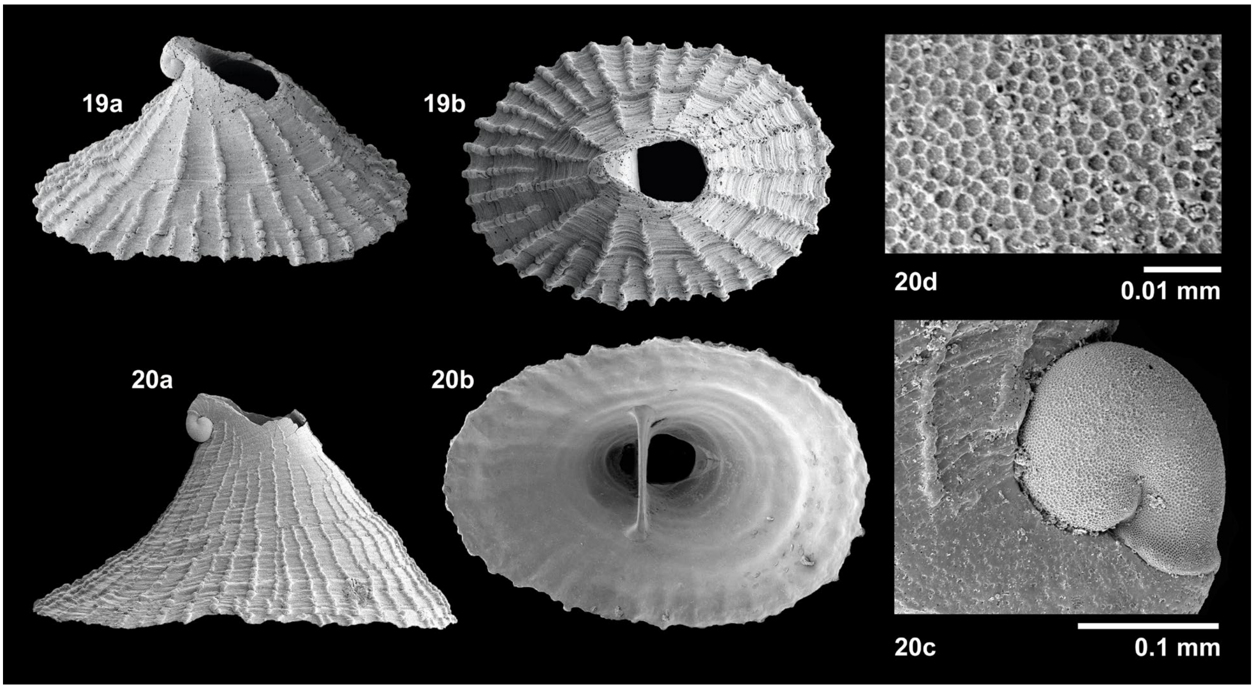
***Profundisepta profundi* (Jeffreys, 1877)**
(Figs 17-18)

Material examined (32 shells). — **Azorean seamounts.** Mar da Prata. • 5 shells; 37.669°N, 25.926°W; 834 m; M151-GeoB23109. • 3 shells; 37.666°N, 25.9666°W; 952 m; M151-GeoB23168. Atlantis Seamount. • 2 shells; 33.971°N, 30.206°W; 677 m; M151-GeoB23404. Great Meteor Seamount. • 1 shell; 29.565°N, 28.339°W; 945 m; M151-GeoB23425R4. • 2 shells; 29.565°N, 28.339°W; 944 m; M151-GeoB23425R6. • 2 shells; 29.568°N, 28.340°W; 855 m; M151-GeoB23425R9. • 1 shell; 29.568°N, 28.3408°W; 856 m; M151-GeoB23427. • 1 shell; 30.087°N, 28.726°W; 906 m; M151-GeoB23429R8. Little Meteor Seamount. • 2 shells; 29.654°N, 29.015°W; 865 m; M151-GeoB23434R4. • 8 shells; 29.654°N, 29.0147°W; 852 m; M151-GeoB23436. **Rockall Bank.** Logachev Mound Province. • 3 shells; 55.422°N, 15.611°W; 1443 m; Moundforce2004-29. • 1 shell; 55.503°N, 15.786°W; 667 m; HERMES2005-23. • 1 shell; 55.452°N, 15.766°W; 1091 m; HERMES2006-12. Kiel Seamount. • 1 shell; 56.706°N, 17.500°W; 902 m; M61-1-313. **Porcupine Basin.** Challenger Mound. • 1 shell; 51.438°N, 11.740°W; 916 m; POS316-528; NBC. • 1 shell; 51.417°N, 11.761°W; 921 m; POS400-GeoB14528; NBC. **Gulf of Mexico.** Yucatan/Campeche Slope. • 2 shells; 23.491°N, 87.170°W; 566 m; M151-GeoB16310.

Literature records. — Type locality is off Portugal, Cape Mondego; 39.917°N, 9.933°W; 994 fathoms; Porcupine (1870) sta. 16 (Jeffreys, 1877: 232-233; Warén, 1980: 14). Watson (1883: 32) reported the species under the synonymous name *Profundisepta acuta*: West Indies, off Culebra Island, 5 shells; 18.64°N, 65.09°W; 713 m; Challenger sta. 24 (NHMUK 1887.2.9.154-9). Dall (1927: 111) reported the subspecies *multifila* from off Georgia, USA: 30.98-30.73°N, 79.64-79.43°W; 538-805 m. Pérez Farfante (1947: 129-130, pl. 56 figs 1-5) added records from Greenland to Florida in the NW Atlantic. Warén (1991: 55, fig. 1E) reported on nine specimens off SW Iceland in a coral habitat at 970 m. Barrio González (2015) reported the taxon from SEAMOUNT 1: Galicia Bank: DW108 (1 live specimen) and from SEAMOUNT



Figs 17-18. *Profundisepta profundi* (Jeffreys, 1877). **17.** Little Meteor Seamount, M151-GeoB23436: (a) external view, L 3.6 mm, W 3.0 mm, H 2.2 mm; (b) protoconch, W 0.26 mm; (c) internal view with septum. **18.** Rockall Bank, Kiel Seamount, M61/1-313: (a) external view, L 4.8 mm, W 3.6 mm, H 3.6 mm; (b) apical view with foramen.



Figs 19-20. *Profundisepta luciae* spec. nov. **19.** Paratype, Atlantis Seamount, M151-GeoB23404, L 2.2 mm, W 1.6 mm, H 1.4 mm, protoconch W 0.18 mm. **20.** Holotype, Great Meteor Seamount, M151-GeoB23425R9: (a) external side view, L 2.2 mm, W 1.5 mm, H 1.2 mm; (b) internal view with septum; (c) protoconch apical view, W 0.19 mm; (d) pitted protoconch sculpture.

2: Hyères Seamount: DW200 (92 shells), DW203 (166 shells); Irving Seamount: DW208 (1 shell), DW225 (1 shell), DW231 (1 shell), DW238 (2 shells); Atlantis Seamount: DW261 (7 shells), DW263 (1 shell) and 1 shell from the Josephine Bank. Ortega and Gofas (2019: 517, figs 2E-F) reported 370 shells from off Gran Canaria; 28.15°N, 15.88°W; 660-655 m; SEAMOUNT 1-DW130.

Remarks. — *Profundisepta profundi* can be identified by its elevated conical outline, a reticulated sculpture and apical foramen with protoconch posteriorly and the near vertical septum inside. It has a northern amphi-Atlantic distribution; in the NE Atlantic it is known from Iceland, the Rockall Bank to Gran Canaria and on the Azorean seamounts. Depth range is 500-1800 m.

Profundisepta alicei (Dautzenberg & H. Fischer, 1897)

Material examined. — None.

Literature records. — Dautzenberg & Fischer (1897: 180) reported the syntypes from the Azores. West of Flores: 39.309°N, 33.536°W; 1372 m; Hirondelle (1888) sta. 47. South of Terceira: 37.767°N, 27.425°W; 1385 m; Princesse-Alice (1895) sta. 46. South of Faial: 38.433°N, 28.850°W; 1165 m; Princesse-Alice (1895) sta. 71. SW of Flores: 39.167°N, 33.417°W; 1360 m; Princesse-Alice (1896), sta. 74. 39.183°N, 32.742°W; 1600 m; Princesse-Alice (1896), sta. 90. McLean & Geiger (1998: 8-9, figs 3H-L) reported 2 shells from the Ibero-Moroccan Gulf. Barrio González (2015: 249-255, figs 88-90) reported 10 shells from the Atlantis Seamount: SEAMOUNT 2-DW261, and 1 shell each from the Galicia Bank and the Josephine Bank.

