



XENOPHORA

T A X O N O M Y

Supplément à Xenophora, Bulletin de l'Association Française de Conchyliologie



Description d'une nouvelle espèce de *Muricopsis* des Îles Galapagos
B. GARRIGUES

A review of the Genus *Euthria* from the Cape Verde Archipelago
K. FRAUSSEN & F. SWINNEN

New insights into *Conus jourdani*, an endemic species from Saint Helena Island
M. TENORIO, F. LORENZ & M. DOMINGUEZ

Note taxonomique sur des Carditidae (Bivalvia : Carditoida) du Maastrichtien et du Danien du bassin de Paris
introduits par Alcide d'Orbigny en 1850
J-M. PACAUD & D. MERLE



Association Française de Conchyliologie

www.xenophora.org
2 square La Fontaine
75016 Paris

Président

Eric Monnier,
e-mail: ericm2007@hotmail.fr
194 Rue du Château des Rentiers - 75013 PARIS

Vice-Président

Alain Robin
e-mail: alrob38@orange.fr
3 rue de la Croix au Beau - 78320 Le Mesnil St Denis



***XENOPHORA TAXONOMY* is a supplement to *XENOPHORA*, the quarterly bulletin published by AFC. It is shipped to all AFC members with the regular publication.**

Guidelines

AFC and its magazine *Xenophora Taxonomy* accept to publish taxonomic works including descriptions of new species and revisions of supraspecific groups of mollusks. The manuscripts must be in accordance with the rules and recommendations of the ICZN (International Code of Zoological Nomenclature). The manuscripts will be submitted to a board of referees before publication. Decisions to publish or not will follow careful refereeing and this committee may suggest changes to the author.

These descriptions will be sent to the Editor of *Xenophora* (redaction@xenophora.org) in english (with an abstract or introduction in French). The illustrations must be provided in high definition, on CD or other digital media. Colour pictures are preferred. Captions of the figures and plates must be provided with the references to the pictures. Texts shall be provided in *.doc, *.txt or *.rtf format, while the photos must be in jpg format with 300 dpi resolution. The pictures submitted can be used by *AFC-Xenophora* for any of its publication, magazine or its web-site.

Publication is free of charge for the authors. The Senior author will receive five print copies of the paper, the juniors three copies.

Copyright © Association Française de Conchyliologie
Reproduction in whole or part without written permission is prohibited.

Impression : Alliance ArtGraphic - ☎ 01 34 61 05 44
1 et 3 Avenue Pavlov p15 - 78190 Trappes

Description d'une nouvelle espèce de *Muricopsis* (Gastropoda: Muricidae: Muricopsinae) des Îles Galapagos.

Bernard GARRIGUES

67 Route de Saint Paul, Lalande 82400 Goudourville (France)

bernardgarrigues@yahoo.fr

RÉSUMÉ: Une nouvelle espèce de Muricidae des Galapagos, Equateur, du genre *Muricopsis* est décrite et comparée aux espèces proches *Muricopsis zeteki* Hertlein & Strong, 1951 et *Muricopsis westonensis* Myers & D'Attilio, 1990. *Muricopsis zeteki* est répandu tout le long de la côte Pacifique tropicale, depuis le Golfe de Californie jusqu'à Guayaquil, Equateur (Keen, 1971) et aussi aux Galapagos. Il est collecté de la zone intertidale jusqu'à 12 m. *Muricopsis westonensis* n'est connu que de la localité-type : les Iles Cocos, Costa Rica de 12 à 27 m. *Muricopsis taupini* n. sp. ne se rencontre que sur l'Île Albany, Galapagos, Equateur entre 5 et 15 m.

MOTS CLES: Mollusca, Gastropoda, Muricidae, Muricopsinae Galapagos, nouvelle espèce.

INTRODUCTION : En étudiant les types de sculpture chez les Muricidae des lignées *Muricopsis/Murexsul*, Merle & Houart (2003) ont isolé un groupe d'espèces de la région tropicale de l'Est Pacifique. Ces espèces apparentées à *Muricopsis zeteki* Hertlein & Strong, 1951 ont en commun le même *pattern* sculptural. Ce *pattern* résulte du ralentissement de la croissance de P2 qui s'atrophie et s'absorbe dans la base de l'épave de P1. En fin de croissance, P2 est atrophié, P1, P3, P4 et P5 bien exprimés, P6 atrophié, avec une décroissance régulière de P1 à P6, ADP développé et MP atrophié. En 2003 Merle & Houart désignaient trois espèces comme faisant partie du groupe « *zeteki pattern* » : *Muricopsis zeteki* ; *M. pauxilla* (Adams, 1854), rencontré du Sud du Golfe de Californie à l'Amérique centrale et *M. galbensis* (Jung, 1969), espèce fossile du Pliocene, Trinidad. Actuellement trois espèces apparentées peuvent être ajoutées à ce groupe : *M. westonensis* Myers & D'Attilio, 1990 (Iles Cocos, Costa Rica ; *M. mcleani* Wiedrick, 2009 (du Golfe de Californie aux Iles Galapagos) et *M. tulensis* Radwin & D'Attilio, 1976 (Baja California, Mexique). Une nouvelle espèce appartenant au groupe « *zeteki pattern* » provenant des Iles Galapagos est décrite ici.

ABREVIATIONS

La méthode descriptive a été utilisée par Merle (1999, 2001, 2005) et Merle *et al.* (2011) pour la description de la sculpture et des denticules internes de la lèvre externe de divers muricidés. La terminologie utilisée est donnée ci-dessous.

Terminologie

P: cordon primaire (cordon apparaissant en premier);
IP: cordon primaire infrasutural;
P1: cordon d'épaulement;
P2-P6: cordons primaires de la partie convexe du tour de la téléoconque;
ADP: cordon primaire adapical du canal;
MP: cordon primaire median du canal siphonal;
ABP: cordon primaire abapical du canal siphonal;
EAB1: cordon primaire de l'extrémité du canal siphonal;

s: cordon secondaire (cordon apparaissant en deuxième);
adis: cordon secondaire adapical de la rampe infrasuturale;
abis: cordon secondaire abapical de la rampe infrasuturale;
s1-s6: cordons secondaires de la partie convexe du tour de la téléoconque;
ads: cordons secondaires adapicaux du canal siphonal;
ms: cordon secondaire median du canal siphonal ;
abs: cordons secondaires abapicaux du canal siphonal;
t: cordons tertiaires (cordons apparaissant en troisième);
ID: denticule infrasutural de l'ouverture;
D1-D6: denticules internes du labre.

Autres abréviations et conservation des spécimens

H: Longueur

D: Largeur

USNM : National Museum of Natural History, Smithsonian Institution, Washington DC, USA

MNHN: Muséum national d'Histoire naturelle (secteur mollusques récents), Paris, France

BG: collection Bernard Garrigues (Castelmoron, France)

CT : collection Christian Taupin (Jouy en Josas, France)

JP : collection Jacques Pelorce (Le Grau du Roi, France)

SYSTEMATIQUE:

Famille Muricidae Rafinesque, 1815

Sous famille Muricopsinae Radwin & D'Attilio, 1971

Genre *Muricopsis* Bucquoy & Dautzenberg, 1882

Espèce-type – *Murex blainvillei* Payraudeau, 1826 par description originale (= *Murex cristatus* Brocchi, 1814). Miocene moyen: Paratethys. Fin du Miocene au Pliocene: Mer, Méditerranée. Actuel: Mer Méditerranée, Est Atlantique (Portugal et Iles Canaries). Fossile: voir Landau *et al.* (2007).

***Muricopsis taupini* n. sp.**
(Figs 1, 3 A-H)

MATERIEL TYPE– Holotype (MNHN IM-2000-31680), Île Albany, un paratype (MNHN IM-2000-31681) même localité, un paratype (BG) même localité.

LOCALITE TYPE – Île Albany, au large de l'île Santiago (San Salvador), Galapagos, sur des rochers à 5-15 m.

DISTRIBUTION – Île Albany, Punta Carrion, entre les îles Santa Cruz et Baltra, Galapagos, par 5- 15 m.

AUTRE MATERIEL EXAMINE: au total 8 spécimens de la même localité et provenant d'anciennes récoltes.

ETYMOLOGIE – En l'honneur de Bernard et Jean-Loup Taupin

DESCRIPTION DE L'HOLOTYPE – Protoconque inconnue. Téléoconque biconique de 5 tours, H: 19, 9 mm, D: 12, 6 mm.



Fig. 2

Fig. 3 – A, B, vue ventrale et dorsale, holotype, MNHN-IIM-2000-31680, Ile Albany, au large de l'île Santiago, Galapagos, à 15-20 m, H : 19,9 mm; C, D, vue ventrale et dorsale, opercule de l'holotype; E, vue ventrale, paratype MNHN-IM-2000-31681, H : 17,3 mm; F, vue dorsale, paratype, H : 19 mm, BG; G, H, vue ventrale et dorsale, de *M. taupini* n. sp., H : 22,8 mm, CT coll.; I, J, vue ventrale et protoconque de *M. zeteki*, Ile Boyerana, Iles Perlas, Panama, juvénile, à 2 m, H : 5,7 mm, JP; K, L, vue ventrale et dorsale, de deux des trois syntypes de *Murex dubius* SOWERBY, 1834, (NHM 1964459) de la collection CUMING, Panama, H : 27 et 28 mm, photo A. SALVADOR (NHM); M, N, vue ventrale et dorsale, de *M. zeteki*, Ile Gobernadora, Santa Catalina, Panama Ouest, sous des rochers à marée basse, L : 25,6 mm, BG; O, vue ventrale de *M. zeteki*, Galapagos, H : 15 mm, photo A. BONNARD; L, M.,; P, Q, vue ventrale et dorsale, holotype of *M. westonensis* Myers & D'Attilio, 1990. (USNM 860014), H : 13,4 mm, photo H. STRONG (USNM); R, S, vue ventrale et dorsale, of *M. westonensis*, Iles Cocos, Costa Rica, en plongée à 27 m deep, L : 13,2 mm, BG. Echelle : 1 mm.



Fig. 4 – Répartition des espèces de *Muricopsis* cités

- *Muricopsis taupini*
- *Muricopsis westonensis*
- *Muricopsis zeteki*

VARIATIONS INTRASPECIFIQUES – La taille de *Muricopsis taupini* n. sp. est comprise entre 16 and 22,8 mm. La morphologie des 8 spécimens examinés est homogène, seulement la couleur de fond est plus ou moins sombre variant du jaune au brun foncé. Toutes les protoconques sont abimées mais chez certains spécimens elles semblent probablement paucispirales sans que l'ont puisse en apprécier le nombre de tours avec précision.

REMERCIEMENTS

L'auteur remercie vivement pour leur aide Elen Strong (USNM), Andreia Salvator (NHM), Christian Taupin, Jacques Pélorce, Andres Bonnard et Jean-Pierre Pointier.

BIBLIOGRAPHIE

- HERTLEIN L.G. & STRONG A.M., 1951. Descriptions of three new species of marine gastropods from West Mexico and Guatemala. *Bull. S. Cal. Acad. Sci.* 50 (2): 76-80, pl. 26.
- KEEN A. M. 1971 – *Sea Shells of Tropical West America*. Second Edition. Stanford University Press, Stanford. California. 1064 pp.
- LANDAU B., HOUART R. & MARQUES DA SILVA C., 2007. *The Early Pliocene Gastropoda, Southern Spain*. Part . 7 – Muricidae. *Paleontos* 11: 1-87.
- MERLE D. 1999. – *La radiation des Muricidae (Gastropoda: Neogastropoda) au Paléogène: approche phylogénétique et évolutive*. Thèse de doctorat, Muséum national d'Histoire Naturelle, Paris, 499 p.
- MERLE, D., 2001. The spiral cords and the internal denticles of the outer lip of the Muricidae: terminology and methodological comments. *Novapex*, 2 (3): 69-91.
- MERLE D. & HOUART, R. 2003. – Ontogenetic changes of the spiral cords as keys of innovation of the muricid sculptural patterns: the example of the *Muricopsis-Murexsul* lineages

(Gastropoda: Muricidae: Muricopsinae). *Comptes Rendus Palevol* 2 (6-7): 547-556.

MERLE D., GARRIGUES B. & POINTIER J.P., 2011. *Fossil and Recent Muricidae of the World. Part Muricinae*. Conchbooks, Hackenheim. 648 pp.

MYERS B.W. & D'ATTILIO A., 1990. Three New Muricean Species from Cocos Island, Costa Rica (Muricidae and Coralliophilidae). *Venus* 49 (4): 281-292.

RADWYN, G.E. & D'ATTILIO, A., 1976. *Murex Shells of the World: an illustrated guide to the Muricidae*. Stanford University Press, Stanford, 284 pp.

Description of a new species of Muricopsis (Gastropoda: Muricidae: Muricopsinae) from the Galapagos Islands.

Bernard GARRIGUES

67 Route de Saint Paul, Lalande 82400 Goudourville (France)

bernardgarrigues@yahoo.fr

ABSTRACT: A new species of Muricidae from Galapagos, Ecuador, of the genus *Muricopsis* is described and compared with the similar species *Muricopsis zeteki* Hertlein & Strong, 1951 (*n.n. pro aculeatus* WOOD, *non* PERRY, also *dubius* G.B. SOWERBY II *non* DILLWYN). and *Muricopsis westonensis* Myers & D'Attilio, 1990. *Muricopsis zeteki* is a widespread species occurring throughout the eastern tropical Pacific from the head of the Gulf of California to Guayaquil, Ecuador (Keen, 1971), but also Galapagos. It is known from the intertidal area to 12 m deep. *Muricopsis westonensis* is only collected from the type locality Cocos Isl., Costa Rica from 12 to 27 m deep. *Muricopsis taupini* n. sp. is only known from Albany Isl., Galapagos, Ecuador from 5 to 15 m deep.

KEY WORDS: Mollusca, Gastropoda, Muricidae, Muricopsinae Galapagos, new species.

INTRODUCTION : Merle & Houart (2003) have identified a species group from the eastern part of the tropical Pacific according to the sculpture type within the muricid *Muricopsis*/*Murexsul* clade. These species close to *Muricopsis zeteki* Hertlein & Strong, 1951, have the same sculptural pattern. This pattern is the result of a decreasing of the P2 growth which degenerate and merge with the base of the P1 spine. At the end of this growth, P2 is atrophied, P1, P3, P4 and P5 are well expressed, P6 is atrophied with a regular decreasing from P1 to P6. ADP is developed and MP atrophied. In 2003, Merle & Houart considered three species in the « *zeteki* pattern group »: *Muricopsis zeteki* Hertlein & Strong, 1951, *M. pauxillus* (Adams, 1854) from the southern part of the California Gulf to Central America, and *M. galbensis* (Jung, 1969) a fossil species from Pliocene, Trinidad. At the present time, three closed species may be added to this group: *M. westonensis* Myers & D'Attilio, 1990 (Cocos Isl., Costa Rica), *M. mcleani* Wiedrick, 2009 (from the Gulf of California to the Galapagos Islands) and *M. tulensis* Radwin & D'Attilio, 1976 (southern Baja California, Mexico). A new species belonging to the « *zeteki* pattern group » is described in this paper.

ABBREVIATIONS :

The descriptive methodology used here follows that of Merle (1999, 2001, 2005) and Merle *et al.* (2011) and the text conventions used to describe the spiral sculpture and the internal denticles of the outer lip are given below.

Text conventions of the spiral sculpture and the internal denticles of the outer lip

P: primary cord (cord appearing in first order)
IP: infrasutural primary cord
P1: shoulder cord
P2-P6: primary cords of the convex part of the teleoconch whorl
ADP: adapical siphonal primary cord

MP: median siphonal primary cord
ABP: abapical siphonal primary cord
EAB1: extreme abapical siphonal primary cord
s: secondary cord (cord appearing in second order)
adis: adapical infrasutural secondary cord
abis: abapical infrasutural secondary cord
s1-s6: secondary cords of the convex part of the teleoconch whorl
ads: adapical siphonal secondary cord
ms: median siphonal secondary cord
abs: abapical siphonal secondary cord
t: tertiary cord (cord appearing in third order)
ID: infrasutural apertural denticle
D1-D6: abapical apertural denticles

Other abbreviations

H: Height
D: Diameter

Repository

USNM : National Museum of Natural History, Smithsonian Institution, Washington DC, USA
MNHN : Muséum national d'Histoire naturelle (sector: Recent molluscs), Paris, France
BG : Bernard Garrigues collection (Castelmoron, France)
CT : Christian Taupin collection (Jouy en Josas, France)
JP : Jacques Pelorce collection (Le Grau du Roi, France)

SYSTEMATICS:

Family Muricidae Rafinesque, 1815

Subfamily Muricopsinae Radwin & D'Attilio, 1971

Genus *Muricopsis* Bucquoy & Dautzenberg, 1882

Type species – *Murex blainvillei* Payraudeau, 1826 by original designation (= *Murex cristatus* Brocchi, 1814). Middle Miocene: Paratethys. Late Miocene to Pliocene: Mediterranean Sea. Recent: Mediterranean Sea, Eastern Atlantic (Portugal and the Canaries). Fossil range from Landau *et al.* (2007).

Muricopsis taupini n. sp.
(Figs 1, 2A-H)

TYPE MATERIAL – Holotype (MNHN IM-2000-31680), Albany Isl., one paratype (MNHN IM-2000-31681) same locality, one paratype (BG) same locality.

TYPE LOCALITY – Albany Isl., off Santiago Isl., Galapagos, on rocks at 5-15 m deep.

DISTRIBUTION – only from the type locality.

OTHER MATERIEL: in total 8 specimens, from the same locality, old collection.

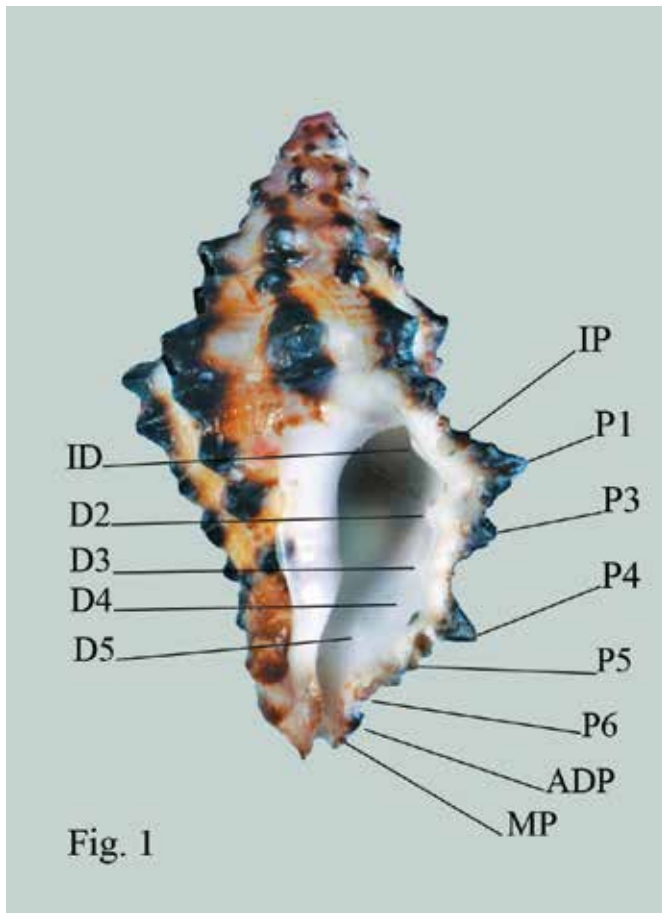


Fig. 1 – Morphology of the spiral cords and of denticles in *Muricopsis taupini* n. sp.

ETYMOLOGY – in honour of Bernard and Jean-Loup Taupin.

DESCRIPTION OF HOLOTYPE – Protoconch unknown. Teleoconch biconic, H 19.9 mm, D 12.6 mm. Five teleoconch whorls. Spire acute. Last whorl of 62 % of the total length of teleoconch. Apical angle of 50°. Spiral sculpture consisting in marked primary cords. First whorl eroded. Second whorl appearance of P1, P2 and P3. Third whorl P2 atrophied and absorbed at the base of the P1 nodule. Fourth whorl IP, P1 and P3. Last whorl: IP on the infrasutural ramp; on the convex part of the whorl: P1, P3, P4, P5 well developed and decrease from P1 to P5; P6 atrophied; siphonal canal, ADP developed, and MP atrophied. Axial sculpture: eight strong varices from the first whorl to the third whorl, seven varices on the fourth whorl and the last whorl. Thick primary cords spines in P1, P3, P4, P5 and ADP. Aperture ovate. Columellar lip adherent adapically, rim slightly erected abapically with two columellar folds. Columellar lip extends nearly to the extremity of the siphonal canal. Outer lip flared with denticles ID, D2, D3, D4 and D5. Siphonal canal open, on 22 % of the total length of teleoconch, slightly dorsally recurved. Smooth intervarical spaces. Shell yellow, black cord spines. Apex pinkish. Aperture white. Operculum with apical nucleus. Radula unknown.

COMPARISON (see also table 1) – *Muricopsis taupini* n. sp. is compared with *M. zeteki* Hertlein & Strong, 1951 (Figs 2I-O) occurring throughout the eastern tropical Pacific from the Gulf of California to Ecuador and to *Muricopsis westonensis* Myers & D'Attilio, 1990, (Figs 2P-S), endemic from Cocos Isl.

Muricopsis zeteki is distinguishable by the following characters: teleoconch of 7-8 whorls; very acute primary cords spines

mainly developed in P1; microsculpture finely spirally striate; chocolate brown colour, white zones between the varices and white spiral strips in P1, P3, P4 and P5. The siphonal canal of *M. taupini* n. sp. is shorter and the abapical part of the outer lip more flared and rounded.

Muricopsis westonensis differ from *M. taupini* n. sp. by a particular multispiral protoconch of 3 1/4 whorls, strong denticles on the columellar lip and a thicker outer lip. *M. westonensis* also distinguish from *M. taupini* by blunt nodes rather than cords spines at intersection of primary cords and axial varices. Moreover the fleshy white colour with tan nodes of *M. westonensis* differ from the yellow and black *M. taupini* n. sp.

INTRASPECIFIC VARIATIONS – The size of *Muricopsis taupini* n. sp. is included between 16 and 22.8 mm. Among the eight specimens examined the morphology is homogeneous, only the background colour is more or less pronounced. All protoconchs are damaged, but in some specimens they suggest to be paucispiral.

	<i>M. zeteki</i>	<i>M. taupini</i>	<i>M. westonensis</i>
Nbr of protoconch whorls	Paucispiral, 11/4	Probably paucispiral	Multispiral, 31/4
Nbr. of teleoconch whorls	7	5	5
Nbr. of varices per whorl	7-8	7	8
Apical angle	49°	50°	55°
Aperture	Ovate, five denticles on the outer lip, two elongate denticles on the columella	Ovate, five denticles on the outer lip, two denticles, weakly apparent, on the columella	Ovate, five denticles on the outer lip, two strong denticles on the columella
Adult size	15 to 28 mm	16 to 22.8 mm	13,4 to 21 mm
Shell colour	Chocolate brown, white areas between the varices, bluish white aperture	Yellow, nodes black, pinkish apex	Fleshy white, nodes pale tan, aperture white

Table 1 – Comparative table of the morphological characters of *M. zeteki* Hertlein & Strong, 1951, *M. taupini* n. sp. and *M. westonensis* Myers & D'Attilio, 1990.

ACKNOWLEDGEMENTS

The author is very grateful for their help to Ellen Strong (USNM), Andreia Salvador (NHM), Christian Taupin, Jacques Pélorce, Andres Bonnard and Jean-Pierre Pointier.

A review of the genus *Euthria* Gray, 1839 (Gastropoda: Buccinidae) from the Cape Verde Archipelago

Koen Fraussen¹ and Frank Swinnen²

¹ Leuvensestraat 25, B-3200 Aarschot, Belgium
koen.fraussen@skynet.be

² Lutlommel 10 B, B-3920 Lommel, Belgium
f.swinnen@skynet.be

Abstract: All known *Euthria* species from the Cape Verde Islands are reviewed. Special attention is given to comparative characteristics for a better understanding of the systematics within the group. The spiral sculpture on the upper spire whorls and the shape of the subsutural slope in combination with protoconch morphology serve to distinguish species, while the spiral sculpture on the last whorls may vary considerably in a few species. We give the characteristic spiral sculpture of all species, discussing the variability when such is observed, with special attention to the spiral sculpture of a number of species that became published without such details in the original description. Differences or similarities in pattern were the source of confusion in earlier studies; some aspects of the pattern are specific while other aspects may perform a high degree of variability that result in a wide phenotypical overlap. As a result we place two names in synonymy: *E. josepedroi* Rolán & Monteiro, 2007 is found to be conspecific with *E. vanda* Rolán & Monteiro, 2007 while *E. ceciliae* Fraussen & Rolán, 2003 is conspecific with *E. marianae* Rolán, Monteiro & Fraussen, 2003.