Remarks. — We did not encounter any additional specimens of *Profundisepta alicei* during the M151 cruise. The species can be easily identified by its smooth teleoconch and apical foramen with posterior protoconch and a near vertical septum inside. It has been recorded on the northern Azorean seamounts, the Galicia Bank, the Gulf of Cadiz including the Lusitanian seamounts in 1165-1600 m.

Profundisepta luciae spec. nov.

(Figs 19-20)
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Profundisepta luciae spec. nov. is a new name for *Profundisepta elmantika* nomen nudum that was described in the doctoral thesis by Barrio González (2015: 257-269); this document is not available as a formal taxonomical publication because (1) no reference is made in the document to any external depository for the thesis (ICZN Article 8.5.3.1-2) and (2) the document has not been registered in the Official Register of Zoological Nomenclature (ZooBank) prior to publication (iczn Article 8.5.3). The type material proposed by Barrio González was not returned to mnhn, owner of the seamount 2 material, despite multiple requests, and we were not able to study it.

Type material (10 shells). — **Azorean seamounts.** • holotype; 1 shell; Great Meteor Seamount; 29.565°N, 28.339°W; 944 m; 25.x.2018; M151-GeoB23425R6; rov grab in bioclastic sand with coral debris; mnhn-im-2000-38608. • paratypes, 2 shells; Little Meteor Seamount; 29.654°N, 29.015°W; 852 m; 25.x.2018; M151-GeoB23436; grab in bioclastic sand with coral debris; mnhn-im-2000-38609. • paratypes, 6 shells; Atlantis Seamount; 33.971°N, 30.206°W; 677 m; 21.x.2018; M151-GeoB23404; grab in bioclastic sand with coral debris; mnhn-im-2000-38610. • paratype, 1 shell; Atlantis Seamount; 33.996°N, 30.177°W; 617 m; 21.x.2018; M151-GeoB23408; grab in bioclastic sand with coral debris; smf 359017.

Other material investigated (10 shells). — **Azorean seamounts.** Mar da Prata. • 3 shells; 37.673°N, 25.925°W; 595 m; 08.x.2018; M151-GeoB23111; grab in bioclastic sand with coral debris; SaM86178. • 3 shells; 37.661°N, 25.918°W; 599 m; 08.x.2018; M151-GeoB23112; grab in bioclastic sand with coral debris; SaM87001. • 1 shell; 37.669°N, 25.906°W; 406 m; 08.x.2018; M151-GeoB23114; grab in bioclastic sand with coral debris; SaM86180. José Gaspar Seamount. • 1 shell; 37.676°N, 25.718°W; 293 m; 12.x.2018; M151-GeoB23131; grab in bioclastic sand; SaM86179. Açor Seamount. • 2 shells; 38.156°N, 29.084°W; 339 m; 13.x.2018; M151-GeoB23139; grab in bioclastic sand with coral debris; SaM85803.

Literature records (8 shells). — Barrio González (2015): • 2 shells; Hyères Seamount; 31.158°N, 28.725°W; 845 m; seamount 2-dw203; dredge in bioclastic sand and coral. • 1 shell; Irving Seamount; 32.265°N, 27.532°W; 670 m; seamount 2-dw237; dredge in sand and coral. • 1 shell; Atlantis Seamount; 34.082°N, 30.255°W; 340 m; seamount 2-dw255; dredge in bioclastic sand. • 4 shells; Atlantis Seamount; 33.997°N, 30.202°W; 420 m; seamount 2-dw258; dredge in bioclastic sand.

Type locality. — Great Meteor Seamount, 29.565°N, 28.339°W, 944 m.

Etymology. — The species is named after Lucía Barrio González, who named the species initially.

Description. — Small (length 2 mm, height 1 mm), fragile, conical shell with elevated conical outline, radiating coarse cords, oblong aperture, apical foramen with near vertical septum inside. Colour white. Protoconch: placed posteriorly from foramen, obliquely set towards apical side protoconch. ¾ whorl, compact, with broad rim near lip; sculpture with shallow pits (diameter 0.5-1.5 µm) loosely arranged in hexagonal pattern, maximum diameter protoconch 180 µm. Teleoconch: Anterior outline straight; posterior concave; base oblong, more convex posteriorly. Foramen oblong, more convex posteriorly, curved septum posteriorly. Sculpture strong irregular radial ribs, absent apically, adapically thin and abapically thicker with rounded protrusions at margin (growing droplets running down a surface); irregular commarginal growth lines; major stages aligned with nodules on radial ribs. Internally smooth with imprint of external sculpture. Septum present at apical half of shell, placed at 30% from posterior end and near vertical, straight in basal view, anteriorly convexly curved towards posterior end foramen, closed at apex posteriorly, open anteriorly. Ventral margin roughly rounded.

Animal: unknown.

Variability: Adult length 1.6-2.0 mm; 35-50 radial ribs of variable strength; shells with fewer- have coarser ribs.

Distribution. — Azorean seamounts, 29.5-38.2°N, 25.7-30.3°W, upper bathyal depth range 293-944 m.

Remarks. — *Profundisepta luciae* spec. nov. was placed in *Profundisepta* in view of its similarity with the type species *P. profundi*; it shares the conical teleoconch with apical foramen with protoconch that is retained in an adult stage. *Profundisepta* forms a clade with the genomically similar *Cornisepta* within Zeidorinae Naef, 1911 (Cunha et al., 2019). The similar genus *Fissurisepta* has a straightened posterior outline and a smooth protoconch, which is lost in adult specimens. A comparison with *Puncturella* is problematic as the genus is polyphyletic and morphologically diverse; it is generally characterised by a strongly curved septum along the posterior apical margin; many species in *Puncturella* retain their protoconch when adult.

A comparison with all hitherto known present day species in *Profundisepta* is meaningful; other fissurellid genera are morphologically different. The sympatric type species *P. profundi* has regular fine axial riblets and regular commarginal growth margins; the diameter of the micro-pits on the protoconch are less than 0.5 µm and the internal septum is obliquely placed towards the posterior (Barrio González, 2015). *Profundisepta luciae* spec. nov. has a near vertical septum, a different sculpture on the teleoconch and the micro-pits on the protoconch are larger. The sympatric *P. alicei* has a smooth teleoconch; its oblique septum and finely pitted sculpture of the protoconch are similar to that of the type species (Barrio González, 2015). Some species in *Profundisepta* were figured in Pérez Farfante (1947) and McLean & Geiger (1998). The western Atlantic *P. sportella* (R. B. Watson, 1883) have strong commarginal ribs with nodular intersections with the axial cords. The Cuban *P. borroi* (Pérez Farfante, 1947) has relatively few strong and smooth axial ribs on a smooth teleoconch. The western Atlantic *P. circularis* (Dall, 1881) has lesser axial ribs on a rather smooth teleoconch and its septum is laterally curved. The Indonesian *P. gemmata* (Schepman, 1908) has fine axial ribs and a curved septum inside. The SW Atlantic *P. denudata* Simone & Cunha, 2014 is predominantly smooth with few regular commarginal growth stages. The South African *P. foraginosa* Herbert &

Kilburn, 1986 has a coarsely-pitted teleoconch.