Résumé: Toutes les espèces connues d'*Euthria* des îles du Cap Vert sont révisées. Un soin particulier est apporté aux caractéristiques comparatives pour mieux comprendre la systématique du groupe. La sculpture spirale des derniers tours de la spire ainsi que le profil de la pente sub-suturale combinés avec la protoconque permettent la séparation des espèces, alors que la sculpture en spirale des derniers tours peut varier considérablement d'une espèce à l'autre. Nous détaillons les caractéristiques de la sculpture spirale de toutes les espèces, montrons la variabilité quand elle existe, en portant une attention particulière à cette sculpture dans un certain nombre de cas qui ont été publiés sans la mentionner dans la description originale. Les différences ou similitudes de dessin ont été à l'origine de nombreuses confusions dans des travaux antérieurs; quelques aspects de la décoration sont spécifiques tandis que d'autres aspects ont une grande variabilité donnant un large recouvrement phénotypique. En conséquence, nous mettons deux noms en synonymie : *E. josepedroi* Rolán & Monteiro, 2007 est considéré comme conspécifique avec *E. vanda* Rolán & Monteiro, 2007 alors que *E. ceciliae* Fraussen & Rolán, 2003 est mis en synonymie avec *E. marianae* Rolán, Monteiro & Fraussen, 2003.

Keywords: MOLLUSCA - GASTROPODA - BUCCINIDAE - *Euthria* – Atlantic Ocean – Cape Verde Archipelago.

Introduction: The restless Atlantic Ocean, lashing the islands of the Cape Verde Archipelago, harbours a unique molluscan fauna. Hiding a rich diversity, with a high degree of endemism, they have attracted the attention of collectors and scientists, even more in recent years. Consequently, the number of recorded species has grown, most of them formerly unknown and new

to science. The genus *Euthria* Gray, 1850 is represented by an important radiation, all its species endemic to the archipelago. The number of described *Euthria* species was growing from 2 in the year 1906, over 6 (4 additional species in the eighties), up to 24 (18 additional species from 2003 to 2012) hereby largely surpassing the amount of *Euthria* (and *Siphonofusus*) species in the entire Indo-West Pacific (16 species known) and the amount of *Buccinulum* species known from the radiation around New Zealand and Australia (11 species known). A first overview of the genus (Rolán, 1987) comprises 8 species of which *E. cornea* from the Mediterranean and 6 from the Cape Verde Islands (in addition one "sp."). A second overview of the genus (Fraussen, 1999) comprises the very same Atlantic species but with in addition the 6 (at that time known) Indo-West Pacific species, while for *E. cornea* not less than 62 synonyms are listed. Suddenly the number of species increased amazingly at the Cape Verde Islands and an overview in the table given by Rolán et al. (2003: 126, table 1) shows already 10 species. Within a couple of years, Monteiro et al. (2005: 97) listed 17 species known. This latest overview dates back to 2005 and since then more species became described but no updated overview was published. Quite a number of those species look more or lesser similar, especially in pattern, and in combination with a moderately high variability this results in determination problems and incorrect naming. This problem is worsened by the moderately large number of papers (12) in 5 different magazines that does not facilitate a comparative study. A number of species, moreover, became described without details about the spiral sculpture, causing a wrong interpretation of the species in question. New material collected at new fishing grounds is therefore difficult to assign to a species, resulting in the ignorance of possible unknown species and, at the same time, the potential danger of the description of synonyms. During the last couple of years it became obvious that we are in need of a revision. With the present study we therefore want to fill this gap in literature, producing a comparative study by compiling all published knowledge in a single paper while focussing on variability and important morphological details.

Abbreviations:

FS: collection Frank Swinnen, Belgium
KF: collection Koen Fraussen, Belgium
MNCN: Museo Nacional de Ciencias Naturales, Colecciones, Spain
MNHN: Muséum national d'Histoire naturelle, France

SYSTEMATICS

BUCCINIDAE Rafinesque, 1815Subfamily **Pisaniinae** Gray, 1857Genus ***Euthria*** M. E. Gray, 1850

Type species by original designation: “*Fusus lignarius* Chiaje” (this is *Fusus lignarius* Lamarck, 1816, a junior synonym of *Murex corneus* Linnaeus, 1758) from the Mediterranean, Recent.

A discussion of the genus including the Indo-West Pacific species is beyond the scope of this paper. The use of the name *Euthria* as a genus, the difficulties for including *Siphonofusus* Kuroda & Habe, 1952 but excluding *Buccinulum* Swainson, 1837 and the variability of the radula are not relevant for the situation in the Cape Verde Islands where all species seems belong to the same radiation. We therefore refer to Shuto (1978: 358-361), Beets (1986: 92-93), Fraussen (1999: 73), Fraussen & Hadorn (1999: 120-121) and Rolán, Monteiro & Fraussen (2003: 125-126).

We keep all species from the Cape Verde Islands in the same genus *Euthria*, without splitting the shallow water *calderoni* group (littoral to 8 m, see Figs 97-116) and the purple-mouthed group (shallow to moderately deep water, see Figs 1-16) from the deep water group. However those groups are easy to distinguish at first sight, we found no consistent differences in protoconch morphology and in structure of the spiral cords on the upper spire whorls. The presence of a ‘strong’ spiral sculpture on the shallow water *calderoni* group species, compared to the presence of ‘weak’ (or absent) spiral sculpture on the deep-water species, is not enough important without other differences.

Comparison: *Afer* Conrad 1858 (type species: “*Fusus afer* (Lamarck)” by original designation = *Murex afer* Gmelin, 1791 (type locality: “Habitat ad Senegal”)) has an almost identical radula and looks quite similar in shape and pattern but differs in having a much larger, bulbous protoconch, a longer siphonal canal and an outer lip that usually has more accentuated internal lirae. This genus seems to be endemic to the West African coastline without any record from the Cape Verde Archipelago.

Euthriostoma Marche-Marchard & Brebion, 1977 (type species: *Euthriostoma gliberti* Marche-Marchard & Brebion, 1977, by original designation) differs in having a small protoconch. The shells are easily recognized by the large, heavy, white shells with high spire. Until present no *Euthriostoma* species is recorded offshore the Cape Verde Archipelago.

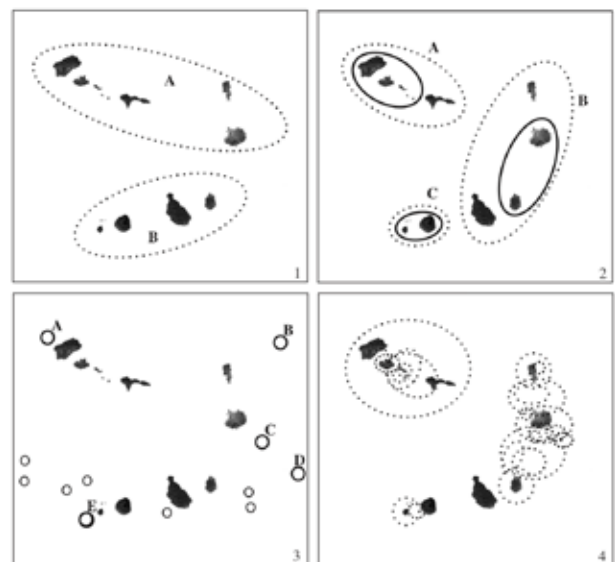
Buccinulum Deshayes, 1830 (type species: “*Buccinum lineatus* Chemnitz” = *Murex lineatus* Gmelin, 1791, subsequent designation by Iredale (1921: 208) = *Buccin linea* Martyn, 1784 as accepted by ICZN Opinion 479 (ICZN, 1957) forms an extensive radiation off New Zealand and Australia comprising shells that look much similar to *Euthria* but that differ in the shape of the central radular tooth (a somewhat broader, less triangular base with rounded margins). We have to keep in mind that, when further study may conclude that the New Zealand *Buccinulum* radiation is congeneric with *Euthria* and its radiation off the Cape Verde Islands, then the name *Buccinulum* has priority over *Euthria*. Radulae of *Euthria* and/or *Buccinulum* species are figured and discussed in detail by Shuto (1978: fig. 2), Cooke

(1917, fig. 1-2, 4-7) and Powell (1929: fig. 83-99). For radulae of *Euthria* species from the Cape Verde Islands we refer to Rolán (1987: 305, pl. 1, fig. 1-6, with also the radula of *E. cornea* for comparison: fig. 7) and Rolán & Monteiro (2007: fig. 12, 23, 29, 37, 38-42).

The Cape Verde Archipelago.

The Cape Verde Archipelago are volcanic islands that originated during the Miocene together with the Canaries. For an account on the geological evolution of the Cape Verde Islands and the chronology with the Canary Islands we refer to Patriat & Labails (2006).

The northern chain of islands is commonly called the Barlovento (or Windward) Group while the southern chain is called the Sotavento (or Leeward) Group, see Text Fig. 1. This geographic dividing, however, does not reflect the geomorphological situation. In reality, the landscape below the surface of the ocean cuts the archipelago in 3 areas, see Text Fig. 2: the western part of the Barlovento Group is separated from Sal and Boavista by a deep (3000 m) and broad bathymetric gap east of São Nicolau while the western part of the Sotavento group is separated from Santiago and Maio by a similar but shallower gap. Maio and Boavista are connected by an extensive shallow flat (50 to 200 m deep) that locally rises to 14 m below sealevel (the João Vicente Valente Bank). Fishing activities like trawling and lobster traps are mainly concentrated on those banks and on the broad slopes around the northern islands, rather than on the steep slopes of the southern islands, see Text Fig. 4. Those features are also reflected in the distribution of fish populations and their genetic similarities (Medina et al., 2007). For an account on the geomorphological aspect of the Cape Verde Islands we refer to Ramalho (2011).

**Text figs 1-4.**

1. Geographic naming. A: Barlovento Group, B: Sotavento Group.
2. Geomorphological. A. western Barlovento Group, B: Boavista Group with João Vicente Valente Bank, C: western Sotavento Group.
3. Seamounts. A: Nola Seamount, B: Senghor Seamount, C: Boa Vista Seamount, D: Cabo Verde Seamount, E: Cadamoosto Seamount.
4. Deep-water areas surveyed by expeditions or fishermen.

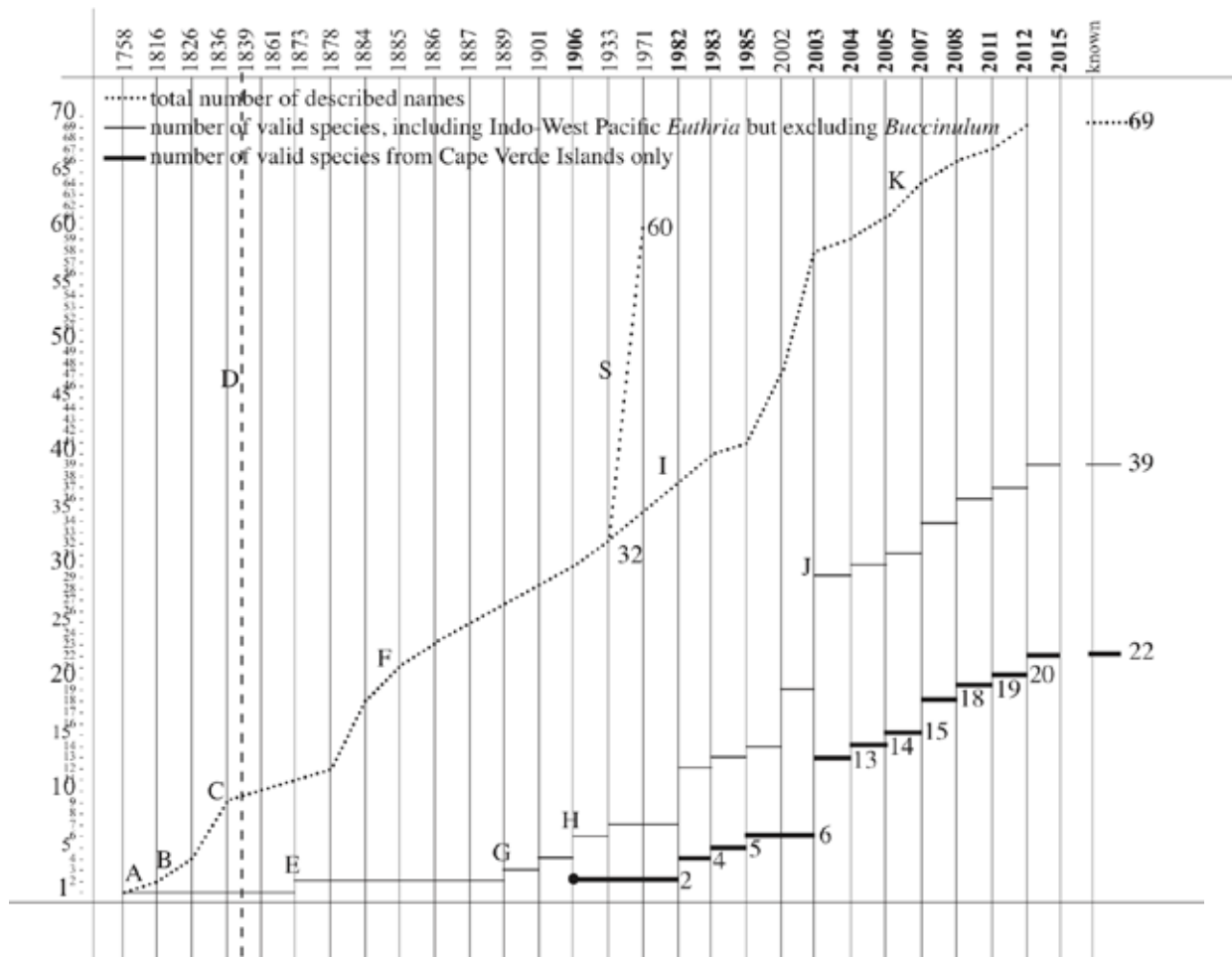


Text fig. 5. Dust from the Sahara over Cape Verde Islands. Image taken by Jacques Descloitres, courtesy of NASA (<http://earthobservatory.nasa.gov/>)

Apart from the islands visible above the ocean, a number of seamounts stay hidden under the surface, their summit reaching up to 20 m under sealevel, see Text Fig. 3. The five largest are Senghor Seamount (up to 93 m below surface, NE off Sal), Boavista and Cabo Verde Seamounts (both SE off Boavista), Maio Seamount (S off Maio), Cadamosto Seamount that is volcanic active (SW off Brava) and Nola Seamount (W off Santo Antão). We have not seen any *Euthria* specimen of which we are sure they came from those places with certainty. Knowledge about the fauna and ecology of seamounts commonly suffer from a lack of sampling (Kvile, 2011: 19)

The fauna and flora is tropical, with a dominant influence from the West African continent (for example also via air, see Text Fig. 5). The Cape Verde Islands are, in today's oceanographic context, situated at a torsion point between the North Equatorial Current (the south-western margin of the Canary Current System (Peña-Izquierdo et al. 2012) flowing along the northern part and the North Equatorial Counter-Current flowing along the southern part of the archipelago. The Canary Current System is bringing rather cold water but enriched with nutrients from upwellings along the African coast. The Counter Current is bringing warmer water that is more favorable for pelagic fauna. For an account on the currents we refer to Peña-Izquierdo et al. 2012, for an account on the pelagic fauna see, among others, Benchimol et al. 2009.

The history of *Euthria* species, with special attention to the Cape Verde Islands.



Text fig. 6. The history of *Euthria* species. Bold solid line: the amount of valid species from the Cape Verde Islands.

A. Since the very first species, *Murex corneus* from Mediterranean, appeared in 1758 in Linnaeus' *Systema Naturae*, the group escaped attention until 1816.

B. In that year the second description of an *Euthria* by Lamarck (*Fusus lignarius*) became at the same time the first synonym.

C. The first half of the 19e century was the start of an increasing list of synonyms, all belonging to the single known species *Euthria cornea*, those descriptions resulting mainly from faunal studies (Risso 1826, Scacchi 1836, ...).

D. The proper genus *Euthria* became described by E. J. Gray in 1839.

E. The second valid species became described by Angas, not earlier than in 1873. *Euthria aracanense*, from Indonesia, is at the same time the first species described within the genus *Euthria* (and thus the oldest author without brackets in this genus).

F. During the second half of the 19e century, the number of synonyms increased steadily, largely due to the descriptions of names in faunal studies (Monterosato, Carus, Locard, ...). Not result in additional valid species, only two valid species remain still.

G. It was not until 1889 that a third valid species (*Euthria ponsonbyi* from South Africa) became added by Sowerby, and until 1901 a fourth (*Euthria queketti* from Japan) by E. A. Smith. These two species are the result of the new discoveries made at new outposts or colonies. The large amounts of catalogues and iconographies (Bruguière, Gmelin, Röding, Sowerby, Reeve, ...) published at the end of the 18e century and continuing far in the 19e century had, contrary to most other genera in the Buccinoidea, not any influence on the number of valid *Euthria* species or synonyms.

H. The first two species from Cape Verde Islands became described in the famous work by Philippe Dautzenberg and Henry Fischer in 1906. This was the start of a rich malacological tradition offshore West Africa. However almost unnoticed among the number of described names (dotted curve) it was also the start of an increasing number of valid *Euthria* species (solid curve). The 3 previously known valid species comprise less than 11 % of the then described names, with a total of 5 species this amount is going to double soon.

I. While the number of described names increases at about the same rate as before (dotted curve), the number of valid species, however, started rising (dotted curve) thanks to the mainly valid descriptions of species. Most of them from the Indo-West Pacific, but with, in addition, some species from the Cape Verde Islands too (Von Cosel, 1982; Von Cosel & Burnay, 1983 and Rolán, 1985). During the last decades couple of the 20e century, the Cape Verde Islands became a popular place for shelling, mainly due to the discoveries of large amounts of existing Conidae.

S. Settepassi described 28 additional form names for *E. cornea*, most of them *nomina nuda*. Those are not included in the graph to avoid an exorbitant rise in the dotted line (from 32 to 60) without any difference in the solid line.

J. In 2003, with 13 species from the Cape Verde Islands known (at that time 14 species in fact, because *E. ceciliae* was not in synonymy yet), the Atlantic surpasses the known Indo-West Pacific fauna.

K. This trend continued until present, with a single Indo-West Pacific species (*E. vokesi* from Somalia) among a majority of species from the Cape Verde Islands. We confirm all those new descriptions, except two, as valid species and therefore both the dotted curve and the solid line produce a similarly rising trend. A short look at the introduction and especially the localities

that are given with the original descriptions of Cape Verdian *Euthria* species shows that every new fishing area results in the discovery of new species and new descriptions. Moreover, the study of the same area or similar area offers new descriptions again, due to the appearance of more comparative material, the discovery of rarer or cryptic species, better fishing techniques, etc.

At present 22 *Euthria* species are known from the Cape Verde Islands. Their number may grow still. For sure their number will not follow Conidae to skyhigh numbers. The Cape Verde Archipelago offers a heterogenous and naturally fragmented landscape for the fauna with a geographic pattern that is characterized by a physical isolation factor that results from the distance and depths between the island groups (Medina et al., 2007: 413). Ecological similarities are higher among some islands, for example the north-western most islands (S. Antao, along Vicente and S. Luzia to S. Nicolau) are the easternmost islands (Sal, Boavista to Maio) while Brava forms a third area with a slightly distinct population structure. Important details is that, however both the Windward Group and the Leeward Group form two zones, the easternmost islands are more similar to each other; with Boavista (for the Windward Group) harbouring populations that are genetically more similar with Maio (for the Leeward group) than when compared with Sal (Medina et al., 2007: 414). For a study on the distribution of fish species at the Cape Verde Islands and the influence of space on those populations we refer to Medina et al. (2007). Fish belong to the pelagic fauna while snails belong to the benthic fauna, nevertheless both marine faunas have many aspects in common. The number of possible *Euthria* species that live in the Cape Verde Archipelago is hard to estimate because the available data are largely insufficient and therefore we have to restrict our conclusions to the mere statement that the discovery of additional new species is more probable along the southern islands.

Variability in *Euthria* species at the Cape Verde Islands.

Intraspecific variability was briefly discussion by Fraussen & Rolán (2003: 83-84) and Fraussen & Afonso (2011: 84, 86-87). Since then, many more specimens were collected with a pattern different from the type. We are now able to confront our initial interpretation with additional material, to place it in a broader context and to formulate a more realistic account on the importance of pattern and colour. For many species, for example the highly variable *E. bernardi* (that displays two different kinds of pattern), our initial interpretation seems to be still correct, while for other species, for example *E. amorimi*, the variability is found to be much higher than the type material suggested. At the same time, however, a number of details in pattern are constant and specific, thus making the pattern a complex determination tool. We therefore discuss the colour and pattern of each species in a distinct aline, separated from the characteristics and the comparison, to remind the reader on the potential danger of such characteristics.

The last whorl of *Euthria* specimens is often variable. Shells with moderately well developed spiral cords on the last whorl may co-exist with shells that have a smooth last whorl (for example *E. calypso* and *E. bernardi*). We consider the occasional presence of spiral cords in otherwise smooth but identical specimens as a remarkable kind of intraspecific variability. The same, but with axial ribs, is observed in *E. pulicaria* by Monteiro & Rolán (2005: 92).

Minor differences in shape, in combination with some differences in colour or erosion, may cause important differences in appearance. For example an eroded specimen (usually being greyish by the acidic quality of the sediment) of *E. calypso* with spiral cords on the last whorl can be confused with *E. darwini* if it had not a larger size and a higher number of spiral cords. Another good example are *E. vandai* and *E. josepedroi* that look quite different at first glance, due to the slightly broader shape and eroded apex, but that have identical sculpture and, apart from some dots, a similar pattern See Figs 80-84.

A third example, in the imagination because not found yet, may be an eroded specimen of *E. amorimi* without pattern or albinistic, thus without the characteristics of the protoconch and upper spire whorls visible, that will be very difficult to distinguish from *E. insalubris*. See Figs 74-79 and 85).

The inside of the aperture is usually ornamented with a weak columellar fold at the transition from columella to siphonal canal and by a number of weak or strong apertural denticles within the outer lip. The number of those last denticles are always given in the original description of a species. We observe that the number of denticles is highly variable, ranging from slightly above the maximum given in the original description, over one or two obscure knobs in the adapical part of the outer lip, to an entirely smooth aperture. In *E. calypso*, for example, the number of internal denticles and lirae may range from entirely smooth (new material, FS) over 9 to 18 (Fraussen, 2004: 10). In *E. helenae* this number ranges from smooth (Rolán et al.: 2007: 10, pl. 7, fig. 35) to 11 or 12 (type material). We therefore do not include the apertural denticles in the comparisons in the present paper.

Some slight variability observed in the strenght, thus depth, of the subsutural concavity seems to be negligible. The broadness of the subsutural concavity, in combination with its strenght, stays an important specific characteristic (see also: Fraussen et al., 2003: 83).

The absence of detailed data is the reason why our knowledge about the locality, depth and habitat of the different forms and patterns is limited. Shells obtained from fishermen are often collected over a moderately broad range, trawled over a long distance. Also lobster traps, and other traps, may have been placed on a considerable distance from each other. There is usually no proof that two morphotypes are effectively collected living together (syntopic) and thus a case of polymorphism rather than originating from two different places and thus being a cline between ecophenotypes.

Apart from the above mentioned signifiers, other morphological details are uncertain still if they may be specific characteristics or if they may be rather useless for determination. Further study may prove that, for example, the differences in pattern in *E. bernardi* are specific and that this name consists of two rather than a single species, or, another example that sounds plausible among collectors, that the spiral cords in *E. calypso* are specific instead of the result of variability. For both examples we doubt if such would be true. Moreover, as long as we do not have molecular data as proof, we are not able to draw a line in between both species, if the case they are two species instead of one, of the two examples above. We have to rely on conchological signifiers.

In the present study we figure a number of shells on which

we cannot stick a name (Fig. 66-67, 96) or that we have to assign to a "cf." name (Figs 52-53, 55-61). In private collections and among shell dealers it may give some frustration to handle shells without name or with a "cf." name. Such a shell occasionally becomes labelled as "new species". Surely, as we know from experience especially in the case of *Euthria* from the Cape Verde Islands, such may be a potential undescribed species indeed. But we suggest to be careful, especially with shells that have a striking pattern, so that other, usually more important, details are not overlooked. Colours and patterns are tricky. We look at a shell and we imagine that we see the morphological characteristics clearly displayed in the pattern and that we understand the differences between the species. On the contrary! Beauty often distracts us. One has also to consider that high variability is an important phenomenon in nature, one of the driving forces of evolution, and recording such is at least as important as describing species to show the magnitude of biodiversity.