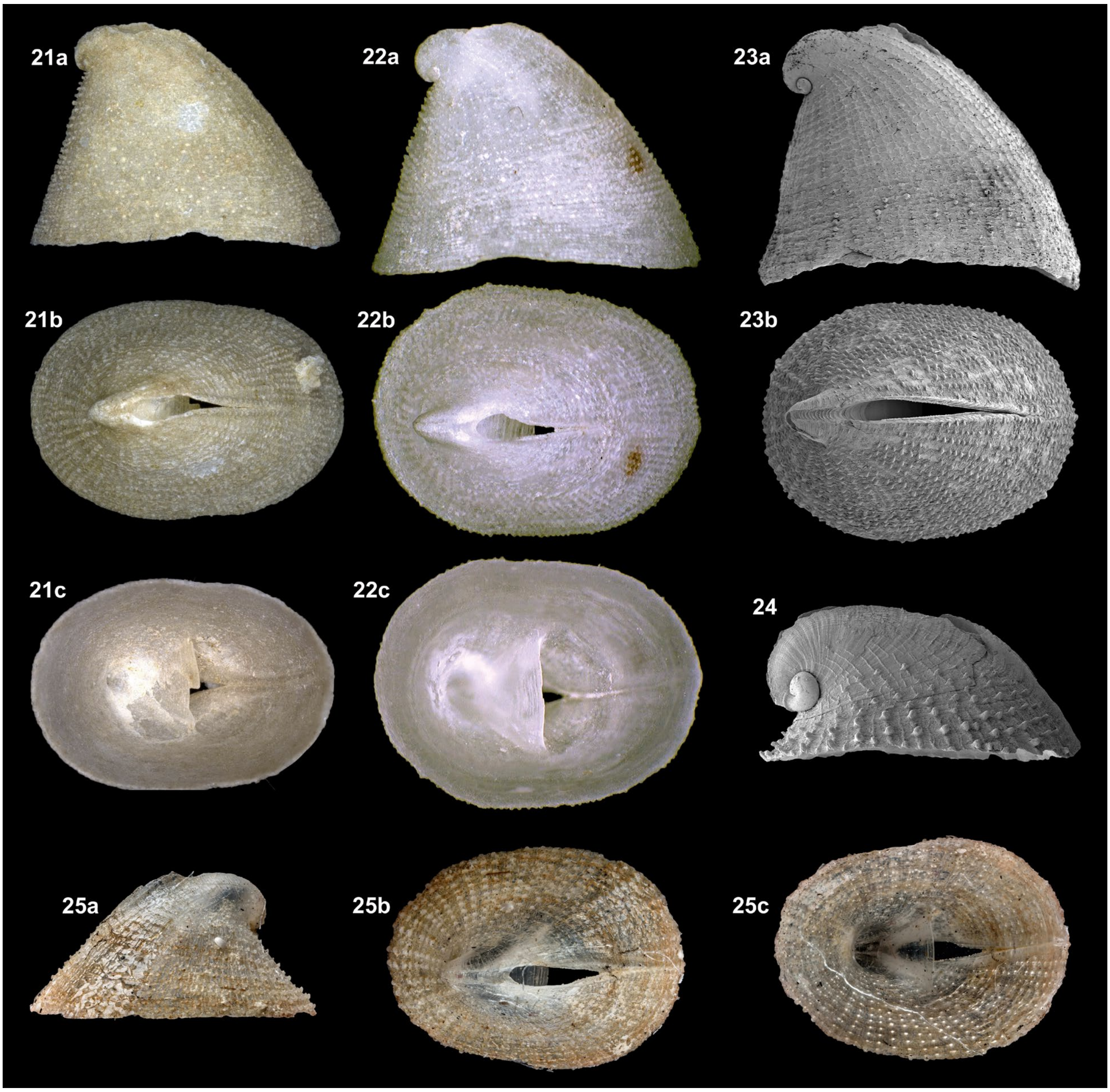
Only empty shells were found in bioclastic sand, frequently with coral fragments. Some shells are old and fragmentary.

Genus *Puncturella* R. T. Lowe, 1827

Type species (by monotypy): *Patella noachina* Linnaeus, 1771.

***Puncturella agger* R. B. Watson, 1883**
(Figs 21-25)

Material examined (193 shells). — **Azorean seamounts.** Mar da Prata. • 20 shells; 37.669°N, 25.926°W; 834 m; M151-GeoB23109. • 12 shells; 37.673°N, 25.925°W; 595 m; M151-GeoB23111. • 26 shells; 37.661°N, 25.918°W; 599 m; M151-GeoB23112. • 2 shells; 37.579°N, 25.914°W; 925 m; M151-GeoB23156. • 1 shell; 37.666°N, 25.9664°W; 952 m; M151-GeoB23168. Atlantis Seamount. •



Figs 21-25. *Puncturella agger* R. B. Watson, 1883. **21.** Azores, Mar da Prata, M151-GeoB23112: (a) external side view, L 5 mm, W 4 mm, H 4 mm; (b) apical view with foramen; (c) internal view with septum. **22-23.** Rockall Bank, HERMES2006-23: (20a-c): L 7 mm, W 6 mm, H 5 mm; (a) external side view; (b) apical view with foramen; (c) internal view with septum. (21a-b): L 4 mm, H 3 mm; (a) external side view; (b) apical view with foramen. **24.** Rockall Bank, Franken Mound, M61/3-615, juvenile shell external side view, L 2 mm, H 1 mm, protoconch W 0.25 mm. **25.** Syntype, West Indies, off Culebra Island, 713 m, CHALLENGER sta. 24, L 4 mm, W 3 mm, H 2 mm (MNHUK 1887.2.9.130, © The Trustees of the Natural History Museum, London): (a) external side view; (b) apical view with foramen; (c) internal view with septum.

29 shells; 33.971°N, 30.206°W; 677 m; M151-GeoB23404. • 8 shells; 33.996°N, 30.177°W; 617 m; M151-GeoB23408. Great Meteor Seamount. • 4 shells; 29.565°N, 28.339°W; 948 m; M151-GeoB23425R1. • 1 shell; 29.565°N, 28.339°W; 945 m; M151-GeoB23425R4. • 2 shells; 30.086°N, 28.726°W; 906 m; M151-GeoB23429R8. • 3 shells; 29.568°N, 28.340°W; 855 m; M151-GeoB23425R9. Little Meteor Seamount. • 2 shells; 29.654°N, 29.0149°W; 865 m; M151-GeoB23434R4. • 16 shell; 29.654°N, 29.0147°W; 852 m; M151-GeoB23436. • 2 shells; 29.654°N, 29.014°W; 811 m; M151-GeoB23437. **Hatton Bank.** • 1 shell; 58.762°N, 18.757°W; 958 m; HERMES2008-117. **Rockall Bank.** Franken Mound. • 6 shells; 56.507°N, 17.310°W; 656 m; M61/3-615. Logachev Mounds. • 18 shells; 55.500°N, 15.785°W; 673 m; Moundforce2004-33A. • 2 shells; 55.500°N, 15.798°W; 593 m; HERMES2005-15. • 4 shells; 55.503°N, 15.786°W; 667 m; HERMES2005-23. • 12 shells; 55.503°N, 15.786°W; 667 m; HERMES2005-23. • 6 shells; 55.445°N, 16.076°W; 767 m; HERMES2005-34. • 1 shell; 55.500°N, 15.799°W; 587 m; HERMES2006-10C. • 8 shells; 55.500°N, 15.799°W; 578 m; HERMES2006-23A. **Porcupine Basin.** Galway Mound. • 4 shells; 55.541°N, 15.653°W; 839 m; POS292-539. • 2 shells; 55.543°N, 15.672°W; 690 m; POS292-540. • 1 shell; 51.454°N, 11.733°W; 860 m; POS316-524. **Galicia Bank.** • 1 shell; 42.874°N, 11.823°W; 1080 m; VH97-61. **Gulf of Mexico**. SW Slope Florida. • 1 shell; 26.337°N, 84.760°W; 507 m; MSM20/4-GeoB16337-2.

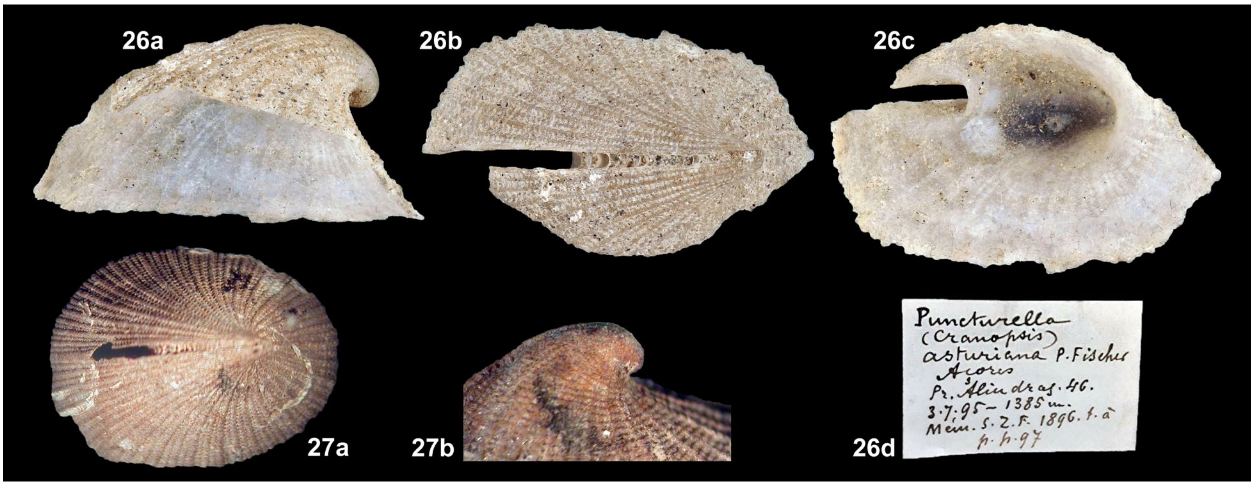
Literature records. — Watson (1883: 32) reported the type data: West Indies, off Culebra Island, 1 shell, 18.633°N, 65.087°W, 713 m, CHALLENGER sta. 24 in coral-mud (NHMUK 1887.2.9.130). Pérez Farfante (1947: 127-128) reported the species from the Gulf of Mexico, off Florida, Cuba and Yucatan. Hoffman et al. (2011) and Hoffman & Freiwald (2018) erroneously reported *P. agger* under the name *Cranopsis granulata* Seguenza, 1863 from the Hatton and Rockall Banks and off Mauritania. Barrio González (2015: 109-123) reported the species as *Cranopsis agger* from SEAMOUNT 2: Great Meteor Seamount. DW152 (1 shell), DW166 (1 shell). Hyères Seamount. DW182 (17 shells), DW183 (1 shell), DW192 (1 shell), DW200 (6 shells), DW202 (1 shell), DW203 (110 shells). Irving Seamount. DW237 (23 shells), DW238 (1 shell), Plato Seamount. DW242 (95 shells), DW247 (4 shells). Atlantis Seamount. DW258 (1 shell), DW263 (55 shells). Additionally, she reported live specimens and shells from the continental slope off the western Iberian Peninsula and the Galicia Bank. Gofas et al. (2021) reported 3 live specimens and 4 shells from the Galicia Bank.

Remarks. — *Puncturella agger* can be identified by the elevated shell with coarsely granulated radial cords, the small apex leaning towards the posterior and the lanceolate foramen placed high on the anterior slope. The similar *P. granulata* has finely aligned granulated cords and a large apex at the posterior end. The amphi-Atlantic *P. agger* is known in the NE Atlantic from the Hatton and Rockall Banks to the Lusitanian and Azorean seamounts in 470-1080 m. In the NW Atlantic, it is known from the West Indies and the Gulf of Mexico. It is commonly found in cold-water coral habitats.

Puncturella asturiana (P. Fischer, 1882)
(Figs 26-27)

Material examined (1 shell). — **Canary Islands.** • 1 shell; El Hierro; 27.667°N, 18.167°W; 1200-1800 m; CANCAP-2.131; RMNH.MOL.22644.

Literature records. — Fischer (1882) reported the type locality from the TRAVAILLEUR (1881), Gulf of Gascogne, 1107-2018 m. A shell from the Azores is stored in the



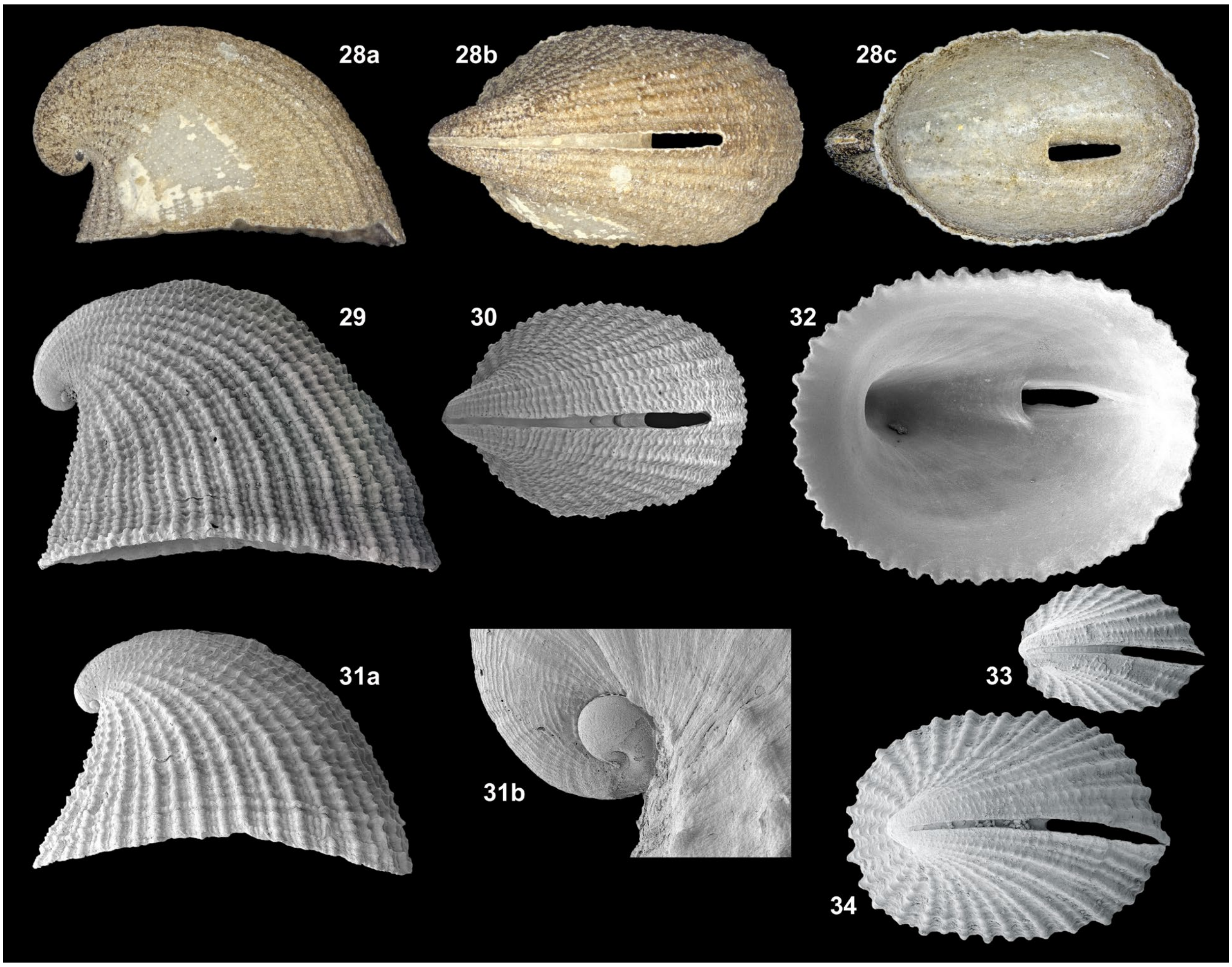
Figs 26-27. *Puncturella asturiana* (P. Fischer, 1882). **26.** Azores, Princesse Alice 1895-46, 1385 m, L 10 mm, H 5 mm (RBINS MT762, © RBINS / DIGIT-3 Belspo Licence: CC BY NC ND, photos: Florence Trus): (a) side view; (b) apical view; (c) internal view with septum; (d) museum label Dautzenberg collection. **27.** Off El Hierro, Canary Islands, CANCAP-2.131 1200-1800 m (Collection NBC Naturalis RMNH.MOL.22644, photos: Bart van Heugten): (a) apical view with foramen, L 15 mm, W 10 mm; (b) side view apex.

Royal Belgian Institute of Natural Sciences (Figs 26a-d rbins-mt762); Princesse Alice 1895, sta. 46, depth 1385 m. Watson (1883) reported the species under the synonym *P. craticia* from the West Indies, off Culebra Island, 18.633°N, 65.087°W, 713 m, challenger sta. 24 (nhmuk 1887.2.9.150). Pérez Farfante (1947: 188-189, pl. 32 figs 1-5) indicated the species from Cape Hatteras, USA to the Lesser Antilles. Barrio González (2015) reported on the seamount 2 material: Azorean seamounts; Hyères Seamount, dw203 (6 shells). Irving Seamount, dw225 (2 shells). Plato Seamount, dw248 (2 shells). Additionally, she provided records from the Lusitanian Seamounts; Gorringe Bank, seamount 1-cp11 (2 shells).

Remarks. — *Puncturella asturiana* is identified by a concave posterior outline, a small apex placed posteriorly, convex anterior outline with a lanceolate foramen. Recently, it has been confused with *P. fornicata,* see for example Hoffman et al. (2011, 2018). We did not encounter the species on the Azorean Seamounts during the M151 cruise. Warén (1991: 55, fig. 1D) figured a dorsal view of a shell from off SW Iceland at 508-476 m as *Cranopsis asturiana* but its coarsely ribbed sculpture and long oblong foramen suggests *Puncturella fornicata*; the former has many fine ribs and a smaller apex that is placed more centrally. The distribution of the rare amphi-Atlantic species in the northern Atlantic is confirmed from the Lesser Antilles, the Azorean seamounts and from Bay of Biscay to the Canary Islands. The depth range is 500-2100 m.