Included species:

E. abrotana Fraussen & Rolán, 2003
E. adeles Dautzenberg & Fischer, 1906
E. amorimi Fraussen, 2004
E. bernardi Fraussen & Rolán, 2003
E. boavistensis Cosel, 1982
E. calderoni Rolán, 1985
E. calypso Cosel & Burnay, 1983
E. cesari Monteiro & Rolán, 2005
E. darwini Monteiro & Rolán, 2005
E. emilioi Fraussen & Afonso, 2011
E. fernandezi Rolán, Monteiro & Fraussen, 2003
E. helenae Rolán, Monteiro & Fraussen, 2003
E. inesae Fraussen, Monteiro & Swinnen, 2012
E. insalubris Fraussen & Rolán, 2003
E. marianae Rolán, Monteiro & Fraussen, 2003
 = *E. ceciliae* Fraussen & Rolán, 2003
E. noliomesi Rolán & Monteiro, 2007
E. placibilis Fraussen, Monteiro & Swinnen, 2012
E. pulicaria Dautzenberg & Fischer, 1906
E. rolani Cosel, 1982
E. soniae Rolán, Monteiro & Fraussen, 2003
E. taeniopsoides Fraussen & Afonso, 2008
E. vandai Rolán & Monteiro, 2007
 = *E. josepedroi* Rolán & Monteiro, 2007
E. species 1
E. species 2
E. species 3
E. species 4
E. species 5

Euthria abrotana Fraussen & Rolán, 2003 (Figs 92-93)

Euthria abrotana Fraussen & Rolán, 2003: 80-81, fig. 11-12. Type locality: Cape Verde Archipelago, from fishermen, without exact information. Holotype in Muséum national d'Histoire naturelle, Paris, MNHN-IM-2000-6855.

Range: Only a single additional specimen is known to us, from off Sal Island (in lobster trap at 120-180 m, KF-4989).

Remarks: *Euthria abrotana* is characterized by the slender shape with high, conical spire having a weak subsutural con-

cavity and with weak axial ribs hardly visible on the two upper spire whorls only; the rather smooth surface has a soft appearance and is covered with numerous (more than 100 on the last whorl) fine spiral threads.

The colour is uniform pale yellowish to golden, the aperture is snow white. Specimens with a pattern are not known yet.

Euthria amorimi differs from *E. abrotana* in its smaller protoconch (1.3 mm instead of 1.7 mm) while the number of whorls is about the same (2 ¼ whorls); its broader shape with shorter spire; the fewer but slightly stronger spiral cords along the spire whorls, while the last whorl is usually smooth; the slightly higher number of axial ribs on the first teleoconch whorl (10 instead of 9) and the second teleoconch whorl (11 or 12 instead of 8 or lesser).

The colour of *E. amorimi* is slightly darker, yellowish, with a pattern of fine, brown spiral lines or bands.

All other known *Euthria* specimens differ from *E. abrotana* in the lower number of spiral threads.

***Euthria adeles* Dautzenberg & Fischer, 1906 (Figs 25-26)**

Euthria adeles Dautzenberg & Fischer, 1906: 23, pl. 2, fig. 9-12. Type locality: Santa Luzia, campagne de 1901 station 1152, 52 m deep. Syntype in Musée Océanographique Monaco.

Range: In moderately shallow water (20-50 m) off Santa Luzia and São Vicente Islands. The species prefers sandy bottoms with rocks.

Remarks: *Euthria adeles* is characterized by the small, broad shell with a rather inflated base and short siphonal canal. A shape with a quite atypical appearance for the genus. All specimens we saw look dead collected and the orange colour may be faded therefore.

Euthria soniae has a similar pattern but differ from *E. adeles* in having a broader shape with much shorter siphonal canal; a broader and deeper subsutural concavity and a much smaller adult size.

***Euthria amorimi* Fraussen, 2004 (Figs 74-79)**

Euthria amorimi Fraussen, 2004: 8-10, fig. 1-9, 18-19. Type locality: south of Sal Island, in lobster traps, 120-180 m deep. Holotype in Muséum national d'Histoire naturelle, Paris, MNHN-IM-2000-5803.

Range: In moderately deep water (120-200 m) off Sal and Boavista Islands.

Remarks: *Euthria amorimi* is characterized by having a rather high number of protoconch whorls (2 ¼) when compared to

the size; the presence of numerous fine spiral threads along the spire whorls and, usually, on the last whorl.

The pattern of *E. amorimi* is based on fine, reddish brown spiral bands on a yellowish background. The siphonal canal is covered by a dark brown band while some specimens may have a somewhat darker band along midwhorl. Occasionally with a dark brown spiral band along the suture (holotype) eventually interrupted by pale blotches, if not absent.

Euthria insalubris differs *E. amorimi* in its lower number of protoconch whorls (1 ¼ instead of 2 ¼) while the diameter is the same (about 1.3 mm); the weak but still more concave subsutural slope; the presence of 4 or 5 broad but flat, obscure spiral cords along the first and second teleoconch whorl (instead of numerous fine spiral cords); the presence of a slightly lower number of axial ribs on the first teleoconch whorl (9 instead of 10) and the second teleoconch whorl (10 instead of 11 or 12) while about 12 smooth, obscure axial ribs are present on the third teleoconch whorl (instead of being smooth); the higher number of teleoconch whorls (7 instead of 6 ½) while the adult size is smaller (30.9 for the holotype of *E. insalubris* instead of 41.0 mm for the holotype of *E. amorimi*).

The pattern of *E. insalubris* ranges from white with a brown touch along the siphonal canal (holotype) to the occasional presence of small brown dots arranged in spiral bands like in *E. calypso*.

Euthria abrotana differs from *E. amorimi* in its larger protoconch (1.7 mm instead of 1.3 mm) while the number of whorls is about the same (2 ¼ whorls); its slender shape with higher spire; the more numerous but finer spiral cords along the spire whorls; the slightly lower number of axial ribs on the first teleoconch whorl (9 instead of 10) and the second teleoconch whorl (8 or lesser instead of 11 or 12) and the absence of pattern.

If it happens that an occasional specimen of *E. amorimi* without pattern is found, and that same shell has an eroded spire, thus without the characteristics of the protoconch and upper spire whorls visible, it will be almost impossible to distinguish such shell from *E. abrotana*.

***Euthria bernardi* Fraussen & Rolán, 2003 (Figs 29-39)**

Euthria bernardi Fraussen & Rolán, 2003: 77-79, fig. 1-8. Type locality: Cape Verde Archipelago, from fishermen, without exact information. Holotype in Muséum national d'Histoire naturelle, Paris, MNHN-IM-2000-6854.

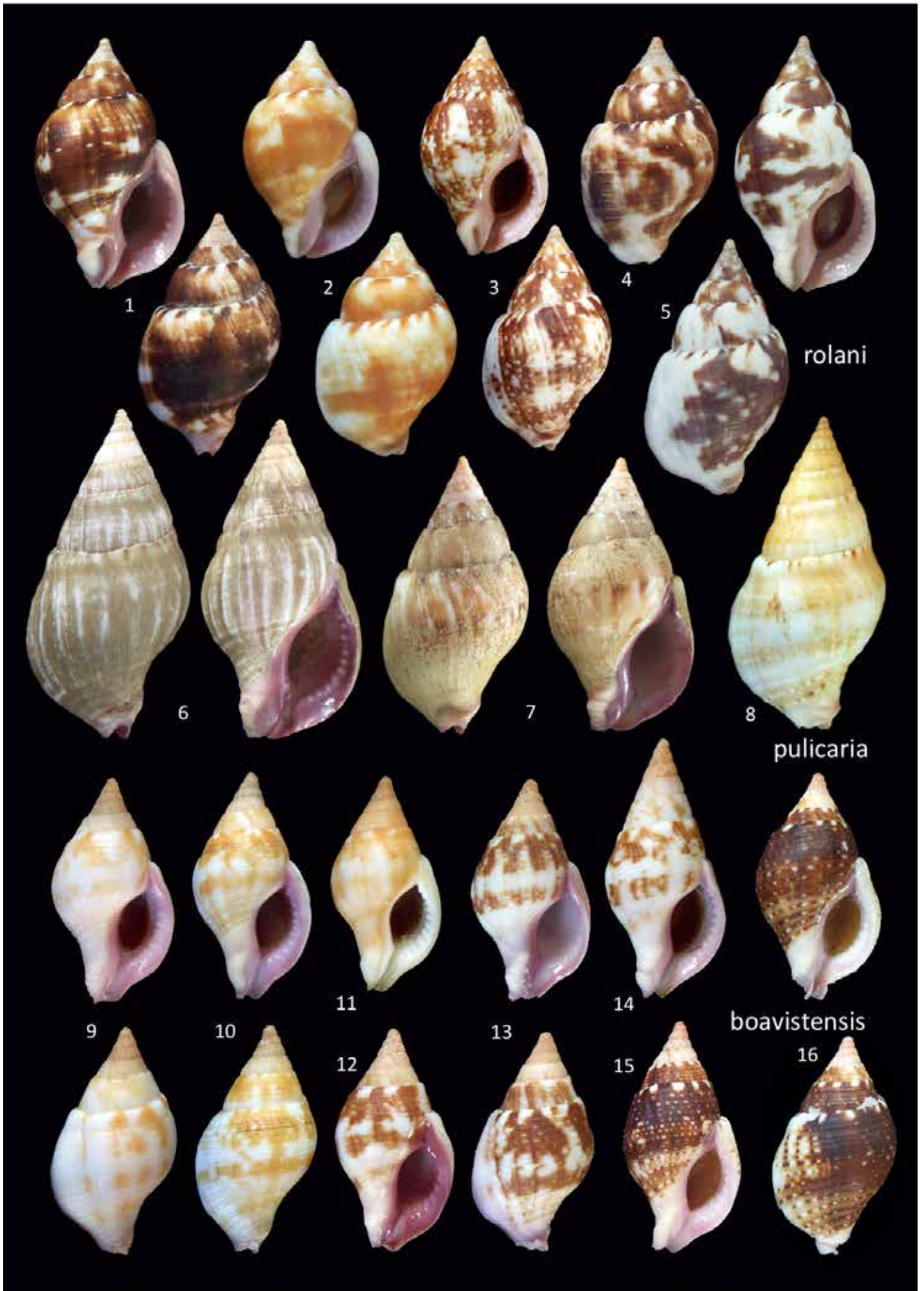
Range: In moderately deep water (140-180 m) off Boavista, Sal, São Vicente and Santa Luzia Islands. The smaller specimens with large dots are known from NW Sal Island.

Remarks: *Euthria bernardi* is characterized by a large, usually thick and occasionally heavy shell, with high spire having and broad and deep subsutural concavity in combination with a

Figs 1-5: *E. rolani* Cosel, 1982. **1:** 36.4 mm, Boavista Isl., dredged at 5 m. **2:** 33.1 mm, **3:** 34.1 mm, **4:** 34.0 mm, São Vicente Isl., in fissures on rock platforms, 6 m. **5:** 40.8 mm, Santa Luzia Isl., Ilhéu Zinho, in sand under rocks, 7-8 m.

Figs 6-8: *E. pulicaria* Dautzenberg & Fischer, 1906. **6:** 41.4 mm, **7:** 37.0 mm, Boavista Isl., 8 miles west off Sal rei, Boavista, in lobster trap. **8:** 43.9 mm, between Fogo and Brava Islands, in lobster traps at 200 m.

Figs 9-16: *E. boavistensis* Cosel, 1982. **9:** 22.1 mm, **10:** 23.0 mm, **11:** 21.7 mm, **12:** 22.4 mm, Boavista Isl., Baía de Sal rei, in sand with rubble under rock slabs, 4-5 m. **13:** 22.2 mm, **14:** 29.0 mm, Boavista Isl., Baía de Sal rei, in sand under large rock slabs, 4-6 m. **15:** 24.0 mm, **16:** 23.6 mm, João VicenteValente Bank, in sand with gravel under dead coral, 29 m.



rather flat, but broad, subsutural cord; the presence of broad but flat spiral cords especially along the base of the heavier shells;

The pattern is highly variable, consisting of small, rather rectangular shaped dots arranged in narrow spiral bands, together with larger, more irregular shaped blotches arranged in a broad subsutural band and one at midwhorl, occasionally a third along the base. The subsutural spiral cord is ornamented with dark, moderately broad dots separated by, usually broad but occasionally narrow, white dots. The tip of the siphonal canal, and usually also the anal notch where the outer lip is connected with the preceding whorl, are dark red brown to dark purplish.

Euthria calypso differs from *E. bernardi* in its smaller size, the absence of a deep subsutural concavity and the weaker spiral and axial sculpture on the upper spire whorls.

The pattern of *E. calypso* is highly variable, but the spiral bands of the pattern are usually separated by broader, pale, interspaces; while the pattern has large brown dots rarely.

A single specimen (Fig. 39) from off Sal Island differs in its broader shape and the more *calypso*-like pattern, but the sculpture of the upper spire whorls is typical for *E. bernardi*.

***Euthria boavistensis* Cosel, 1982 (Figs 1-5)**

Euthria boavistensis Cosel, 1982: 158-159, pl. 5, fig. 4-5. Type locality: Boavista, Sal Rei. Holotype in SMF 254920.

Range: In shallow water (1-6 m) at Boavista and the João VicenteValente Bank. The species prefers sandy bottom with stones but is also found on more muddy bottoms when stones and rocks are present, at the base of rocks.

Remarks: *Euthria boavistensis* is characterized by a small, moderately thin but solid shell; a broad shape with moderately short spire resulting in a semi-oval shell; the conical spire with laterally flattened whorls; in combination with a weak sculpture of fine spiral threads.

The colour is varying from pale yellow to dark chocolate; with large, irregular shaped yellowish to dark brown dots arranged in three broad spiral bands, separated by paler bands; occasionally small white spots arranged in narrow spiral bands present along the last whorl. Both the apex and the siphonal canal are white, while the aperture is purple.

We regard *Euthria* sp. discussed by Rolán (1987: 299-300, fig. 8) conspecific to *E. boavistensis*, the absence of spiral sculpture on the shell and the paler colour of the animal falling within the infraspecific variability of the species.

Euthria rolani differs from *E. boavistensis* in its much broader shape with shorter, constricted, base; the smoother whorls

and the presence of a small fasciole along the siphonal canal.

Euthria pulicaria differs from *E. boavistensis* in its usually broader shape with a shorter siphonal canal, its inflated base; its subsutural concavity and the larger adult size.

***Euthria calderoni* Rolán, 1985 (Figs 112-116)**

Euthria calderoni Rolán, 1985: 6-7, fig. 1-4. Type locality: Sal, Algodeiro. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN.

Range: In shallow water (1-6 m) at Sal, Maio, Santiago, Boavista, São Vicente and Brava Islands. The species prefers sandy bottoms where it lives at the base of stones, rocks and in cavities.

Remarks: *Euthria calderoni* is characterized by the small shell with high spire, having a sculpture of dominant but moderately fine axial ribs especially along the upper spire whorls and spiral cords that grow moderately broad especially along the last whorl.

The colour is dark, greyish or greenish, with pale spots especially along midwhorl, in combination with fine, dark, interrupted spiral lines.

Euthria taeniopsoides differs from *E. calderoni* in its higher number of protoconch whorls (2 instead of 1 ½) in combination with a similar or slightly smaller diameter (1.0 mm instead of 1.1 mm); and the thin and sharp spiral cords along the base. The colour of *E. taeniopsoides* is usually vivid, however dark specimens exist. One can distinguish those dark shells of *E. taeniopsoides* only by the differences in sculpture and protoconch

Euthria emilioi differs from *E. calderoni* in its slightly more slender shell with slightly more laterally flattened whorls. The sculpture is in all aspects almost identical apart from the spiral cords along the last whorls that are usually slightly broader. The colour of *E. emilioi* is vivid without pattern.

***Euthria calypso* Cosel & Burnay, 1983 (Figs 40-53, 55-61)**

Euthria calypso Cosel & Burnay, 1983: 151-154, pl. 14, fig. 1-4. Type locality: Maio, Calypso station 91, 15°34.5'N, 23°11.5'W, 185 m deep. Holotype in Muséum national d'Histoire naturelle, Paris, MNHN-IM-2000-6851.

Range: In moderately deep water (100-200 m) off Sal and Boavista Islands.

Remarks: *Euthria calypso* displays a high variability and is hard to define. The shape is usually moderately slender with a high spire; the whorls are laterally flattened and have a weak sub-

Figs 17-19: *E. soniae* Rolán, Monteiro & Fraussen, 2003. **17:** 50.7 mm, Boavista Isl., off Gatas, in lobster trap at 130-180 m. **18:** 49.1 mm, between São Vicente and São Nicolau Islands, in lobster trap at 75-120 m, KF-4915. **19:** 48.7 mm, Off Boavista Isl., on muddy bottom, in lobster trap at 150-200 m.

Figs 20-22: *E. placibilis* Fraussen, Monteiro & Swinnen, 2012. **20:** 30.3 mm, holotype, fishing area situated off São Vicente, Santo Antão, Santa Luzia and São Nicolau, trawled, 120-180 m, in MNHN-IM-2000-24752. **21:** 32.1 mm, off western Barlovento Group, in lobster trap at 100-150 m. **22:** 34.5 mm, off São Nicolau Isl., in lobster trap at 150 m.

Figs 23-24: *E. helenae* Rolán, Monteiro & Fraussen, 2003. **23:** 43.2 mm, **24:** 38.6 mm, São Vicente Isl., off San Pedro, deep water.

Figs 25-26: *E. adeles* Dautzenberg & Fischer, 1906. **25:** 26.6 mm, **26:** 25.4 mm, São Vicente Isl., Mindelo Bay, 20-30 m, dredged.

Figs 27-28: *E. fernandezi* Rolán, Monteiro & Fraussen, 2003. **27:** 55.5 mm, Boa Vista Isl., off gatas, in lobster trap at 130-180 m. **28:** 52.8 mm, between Mao and Boavista Islands, by fishermen, 75-125 m, KF-7225.



sutural concavity that may be somewhat more accentuated in sculptured specimens; the protoconch has about 2 whorls; the first two whorls have 10 or 11 axial ribs that become much weaker or absent along the third whorl; the spiral sculpture consists of 3 or 4 fine spiral cords on first teleoconch whorl; the teleoconch and body whorls are usually smooth but occasionally have broad but weak spiral cords; the length of the siphonal canal is varying from moderately short (holotype) to moderately long.

The pattern is quite pale, with small red-brown, rectangular blotches, neatly arranged in narrow spiral bands; separated by narrow interspaces, ranging in width from a fine line to slightly broader than the spiral band; aperture snow white. The tip of the siphonal canal is usually white (holotype) or may have some brown striked.

Many specimens show a broad, more densely patterned, spiral band along midwhorl. In the much darker patterned specimens this band, but darker, is situated on exactly the same place.

Also the subsutural band may vary from a limited number of small spots, over more but still small spots (holotype) and larger spots, to a moderately dark band interrupted by a limited number of white dots. Occasionally the subsutural band is, together with the narrow spiral bands along the whorl, almost continue.

Euthria amorimi differs from *E. calypso* in its sculpture of numerous, fine spiral threads along the spire whorls and, usually, also along the last whorl; the usually weaker subsutural concavity and its slightly smaller adult size.

The pattern of *E. amorimi* consists of narrower spiral lines that are rarely interrupted on a yellowish background.

Euthria darwini differs from *E. calypso*, and in particular the ones with spiral cords, in its lower number of spiral cords (4 or 5 on the penultimate whorl and about 18 on the last whorl) and a smaller adult size.

***Euthria cesari* Monteiro & Rolán, 2005 (Fig. 94)**

Euthria cesari Monteiro & Rolán, 2005: 93-94, fig. 10-16. Type locality: Cape Verde Islands, by fishermen, most probably from Brava Island. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/46684.

Range: Known from moderately deep water off Brava Island (type material) and a single additional specimen off Boavista Island (off Gatas, in lobster traps at 130-180 m deep, FS).

Remarks: *Euthria cesari* is characterized by a smooth, glossy shell with some weak axial ribs on the upper spire whorl only. The pattern of *E. cesari* is quite peculiar, consisting of small, reddish brown, rather rectangular shaped dots that are arranged in narrow spiral bands, with narrow interspaces, on a white to pale yellow background. The subsutural cord is ornamented with fine axial lines rather than dots. The apex is orange and the aperture is snow white. Occasionally the colour may be pale without pattern (Monteiro et al., 2005: fig. 13-15).

Some paler specimens of *Euthria marianae* may have a somewhat similar appearance in pattern but differs from *E. cesari* by the broader shape, the pattern with broader spiral bands that are lower in number along the spire whorls (3 along the penultimate whorl instead of 5 or 6) and the pinkish apex.

***Euthria darwini* Monteiro & Rolán, 2005 (Fig. 54)**

Euthria darwini Monteiro & Rolán, 2005: 94-95, fig. 17-22. Type locality: South of Boavista, 3 miles off Curral Velho, 50-75 m deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/46690.

Also figured as *Euthria adeles* by Rolán, 1987: fig. 5.

Range: Known from off Boavista Island (type material) and one additional specimen from off Sal Island (Palmeira, in lobster trap at 100-120 m, FS).

Remarks: *Euthria darwini* is characterized by a small, rather heavy shell, sculptured with big, broad spiral cords, spire whorls with 5 or 6 cords, body whorl with about 18 such cords.

All shells we studied have a greyish and eroded surface, consequently the pattern and colour are hard to detect.

Some shells of *Euthria calypso*, in this case the ones that have well developed spiral cords on the last whorl, look similar but differ by the higher number of spiral cords and the larger adult size.

***Euthria emilioi* Fraussen & Afonso, 2011 (Figs 103-109)**

Euthria emilioi Fraussen & Afonso, 2011: 87-90, fig. 1-4. Type locality: Derrubado, northern Boavista Island, attached under large rock boulders covered by algae, on sandy bottom with gravel, 1-2 m deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/55112.

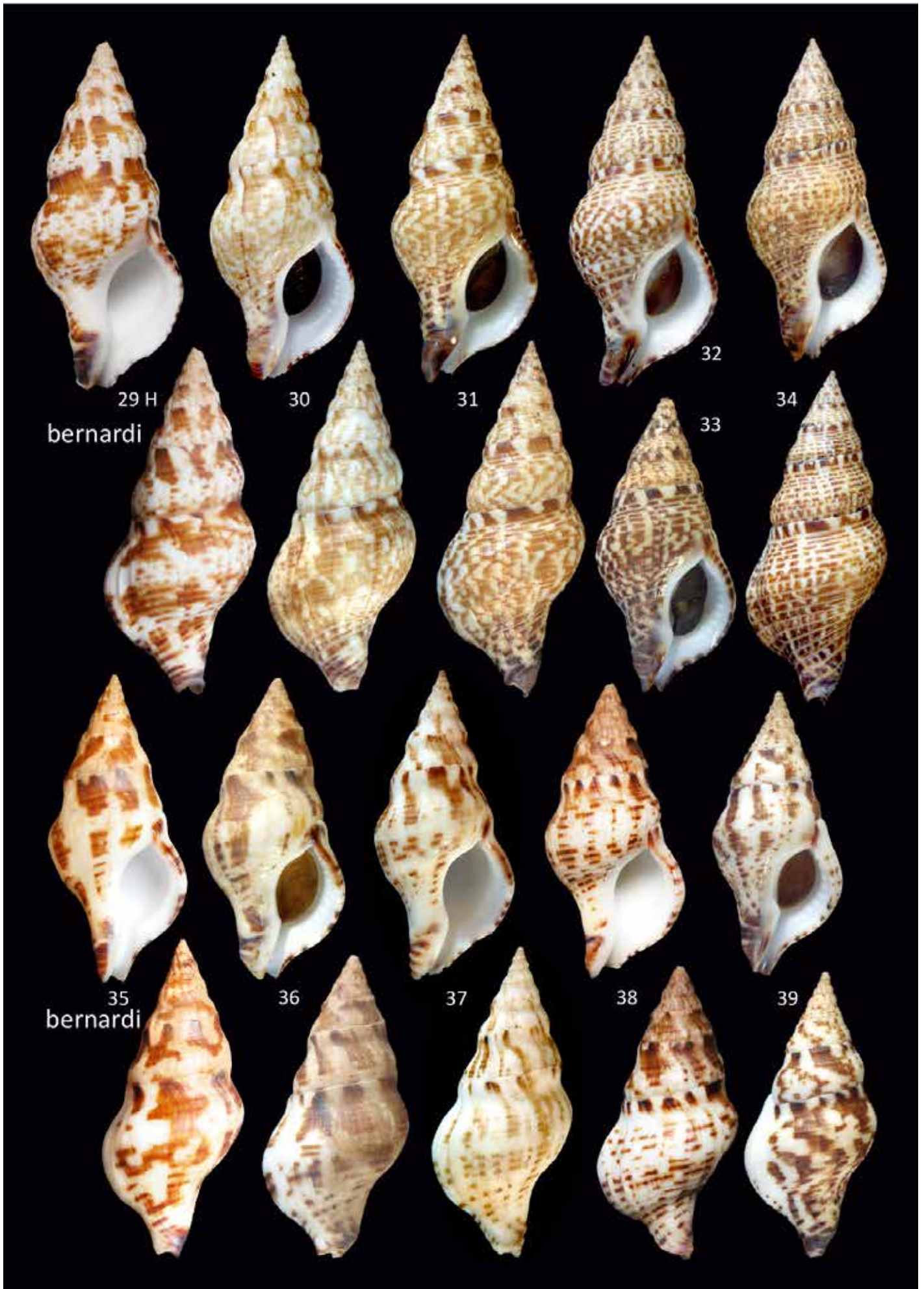
Also figured as *Euthria* aff. *calderoni* by Rolán, 1987: tav. 1 fig. 6, fig. 9a, and as *Euthria calderoni* by Fraussen & Afonso, 2008: fig. 6-7.