Puncturella fornicata Locard, 1898
(Figs 28-34)

Material examined (216 shells). — **Azorean seamounts.** Mar da Prata. • 1 shell; 37.669°N, 25.926°W; 834 m; M151-GeoB23109. • 1 shell; 37.673°N, 25.925°W; 595 m; M151-GeoB23111. • 1



Figs 28-34. *Puncturella fornicata* Locard, 1898. **28.** Atlantis Seamount, L 6 mm, W 4 mm, H 4 mm: (a) external side view; (b) dorsal view with foramen; (c) internal view with septum. **29.** Porcupine Bank, Twin Mounds, ark/xix-283, L 7 mm, L 5 mm, H 5 mm, protoconch W 0.30 mm. **30.** Rockall Bank, Kiel Seamount, M61/1-300, L 5 mm, W 3 mm, H 4 mm. **31-34.** Mauritania, Banda Mounds, pos346-GeoB11587. (31a-b): L 6 mm, H 4 mm; (a) external side view of shell; (b) protoconch W 0.21 mm. (32): internal view of shell with septum, L 7 mm, W 5 mm. (33): juvenile shell, L 3 mm, W 2 mm. (34): subadult shell, L 5 mm, W 4 mm.

shell; 37.661°N, 25.918°W; 599 m; M151-GeoB23112. Atlantis Seamount. • 2 shells; 33.971°N, 30.206°W; 677 m; M151-GeoB23404. **Hatton Bank.** • 2 shells; 58.734°N, 18.718°W; 822 m; HERMES2008-92. • 1 shell; 58.762°N, 18.757°W; 958 m; HERMES2008-117. **Rockall Bank.** Kiel Seamount. • 12 shells; 56.697°N, 17.523°W; 863 m; M61/1-300. Bremen Mound. • 1 shell; 57.107°N, 16.587°W; 803 m; M61/3-596R3. Logachev Mounds. • 2 shells; 55.521°N, 15.663°W; 782 m; M2001-39. • 1 shell; 55.436°N, 16.116°W; 784 m; Moundforce2004-41C. • 4 shells; 55.503°N, 15.786°W; 667 m; HERMES2005-23. **Porcupine Basin.** Galway Mound. • 1 shell; 55.541°N, 15.653°W; 839 m; POS292-539. • 2 shells; 55.543°N, 15.672°W; 690 m; POS292-540. • 1 shell; 55.536°N, 15.656°W; 889 m; POS292-541. • 1 shell; 51.454°N, 11.733°W; 860 m; POS316-524. Challenger Mound. • 2 shells; 51.438°N, 11.740°W; 916 m; POS316-528. Propeller Mound. • 1 shell; 51.455°N, 11.752°W; 857 m; M61/3-553. Twin Mounds. • 1 shell; 53.100°N, 14.970°W; 930 m; PS64-283. Castor Mound. • 1 shell; 51.441°N, 11.787°W; 1059 m; M61-1-221. • 3 shells; 51.430°N, 11.794°W; 1029 m; M61-1-223. **Mauritania.** Banda Mound Complex. • 3 shells; 17.646°N, 16.666°W; 442 m; POS346-GeoB11564. • 3 shells; 17.650°N, 16.668°W; 441 m; POS346-GeoB11566. • 7 shells; 17.659°N, 16.668°W; 428 m; POS346-GeoB11567. • 20 shells; 17.664°N, 16.673°W; 514 m; POS346-GeoB11568. • 5 shells; 17.667°N, 16.672°W; 440 m; POS346-GeoB11569. • 7 shells; 17.675°N, 16.670°W; 458 m; POS346-GeoB11578. • 26 shells; 17.679°N, 16.668°W; 450 m; POS346-GeoB11579. • 10 shells; 17.684°N, 16.668°W; 481 m; POS346-GeoB11580. • 5 shells; 17.670°N, 16.681°W; 577 m; MSM16-3-GeoB14895. • 1 shell; 17.670°N, 16.674°W; 505 m; MSM16-3-GeoB14898. • 8 shells; 17.482°N, 16.692°W; 450 m; MSM16-3-GeoB14911. Timiris Mound Complex. • 36 shells; 18.983°N, 16.866°W; 482 m; POS346-GeoB11587. • 23 shells; 18.983°N, 16.864°W; 474 m; POS346-GeoB11588. • 13 shells; 18.962°N, 16.870°W; 548 m; MSM16-3-GeoB14876. • 63 shells; 18.963°N, 16.869°W; 498 m; MSM16-3-GeoB14877. • 2 shells; 18.966°N, 16.868°W; 493 m; MSM16-3-GeoB14878. Tanoudert Canyon. • 1 shell; 20.243°N, 17.668°W; 490 m; MSM16-3-GeoB14799. Tamxat Mound Complex. • 2 shells; 17.543°N, 16.663°W; 510 m; MSM16-3-GeoB14904. • 14 shells; 17.483°N, 16.694°W; 535 m; MSM16-3-GeoB14910.

Literature records. — Locard (1898: 78-79, pl. V figs 1-3) indicated the type locality: off Western Sahara, Cape Bojador, 26.333°N, 14.883°W, 782 m, TALISMAN (1883) sta. 65 (stated as 67). Barrio González (2015) reported the species as the syonym *Cranopsis gofasi* nomen dubium from SEAMOUNT 2: Azorean Seamounts; Hyères Seamount: DW200 (2 shells), DW203 (1 shell); Irving Seamount. DW208 (1 shell).

Remarks. — The species is placed in *Puncturella* as it has an internal septum; the morphologically similar *Rimula* has no septum. It is the only NE Atlantic species in *Puncturella* with the foramen in the middle of the anterior slope and where the apex is near the posterior margin.

Gofas et al. (2021: 36) suggested Locard's species but they did not report present day records. Hoffman et al. (2011, 2018) reported it under the name *Cranopsis asturiana* (P. Fischer, 1882); the genus *Cranopsis* has been syonymised with *Puncturella* (Cunha et al., 2019). Barrio-González (2015) reported it under the synonym *Cranopsis gofasi* nomen nudum (her document is not available under ICZN requirements, Articles 8.5.3, 8.5.3.1-2).

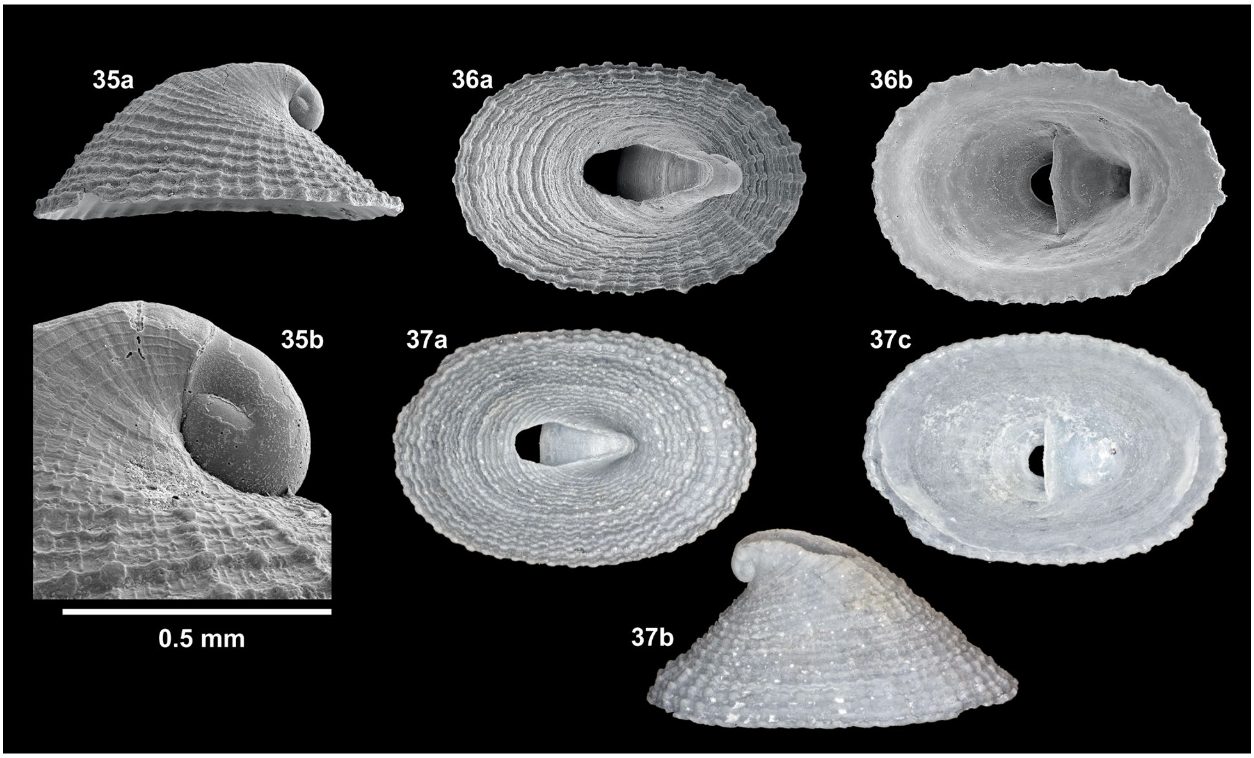
Empty shells are commonly found in cold-water coral habitats in the NE Atlantic from Iceland to Mauritania and on the Azorean Seamounts. The depth range is 440-1059 m.

Puncturella plecta R. B. Watson, 1883
(Figs 35-37)

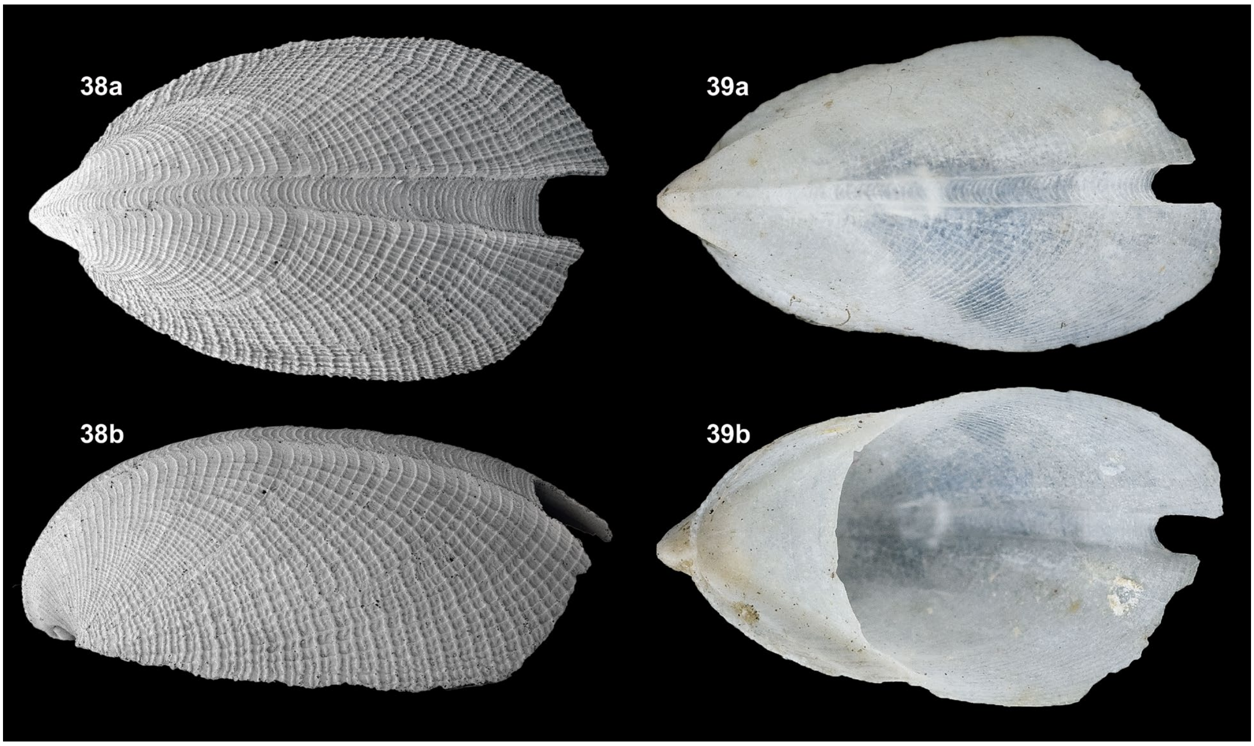
Material examined (19 shells). — **Azorean seamounts.** Mar da Prata. • 1 shell; 37.661°N, 25.918°W; 599 m; M151-GeoB23112. Atlantis Seamount. • 1 shell; 33.971°N, 30.206°W; 677 m; M151-GeoB23404. Little Meteor Seamount. • 1 shell; 29.654°N, 29.015°W; 852 m; M151-GeoB23436. **Mauritania.** Banda Mound Complex. • 2 shells; 17.664°N, 16.673°W; 514 m; POS346-GeoB11568. • 2 shells; 17.679°N, 16.668°W; 450 m; POS346-GeoB11579. • 1 shell; 17.684°N, 16.668°W; 481 m; POS346-GeoB11580. Timiris Mound Complex. • 1 shell; 18.983°N, 16.864°W; 474 m; POS346-GeoB11588. • 2 shells; 18.963°N, 16.869°W; 498 m; MSM16-3-GeoB14877. Tamxat Mound Complex. • 1 shell; 17.548°N, 16.662°W; 414 m; MSM16-3-GeoB14903. • 4 shells; 17.543°N, 16.663°W; 510 m; MSM16-3-GeoB14904. • 1 shell; 17.541°N, 16.667°W; 486 m; MSM16-3-GeoB14905. **USA.** Off Cape Lookout. • 2 shells; 34.324°N, 75.788°W; 387 m; TRACOS2010-11. • 1 shell; 34.207°N, 75.859°W; 387 m; TRACOS2010-33.

Literature records. — Watson (1883: 34-35) indicated the type locality: West Indies, off Culebra Island, 18.633°N, 65.087°W, 713 m, CHALLENGER sta. 24, NHMUK 1887.2.9.129. Jeffreys (1883: 676-677, pl. 50 fig. 11) reported the synonymous name *Puncturella clathrata* a few weeks after Watson's publication with the type locality: off Portugal, 39.650°N, 9.487°W, 1453 m, PORCUPINE sta. 17a, NHMUK 85.11.5.1405. Pérez Farfante (1947: 135-136, pl. 59 figs 1-3) figured a shell from off Georgia, USA. Barrio González (2015: 85) reported the species as *P. clathrata* from SEAMOUNT 2 material: Great Meteor Seamount. DW152 (1 shell). Hyères Seamount. DW182 (2 shells), DW200 (1 shell), DW203 (2 shells). Irving Seamount. DW237 (3 shells). Plato seamount. DW242 (4 shells). Josephine Bank (3 shells). She figured type specimens of both *P. clathrata* and *P. plecta* (Barrio González, 2015: 86, fig. 22). Hoffman et al. (2018) reported the species from Mauritania as *Profundisepta profundi* (*lapsus calami*).

Remarks — *Puncturella plecta* can be identified by its oval outline of the margin, low elevation and large apical foramen. It is an amphi-North Atlantic species. Depth range is 387-1453 m.



Figs 35-37. *Puncturella plecta* R. B. Watson, 1883. **35.** Azores, Mar da Prata, M151-GeoB23112: (a) external view old shell, L 2.7 mm, W 1.6 mm, H 1.3 mm; (b) protoconch W 0.34 mm. **36.** Mauritania, Tamxat Mound Complex, MSM16/3-GeoB14904: (a): apical view with foramen, H 1.6 mm, W 2.4 mm. (b): internal view shell with septum, W 1.7 mm, L 2.5 mm. **37.** SE Rockall Bank, HERMES2005-23: (b) external side view, L 5.0 mm, W 3.2 mm, H 2.7 mm; (a) external apical view with foramen; (c) internal view with septum.



Figs 38-39. *Zeidora naufraga* R. B. Watson, 1883. **38.** Azores, Mar da Prata, M151-GeoB23112, L 4.3 mm, W 2.5 mm, H 1.5 mm. (a): apical view; (b) external side view. **39.** Holotype, West Indies, off Culebra Island, 713 m, CHALLENGER sta. 24, L 8.5 mm, W 4.5 mm. (a): apical view; (b) internal view. (NHMUK 1887.2.9.128, © The Trustees of the Natural History Museum, London).

Genus *Zeidora* A. Adams, 1860

Type species (by monotypy): *Zeidora calceolina* A. Adams, 1860.

***Zeidora naufraga* R. B. Watson, 1883**
(Figs 38-39)

Material examined (3 shells). — **Azorean seamounts.** Mar da Prata. • 2 shells; 37.661°N, 25.918°W; 599 m; M151-GeoB23112. **Lusitanian Seamounts.** Gorringe Bank. • 1 shell; 36.567°N, 11.573°W; 180 m; VH97-80.

Literature records. — Watson (1883: 27-28, pl. 42) indicated the type locality: West Indies, off Culebra Island, 1 shell, 18.633°N, 65.087°W, 713 m, CHALLENGER sta. 24 (NHMUK 1887.2.9.128). Dautzenberg & Fischer (1897: 179) reported a shell from the Azorean seamounts, West of Flores, 39.187°N, 32.742°W, 1600 m, PRINCESSE-ALICE (1896) sta. 90. Cossignani & Ardovini (2011: 95) figured a shell from Algeria.

Remarks. — The species can easily be identified by the laterally symmetrical shell and the large septum extending to the margins. It is an amphi-Atlantic and western Mediterranean species. In the NE Atlantic it is known from the Azorean and Lusitanian seamounts.

DISCUSSION

Barrio González (2015) reported shells of *Cranopsis larva* Dall, 1927 from the Azorean seamounts. We did not encounter the species in the M151 samples but conclude that the species is not yet reported in the NE Atlantic. The holotype (USNM 108148) of *Puncturella larva* (Dall, 1927) was found off Fernandina, USA and was figured and redescribed by Pérez Farfante (1947: 126, pl. 54 figs 8-10). To date, the type set from the western Atlantic is the only known material. The immature holotype has a depressed outline with elongated base, widely spaced granulose radiating ribs, internally a short and narrow septum; its apex is near the posterior margin with an elevated glossy protoconch. The specimens figured by Barrio González (2015: 125, figs 38-40) as *Cranopsis larva* share characters like the protruding protoconch, lanceolate foramen and the terminal apex at a subadult stage but it differs by having a short and broad septum and a broader base. We herein refer to it as *Puncturella* cf. *larva* (Dall, 1927). *Cranopsis* was synonymised with *Puncturella* by Cunha et al. (2019).