Range: In shallow water (1-2 m) at northern Boavista island. The species is found attached to large rocks and boulders on a sandy bottom, eventually with gravel.

Remarks: *Euthria emilioi* is characterized by the small shell with high spire, having a sculpture of dominant but moderately fine axial ribs along the upper spire whorls only and broad spiral cords along all whorls. The colour is uniform, vivid, usually yellow or orange, occasionally golden brown.

Euthria taeniopsoides differs from *E. emilioi* in its higher number of protoconch whorls (2 instead of 1 ½) in combination with a similar or slightly smaller diameter (1.0 mm instead of 1.1 mm); the deeper subsutural concavity and its thin but sharp spiral cords along the base.

Figs 29-39: *E. bernardi* Fraussen & Rolán, 2003. **29:** 65.0 mm, holotype, from fishermen, without exact information, in MNHN-IM-2000-6854. **30:** 64.8 mm, **31:** 67.3 mm, off Boavista Isl., in lobster trap at 150-200 m. **32:** 67.8 mm, between São Vicente and Santa Luzia Islands, in lobster trap at 160-180 m. **33:** 60.8 mm, off Boavista Isl., in lobster trap at 150-200 m. **34:** 64.0 mm, between São Vicente and Santa Luzia Islands, in lobster trap at 160-180 m. **35:** 45.9 mm, paratype 4, from fishermen, without exact information, in MNHN. **36:** 48.4 mm, NW off Sal Isl., in lobster trap at 140-180 m. **37:** 51.5 mm, from fishermen without exact information, in lobster trap at 120-180 m, KF-5294. **38:** 49.3 mm, paratype 6, from fishermen without exact information, in MNHN. **39:** 42.2 mm, NW off Sal Isl., in lobster trap at 140-180 m.



The pattern of *E. taeniopsoides* is highly variable but always with some pattern of pale or white dots and fine, interrupted spiral lines.

Euthria calderoni differs from *E. emilioi* in its slightly broader shell with slightly more convex whorls. The sculpture is in all aspects almost identical apart from the spiral cords along the last whorls that are usually slightly narrower.

The pattern of *E. calderoni* is much darker with some pattern of paler or white dots and fine, interrupted spiral lines.

***Euthria fernandezi* Rolán, Monteiro & Fraussen, 2003** (Figs 27-28)

Euthria fernandezi Rolán, Monteiro & Fraussen, 2003: 121, fig. 16-18, 28B, 28D. Type locality: Between Maio and Boavista, dredged, 75-125 m deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/46584.

Range: In moderately deep water (130-180 m) off Maio and Boavista Islands.

Remarks: *Euthria fernandezi* is characterized by the large shell (51.3 mm, holotype) with a large protoconch (more than 2 whorls and 2.2 mm in diameter), the angulated spire whorls with big axial knobs on the upper spire whorls and a moderately deep subsutural concavity and the about 13 broad but low spiral cords that are much more accentuated along the base. The pattern is characterized by dark brown blotches separated by some snow white blotches and arranged in spiral bands. One broad such spiral band covering two spiral cords at midwhorl (holotype), and one or more similar but paler bands along the base and on top of the spiral cords at the base. The background is usually pale yellowish, tending to golden, occasionally ornamented with fine brown irregular axial lines. The labral varix is slightly darker: the top of the broad spiral cords covered with brown while the interspaces are pale yellowish.

Euthria soniae differs from *E. fernandezi* in its slender shape with slightly higher spire; the more numerous and much finer spiral cords and the usually more glossy appearance.

The pattern of *E. soniae* is usually much darker, chocolate brown in fresh specimens, however pale specimens exist; with a pattern of irregular axial lines or axially oriented streaks and the usually white siphonal canal.

Euthria helenae differs from *E. fernandezi* in its slender shape with higher spire and the finer spiral cords.

The pattern of *E. helenae* consists of finer spiral lines and a usually dark siphonal canal.

***Euthria helenae* Rolán, Monteiro & Fraussen, 2003** (Figs 23-24)

Euthria helenae Rolán, Monteiro & Fraussen, 2003: 121-125, fig. 19-22, 26, 28F. Type locality: Between São Nicolau and São Vicente, in traps, 75-125 m deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/46585.

Figs 40-51: *E. calypso* Cosel & Burnay, 1983. **40:** 44.6 mm, holotype, Maio, Calypso station 91, 15°34.5'N, 23°11.5'W, 185 m deep, in MNHN-IM-2000-6851. **41:** 54.1 mm, **42:** 39.7 mm, Boavista Isl., off Gatas, in lobster trap at 130-180 m. **43:** 53.2 mm, **44:** 46.0 mm, off Boavista Isl., in lobster trap at 150-200 m. **45:** 47.1 mm, NW off Sal Isl., in lobster trap at 140-180 m. **46:** 47.0 mm, **47:** 57.9 mm, **48:** 51.4 mm, **49:** 45.5 mm, **50:** 50.0 mm, off Boavista Isl., in lobster trap at 150-200 m. **51:** 47.5 mm, between Sal and Boavista Islands, in lobster trap at 150-200 m.

Range: In moderately deep water around the western Barlovento Group. Known from São Nicolau and São Vicente Islands.

Remarks: *Euthria helenae* is characterized by the slender shape with high spire, the angulated spire whorls with big axial ribs and a deep subsutural concavity and the about 15 fine but sharp spiral cords.

The pattern is characterized by fine, pale brown spiral lines situated on top of the spiral sculpture, with a faded appearance even in fresh specimens, on a cream white background. The siphonal canal or its tip is darker, with more accentuated brown spiral lines or with broad, more diagonally oriented brown streaks, occasionally entirely brown.

Euthria soniae differs from *E. helenae* in its broader shape; the numerous and much finer spiral cords, the rather glossy appearance and the slightly larger adult size.

The pattern of *E. soniae* is usually much darker, chocolate brown in fresh specimens, however pale specimens exist; with a pattern of irregular axial lines or axially oriented streaks and the usually white siphonal canal.

***Euthria inesae* Fraussen, Monteiro & Swinnen, 2012** (Figs 90-91)

Euthria inesae Fraussen, Monteiro & Swinnen, 2012: 20-22, text fig. C, fig. 8-12. Type locality: fishing area situated off São Vicente, Santo Antão, Santa Luzia and São Nicolau, in lobster traps, 50-120 m deep. Holotype in Muséum national d'Histoire naturelle, Paris, MNHN-IM-2000-24753.

Range: In moderately shallow to moderately deep water (50-180 m) around the western Barlovento Group.

Remarks: *Euthria inesae* is characterized by the smooth shell (except some fine spiral cords along the first two teleoconch whorls) ornamented with a vivid pattern of small, subsuturally regular but otherwise irregular, dots arranged in broad spiral bands, on a cream to flesh coloured background.

Euthria marianae differs from *E. inesae* in its deeper subsutural concavity and broad, but weak, spiral cords along the base.

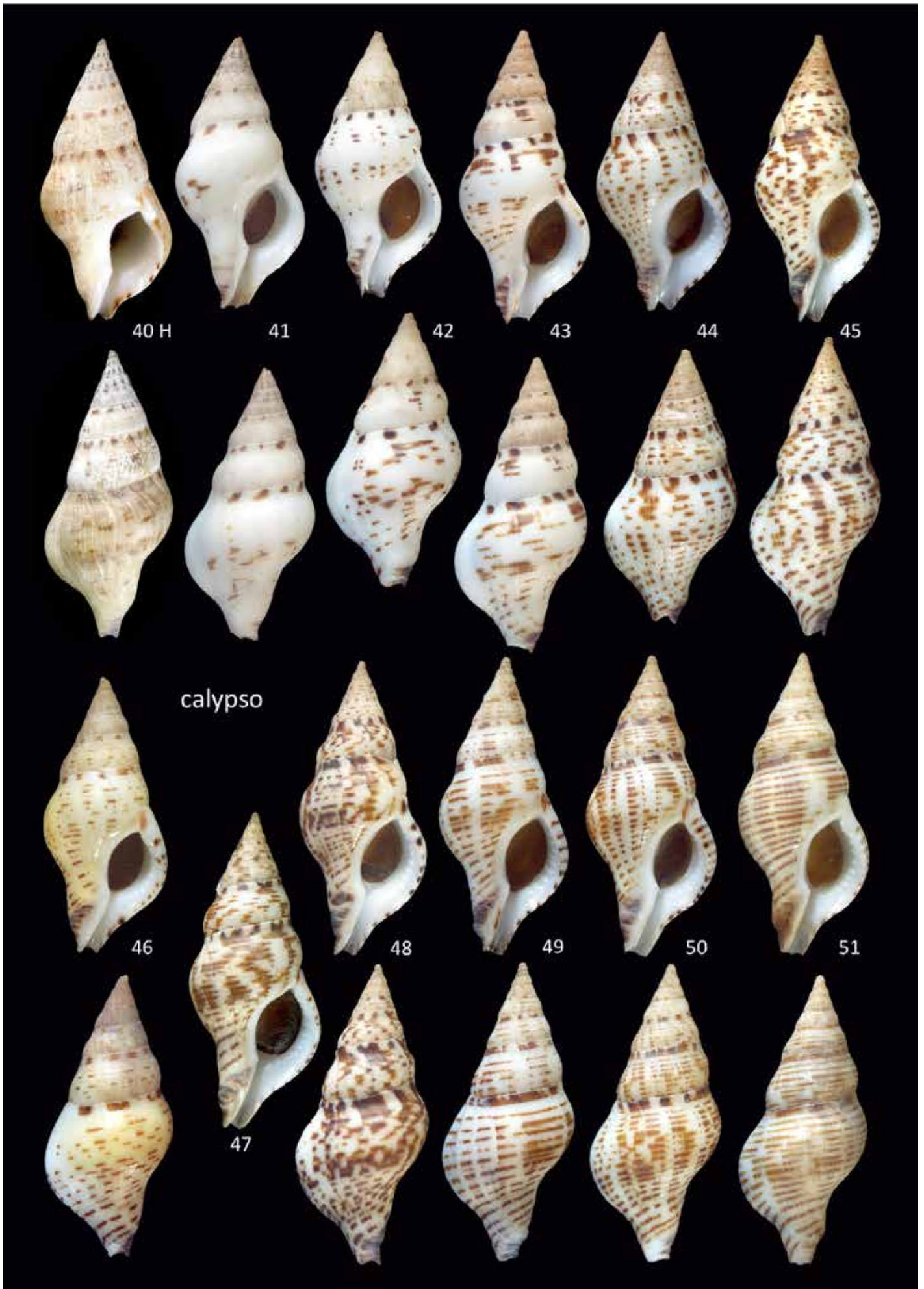
The pattern of *E. marianae* differs in possessing a pink apex, a paler background, narrow white spiral cords along the base or an entirely white base, usually 1 to 3 fine white spiral lines along the subsutural slope and a paler siphonal canal.

***Euthria insalubris* Fraussen & Rolán, 2003** (Figs 68-73, 85)

Euthria insalubris Fraussen & Rolán, 2003: 79-80, fig. 9-10. Type locality: Cape Verde Archipelago, from fishermen, without exact information. Holotype in Muséum national d'Histoire naturelle, Paris, MNHN-IM-2000-6839.

Range: In moderately deep water (100-200 m) off Sal and Boavista Islands.

Remarks: *Euthria insalubris* is characterized by the medium to



moderately small sized shell (holotype: 30.9 mm) with a small protoconch (1 ¼ whorl, diameter about 1.3 mm), the weak but broad subsutural concavity and the presence of 4 to 5 fine, obscure spiral cords along the first three spire whorls.

The colour of *E. insalubris* is pale, usually without pattern (holotype), occasionally with small brown dots arranged in spiral bands like in *E. calypso*. The anal notch, where the outer lip is connected with the preceeding whorl, and siphonal canal are usually red-brown.

Euthria amorimi differs from *E. insalubris* in its higher number of protoconch whorls (2 ¼ instead of 1 ¼) while the diameter is the same (about 1.3 mm); its weaker subsutural concavity; the presence of numerous fine spiral cords along all spire whorls (instead of 4 or 5 broad but flat, obscure spiral cords along the first and second teleoconch whorl and a smooth penultimate whorl); the presence of a slightly higher number of axial ribs on the first teleoconch whorl (10 instead of 9) and the second teleoconch whorl (11 or 12 instead of 10) while the third teleoconch whorl is smooth (rather than with about 12 smooth, obscure axial ribs); the lower number of teleoconch whorls (6 ½ instead of 7) while the adult size is larger (41.0 mm for the holotype of *E. amorimi* instead of 30.9 for the holotype of *E. insalubris*).

The pattern of *E. amorimi* ranges from white to yellowish with fine, brown spiral lines, those lines occasionally clustered together in a broader band.

If it happens that an occasional specimen of *E. amorimi* without pattern is found, and that same shell has an eroded spire, thus without the characteristics of the protoconch and upper spire whorls visible, it will be almost impossible to distinguish such shell from *E. abrotona*.

***Euthria marianae* Rolán, Monteiro & Fraussen, 2003** (Figs 86-89)

Euthria marianae Rolán, Monteiro & Fraussen, 2003: 120-121, fig. 8-12, 24B, 28C. Type locality: Between São Nicolau and São Vicente, in traps, 75-100 m deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/46583.

Euthria ceciliae Fraussen & Rolán, 2003: 82-83, fig. 19-30. Type locality: São Vicente, by divers, 20-80 m deep. Holotype in Muséum national d'Histoire naturelle, Paris, MNHN-IM-2000-6849.

Range: In moderately shallow (20-80 m) to moderately deep water (75-100 m) around the western Barlovento Group, known from São Nicolau and São Vicente Islands. One record from off Boavista Island (in lobster traps at 150-200 m) needs confirmation.

Remarks: *Euthria marianae* is characterized by a pink apex; a protoconch consisting of 1 ¾ to 1 ½ whorls, about 1.5 mm in diameter; a medium sized shell of 33 mm (holotype *E. ceciliae*) to 36.9 mm (holotype *E. marianae*) with 6 to 6 ¼ teleoconch

whorls; the presence of 3 or 4 strong spiral cords on the first teleoconch whorl, those spiral cords becoming much weaker along the first whorl while increasing in number, the second teleoconch whorl being smooth or not having 7 to 14 obscure or weak spiral cords; the presence of 10 or 11 axial ribs on the first teleoconch whorl, eventually 11 to 13 much weaker ribs on the second whorl.

The dark chestnut brown pattern of small, irregular blotches is highly variable, forming dark bands or scattered spots on a cream to white background. Two fine white spiral lines are occasionally present along the subsutural slope while 2 to 6 are running along the base and siphonal canal. Often the base and siphonal canal are entirely cream or white. Occasionally also the subsutural slope may be cream or white (*E. marianae*) with a narrow band of pattern visible still just above the suture. It may be possible that specimens from shallower water, 20-80 m (type material of *E. ceciliae*), are darker than specimens from deeper water, 75-100 (type material of *E. marianae* and recently obtained specimens).

Euthria inesae differs from *E. marianae* in its weaker subsutural concavity, its smooth base without spiral cords and the slightly smaller adult size.

The background colour of *E. inesae* is usually slightly darker while the pattern is slightly paler, except along the subsutural slope; the apex is pale or white (instead of pink); the pattern differs in consisting of larger blotches that are more axially arranged, with narrow pale or white spiral bands along the upper part of the base (the upper border of it situated at the same place as in *E. marianae*) but with an additional pale or white spiral band along midwhorl and without such lines along the subsutural slope or lower base. The siphonal canal is usually brown.

Euthria cf. *marianae* as figured by Rolán, Monteiro & Fraussen, 2003 on fig. 13-15 differs from typical *E. marianae* in having more regular shaped blotches that are nicely arranged in narrower spiral bands and in having a thick, *E. rolani*-like, subsutural cord.

***Euthria noliomesi* Rolán & Monteiro, 2007** (Figs 62-65)

Euthria noliomesi Rolán & Monteiro, 2007: 4-5, pl. 2, fig. 8-12. Type locality: off Boavista island, 150-200 fms deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/47003.

Range: In deep water (100-400 m) off Sal and Boavista Islands.

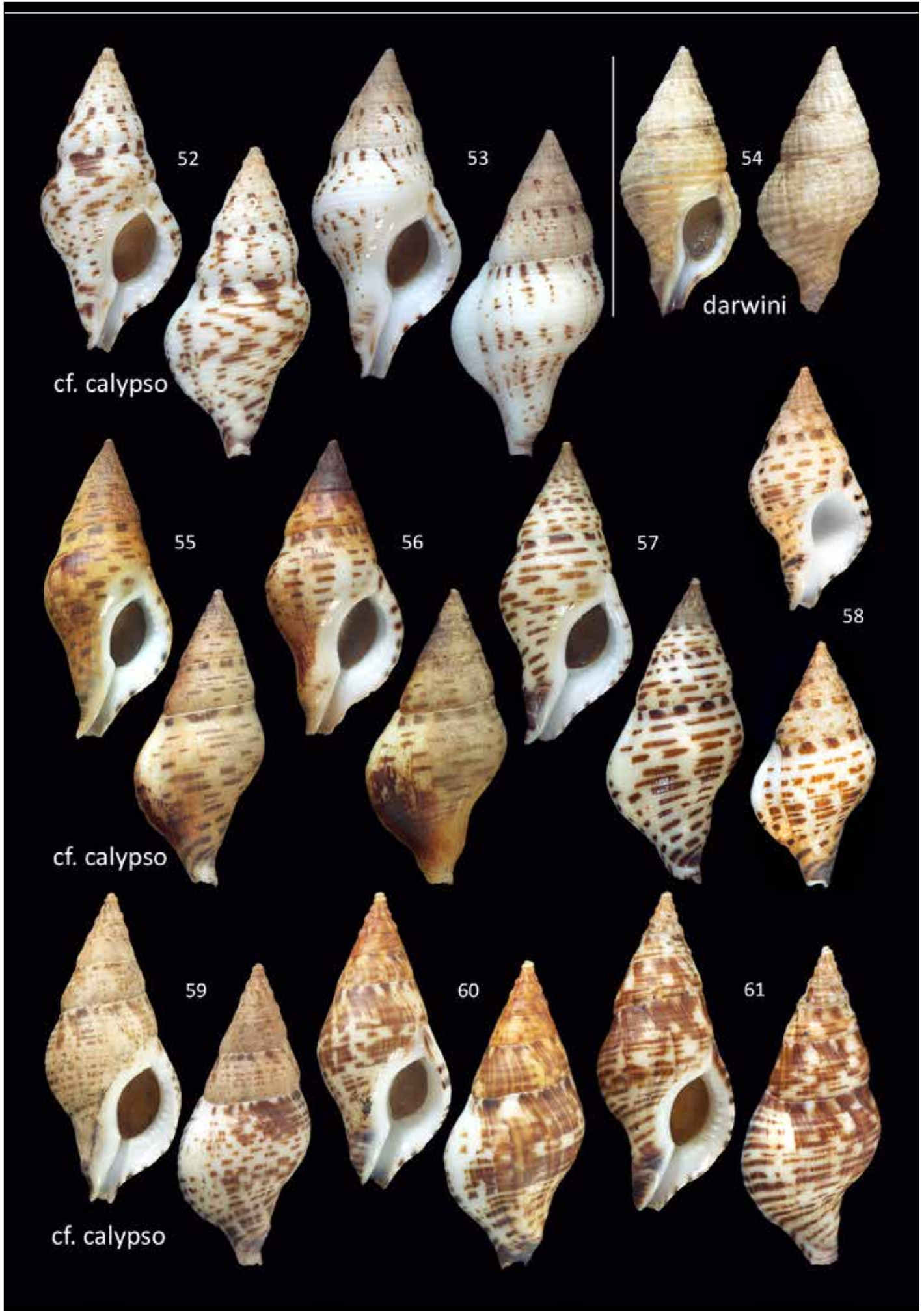
Remarks: *Euthria noliomesi* is characterized by a broad protoconch (1.8 mm); a rather broad shape with short base; the usually slightly angulated whorls; the presence of numerous minute spiral cords (about 40 such threads on the 5e whorl), only visible under magnification, running along all spire whorls

Figs 52-53: *E. cf. calypso* Cosel & Burnay, 1983. **52:** 44.2 mm, NW off Sal Isl., in lobster trap at 140-180 m. **53:** 48.3 mm, off Boavista Isl., in lobster trap at 150-200 m.

Fig. 54: *E. darwini* Monteiro & Rolán, 2005, 34.7 mm, Sal Isl., off Palmeira, in lobster trap at 100-120 m.

Figs 55-58: *E. cf. calypso* Cosel & Burnay, 1983. **55:** 46.5 mm, **56:** 45.6 mm, off Boavista Isl., in lobster trap at 100-150 m. **57:** 44.1 mm, off Boavista Isl., in lobster trap at 150-200 m. **58:** 33.9 mm, between Sal and Boavista Islands, in lobster trap at 100-200 m, KF-4363.

Figs 59-61: *E. cf. calypso* Cosel & Burnay, 1983. **59:** 41.9 mm, **60:** 39.0 mm, **61:** 44.3 mm, NW off Sal Isl., in lobster trap at 140-180 m.



down to the body whorl (holotype) or, occasionally, down to the penultimate whorl only and thus leaving the last whorl smooth. The colour is pale, with a limited amount of small dots arranged in narrow spiral bands, quite similar to what is seen in *E. calypso*.

For a description of the animal and radula we refer to Rolán et al. (2007: 4).

The shells discussed as *Euthria* cf. *noligomesi* by Rolán et al. (2007: 5-6, pl. 3, fig. 13-17) are, without doubt, this same species.

Euthria calypso differs from *E. noligomesi* in its smaller protoconch; the slender shape with a more stretched base; a smooth surface without fine spiral threads and the larger adult size. Differences in size, however, are subject of strong variation in some species and we suggest to avoid using this as a specific characteristic.

***Euthria placibilis* Fraussen, Monteiro & Swinnen, 2012** (Figs 20-22)

Euthria placibilis Fraussen, Monteiro & Swinnen, 2012: 17-19, text fig. A, fig. 1-7. Type locality: fishing area situated off São Vicente, Santo Antão, Santa Luzia and São Nicolau, trawled, 120-180 m deep. Holotype in Muséum national d'Histoire naturelle, Paris, MNHN-IM-2000-24752.

Range: In moderately deep water (120 to 180 m) around the western Barlovento Group.

Remarks: *Euthria placibilis* is characterized by the moderately broad shape with stretched base; the strong axial knobs on the shoulder; in combination with the presence of numerous obscure, almost invisible, spiral cords, along the lower spire whorls and last whorl.

The pattern is pale, consisting of pale brown, moderately narrow spiral bands, occasionally interrupted by a pale dot.

Euthria soniae differs from *E. placibilis* in possessing slightly stronger spiral cords that are visible with the naked eye (rather than microscopic), its much weaker axial sculpture and a larger adult size.

The pattern of *E. soniae* is usually more expressive, consisting of irregular dots and spots, arranged in fine axial strikes.

Euthria fernandezi differs from *E. placibilis* in its much broader spiral cords; its much weaker axial sculpture and the sharper, well defined shoulder.

The pattern of *E. fernandezi* is usually more elaborated, consisting of irregular dots and spots, arranged in moderately narrow spiral bands, and with a darker siphonal canal.