Fifteen bathyal species in Fissurellidae were found on the Azorean seamounts. Only the distribution of the *Profundisepta luciae* spec. nov. is limited to the Azorean seamounts and the taxon is likely endemic to the area. Fourteen species have a NE Atlantic distribution; five species in this set are also found in the Mediterranean Sea and seven species have an amphi-Atlantic distribution. Fissurellidae have a much wider distribution than other genera and families investigated on the Azorean seamounts. The endemicity of the family is about 7%. All other genera and families in Vetigastropoda and Caenogastropoda that were studied on the Azorean seamounts exhibit a higher endemicity: *Anatoma* (Hoffman et al., 2021: 75%), *Clelandella* (Gofas, 2007: 100%), *Calliostoma* (Gofas & Hoffman, 2020: 56%), Seguenziidae (Hoffman et al., 2020a: 50%), Skeneimorpha (Hoffman et al., 2020c: 46%), *Trituba* (Gofas, 2003: 100%),

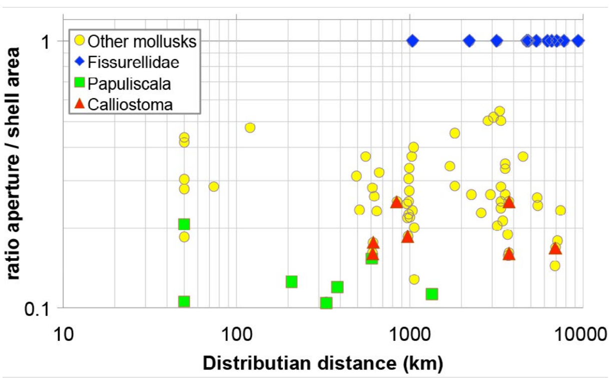


Fig. 40. A weak relationship between distribution distance and relative aperture size as proxy for foot size. Species in *Papuliscala* (green squares) show a relatively small distribution compared to species in Fissurellidae (blue diamonds). Other species in *Calliostoma* (red triangles) and a large mixed group (yellow circles; Skeneidae, Seguenziidae and general species in Seguenzioidea) show an intermediate behaviour.

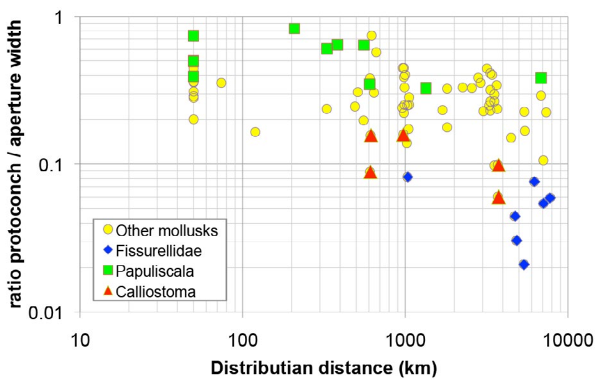


Fig. 41. A weak relationship between distribution distance and relative protoconch size as proxy for size of eggs. Species in *Papuliscala* (green squares) show a relatively small distribution range compared to species in Fissurellidae (blue diamonds). Other species in *Calliostoma* (red triangles) and a large mixed group (yellow circles; Skeneidae, Seguenziidae and general species in Seguenzioidea) show an intermediate behaviour.

Eulimidae (Hoffman & Freiwald, 2020: 40%), *Papuliscala* (Hoffman et al., 2020b: 91%) and Rissoidae (Gofas, 2007; Hoffman & Freiwald, 2021: 81%). Hence, we conclude that long distance distribution of fissurellid species (larvae, juveniles or adults) is more efficient than that of other vetior caenogastropods. The simple protoconchs of the fissurellids suggest a direct development or a short lecitotrophic stage and they seem not suited for long-distance migration. Using simple dimensions of the shell we investigated whether the relatively large foot of fissurellids found on the Azorean seamounts may have helped in long-distance migrations.

As a proxy of the relative size of the foot, we use measures related to the aperture and the whole shell. A weak relationship exists between the dimensionless parameter [(height-aperture * width-aperture) / (height-shell * width-shell)] and the approximated maximum distribution distance as used in Hoffman & Freiwald (2021), see Fig. 40. The large aperture of a fissurellid is weakly correlated with a large distribution range when compared to smaller distribution distances for species in *Papuliscala*. The genera with a relatively small aperture like the genus *Trituba* (Gofas, 2003) or species in *Eulimidae* (Hoffman & Freiwald, 2020) also show lower distribution distances like *Papuliscala* (Hoffman et al., 2020b). Distribution possibly took place by pelagic rafting with specimens attached to a substrate exposed to sea currents or to mobile fauna (e.g. fish). It is likely that the large foot facilitates effective pelagic rafting. In contrast, other genera with a comparatively smaller foot size / animal volume ratio could struggle during long distance transport on a pelagic raft.

We also investigated the relationship between the relative size of the protoconch (by means of the ratio of the width of the protoconch over the width of the aperture) and the distribution distance, see Fig. 41. Shells with a large protoconch / aperture ratio (for example *Papuliscala*) have a smaller distribution distance then those with a small ratio (Fissurellidae). When the larvae have a comparable size to the aperture, it is unlikely that many eggs are spawned or many brooded larvae are formed during the life cycle of a gastropod. Consequently, long-distance migration for species with few offspring could be a risky reproduction strategy. In contrast, a small protoconch / aperture ratio may be associated with more eggs spawning during a life cycle of a specimen and hence better suited for long-distance migration (possibly in Fissurellidae).

The correlations suggested by Figs 40-41 are feasible albeit that other factors might be responsible for the wide distribution range of Fissurellidae found on the Azorean seamounts and the short range for *Papuliscala* and *Trituba*. In contrast, Cunha et al. (2017) proved on a high degree of endemicity of species in the genus *Fissurella* and of one species in *Diodora* on the Cape Verde Islands. They stated typical free larval periods of 4-5 days and a potential passive migration distance of about 75 km, well in excess of inter-island distances at Cape Verde. Consequently, a wider distribution of species should be expected. As explanation they proposed that the diversification of Cape Verde *Fissurella* was most likely promoted by patterns of ocean circulation that favour local retention. These conditions do not apply to migration of species on the Azorean seamounts as they are distributed widely. Age models discussed by Cunha et al. (2017) indicated that the diversification took place approximately at the Plio-Pleistocene Boundary, which would be associated with a 40 m drop in sea level and an areal increase in coastal habitat with improved survival conditions for larvae. A similar endemicity model applies for a Cape Verdian diversification in the gastropod genus *Conus*. A decrease in sea-level would not have contributed significantly to an increase in habitat on the Azorean seamounts.

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REFERENCES

Barrio González, L., 2015. Estudio sistemático, anatómico y filogenético de los moluscos de la subfamilia Emarginulinae (Gastropoda, Vetigastropoda, Fissurellidae) de los fondos batiales del Atlántico Norte. Dpto. De Zooloxía e Antropoloxía Física Facultade dan Bioloxía y Estación de Bioloxía Mariña da Graña, University of Santiago de Compostella, Spain, doctoral thesis: 382 pp.

Ceragato, A. & Tabanelli, C., 2006. Revisione della malacofauna pliocenica di Rio Albonello IV. Due taxa dimenticati di Giuseppe Seguenza. — Bollettino Malacologico, 42: 33-37.

Cossignani, T. & Ardovini, R., 2011. Mediterranean malacology: 1-530. L'informatore Piceno, Ancona.