***Euthria pulicaria* Dautzenberg & Fischer, 1906** (Figs 6-8)

Euthria pulicaria Dautzenberg & Fischer, 1906: 24, pl. 2, fig. 6-8. Type locality: Boa Vista, campagne de 1901 station 1203, 91 m

Figs 62-65: *E. noligomesi* Rolán & Monteiro, 2007. **62:** 40.5 mm, Sal Isl., off Palmeira, in lobster traps at 100-120 m. **63:** 37.8 mm, holotype, off Boavista Isl., 150-200 fms, in MNCN-15.05/47003, photo copyright and courtesy of CSIC and MNCN. **64:** 34.5 mm, **65:** 35.4 mm, between Sal and Boavista Islands, in lobster trap at 150-200 m.

Figs 66-67: *E. species 1*. **66:** 33.6 mm, **67:** 37.5 mm, NW off Sal Isl., in lobster trap at 140-180 m.

Figs 68-73: *E. insalubris* Fraussen & Rolán, 2003. **68:** 30.9 mm, holotype, from fishermen, without exact information, in MNHN-IM-2000-6839. **69:** 35.1 mm, off Boavista Isl., in lobster trap at 150-200 m. **70:** 35.9 mm, **71:** 35.2 mm, **72:** 42.2 mm, **73:** 37.9 mm, between Sal and Boavista Islands, by fishermen, 100 m.

deep. Syntypes in Musée Océanographique Monaco.

Range: In moderately shallow water (50-70 m) off Sal and Boavista Islands. One record from between Fogo and Brava islands (in lobster traps at 200 m, FS) needs confirmation. One record from 8 miles west off Sal Rei (Boavista) may have been trapped on a seamount.

Remarks: *Euthria pulicaria* is characterized by the semi-oval shape with a high, conical spire and an inflated base; the broad subsutural spiral cord in combination with a broad but weak subsutural concavity. The last whorl may be smooth or occasionally covered by moderately well developed axial ribs or riblets (see also Dautzenberg et al., 1906: 24 and Monteiro et al., 2005: 92).

A pattern of small red-brown dots, arranged in spirals, covers a white to yellow, often bright, ground colour; occasionally greyish. The aperture is usually bright purple.

Euthria boavistensis differs from *E. pulicaria* by its more stretched base with longer siphonal canal; the absence of a subsutural concavity and the smaller adult size.

***Euthria rolani* Cosel, 1982** (Figs 9-16)

Euthria rolani Cosel, 1982: 157-158, pl. 5, fig. 1-3. Type locality: Santa Luzia, Curral. Holotype in SMF 254919

Range: In shallow water (1-8 m) at Santa Luzia and Boavista Islands and on the João Vicente Valente Bank. The species lives buried in sand under big stones, rocks and in fissures of rock platforms.

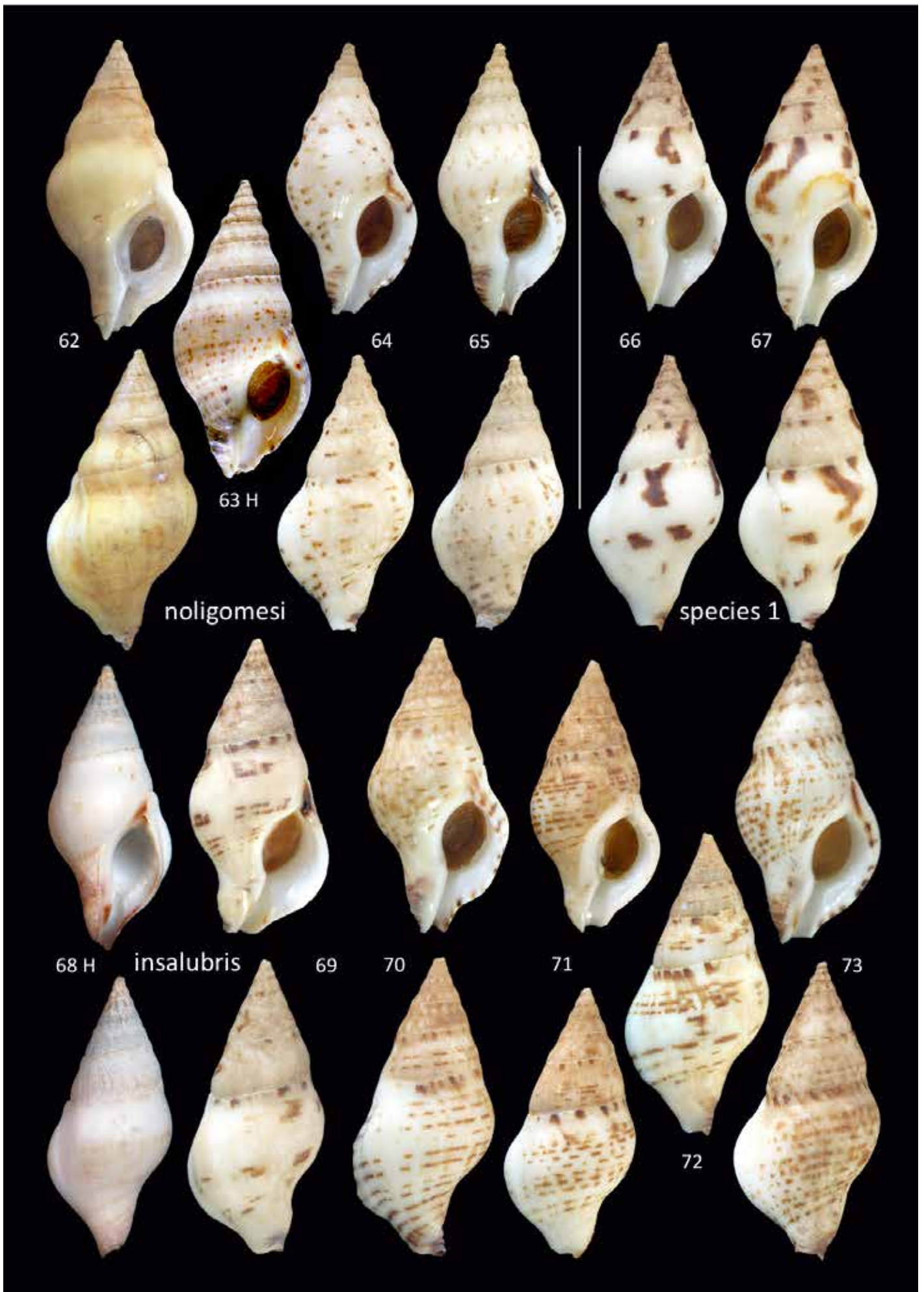
Remarks: *Euthria rolani* is characterized by a broad, heavy shell; a broad shape with short spire resulting in an almost oval or round shell and a swollen shoulder (instead of a subsutural ramp) with deep suture.

The colour is varying from pale brown to dark chocolate; with large dots; often separated by paler, usually axially orientated, straight or zig-zag bands; occasionally with some small white spots arranged in narrow spiral bands present along the penultimate and last whorl. Both the apex and the siphonal canal are paler; the aperture is purple.

Euthria boavistensis differs from *E. rolani* in its slender shape with higher, conical spire and with a stretched base; the weakly sculptured whorls and the slender, simple siphonal canal without fasciole.

***Euthria soniae* Rolán, Monteiro & Fraussen, 2003** (Figs 17-19)

Euthria soniae Rolán, Monteiro & Fraussen, 2003: 117-120, fig. 2-7, 23B, 25A, 28E. Type locality: Cape Verde Archipelago, by



fishermen, most likely around the Barlavento group. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/46582.

Range: In moderately deep water (130-200 m) off Boavista Island.

Remarks: *Euthria soniae* is characterized by the large and slender shell with high spire, the angulated spire whorls with broad and deep subsutural concavity; the weak axial knobs on the upper spire whorls and the obscure spiral sculpture consisting of numerous fine spiral threads giving the surface a soft appearance.

The dark pattern of *E. soniae* is chocolate brown in fresh specimens, with irregular axial lines or axially oriented streaks on a cream background. The siphonal canal is usually white. Pale specimens without striking pattern exist.

Euthria fernandezi differs from *E. soniae* in its broader shape; the much broader spiral cords especially on the base and the sharper, well defined shoulder.

The pattern of *E. fernandezi* is much paler, with smaller and more rectangular shaped blotches arranged in spiral bands. The tip of the siphonal canal is brown.

Euthria helenae differs from *E. soniae* in its slender shape; the stronger spiral cords that are lower in number and the smaller adult size.

The pattern of *E. helenae* is paler, consisting of fine, pale brown spiral lines with a faded appearance on top of the spiral sculpture on a usually paler background. The tip of the siphonal canal is dark brown.

***Euthria taeniopsoides* Fraussen & Afonso, 2008** (Figs 97-102)

Euthria taeniopsoides Fraussen & Afonso, 2008: 53-60, fig. 1-5, 9-14. Type locality: northern Sal island, Terrinha Fina, ¼ to 2 m deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/47555.

Range: In shallow water (¼ to 2 m) off Sal Island. The species prefers living under rocks in tide pools at ¼ to ½ m deep and under rocks and rock slabs in gravel and sand at ½ to 2 m deep.

Remarks: *Euthria taeniopsoides* is characterized by the small shell, having a high spire and the fine but sharp spiral cords especially along the base.

The colour is usually vivid, with pale spots especially along mid-whorl; usually in combination with fine, dark, interrupted spiral lines. The colour shows a strong degree of variability which is geographically or ecologically indicated (ecophenotypes) with little or without polymorphism (variability within a population). One can recognize the three populations around Sal Island:

reddish-brown shells at the northwest coast (type locality), almost black shells on the east coast and a population of pale yellowish shells on the central-east coast, as already recorded by Fraussen et al. (2011: 86-87, fig. 7-10).

The number of spiral cords and axial ribs is quite variable in this species. The spiral cords on the last whorl may vary from 12 or 13 (in the holotype) to up to 20 (in new material, FS). Until now the maximum amount of observed spiral cords differs considerably between the orange-red form (up to 15 spiral cords on the last whorl) and the yellow form (up to 20 spiral cords).

Euthria calderoni differs from *E. taeniopsoides* in having fewer protoconch whorls (1 ½ instead of 2), broader spiral cords, especially along the base and in having fewer axial ribs on the upper spire whorls. The colour of *E. calderoni* is usually much darker (however dark forms of *E. taeniopsoides* exist also, at the east coast of Sal).

Euthria emilioi differs from *E. taeniopsoides* in having fewer protoconch whorls (1 ½ instead of 2) in combination with a similar or slightly larger diameter (1.1 mm instead of 1.0 mm); a much weaker subsutural concavity and much broader spiral cords especially along the base. The colour of *E. emilioi* is uniform (however usually also vivid) without pattern.

***Euthria vandai* Rolán & Monteiro, 2007** (Figs 80-84)

Euthria vandai Rolán & Monteiro, 2007: 6-7, pl. 4, fig. 18-23, pl. 8, fig. 43. Type locality: off Boavista island, 150-200 fms deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/47004.

Euthria josepedroi Rolán & Monteiro, 2007: 7-9, pl. 5, fig. 24-29. Type locality: off Boavista Island, 150-200 fms deep. Holotype in Museo Nacional de Ciencias Naturales, Madrid, MNCN-15.05/47005.

Range: In moderately deep to deep water (130-400 m) off Sal and Boavista Islands.

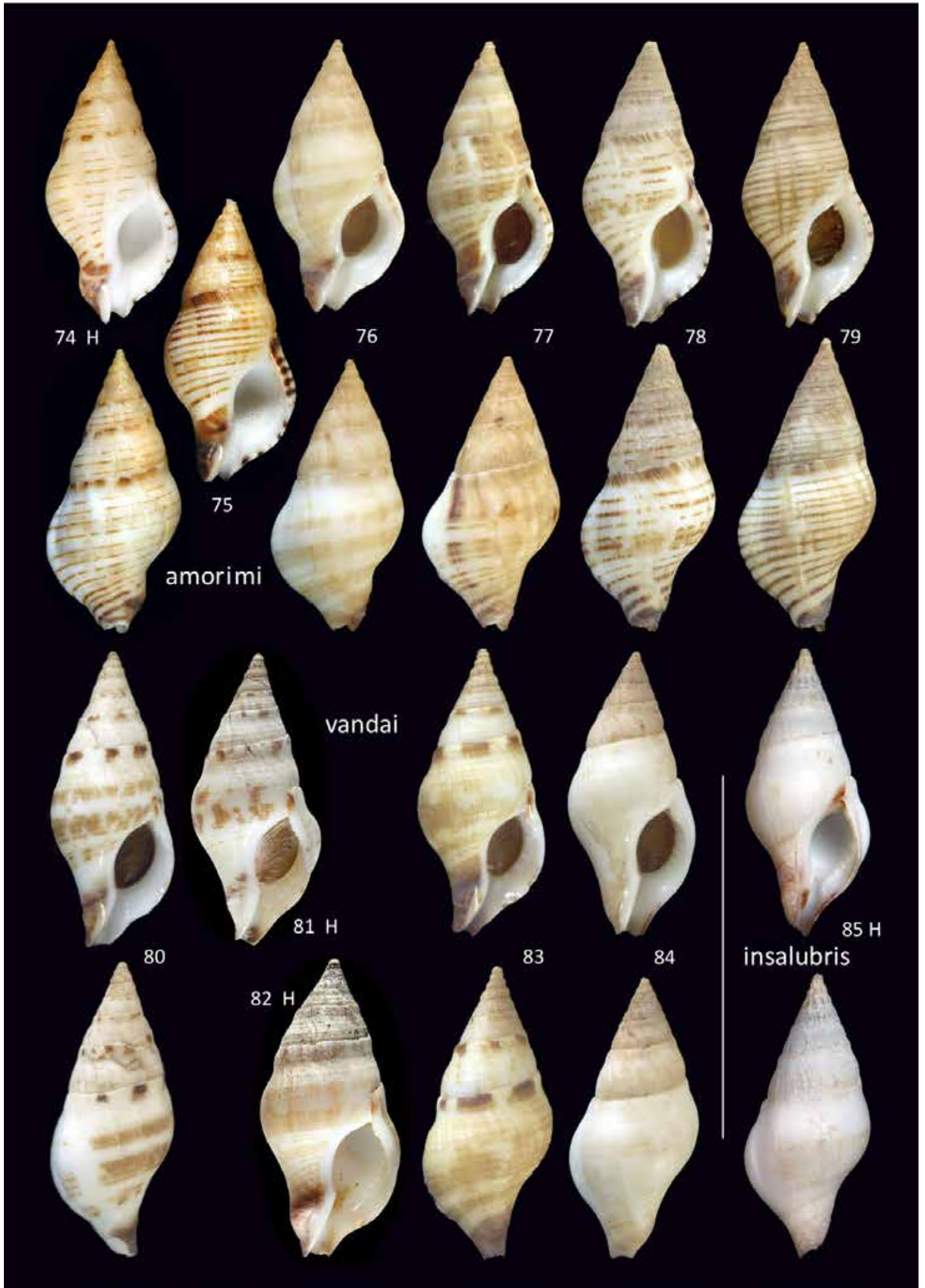
Remarks: *Euthria vandai* is characterized by the rather small to medium sized shell; the broad but weak subsutural cord in combination with a broad but usually rather weak subsutural concavity; the presence of 9 or 10 spiral cords, still visible when the shell is not eroded, on the fifth (ante-penultimate) whorl and the presence of rather well developed apertural denticles inside the adapical part of the outer lip.

The pattern is quite pale, consisting of small to moderately large brown dots arranged in 1 broad or 2 narrower spiral bands at midwhorl and an additional, narrower subsutural spiral band along the suture (holotype of *E. vandai*); those dots occasionally obscure or absent and forming a pale, yellowish brown band along midwhorl (holotype of *E. josepedroi*). The

Figs 74-79: *E. amorimi* Fraussen, 2004. **74:** 40 mm, holotype, south of Sal Isl., in lobster traps at 120-180 m, in MNHN-IM-2000-5803. **75:** 39.9 mm, paratype 3, south of Sal Isl., in lobster traps at 120-180 m, KF-4470. **76:** 34.2 mm, Boavista Isl., off Gatas, in lobster trap at 130-180 m. **77:** 34.0 mm, off Boavista Isl., in lobster trap at 150-200 m. **78:** 36.0 mm, NW off Sal Isl., in lobster trap at 120-130 m. **79:** 38.6 mm, off Boavista Isl., in lobster trap at 150-200 m.

Figs 80-84: *E. vandai* Rolán & Monteiro, 2007. **80:** 38.5 mm, Boavista Isl., off Gatas, in lobster trap at 130-180 m. **81:** 37.2 mm, holotype, off Boavista Isl., 280-400m., in MNCN-15.05/47004, photo copyright and courtesy of CSIC and MNCN. **82:** 36.4 mm, holotype of *E. josepedroi*, off Boavista Isl., 150-200 fms deep, in MNCN-15.05/47005, photo copyright and courtesy of CSIC and MNCN. **83:** 33.0 mm, **84:** 38.0 mm, between Sal and Boavista Islands, in lobster trap at 150-200 m.

Fig. 85 (= fig. 68): *E. insalubris* Fraussen & Rolán, 2003, 30.9 mm, holotype, from fishermen without exact information, in MNHN-IM-2000-6839.



siphonal canal is ornamented with a brown band or dot, the tip is usually slightly darker.

The protoconch of both holotypes of *E. vandai* and *E. josepedroi* are somewhat eroded, we therefore can assume with some certainty that the number of whorls is higher than mentioned in the description. As far as we can judge the number of protoconch whorls of *E. vandai* may be 2 instead of 1 $\frac{3}{4}$ (description of *E. vandai*) to 1 $\frac{3}{4}$ instead of 1 $\frac{1}{4}$ to 1 $\frac{1}{2}$ (description of *E. josepedroi*).

The holotype of *E. josepedroi* differs only slightly from the holotype of *E. vandai* in its broader shape with a slightly deeper subsutural concavity and the paler pattern. The sculpture is identical in both specimens, as well as the general outline of the shell. We therefore regard both morphs as conspecific. We chose *E. vandai* as the senior species because it is closer in shape and pattern to the recently collected material.

Euthria insalubris differs from *E. vandai* in its smaller protoconch (1.3 mm instead of 1.5 to 1.8 mm, for an almost similar number of whorls); its lower number of spiral cords along the fourth whorl (4 broad and flat cords instead of about 9 or 10 finer cords) and the higher number of teleoconch whorls (7 whorls instead of 6) compared to a smaller size (30.9 mm instead of 37.2 (holotype of *E. vandae*) and 36.4 mm (holotype of *E. josepedroi*)).

The colour of *E. insalubris* is paler, almost white, than the colour of *E. vandae* but we have not seen sufficient specimens of both species to know the limits of their infraspecific variability. An occasional pale coloured specimen of *E. vandai* with pale pattern and, at the same time being eroded, thus without the characteristics of the sculpture on the upper spire whorls visible, will be almost impossible to distinguish from *E. insalubris*.

Euthria bernardi differs from *E. vandai* in its larger, more bulbous protoconch (2 $\frac{1}{4}$ to 2 $\frac{1}{2}$ whorls instead of fewer than 2); fewer spiral cords along the first teleoconch whorl (3 instead of 5) while it has fewer spiral cords on the third and fourth whorl (about 6 or 7 instead of 9 or 10); those spiral cords are much broader with narrow interspaces; the higher number of teleoconch whorls (7 or 8 instead of 6); a much larger adult size and a usually more elaborated pattern.

Euthria calypso differs from *E. vandai* in its strong subsutural cord and the pattern of smaller, more equally sized dots on a white background.

***Euthria* species 1 (Figs 66-67)**

A number of shells from off Sal Island (in lobster trap at 140-180 m, FS) differ from in *E. nologomesi* by the pattern of much larger dots and the slightly broader spiral cords. The shell look more similar to *E. calypso*.

Figs 86-89: *E. marianae* Rolán, Monteiro & Fraussen, 2003. **86:** 39.4 mm, off western Barlovento Group, in lobster trap at 100-150. **87:** 33.0 mm, holotype of *E. ceciliae*, off São Vicente Isl., by divers, 20-80 m, in MNHN-IM-2000-6849. **88:** 40.3 mm, São Vicente Isl., off San Pedro, by fishermen. **89:** 37.0 mm, "off Boavista Isl., in lobster trap at 150-200 m."

Figs 90-91: *E. inesae* Fraussen, Monteiro & Swinnen, 2012. **90:** 31.1 mm, holotype, fishing area situated off São Vicente, Santo Antão, Santa Luzia and São Nicolau, in lobster traps, 50-120 m, in MNHN-IM-2000-24753. **91:** 30.8 mm, off western Barlovento Group, in lobster trap at 100-150.

Figs 92-93: *E. abrotana* Fraussen & Rolán, 2003. **92:** 40.1 mm, holotype, from fishermen without exact information, in MNHN-IM-2000-6855. **93:** 44.1 mm, off Sal Isl., in lobster trap at 120-180 m, in KF-4989.

Fig. 94: *E. cesari* Monteiro & Rolán, 2005, 48.4 mm, Boa Vista, off Gatas, in lobster trap at 130-180 m.

Fig. 95: *E. species 2*, 34.0 mm, from fishermen without exact information, P. Bernard coll. in MNHN.

Fig. 96: *E. species 3*, 43.5 mm, off Sal Isl., in lobster trap at 120-180 m, KF-5261.

***Euthria* species 2 (Fig. 95)**

The single shell from unknown locality is stored in the Bernard collection in the Muséum national d'Histoire naturelle, Paris. It differs from all known species by the moderately thin, broad shaped shell with a glossy surface. The colour is reddish brown with small white spots arranged in spiral bands that are separated by solid, brown spiral lines. The pinkish coloured aperture suggests an habitat in moderately shallow water. The shell looks similar to *Euthria cornea* from the Mediterranean but differs in the much weaker subsutural concavity, the remarkable glossy surface, the weak axial sculpture on the upper spire whorls and the shorter and straighter siphonal canal.

It is the single specimen known to us and therefore we are not able to produce a description with a solid comparison.

***Euthria* species 3 (Fig. 96)**

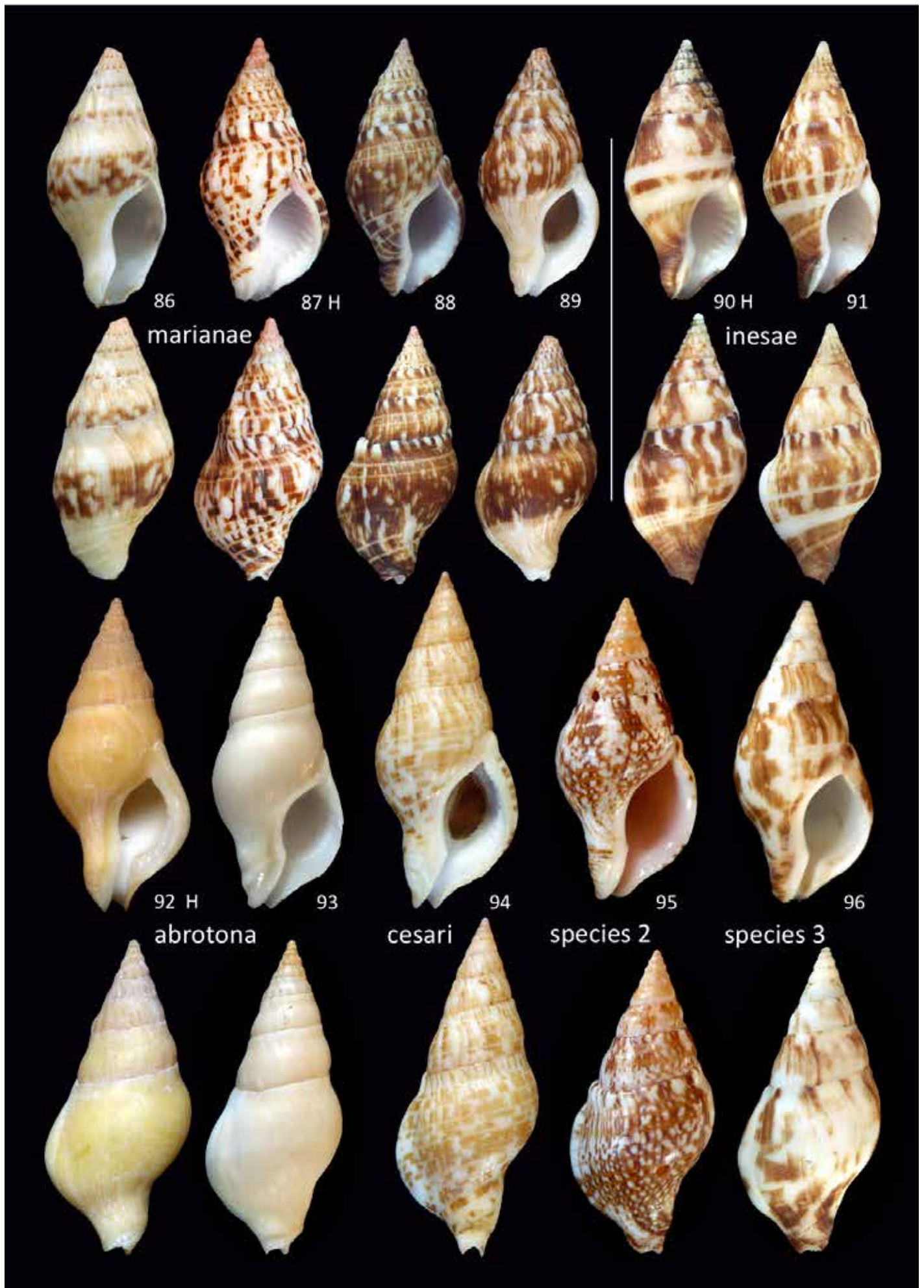
The single shell from off Sal Island (in lobster trap at 120-180 m, KF-5261) differs from *E. inesae* in having a larger shell in combination with a shorter siphonal canal and the absence of a subsutural concavity. The pattern has more axial streaks also along the siphonal canal while white spiral bands are absent except of a weak trace along midwhorl. The upper spire whorls are eroded and no spiral sculpture is available for study.

***Euthria* species 4 (Figs 110-111)**

A number of shells from São Vicente island (Calhau, under rocks, 2-3 m deep, FS) differ from *E. calderoni* in having a more accentuated axial sculpture forming a shoulder,

REFERENCES

- BECHIMOL, C., FRANCOUR, P. & LESOURD, M., 2009. The preservation of marine biodiversity in West Africa, the Case of Cape Verde Islands: proposal of a new biodiversity policy management. In: *1st Cape Verde Congress of Regional Development*, Praia, Santiago Island, Cape Verde, July 6th-8th 2009: 297-318.
- BEETS, C., 1986. Notes on *Buccinulum*, a reappraisal. *Scripta Geologica*, 82: 83-100.
- COOKE, A. H., 1917. The radula of the genus *Euthria* Gray. *Proceedings of the Malacological Society*, 15(5): 232-235.
- COSEL, R. VON, 1982. Zwei neue *Euthria*-Arten von den Kapverdischen Inseln (Prosobranchia: Buccinidae). *Archiv für Molluskenkunde*, 112(1-6): 157-163.
- COSEL, R. VON & BURNAY, L. P., 1983. A new *Euthria* from deeper shelf of the Cape Verde Islands. *Archiv für Molluskenkunde*, 113(1-6): 151-157.
- DAUTZENBERG, P. & FISCHER, H., 1906. Mollusques provenant des dragages effectués à l'ouest de l'Afrique pendant les campagnes de S. A. S. le Prince de Monaco, *Résultats des*



- Campagnes Scientifiques accomplies sur son yacht par Albert 1er Prince Souverain de Monaco*, 32: 1-125, pls. 1-5.
- FRAUSSEN, K., 1999. A listing of recent *Euthria* (Mollusca: Gastropoda: Buccinidae). *Gloria Maris*, 37(5-6): 77-81.
- FRAUSSEN, K., 2004. A new *Euthria* (gastropoda: Buccinidae) from the Cape Verde Archipelago. *Gloria Maris*, 43(4): 7-14.
- FRAUSSEN, K. & AFONSO, C., 2008. A new *Euthria* (Buccinidae, Gastropoda) from the Cape Verde Archipelago. *Gloria Maris*, 47(3): 53-60.
- FRAUSSEN, K. & AFONSO, C., 2011. Variability in the shallow water species of the genus *Euthria* (Buccinidae, Gastropoda) in the Cape Verde Archipelago, with the description of *Euthria emilioi* sp. nov. *Gloria Maris*, 50(3-4): 83-92.
- FRAUSSEN, K. & HADORN, R., 1999. Rediscovery of *Fusinus subangulatus* (von Martens, 1903) and description of a new Somalian *Fusinus* (Gastropoda: Fascioliidae), including some notes on the taxonomical position of the genus *Siphonofusus* Kuroda & Habe, 1952. *Vita Marina*, 46(3-4): 111-122.
- FRAUSSEN, K., MONTEIRO, B. & SWINNEN, F., 2012. Two beautiful and new *Euthria* (Gastropoda: Buccinidae) from the northern Cape Verde Archipelago. *Gloria Maris*, 51(1): 16-24.
- FRAUSSEN, K. & ROLÁN, E., 2003. Four new *Euthria* (Gastropoda: Buccinidae) from the Cape Verde Archipelago. *Gloria Maris*, 42(4-5): 76-93.
- GRAY, M. E., 1850. Figures of molluscos animals selected from various authors. Vol. 4. Longman, Brown, Green and Longmans, London. pp. 219.
- International Commission on Zoological Nomenclature, 1957. Opinion 479. Validation under the Plenary Powers of Specific Names for Nine species of the class Gastropoda Occurring in the New Zealand Area as published by Martyn (T.) in 1784 in the work entitled the Universal Conchologist (Opinion supplementary to Opinion 456). Opinions and declarations rendered by the International Commission on Zoological Nomenclature 16(22), 365-416.
- IREDALE, T., 1921. Molluscan nomenclatural problems and solutions. *Proceedings of the Malacological Society of London*, 14(5-6): 198-208.
- KVILE, K. Ø., 2011. The Seamount Ecosystem Evaluation Framework for North Atlantic and Mediterranean Seamounts: patterns of knowledge and functioning. Thesis 2010-2011, University of Azores.
- MEDINA, A., BRÊTHES, J.-C., SÉVIGNY, J.-M. & ZAKARDJIAN, B., 2007. How geographic distance and depth drive ecological variability and isolation of demersal fish communities in an archipelago system (Cape Verde, Eastern Atlantic Ocean). *Marine Ecology*, 28: 404-417.
- PATRIAT, M. & LABAILS C., 2006. Linking the Canary and Cape-Verde Hot-Spots, Northwest Africa. *Marine Geophysical researches*, 27(3): 201-215.
- PEÑA-IZQUIERDO, J., PELEGRI, J. L., PASTOR, M. V., CASTELLANOS, P., EMELIANOV, M., GASSER, M., SALVADOR, J. & VÁZQUEZ-DOMÍNGUEZ, E., 2012. The continental slope current system between Cape Verde and the Canary Islands. In: Advances in Spanish physical Oceanography. *Scientia Marina*, 76S1: 65-78. Doi: 10.3989/scimar.03607.18C.
- POWELL, A. W. B., 1929. The Recent and Tertiary Species of the Genus *Buccinulum* in New Zealand, with a Review of Related Genera and Families. *Transactions of the New Zealand Institute*, 60(1): 57-101.
- RAMALHO, R. A. S., 2011. The Cape Verde Archipelago. In: Building the Cape Verde Islands, Part 2: 13-26. Springer Theses. Springer-Verlag Berlin Heidelberg 2011, 207 pp.
- ROLÁN, E., 1985. A new *Euthria* of the Cape Verde Islands. *La Conchiglia*, 17 (190-191): 6-7.
- ROLÁN, E., 1987. The species in the genus *Euthria*. (Mollusca: Gastropoda). *Argonauta*, 3(5-6): 291-308.
- ROLÁN, E. & MONTEIRO, A., 2005. Study of three samples of *Euthria* (Mollusca: Buccinidae) from the Cape Verde archipelago with description of two new species. *Gloria Maris*, 44(5): 90-103.
- ROLÁN, E. & MONTEIRO, A., 2007. New information on the genus *Euthria* (Mollusca, Buccinidae) from the Cape Verde archipelago, with description of three new species. *Gloria Maris*, 46(1-2): 1-22.
- ROLÁN, E., MONTEIRO, A. & FRAUSSEN, K., 2003. Four new *Euthria*. (Mollusca, Buccinidae) from the Cape Verde archipelago, with comments on the validity of the genus. *Iberus*, 21(1): 115-127.
- SHUTO, T., 1978. On the genera *Siphonofusus* and *Euthria* of the Indo-West Pacific. *Transactions and Proceedings of the Palaeontological Society, Japan, New Series*, 111: 358-369.

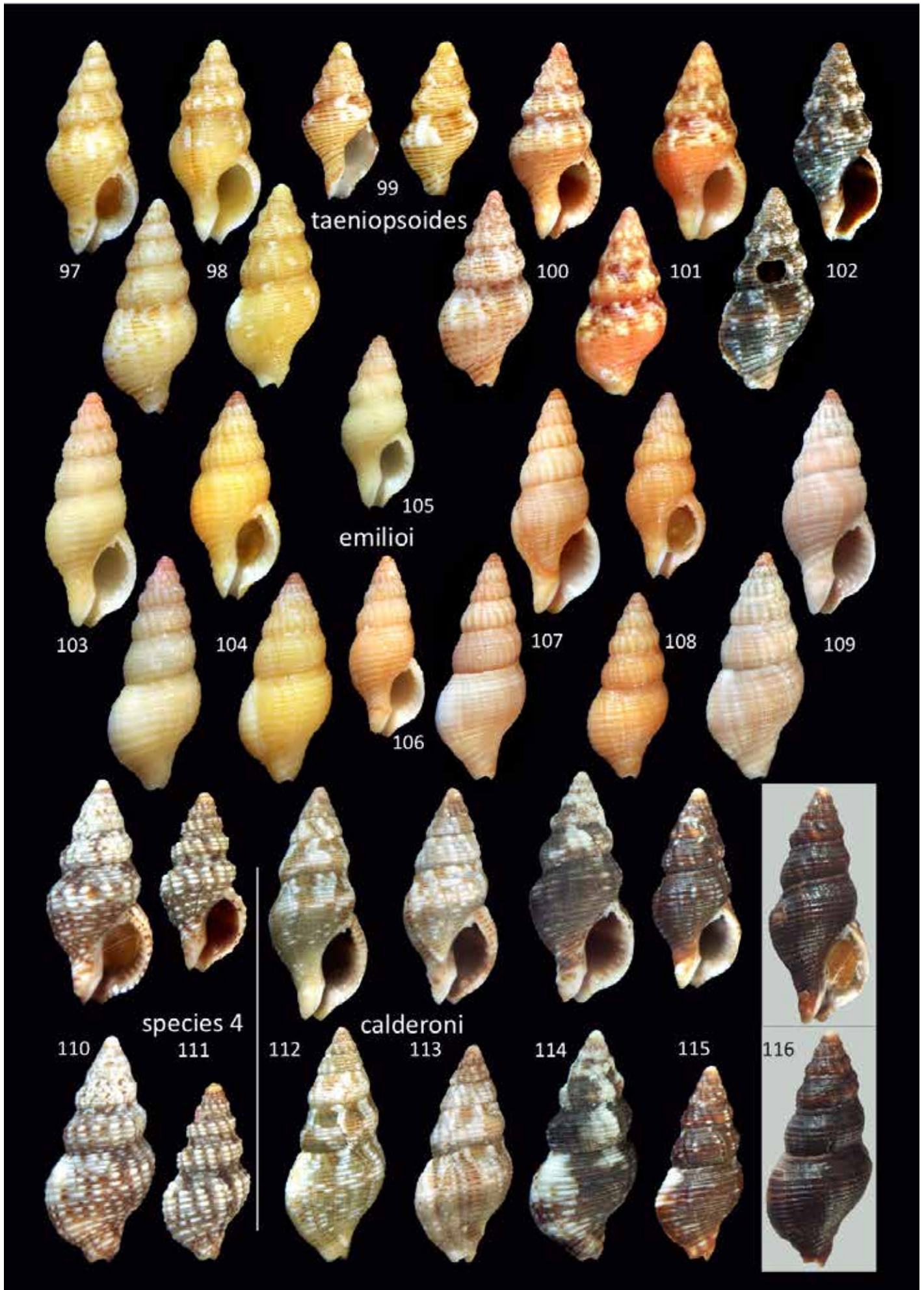
Figures - All in collection Frank Swinnen (FS), except when mentioned otherwise.

Figs 97-102: *E. taeniopsoides* Fraussen & Afonso, 2008. **97:** 13.5 mm, Sal Isl., Ilhéus do Chano, under boulders, 2-3 m. **98:** 11.5 mm, Sal Isl., Ribeiro de Passo, Lajedo de Socorro, in fine sand under rock slabs, 0.5-2 m. **99:** 9.0 mm juvenile, Sal Isl., Ilhéus do Chano, under boulders, 2-3 m. **100:** 12.5 mm, **101:** 12.1 mm, Sal Isl., Terrinha Fina, in sand with gravel under black rocks, ¼-½ m. **102:** 11.2 mm, Sal Isl., Pedra Lume, in gravel under rock slabs, 1-2 m, KF-6132.

Figs 103-109: *E. emilioi* Fraussen & Afonso, 2011. **103:** 16.0 mm, **104:** 13.6 mm, **105:** 11.7 mm, **106:** 13.9 mm, **107:** 16.8 mm, **108:** 11.8 mm, **109:** 15.2 mm, northern Boavista Isl., Derrubado, attached under large rock boulders covered by algae, on sandy bottom with gravel, 1-2 m.

Figs 110-111: *E. species 4*. **110:** 10.7 mm, São Vicente Isl., Calhau, under rocks, 2-3 m. **111:** 15.2 mm, São Vicente Isl., Calhau, under small stones on rock platform, ½ m.

Figs 112-116: *E. calderoni* Rolán, 1985. **112:** 14.5 mm, **113:** 13.4 mm, Sal Isl., Baía de Murdeiro, under rock slabs, 0.5-1.5 m. **114:** 16.1 mm, **115:** 12.9 mm, Sal Isl., Pedra Lume, in gravel under rock slabs, 1-2 m. **116:** 14.5 mm, São Vicente Isl., Calhau, under small rocks with algae, 1-2 m.



New insights into *Conus jourdani* da Motta, 1984 (Gastropoda, Conidae), an endemic species from Saint Helena Island

Manuel J. TENORIO

Dept. CMIM y Química Inorgánica-INBIO, Facultad de Ciencias, Torre Norte, 1ª Planta, Universidad de Cádiz, 11510 Puerto

Real, Cádiz, SPAIN

e-mail: manuel.tenorio@uca.es

Felix LORENZ

Fr.-Ebert-Str 12, 35418 Buseck, GERMANY.

e-mail: felix@cowries.info

Michel DOMINGUEZ

Museo Nacional de Ciencias Naturales (MNCN-CSIC), José Gutiérrez Abascal 2, 28006 Madrid, SPAIN.

e-mail: michel@mncn.csic.es

ABSTRACT

The taxon *Conus jourdani* da Motta, 1984 from Saint Helena Island is reviewed. Originally described based upon dead, beached shells and after being virtually absent from collections, it has become available to science in live-collected state for the first time. The radular morphology has been examined. The DNA sequences of a fragment of the *cox1* gene have been obtained, and the phylogenetic relationships of this species with other cone snails from West Africa and the Mediterranean have been determined. The results indicate a relationship with the cones from Angola, confirming the placement of this species in genus *Varioconus* da Motta, 1991.

INTRODUCTION

Saint Helena Island is a small (16 x 8 km²) volcanic tropical island in the South Atlantic Ocean, and one of the most remote settled islands in the world. The nearest land is Ascension Island, which is 1,125 kilometers to the North West. The island is located 4,000 kilometers east of Rio de Janeiro, Brazil, and 1,950 kilometers west of the Kunene River, which marks the border between Namibia and Angola in Southwestern Africa (Fig. 1).



Fig. 1.- Geographic location of Saint Helena Island in the South Eastern Atlantic Ocean.

Administratively, it is part of the British Overseas Territory of Saint Helena, Ascension, and Tristan da Cunha, and it had a population 4,255 inhabitants in 2008. Apart from its isolation, the island is widely known because Napoleon Bonaparte was exiled there upon his defeat in the battle of Waterloo in 1815.

Even nowadays, Saint Helena Island remains very isolated. The reason for this is the lack of any air connections, as there is no airport and it can only be reached by sea. The main connection with Saint Helena is the *Royal Mail Ship (RMS) Saint Helena*, which runs between Saint Helena and Cape Town on a 5-day voyage, also visiting Ascension Island and Walvis Bay. The island has a commercial airport under construction expected to be open to air traffic in the summer of 2016, which will improve the communications and travels with the rest of the world.

The marine molluscs of Saint Helena were first listed in Jeffreys (1872), with a total of 41 species. A more complete annotated checklist was compiled by Smith (1890), and later updated in Smith (1892). The number of marine mollusc species and "forms" was raised to 178, but it was also stated that: "this number, however, does not at all approximate the total of species which really exist around St. Helena; for, in addition to those which I have been able to determine, there is a considerable number, nearly a hundred species, which, on account of their immature or bad condition, could not be satisfactorily identified or described." In spite of this, Smith's works were followed by a large time lapse in which no updates were introduced to the Saint Helena marine malacofauna inventory. An annotated list of the marine molluscs of Ascension Island (Rosewater 1975) compared the species from this locality with those from Saint Helena, taking the works of Smith as a reference. Thus, a total of 89 species were recorded from Ascension Island, with a low level of confirmed endemism (ca. 1%). This was compared to the much larger number of species (178) listed in Smith (1890), and also with the fact that 51% of such species were considered endemic to Saint Helena. The striking difference in the number of endemic species was attributed to the differences in the geological ages of the two Islands: Saint Helena is on the order of 20 million years old (probably dating from the Miocene), whereas Ascension Island is only 1 to 2 million years old at most (Pleistocene origin; Rosewater 1975). The rest of the Saint Helena molluscan fauna is composed of Western Atlantic species (14%), Western African species (14%), amphi-Atlantic species (5%), in addition to a 16% of pantropical, worldwide-distributed species.

Recently, thanks to the Darwin Initiative (<http://www.darwininitiative.org.uk/>), the marine biodiversity of Saint Helena Island is being mapped in order to create a Marine Management Plan. This includes a survey of the marine invertebrates of the island, of which molluscs constitute an important part. An important outcome of this project funded by the Darwin Initiative has been the publication of the book *Marine Life of St. Helena* (Brown 2014). As a result of systematic field sampling and observation, an updated list comprising 168 species of molluscs has now been entered into the Saint Helena Marine Species Database (Brown 2013), virtually as many as those described by Smith (1890).

The presence of cone snails among the molluscan fauna of Saint Helena had already been noted by Smith (1890), who listed three species of cones, namely "*Conus testudinarius* Martini", a "*Conus* sp.", and a species identified as "*Conus irregularis* Sowerby". The specimens identified as "*Conus testudinarius* Martini" (two specimens), were shells of *Chelyconus ermineus* (Born, 1778). Smith (1890) was most likely following Hidalgo (1879) as a reference for identification, since the name-author combination *Conus testudinarius* Martini was used in that work, instead of the more correct *Conus testudinarius* Hwass in Bruguière, 1792 (= *Chelyconus ermineus* (Born, 1778)). The specimen referred to as "*Conus* sp." in Smith (1890) was represented by a single much-worn shell, shaped like *Ketyconus tinianus* (Hwass in Bruguière, 1792), but apparently thicker and more strongly striated transversely. It is unclear to what species this specimen might correspond to, as no picture accompanied the description. It might represent a beached specimen of *Sciteconus mozambicus* (Hwass in Bruguière, 1792) washed ashore. This species is one of the few cone snails with a confirmed occurrence along the coasts of Namibia (Tenorio et al. 2008). The specimens cited as "*Conus irregularis* Sowerby" (= *Africonus irregularis* (G. B. Sowerby II, 1858)) were undoubtedly misidentified, as this taxon corresponds to a species endemic to the Cape Verde Islands (Monteiro et al. 2004). Smith (1890) already noted the conchological differences between Sowerby's *Conus irregularis* and the shells from Saint Helena when he wrote: "The specimens from St. Helena are of a shorter growth than those figured by Sowerby (Thes. Conch, iii. pl. 104. figs. 418, 419); they are broader at the shoulder and more suddenly contracted anteriorly. They also are more highly painted, exhibiting a considerable amount of olive-brown longitudinal streaks, which are interrupted at their middle by the bluish-white irregular zone dotted and spotted with olive-brown. The spire is either almost uniformly dark chestnut brown, or else white, blotched with that colour. Some small specimens, about 3/4 inch long, which I believe to be the young of this species, are still more brightly coloured, being more or less copiously blotched with brown-black; and the spire is radiately lined and spotted with the same tint."

Almost 100 years later, the taxon *Conus jourdani* da Motta, 1984 (Fig. 2) was described from Saint Helena Island.

The original description of this species, based upon a few dead-collected specimens, matches in many aspects the comments made by Smith (1890) about the specimens identified by him as *Conus irregularis* Sowerby: "*Conus jourdani* sp. n. description: The shell is medium / small in size, with a conical spire formed by eight whorls; the top of the last four whorls, including the shoulder, is accentuated by a marked convexity and a sculpture of strong axial lirae. The apex is obtuse.

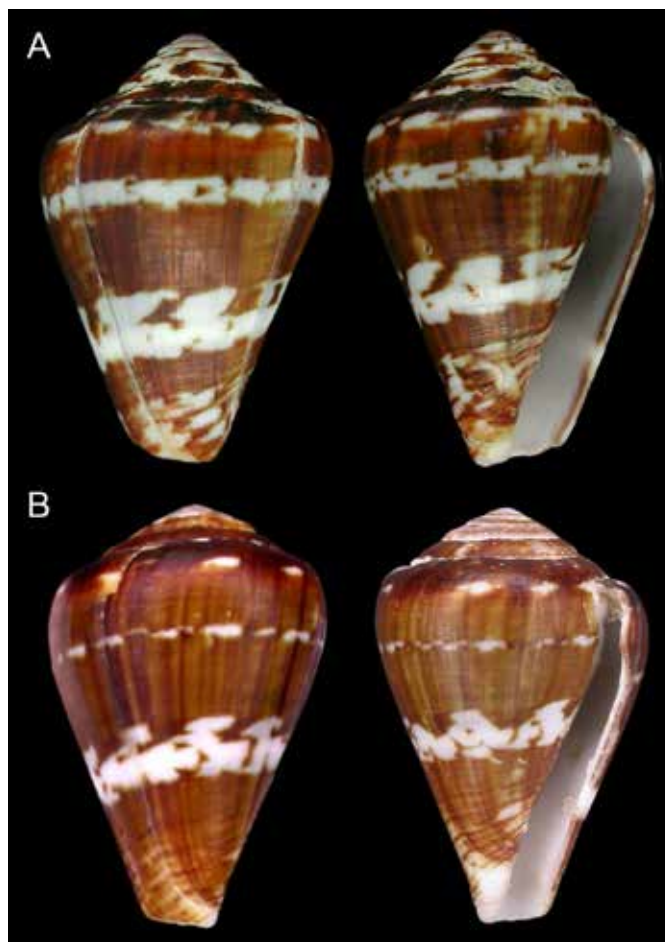


Fig. 2.- *Conus jourdani* da Motta, 1984: A) Holotype, 28.2 x 18.5 mm, MNHG 983.575; B) Paratype, 30.0 mm, SMNS collection.

The last whorl is wide at the shoulder, which is subangulated and rounded, with flat sides, falling rapidly towards the base, and with a network of fine axial and spiral striae and many transverse wrinkles at the front end. The background color is chestnut brown, ornated under the shoulder with a necklace of horizontally-elongated bluish spots, followed on the periphery by a narrow band of the same color irregularly mottled with brown spots, while the lower half is uniformly bluish. The basal end has again three rows of bluish spots, similar to those in the shoulder. The aperture is bluish white inside, with an edge outside the outer lip, which is slightly sinuous and elongated toward the front end. The spire is dark brown, mottled with blue spots, while the post-embryonic whorls are bluish-brown."

The author remarked that this new species seemed to be endemic to Saint Helena Island, and that the structure and the shape of its shell was completely different from those of every other small- or mid-size cone shell found in the waters of Cape Verde, or along the western coast of Africa at the time. It was named after Ken Jourdan, a correspondent of Bob da Motta, who collected the specimens back in 1977 and brought them to the attention of the author. The considerable difficulties in getting to the windward side (south) of the island and in locating the spot where the few available specimens were collected were also narrated in da Motta (1984). Taking all evidence into consideration, it is very likely that the specimens first collected in Saint Helena and identified as "*Conus irregularis* Sowerby" by Smith (1890) were actually individuals of *Conus jourdani* da Motta, 1984.

Since its original description in 1984, no specimens of *C. jourdani* other than those in the type material (Muséum d'Histoire Naturelle, Geneva, Switzerland) and those present in da Motta's reference collection (now hosted in the Staatliches Museum für Naturkunde, Stuttgart, Germany) were available for study. The species had never been collected alive, and nothing was known about its ecology, habitat, variability, etc. Based upon shell morphology grounds, Tucker & Tenorio (2009) placed the species *jourdani* in genus *Varioconus* da Motta, 1991. Due to the very limited data on range, habitat, population status, or threats, and the fact that the species had not been recorded since its original description in the 1980s, *V. jourdani* remained assessed as "Data Deficient" in the IUCN Red List (Tenorio 2012). Survey work was recommended in order to gather sufficient data on which to determine the degree of threats confronted by this species.