Costa, O.G., 1830 ["1829"]. Catalogo sistematico e ragionato de' testacei delle Due Sicilie: 1-8, i-cxxxii, pls 1-3. Tipografia della Minerva, Napoli. http://www.biodiversitylibrary.org/ia/catalogosistematoocost

Cunha, R. L., Assis, J. M., Madeira C., Seabra, R., Lima, F.P., Lopes, E.P., Williams, S.T. & Castilho, R., 2017. Drivers of Cape Verde archipelagic endemism in keyhole limpets. — Scientific Reports, 7: 41817 (11 pp.). https://doi.org/10.1038/srep41817

Cunha, T. J., Lemer, S., Bouchet, P., Kano, Y. & Giribet, G., 2019. Putting keyhole limpets on the map: phylogeny and biogeography of the globally distributed marine family Fissurellidae (Vetigastropoda, Mollusca). — Molecular Phylogenetics and Evolution, 135: 249-269. https://doi.org/10.1016/j.ympev.2019.02.008

Dall, W.H., 1927. Small shells from dredgings off the southeast coast of the United states by the United States Fisheries Steamer "Albatross", in 1885 and 1886. — Proceedings of the United States National Museum, 70 (2667): 1-134. https://www.biodiversitylibrary.org/page/15670453

Dautzenberg, Ph. & Fischer, H., 1896. Dragages effectués par l'Hirondelle et par la Princesse Alice 1888-1895. 1. Mollusques Gastéropodes. — Mémoires de la Société Zoologique de France, 9: 395-498, pls 15-22. http://biodiversitylibrary.org/page/10117292

Dautzenberg, Ph. & Fischer, H., 1897. Dragages effectués par l'Hirondelle et par la Princesse Alice 1888-1896. — Mémoires de la Société Zoologique de France, 10: 139-234, pls 3-7. http://biodiversitylibrary.org/page/10107630

Fischer, P., 1882-1883. Diagnoses d'espèces nouvelles de mollusques recueillis dans le cours des expéditions scientifiques de l'aviso "Le Travailleur" (1880 et 1881). — Journal de Conchyliologie, 30 (1): 49-53 (1882); 30 (4): 273-277 (1883). http://biodiversitylibrary.org/page/16222876

Frank, N., 2018. Short Cruise report. M151. Atlantic thermocline ocean and ecosystems dynamic during natural climate change. Ponta Delgada – Funchal, Portugal. October 6 – 31 October 2018. 15 pp. (not published) Institut für Umweltphysik, Universität Heidelberg, Heidelberg, Germany.

Gofas, S., 1993. Mission Océanographique seamount 2. Compte-rendu et liste des stations. mnhn, unpublished. https://doi.org/10.5281/zenodo.6480952

Gofas, S., 2003. An endemic radiation of *Trituba* (Mollusca, Gastropoda) on the North Atlantic seamounts. — American Malacological Bulletin, 17 (1-2): 45-63. https://biodiversitylibrary.org/page/45999833

Gofas, S., 2005. Geographical differentiation in *Clelandella* (Gastropoda: Trochidae) in the northeastern Atlantic. — Journal of Molluscan Studies, 71 (2): 133-144. https://doi.org/10.1093/mollus/eyi016

Gofas, S., 2007. Rissoidae (Mollusca: Gastropoda) from northeast Atlantic seamounts. — Journal of Natural History, 41 (13-16): 779–885. https://doi.org/10.1080/00222930701298085

Gofas, S. & Hoffman, L., 2020. Deep-water Calliostomatidae (Vetigastropoda, Gastropoda) from the South Azorean Seamount Chain. — Iberus, 38 (2): 195-211. https://doi.org/10.5281/zenodo.4960261

Hoffman, L. & Freiwald, A., 2018. Last snails standing: a tale of Fissurellidae (Gastropoda) from deep-water coral habitats off Mauritania since the Pleistocene. — Miscellanea Malacologica, 7 (6): 115-126.

Hoffman, L. & Freiwald, A., 2020. Bathyal Eulimidae (Gastropoda: Vanikoroidea) from the Azorean seamounts collected during the R/V Meteor Cruise M151 Athena. — Miscellanea Malacologica, 8 (6): 81-99.

Hoffman, L. & Freiwald, A., 2021. Bathyal species in Rissoidae (Gastropoda) from Azorean seamounts. — Biodiversity Journal, 12 (4): 777-792. https://doi.org/10.31396/Biodiv.Jour.2021.12.4.777.792

Hoffman, L., Gofas, S. & Freiwald, A., 2020a. New and little-known Seguenziidae (Vetigastropoda, Gastropoda) from the South Azorean Seamount Chain. — Iberus, 38 (1): 1-18. https://doi.org/10.5281/zenodo.4824367

Hoffman, L., Gofas, S. & Freiwald, A., 2020b. Ten new species in *Papuliscala* de Boury, 1911 (Gastropoda, Epitoniidae) from the South Azorean Seamount Chain. — Iberus, 38 (1): 29-53. https://doi.org/10.5281/zenodo.4836181

Hoffman, L., Gofas, S., Freiwald, A., 2020c. A large biodiversity of "skeneimorph" (Gastropoda: Vetigastropoda) species from the South Azorean Seamount Chain, with the description of seventeen new species. — Iberus, 38 (Supplement 9): 1-82. https://doi.org/10.5281/zenodo.4969080

Hoffman, L., Gofas, S., Freiwald, A., 2021. The genus *Anatoma* Woodward, 1859 (Gastropoda, Anatomidae) from Azorean seamounts. — Iberus, 39 (2): 139-152. https://doi.org/10.5281/zenodo.5035715

Hoffman, L., van Heugten, B. & Lavaleye, M.S.S., 2011. Gastropoda (Mollusca) from the Rockall and Hatton Banks, northeastern Atlantic Ocean. Part 2. — Miscellanea Malacologica, 4 (6): 85-118.

Jeffreys, J.G., 1877. New and peculiar Mollusca of the Patellidae and other families of Gastropoda procured in the Valorous expedition. — Annals and Magazine of Natural History, (4) 19 (111): 231-243. http://biodiversitylibrary.org/page/26456858

Libassi, I., 1859. Memoria sopra alcune conchiglie fossili dei dintorni di Palermo. — Atti dell'Accademia di Scienze, Lettere e Arti di Palermo, Nuova Serie, 3: 1-47 + 1 pl. http://biodiversitylibrary.org/page/9246863

Locard, A., 1897-1898. Expéditions scientifiques du Travailleur et du Talisman pendant les années 1880, 1881, 1882 et 1883. Mollusques testacés. Tome 1: 1-516 pls 1-22 (1897); Tome 2: 1-515, pls 1-18 (1898). Masson, Paris. http://www.biodiversitylibrary.org/bibliography/10477

McLean, J.H., 1970. Descriptions of a new genus and eight new species of Eastern Pacific Fissurellidae, with notes on other species. — The Veliger, 12 (3): 362-367.

McLean, J.H., & Geiger, D.L., 1998. New genera and species having the *Fissurisepta* shell form, with a generic-level phylogenetic analysis (Gastropoda: Fissurellidae). — Contributions in Science, Natural History Museum of Los Angeles County, 475: 1-32.

MolluscaBase, eds., 2022. MolluscaBase. Fissurellidae J. Fleming, 1822. Accessed through: World Register of Marine Species at: https://www.marinespecies.org/aphia.php?p=taxdetails&id=111 on 2022-06-10.

Ortega, J. & Gofas, S., 2019. The unknown bathyal of the Canaries: new species and new records of deep-sea Mollusca. — Zoosystema, 41 (26): 513-551. http://sciencepress.mnhn.fr/sites/default/files/articles/pdf/zoosystema2019v41a26.pdf

Pérez Farfante, I., 1943a. The genus *Diodora* in the Western Atlantic. — Johnsonia, 1 (11): 1-20.

Pérez Farfante, I., 1943b. The genera *Lucapina* and *Diodora* in the Western Atlantic. — Johnsonia, 1 (18): 4-6.

Pérez Farfante, I., 1947. The genera *Zeidora, Nesta, Emarginula, Rimula* and *Puncturella* in the western Atlantic. — Johnsonia, 2 (24): 93-148.

Piani, P., 1985. Revisione del genere *Emarginula* Lamarck, 1801 in Mediterraneo. — Lavori della Società Italiana di Malacologia, 21: 193-238 [dated 1984 on front page].

Seguenza, G., 1863. Paleontologia malacologica delle rocce terziarie del distretto di Messina studiata nei suoi rapporto zoologici e geognostici. — Annali dell'Accademia degli Aspiranti Naturalisti, (3) 2: 77-95, pls 4-5. http://books.google.es/books?id=GU4XAAAAYAAJ&pg=PA78-IA3

Simone, L.R.L. & Cunha, C.M., 2014. Taxonomical study on the mollusks collected in Marion-Dufresne (MD55) and other expeditions to SE Brazil: the Fissurellidae (Mollusca, Vetigastropoda). — Zoosystema, 3835 (4): 437-468. https://doi.org/10.11646/zootaxa.3835.4.2

Warén, A., 1980. Marine Mollusca described by John Gwyn Jeffreys, with the location of the type material. — Conchological Society of Great Britain and Ireland, Special Publication 1: 1-60, pls 1-8.

Warén, A., 1991. New and little known Mollusca from Iceland and Scandinavia. — Sarsia, 76 (1-2): 53-124.

Watson, R.B., 1879-1883. Mollusca of H.M.S. 'Challenger' Expedition. — Journal of the Linnean Society of London, 14: 506-529, 586-605, 692-716 (1879); 15: 87-126, 217-230 (1880), 245-274, 388-412, 413-455, 457-475 (1881); 16: 247-254, 324-343, 358-372, 373-392 (1882), 594-611 (1883); 17: 26-40, 112-130, 284-293, 319-340, 341-346 (1883). http://www.biodiversitylibrary.org/item/99383