Thanks to recent surveys of the marine invertebrate fauna carried out in Saint Helena Island, populations of *V. jourdani* were located and fresh specimen became available to allow a closer study of this species. Moreover, it has been possible to obtain DNA sequences and determine the phylogenetic relationships of this species with other cone snails from West Africa and the Mediterranean, to examine its radular morphology, and to gather information about its variability and distribution around the island. The results of the investigations on what can be considered a true rediscovery of a lost species are presented in this work.

MATERIAL AND METHODS

Taxonomy follows Tucker & Tenorio (2009) with the updates and modifications based on Tucker & Tenorio (2013). Most specimens were collected by SCUBA diving, in recent years. We have studied specimens from two different populations, one from the vicinity of Flagstaff Bay, to the north (10-15 m depth), and the other from Black Rock (25-35 m depth), two rocky islets located to the south end of the island. The latter locality is approximately 3 kilometers to the West of the type locality, Lot's Wife Ponds. The sampling localities are shown in Fig. 3.

Description of shell morphology follows the terminology established in Röckel et al. (1995). For morphometric comparisons, adult shells were measured with digital calipers,

with measurements rounded to the nearest 0.1 millimeter. The measurements are in a spreadsheet, deposited as supporting information at <https://dl.dropboxusercontent.com/u/30741402/jourdani.xlsx>. For comparison of shell morphometry, analysis was performed using covariance (ANCOVA) for the shell parameters: maximum diameter (MD); height of the maximum diameter (HMD); and spire height (SH), while using locality as factor, and shell length (S_L) as a covariate. Mean values of S_L were compared statistically (t -, U -, and F -tests). Statistical tests were carried out using STATGRAPHICS 5.1 or PAST3 (Hammer et al., 2001), once all the measurement sets passed the normality tests.

Terminology for radular morphology follows Tucker & Tenorio (2009), with abbreviations following Kohn et al. (1999). The number of individuals for which the entire radula was examined is indicated. Specimens of shells containing the dried animal inside were rehydrated by treatment with 70% alcohol, which was progressively diluted with water over a period of 24 hours or more, depending on size and condition of the specimen. Once the animal was soft enough, it was removed from the shell. The soft parts containing the radular sac were digested in concentrated aqueous potassium hydroxide for 24 hours. The resulting mixture was then placed in a petri dish and examined with a binocular microscope. The entire radula was removed with fine tweezers and rinsed with distilled water, then mounted on a slide using Aquatex (Merck, Germany) Mounting Medium, and examined under a compound microscope. Photographs were obtained with a charge-coupled device (CCD) camera attached to the microscope.

PHYLOGENETIC ANALYSES

Phylogenetic analyses were performed at the nucleotide level based on a data matrix that included new sequences obtained from 14 specimens representing eight cone species collected in Angola and Saint Helena Island, as well as published sequences from GenBank corresponding to cone species from the Cape Verde Islands, Senegal, and the Mediterranean Sea. Details of species, locality, GenBank accession numbers, and voucher specimens are given in Table 1. Muscle tissue was preserved in absolute ethanol, and total genomic DNA was isolated following a standard phenol-chloroform extraction protocol. Universal primers for mitochondrial *cox1* gene (Folmer et al. 1994) were used to amplify by PCR a fragment of about 600 base pairs. All PCRs were conducted in 25 μ l reactions containing 2.5 μ l of buffer (10X PCR Buffer, Mg^{2+} plus), 0.5 μ l of dNTP mixture (2.5 mM each dNTP), 0.5 μ l of each primer (10 μ M each primer), 0.2 μ l of Taq DNA polymerase (1U TaKaRa TaqTM), and 0.5 μ l of template DNA (50-100 ng/ μ l). PCR cycling conditions included an initial denaturing step at 94 $^{\circ}$ C for 5 minutes; 40-45 cycles of denaturing at 94 $^{\circ}$ C for 1 minute, annealing at 50 $^{\circ}$ C for 1 minute, and extending at 72 $^{\circ}$ C for 1 minute; and a final extending step of 72 $^{\circ}$ C for 10 minutes. PCR products were purified employing standard ethanol/sodium acetate precipitation, and directly sequenced using the corresponding PCR primers. Samples were Sanger sequenced in an automated DNA sequencer (ABI 3730xl DNA Analyzer) using the Big-Dye Deoxy Terminator version 3.1 cycle-sequencing kit (Applied Biosystems, USA) by Secugen S.L., Spain. Alignment of sequences was guided by amino acid translations (with the invertebrate genetic code) using TranslatorX (Abascal et al., 2010) and MAFFT version 5.0 (Katoh et al., 2005). Models of evolution that best fit the data set were selected independently for Bayesian in-

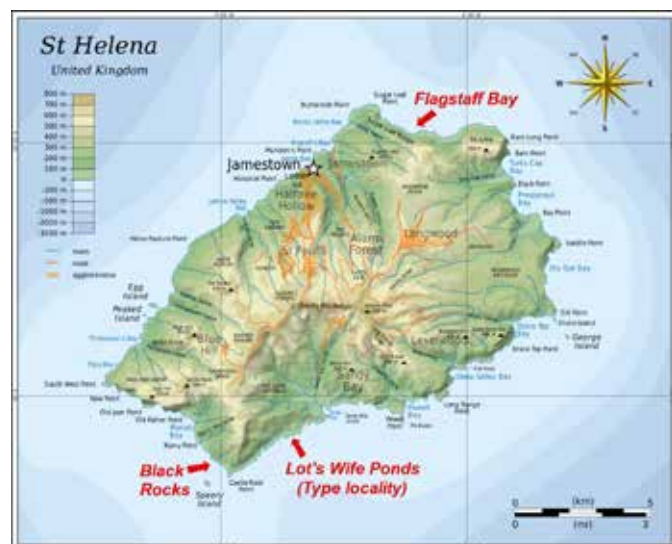


Fig. 3.- Locations of the sampling sites in Saint Helena Island (in red). Map source: Wikimedia Commons.

ference (BI) and Maximum Likelihood (ML) analyses, according to the Bayesian information criterion (HKY+G) and the Akaike information criterion (GTR+G), respectively. Both models were selected using jModelTest version 2.1.6 (Darriba et al., 2012) run on the CIPRES Science Gateway portal version 3.3 (Miller et al., 2010). BI analysis was performed with MrBayes version 3.2.6 (Ronquist et al., 2012) run on the CIPRES Science Gateway portal version 3.3 (Miller et al., 2010) conducting two independent Markov chain Monte Carlo runs (with four chains each) for 10 million generations each, sampling every 1000 generations, and discarding the first 25% of samples as burn-in. ML analysis was performed with PhyML version 3.0 (Guindon et al., 2010). The robustness of the inferred trees was tested by nonparametric bootstrapping employing 10,000 pseudoreplicates. The species from the Cape Verde Islands and *Lautoconus ventricosus* from the Mediterranean Sea were used as outgroups in both phylogenetic analyses (BI and ML).

Abbreviations

Museums and institutions

MHNG: Muséum d'Histoire Naturelle, Geneva, Switzerland.
MNCN: Museo Nacional de Ciencias Naturales, Madrid, Spain.
MNHN: Muséum Nationale d'Histoire Naturelle, Paris, France.
MSF: Molluscan Science Foundation, Inc., Owing Mills, Maryland, USA.
SMNS : Staatliches Museum für Naturkunde, Stuttgart, Germany.
UMMZ: University of Michigan Museum of Zoology, Ann Arbor, Michigan, USA.
MJT: Manuel J. Tenorio reference collection, Jerez, Spain.

Shell morphometry

S_L maximum shell length	AH aperture height
MD maximum diameter	RD relative diameter (= MD/AH)
SH spire height	RSH relative spire height (= SH/SL)
HMD height of maximum diameter	PMD relative position of the maximum diameter (= PMD/AH)

Radular morphometry

S_L/T_L shell length/radular tooth length
T_L/AP_L radular tooth size/anterior portion length
$100B_L/AP_L$ 100 x blade length/anterior portion length

RESULTS

Phylogenetic Analysis

The ML analyses based on a 693-bp fragment of the mitochondrial *cox1* gene yielded the tree shown in Fig. 4. The BI analyses arrived at an identical topology ($-\ln L = -1857.37$ for run 1; $-\ln L = -1855.35$ for run 2). Specimens from Saint Helena Island, which form a monophyletic group, were recovered within the clade formed by specimens from Angola, with high statistical support. Four sites were variables in the sequences of the specimens from Saint Helena Island, and all nucleotide substitutions occurred in the third codon position.

Since specimens from Saint Helena form a clade whose closer sister group taxa are species from Angola, and these

Species	Locality	GenBank accession Nº	Voucher Nº
<i>Varioconus chytreus</i>	Baia da Lucira, Angola	KU892090	MNCN/ADN 86679
<i>Lautoconus dorotheae</i>	W coast of Madeleine Is., Dakar, Senegal	KJ550548	MNHN IM2009-8702
<i>Varioconus franciscoi</i>	São Nicolau, Angola	KU892089	MNCN/ADN 86678
<i>Lautoconus hybridus</i>	Dakar, Senegal	KJ550301	MNHN IM2009-18301
<i>Africonus infinitus</i>	Maio Is., Cape Verde	AY588187	Duda & Rolán (2005)
<i>Africonus irregularis</i>	Boa Vista Is., Cape Verde	AY588188	Duda & Rolán (2005)
<i>Africonus josephinae</i>	Boa Vista Is., Cape Verde	AY588190	Duda & Rolán (2005)
<i>Varioconus jourdani</i>	Saint Helena Island	KU892095-99, KU892100-01	MNCN/ADN 86684-85, 87-91
<i>Varioconus lobitensis</i>	Baía Farta, Angola	KU892094	MNCN/ADN 86683
<i>Africonus longilineus</i>	Sal Is., Cape Verde	AY588193	Duda & Rolán (2005)
<i>Africonus luquei</i>	Boa Vista Is., Cape Verde	AY588195	Duda & Rolán (2005)
<i>Africonus maioensis</i>	Maio Is., Cape Verde	AY588199	Duda & Rolán (2005)
<i>Lautoconus mercator</i> (1)	Dakar area, Senegal	KJ550378	MNHN IM2009-19232
<i>Lautoconus mercator</i> (2)	Dakar area, Senegal	AY588200	UMMZ 301996
<i>Varioconus micropunctatus</i>	Baía da Lucira, Angola	KU892092	MNCN/ADN 86681
<i>Lautoconus pineau</i>	Dakar, Senegal	KJ550412	MNHN IM2009-19240
<i>Varioconus trovaai</i>	Baía da Lucira, Angola	KU892088	MNCN/ADN 86677
<i>Varioconus variegatus</i>	Inhamangano, Angola	KU892091	MNCN/ADN 86680
<i>Lautoconus ventricosus</i>	Gulf of Gabes, Tunisia	KJ550006	MNHN IM2009-18301
<i>Varioconus zebroides</i>	Sao Nicolau, Angola	KU892093	MNCN/ADN 86682

Table 1. List of species, locality of collection, GenBank accession numbers (new sequences in bold) and voucher numbers.

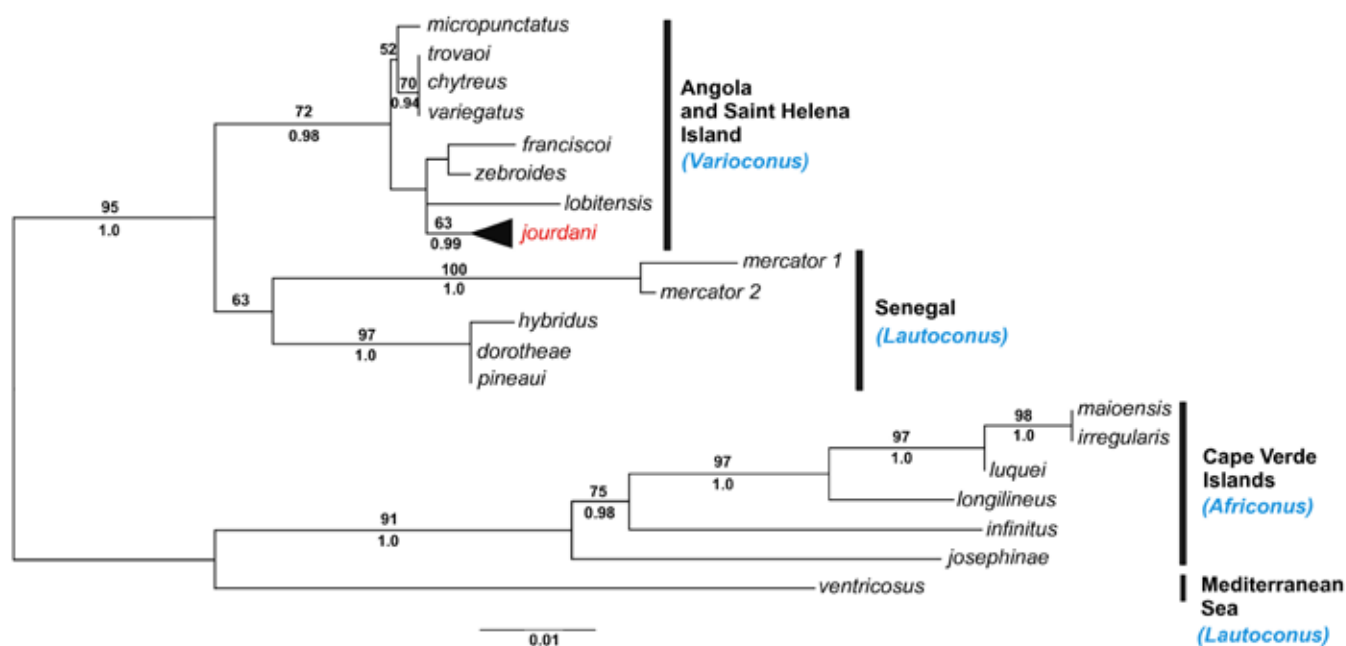


Fig. 4.- Phylogenetic relationships of *V. jourdani* from Saint Helena Island (7 individuals) and other West African cones inferred from mitochondrial *cox1* gene using ML and BI analyses. Numbers on each branch represent support values for ML (bootstrap proportions, up) and BI (posterior probabilities, down), respectively. Only support values above 50 % bootstrap proportions or 0.90 Bayesian posterior probabilities are shown. Scale bar indicates substitutions per site.

are ascribed to genus *Varioconus*, it is reasonable to name the cone species from Saint Helena as *Varioconus jourdani*, a combination that was already proposed by Tucker & Tenorio (2009). Cones from the Mediterranean Sea and those endemic from Senegal were considered congeneric by Tucker & Tenorio (2009), and placed in genus *Lautoconus*. However, the reconstructed phylogenetic tree indicates that this genus is paraphyletic. One possible taxonomic interpretation is that the cones from Senegal actually belong to genus *Varioconus*, which thus defined would become a larger taxonomic unit including many species from mainland Africa. Alternatively, we may consider the introduction of a new genus for the placement of the endemic cones of Senegal as a sister group to the endemic cones from Angola. Molecular and morphological studies, currently in progress, would help in disentangling the question. In any case, since *L. ventricosus* is the type species for genus *Lautoconus*, this genus would only be applicable to the species from the Mediterranean and neighboring Atlantic. The phylogenetic relationships between *L. ventricosus* and the endemic cones of Cape Verde are also being currently studied in detail.

To summarize, as a result of this phylogenetic study we can conclude that all specimens from Saint Helena clustered together with no clear group separation among individuals from different populations in the island, this being consistent with one single species hypothesis. Saint Helena Island cones are closely related to endemic cones from Angola, and hence they should be ascribed to the taxon *Varioconus jourdani*.

SYSTEMATICS

Family CONIDAE Flemming, 2009

Subfamily CONINAE Tucker & Tenorio, 2009

Genus *Varioconus* da Motta, 1991

Varioconus jourdani (da Motta, 1984)

Fig. 2; Plates 1 and 2

Type material: Holotype (MNHG 983.575; 28.2 x 18.5 mm, Fig. 2). 4 paratypes deposited in several institutions: paratype 1 (30 x 21 mm); paratype 2 (30 x 19.7 mm); paratype 3 (30.2 x 20 mm); and paratype 4 (29.7 x 19.7 mm).

Type locality: Lot's Wife Pond, South Side (Windward) of Saint Helena Island (UK), South Atlantic.

Material examined: More than 25 live-collected specimens from two separate populations. See Fig. 3 for localities. The examined specimens are in the MSF collection, and in the reference collections of the first and second authors.

Distribution and habitat: Endemic to Saint Helena Island, with several separate populations known. Reports of this species from Ascension Island are unreliable at this stage. There are two specimens of dead, worn shells resembling *V. jourdani* at the SMNS with labels that state "Ascension Island" as locality, but with no additional information. Divers report a slender variation, predominantly found along the north coast of the island, in groups of several individuals on rocks in turbulent water at 10-12 m. Isolated individuals of a broader form, more closely resembling the type material, are found isolated at 30-35 m on and among rocks, in quieter areas to the south of the Island. There is no other cone snail species living in direct sympatry with *V. jourdani*.

Description of the shell: Morphometric parameters: L = 21 – 31 mm; average L = 28 mm; RD = 0.66 – 0.78; RSH

= 0.13 – 0.21; PMD = 0.82 – 0.87. Moderately small, solid, compact, broadly and ventricosely conical shell. The sides of the last whorl are straight, convex below the shoulder. The shoulder is rounded, and the spire moderately elevated with straight profile. The surface of the last whorl is smooth above the base. The spire whorls are usually convex, covered with very fine arcuate radial hairlines. Cords are absent. Protoconch not studied due to erosion, but assumed to be paucispiral. The ground color of the shell is bluish-white with a variable number of patterned zones, usually below the shoulder, in the center and in the lower third; there is a great variability in the color and in the extension of the pattern, with dark brown being the most common, but also orange-brown or pinkish. The ground-color areas may appear speckled with dots and/or irregular fine axial lines; the spire whorls usually exhibit brown or orange-brown blotches. The aperture is purplish-white in the inside, with the internal margin of the lip stained purple interrupted by two narrow white bands, one at the height of the shoulder and the other at the lower third. The periostracum is pale yellow and translucent. The operculum is small, elongated (Fig. 5), and typical of a *Varioconus*. Most shells found alive are incrustated with calcareous algae.

Living animal and radula: A freshly preserved animal was of reddish brown color with numerous minute paler specks. The tentacles are black, the eye stalks reddish. 38 to 43 teeth in radular sac. Radular tooth (Fig. 6) of medium size ($S_L/T_L = 47 - 53$), with a short, pointed barb and with the anterior section equal or slightly shorter than the posterior section of the



Fig. 5.- Operculum of *V. jourdani* from Black Rock, South Saint Helena Island, 25-35 m depth. S_L 30.0 mm tooth ($T_L/AP_L = 2.0 - 2.3$). Waist evident. Blade rather indistinct covering most of the anterior section ($100B_L/AP_L = 64\% \text{ to } 81\%$). 23 – 29 denticles in serration, arranged in one row in the apical portion, becoming 2-3 rows below, ending in a rounded terminating cusp. Base large, with a basal spur.

Comparisons: In the original description, this taxon was considered most similar to *Lautoconus taslei* (Kiener, 1850) (Fig. 7A). This species is pear-shaped, with a swollen shoulder strongly attenuated towards the base. However, the background color is greenish-yellow, with two whitish spiral bands, while the aperture is dark purple. *V. jourdani* was also compared to *Conus olivaceus* Kiener, 1850, now considered a synonym of *L. taslei*, and to *Conus damottai* Trovão, 1979 (endemic to the Cape Verde Islands) and *Conus orri* Ninomiya & da Motta, 1982 (Fig. 7B). Actually, according to the phylogenetic study, all these species, placed in the genera *Lautoconus*

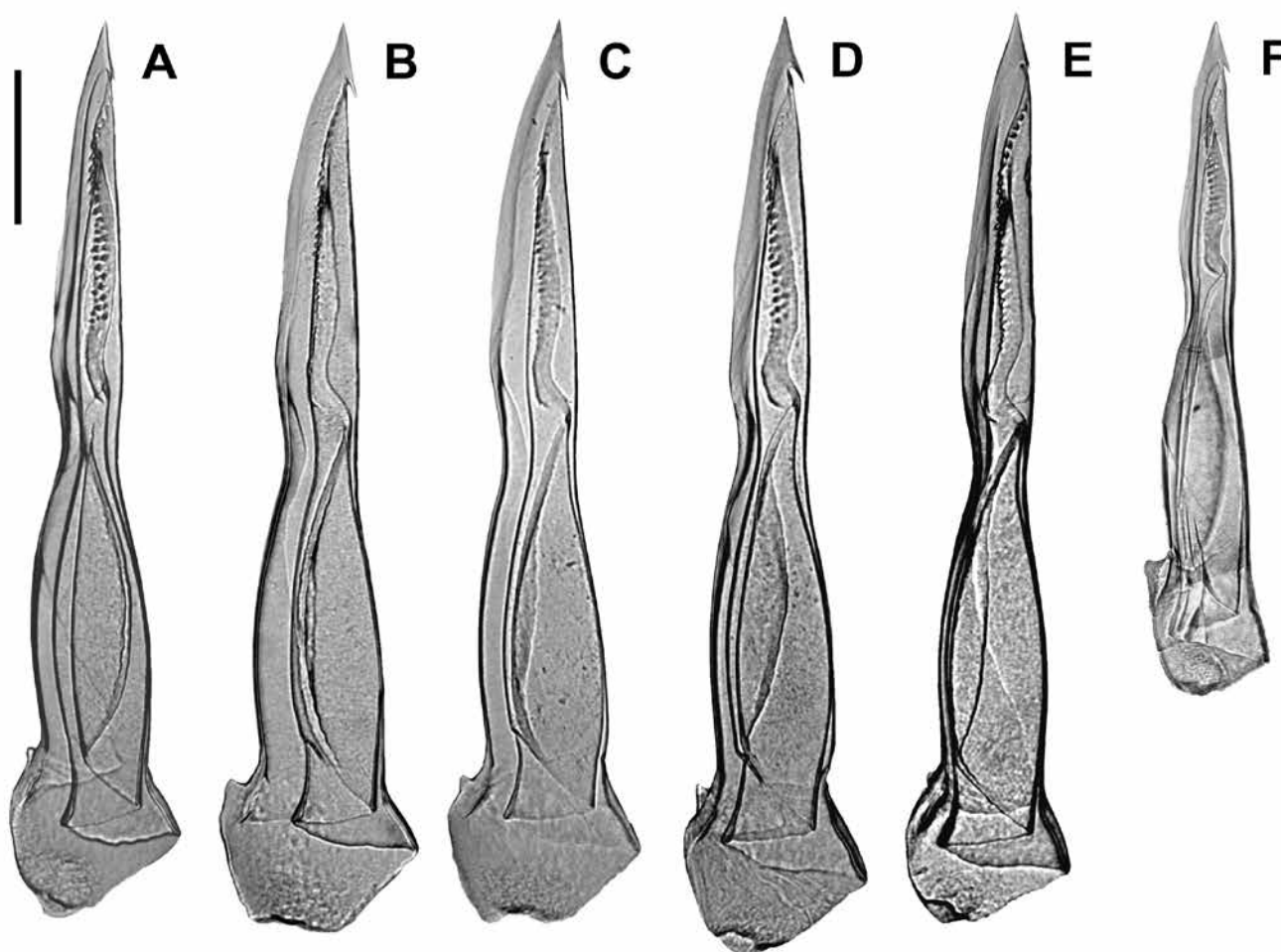


Fig. 6.- Radular teeth of *V. jourdani* from Black Rock, South Saint Helena Island, except F (Flagstaff Bay, North Saint Helena Island). A) S_L 27.1 mm; B) S_L 30.1 mm; C) S_L 29.9 mm; D) S_L 30.3 mm; E) S_L 28.7 mm; F) S_L 22.9 mm. Bar scale = 0.1 mm.



Plate 1.- 1-8 *Varioconus jourdani* (da Motta, 1984), Flagstaff Bay, Saint Helena Island, 10-15 m depth. 1a-b, 24.0 mm; 2 28.2 mm; 3a-b 22.6 mm; 4a-b 24.7 mm; 5 28.7 mm; 6a-b 21.1 mm; 7a-b 22.9 mm; 8 16.8 mm. 1 to 6 in MSF collection; 7 and 8 in MJT collection.

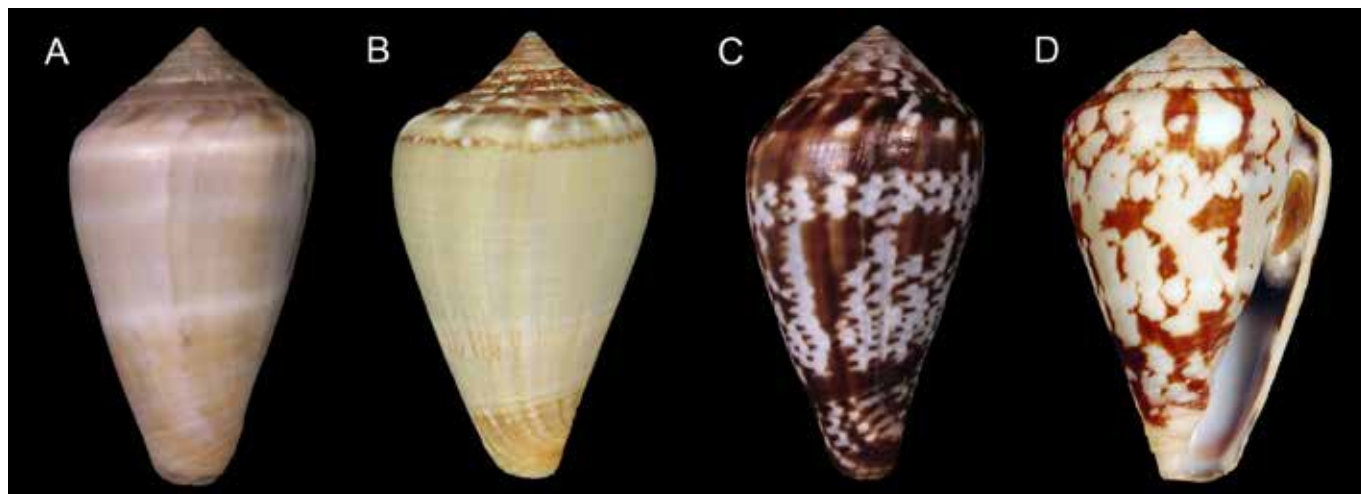


Fig. 7.- A) *Lautoconus taslei* (Kiener, 1850), 38.7 mm, Joal Fadiouth, Senegal, MJT collection; B) Paratype 3 of *Conus orri* Ninomiya & da Motta, 1982, 30.2 mm, Bojol Island, Gambia, SMNS collection; C) *Varioconus aemulus* (Reeve, 1844), 41.6 mm, Baía do Mussulo, Luanda Province, Angola, MJT collection; D) *Varioconus xicoi* (Röckel, 1987), 29.8 mm, Praia de Santiago, Luanda Province, Angola, MJT collection.

and *Africonus*, are only distantly related to *V. jourdani*. The cone species from Angola most similar to *V. jourdani* in terms of shell morphology are possibly *Varioconus aemulus* (Reeve, 1844) (Fig. 7C), and also *Varioconus xicoi* (Röckel, 1987) (Fig. 7D). The former is narrower-bodied than *V. jourdani*, whereas the latter has a distinctive angulate or subangulate shoulder, rather than rounded.

Remarks: The shell of *V. jourdani* exhibit the characters observed in other species of the genus *Varioconus*, namely the absence of cords on the sutural ramp and the rounded, indistinct shoulder. Likewise, the radular tooth morphology is fully consistent with the placement in this genus. We have studied specimens from two different populations, from the north and south of the island respectively. These correspond

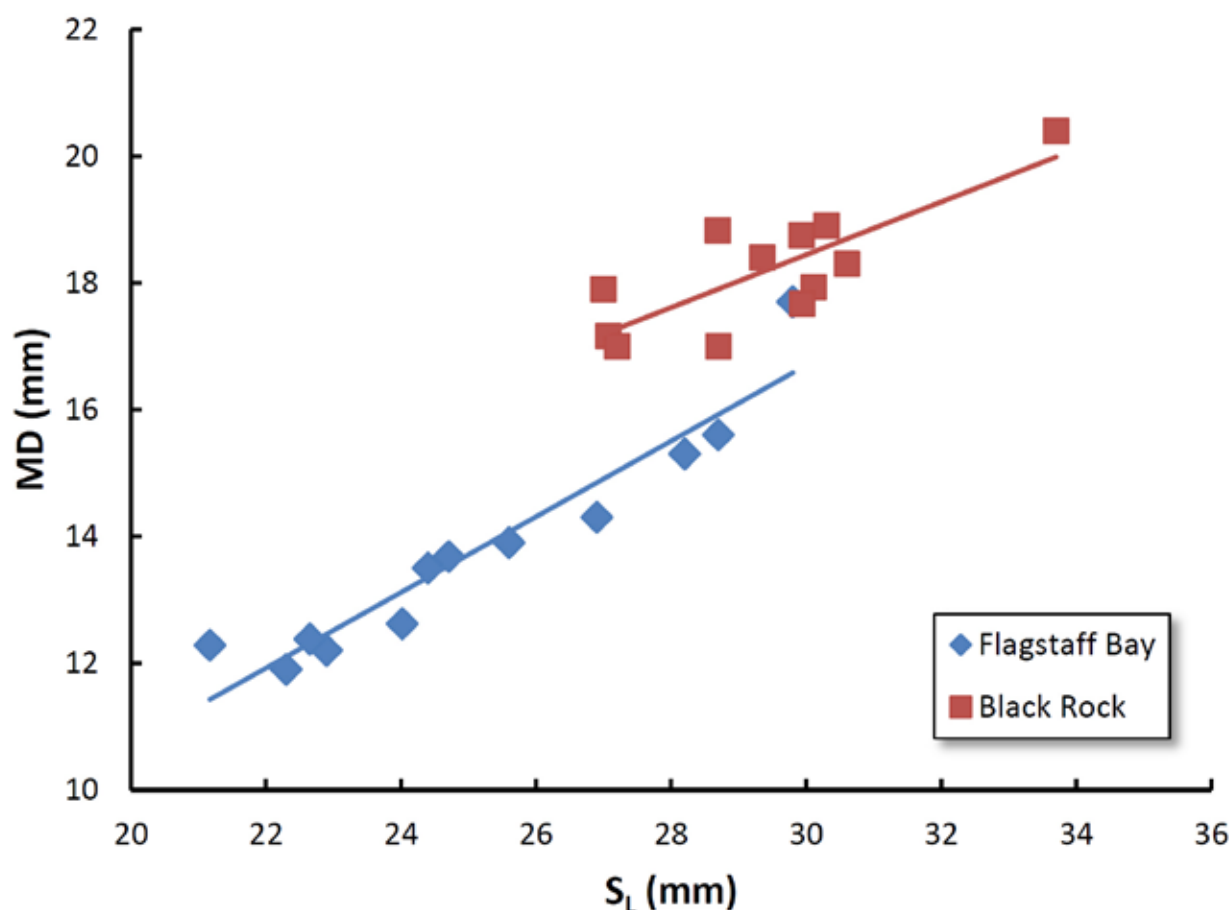


Fig. 8.- Plot of MD versus S_L for individuals from northern and southern populations of *V. jourdani*: Flagstaff Bay (◆) and Black Rock (■).



Plate 2.- **1-8** *Varioconus jourdani* (da Motta, 1984), Black Rock, Saint Helena Island, 25-30 m depth. **1a-b**, 27.1 mm; **2a-b** 29.4 mm; **3a-b** 30.1 mm; **4a-b** 29.9 mm; **5a-b** 30.3 mm; **6a-b** 28.7 mm; **7a-b** 29.9 mm; **8a-b** 27.2 mm. MSF collection.

respectively to two shell morphotypes, one being more slender, and the other more inflated. The difference in the MD/ S_L ratio between the two populations is clearly shown on the plot represented in Fig. 8.

Additional material from different places and depths around the island will be necessary to ascertain the consistency of this observation. Although the number of individuals studied is insufficient to draw any solid conclusion, a statistical comparison between the individuals from the northern and southern populations revealed significant differences in S_L ($t = 4.425$, $p = 0.00021$; $U = 13.5$, $p = 0.00081$) and in MD (ANCOVA on MD, population locality as factor, and S_L as covariate: $F = 38.98$, $p = 0$). Thus, specimens from Flagstaff Bay (Plate 1) have a smaller mean S_L (25.1 mm versus 29.4 mm) and are significantly narrower-bodied than those from Black Rock (Plate 2). The former exhibit a more constant, darker color pattern (although with exceptions, i. e. Plate 1, Fig. 5) than the specimens from the south of the island, which are far more variable and exhibit lighter, more vivid colors (uniform pale pink in some cases). There are also differences in radular morphometry (Fig. 6F; in parameters T_L/AP_L and $100B/AP_L$), but the radula was only examined in one specimen of this population. The north and south populations, however, were not resolved molecularly using *cox1* alone. For the time being, we consider the individuals of these two populations conspecific, and within the variability of the single taxon *V. jourdani*. Having merely a single species in different habitats around Saint Helena Island agrees with the situation in the Canary Islands, where the variable *Lautoconus guanche* (Lauer, 1993) is spread throughout the different islands of the archipelago (Cunha et al. 2014). However, further studies and examination of more individuals from different populations around the island might eventually afford sufficient information providing support for an alternative species hypothesis, i.e., multiple species and the occurrence in Saint Helena Island of a species radiation process similar to that observed in other oceanic archipelagos like the Cape Verde Islands (Cunha et al. 2005; Duda & Rolán 2005).

The majority of the gastropod species recorded by Brown (2014) indicates that Saint Helena Island was populated mainly by West African species. This is easily explained by prevailing ocean currents in this part of the Atlantic. The Benguela, or South Equatorial current, carries warm surface water along the coast of Angola northwards, and then moves west in to the Atlantic. An Equatorial counter current, running in west to east direction separates the Benguela from the northern Equatorial current. The species of Cassidae, Ranellidae and Bursidae are conchologically inseparable from their West African populations, and most of them are amphi-Atlantic. The two species of Cypraeidae present in Saint Helena Island are of West African origin, with the closest relatives in the Cape Verde Islands, but both have developed distinct features (*Naria spurca sanctaehelenae* (Schilder, 1930) and *Luria lurida oceanica* (Schilder, 1930)). Their molecular data suggest a close relationship, but in isolation, supported by their distinctive shells, which allow a safe distinction from West African populations of their respective relatives (Dr. Christopher P. Meyer, pers. comm. with the second author, 2015). Many of the Gastropods of Saint Helena Island also occur at Ascension Island, which is an indication that those species that have settled in these remote places have long-lasting veliger stages, and have arrived to Ascension

Island rather recently, possibly with Saint Helena Island as a stepping-stone. The arrival of species from the opposite direction, from the Caribbean or South America, via Ascension, to Saint Helena Island has apparently not happened. The question is how the ancestor of *V. jourdani* initially got to this remote place, and when. Dating analyses based on molecular phylogenies with more taxa and genes are essentials to answer these questions. Unfortunately, no egg-capsules or specimens of *V. jourdani* with a well preserved protoconch are available to us at this point to allow conclusions on its mode of development. Whether *V. jourdani* has become an intracapsular developer, or if it retained a planktonic phase may become an important aspect once the status of its two morphologically divergent populations can be ascertained.

ACKNOWLEDGEMENTS

We wish to thank Dr. Judith Brown, manager of the Darwin Marine Biodiversity and Mapping Project, Environment and Natural Resources Directorate, Saint Helena Government, David Jenkins, and Richard Moors, who supplied the specimens and information on its habitat, and the Molluscan Science Foundation, Inc. (MSF, Owning Mills, MD, USA). Many thanks also to Dr. Christopher P. Meyer (Smithsonian-National Museum of Natural History, Washington D. C., USA). Our most sincere thanks to: Prof. Rafael Zardoya (MNCN-CSIC, Madrid, Spain) and Michael A. Mont for the valuable suggestions and constructive criticism made upon reading the manuscript. Sequencing was funded by the project CGL2013-45211-C2-2-P from the Ministerio de Economía y Competitividad of Spain to Rafael Zardoya.

BIBLIOGRAPHY

- ABASCAL, F., ZARDOYA, R. & TELFORD, M.J. 2010. TranslatorX: multiple alignment of nucleotide sequences guided by amino acid translations. *Nucleic Acids Research* 38(2):W7-W13.
- BROWN, J. 2013. Monthly Newsletter from the Environmental Management Directorate, (March issue). <http://www.sainthelena.gov.sh/wp-content/uploads/2012/08/March-2013.pdf>
- BROWN, J. 2014. Marine Life of St. Helena. Pub. Pisces. 224 pp.
- CUNHA, R. L., CASTILHO, R., RÜBER, L. & ZARDOYA, R. 2005. Patterns of cladogenesis in the venomous marine gastropod genus *Conus* from the Cape Verde Islands. *Systematic Biology* 54: 634–650.
- CUNHA, R. L., LIMA, F. P., TENORIO, M. J., RAMOS, A. A., CASTILHO, R. & WILLIAMS, S. T. 2014. Evolution at a Different Pace: Distinctive Phylogenetic Patterns of Cone Snails from Two Ancient Oceanic Archipelagos. *Systematic Biology* 63(6): 971–987.
- DA MOTTA, A. J., 1984. Three new *Conus* species (Gastropoda: Conidae). *La Conchiglia: International Shell Magazine*, 16 (178–9): 24–26.
- DA MOTTA, A. J. 1991. A Systematic Classification of the Gastropod Family Conidae at the Generic Level. *La Conchiglia*, Rome. 48 pp.
- DARRIBA, D., TABOADA, G.L., DOALLO, R. & POSADA, D. 2012. jModelTest 2: more models, new heuristics and parallel computing. *Nature Methods* 9(8): 772.

- DUDA, T. F., Jr. & ROLÁN, E. 2005. Explosive radiation of Cape Verde *Conus*, a marine species flock. *Molecular Ecology* 14: 267–272.
- FOLMER, O., BLACK, M., HOEH, W., LUTZ R. & VRIJEN-HOEK, R. 1994. DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology* 3(5): 294–299.
- HAMMER, Ø., HARPER, D.A.T. & RYAN, P.D. 2001. PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* 4(1): 9 pp. http://palaeo-electronica.org/2001_1/past/issue1_01.htm
- HIDALGO, J. G. 1879. *Moluscos del Viaje al Pacífico verificado de 1862 a 1865 por una comisión de Naturalistas enviada por el Gobierno Español. Parte 3 – Univalvos Marinos*. 144 pp., Madrid.
- JEFFREYS, J. G. 1872. The Mollusca of St. Helena. *Annals And Magazine of Natural History series 4* 9: 262–264.
- KATOH, K., KUMA, K., TOH, H. & MIYATA, T. 2005. MAFFT version 5: improvement in accuracy of multiple sequence alignment. *Nucleic Acids Research* 33(2): 511–518.
- KOHN, A.J., NISHI, M. & PERNET, B. 1999. Snail spears and scimitars: a character analysis of *Conus* radular teeth. *Journal of Molluscan Studies* 65: 461–481.
- LAUER, J. M. 1993. Description of a new species of *Conus* (Mollusca: Prosobranchia: Conidae) from the Canary Islands. *Apex* 8: 37–50.
- MILLER, M.A., PFEIFFER, W. & SCHWARTZ, T. 2010. “Creating the CIPRES Science Gateway for inference of large phylogenetic trees” in *Proceedings of the Gateway Computing Environments Workshop* (GCE), New Orleans, LA pp 1 – 8.
- MONTEIRO, A. J., TENORIO, M. J. & POPPE, G. T. 2004. A Conchological Iconography: The family Conidae. The West African and Mediterranean species of *Conus*. ConchBooks, Hackenheim, Germany.
- RÖCKEL, D., KORN, W. & KOHN, A. J. 1995. Manual of the living Conidae, Volume 1: Indo-Pacific Region: 1–517. Hackenheim. Verlag Christa Hemmen.
- RONQUIST, F., TESLENKO, M., MARK, P. VAN DER, AYRES, D., DARLING, A., HÖHNA, S., LARGET, B., LIU, L., SUCHARD, M.A. & HUELSENBECK, J.P. 2012. MrBayes 3.2: Efficient Bayesian Phylogenetic Inference and Model Choice Across a Large Model Space. *Systematic Biology* 61(3): 539–542.
- ROSEWATER, J. 1975. An Annotated List of the Marine Mollusks of Ascension Island, South Atlantic Ocean. *Smithsonian Contributions to Zoology*, 189, 41 pp.
- SMITH, E. A. 1890. Report on the marine molluscan fauna of the Island of St. Helena. *Proceedings of the Zoological Society of London* : 247–322, plates XXI–XXIV.
- SMITH, E. A. 1892. XIII.—Further additions to the known marine Molluscan fauna of St. Helena. *Annals and Magazine of Natural History: Series 6* 10(56): 129
- TENORIO, M. J. 2012. *Conus jourdani*. The IUCN Red List of Threatened Species: <http://www.iucnredlist.org/details/192854/0>. Downloaded on 02 March 2016.
- TENORIO, M. J., MONTEIRO, A. J. & TERRY, Y. 2008. A Conchological Iconography: The family Conidae. The South African Species of *Conus*. ConchBooks, Hackenheim, Germany.
- TUCKER, J. K. & TENORIO, M. J. 2009. Systematic classification of Recent and fossil Conoidean gastropods, with keys to the genera of cone shells. ConchBooks, Hackenheim, Germany, 295 pp.
- TUCKER, J. K. & TENORIO, M. J. 2013. Illustrated catalog of the living cone shells. Mdm Publishing, Wellington FL, USA, 517 pp.

Note taxonomique sur des Carditidae (Bivalvia : Carditoidea) du Maastrichtien et du Danien du bassin de Paris introduits par Alcide d'Orbigny en 1850

Jean-Michel PACAUD & Didier MERLE

Muséum National d'Histoire Naturelle, CR2P, CNRS, UPMC
8, rue Buffon, CP 38, 75005 Paris (France)
e.mail : pacaud@mnhn.fr
dmerle@mnhn.fr

Résumé : L'examen du matériel type du taxon *Cardita hebertiana* d'Orbigny, 1850 provenant du Maastrichtien (Crétacé supérieur) de Vertus (Marne) et du Danien (Paléocène inférieur) du Port-Marly (Yvelines) et de Meudon (Hauts-de-Seine) montre que plusieurs espèces ont été confondues. Les spécimens de Vertus sont tout à fait conformes à la description et correspondent donc bien au taxon *C. hebertiana* qui est assigné au genre *Glyptoactis* (*Baluchicardia*). Un lectotype est désigné pour cette espèce. En revanche, les spécimens du Port-Marly et de Meudon diffèrent notablement de la diagnose donnée par d'Orbigny pour le taxon *C. hebertiana*. Ils correspondent à trois autres espèces, dont l'une, décrite du Danien de Belgique, *Venericor duponti* (Cossmann, 1908), est signalée pour la première fois dans le bassin de Paris (France). Les deux autres espèces sont nouvelles et sont nommées : *Venericardia elisabethae* nov. sp. et *Paraglans lydiae* nov. sp.

Mots clés : Bivalvia, Carditidae, Maastrichtien, Danien, Taxonomie, Lectotype.

Abstract: The examination of the type material of *Cardita hebertiana* d'Orbigny, 1850 from the Maastrichtian of Vertus (Marne) and from the Danian of Le Port-Marly (Yvelines) and Meudon (Hauts-de-Seine) shows that several species were confused. The specimens from Vertus are completely in accordance with the description and thus correspond well to *C. hebertiana*, which is assigned to *Glyptoactis* (*Baluchicardia*). A lectotype is designated for this species. On the other hand, the Danian specimens from Le Port-Marly and Meudon differ obviously from the diagnosis given by Orbigny for *C. hebertiana*. They correspond to three other species, among which one described from the Belgian Danian, *Venericor duponti* (Cossmann, 1908), is recorded for the first time in the Paris Basin (France). The two other species are new and are named: *Venericardia elisabethae* nov. sp. and *Paraglans lydiae* nov. sp.

Key words: Bivalvia, Carditidae, Maastrichtian, Danian, Taxonomy, Lectotype.

Introduction

DESOR (1847) a proposé la création de l'étage Danien (Paléocène inférieur) et a montré la similitude paléontologique entre les dépôts de Faxé (Danemark), de Vigny (Val d'Oise) et de Laversines (Oise). Par ailleurs, l'âge des gisements de Vertus et du Mont-Aimé a été discuté (GUILLEVIN, 1976 ; 1977 ; BIGNOT, 1987) sans pour autant conclure sur leur position. Cependant, un examen récent du matériel d'ostracodes (GUERNET, 2016), ainsi que la découverte d'une dent de mosasaure signe un âge maastrichtien (Crétacé supérieur) et non danien. D'ORBIGNY

A. (1850a) publie une note sur le Danien du bassin de Paris et propose pour la première fois, la description de nombreux fossiles daniens. Ces descriptions sont fondées sur une approche originale : l'étude des moulages d'empreintes (PACAUD & MERLE, 2002). Dans le cadre de la rédaction de l'ouvrage sur le Stratotype du Danien (travail en cours) nous avons dressé l'inventaire faunistique des mollusques. Il apparaît, après examen du matériel type conservé au MNHN, que le taxon *Cardita hebertiana* décrit par D'ORBIGNY A. (1850a) de Vertus (Marne), du Port-Marly (Yvelines) et de Meudon (Hauts-de-Seine) (**Fig. 1**) correspond à quatre espèces différentes. De plus, le matériel provenant de Vertus, qui selon nous, correspond parfaitement à la diagnose donnée par d'Orbigny pour ce taxon, est d'âge maastrichtien. Nous conservons donc le nom *Cardita hebertiana* pour le matériel crétacé que nous assignons au genre *Glyptoactis* (*Baluchicardia*) et désignons un lectotype pour fixer le matériel type. Les spécimens daniens correspondent à trois autres espèces dont deux nouvelles sont décrites dans ce travail.

Abréviations.

MNHN.F Muséum National d'Histoire Naturelle, Collection de Paléontologie (Paris, France).
IRScNB Institut Royal des Sciences Naturelles de Belgique (Bruxelles).
DUV Diamètre umbono-ventral.
DAP Diamètre antéro-postérieur.

Systématique.

Super-Famille **Carditoidea** Fleming, 1820
Famille **Carditidae** Fleming, 1820
Sous-Famille Carditesinae Chavan, 1969
Genre ***Glyptoactis*** Stewart, 1930
Sous-Genre ***Baluchicardia*** Rutsch & Schenk, 1940

Espèce-type : *Cardita beaumonti* d'Archiac & Haime, 1854
par désignation originale.

Origine : Danien (Paléocène inférieur), Pakistan.

Remarques. Les travaux de HEASLIP (1968) ont largement contribué à accroître les connaissances sur le genre *Baluchicardia*. CHAVAN (1969) rattache *Baluchicardia* au genre *Glyptoactis* Stewart, 1930 (Espèce type : *Venericardia hadra* Dall, 1903 par désignation originale). Il est reconnu que les espèces de *Baluchicardia*, issues probablement au Crétacé supérieur d'espèces du genre *Venericardia* Lamarck, 1804 (Espèce type : *Venus imbricata* Lamarck, 1801 par désignation subséquente – Schmidt, 1818), sont à l'origine des *Glyptoactis* (Heaslip,

1968 ; Freneix, 1972). A partir des données de Heaslip et de celles de Chavan, les critères définissant *Baluchicardia* sont les suivants : la coquille est caractérisée par une forme courte en avant, allongée en arrière, une forte convexité, une troncature postérieure marquée, par des côtes tripartites comportant une partie médiane (ou corde centrale) noduleuse et des paracôtes plus ou moins développées. A la charnière, la dent cardinale antérieure droite (3a) est située au bord antérieur de la fossette (2') dans laquelle s'engage la cardinale antérieure gauche (2). *Baluchicardia* est connu depuis le Maastrichtien jusqu'à l'Éocène dans les provinces indo-méditerranéenne et caraïbes du domaine téthysien ainsi que dans le domaine sud-atlantique. Le genre *Rotundicardia* Heaslip, 1968 (Espèce type : *Venericardia rotunda* Lea, 1833 par désignation originale) possède le même type de charnière, mais montre une forme plus arrondie, sans troncature postérieure et des côtes tendant à la simplification. Chez les sous-genres *Glyptoactis* sensu stricto et *Claibornicardia* Stenzel & Krause, 1957 (Espèce type : *Cardita alticostata* Conrad, 1833 par désignation originale), la charnière diffère par l'alignement en arc des cardinales (3a) et (3b) ; (3a) est située au-dessus de la fossette (2'), au lieu d'être en position marginale antérieure de cette fossette (FRENEIX 1972).

***Glyptoactis (Baluchicardia) hebertiana* (d'Orbigny A, 1850)**
(Pl. 1, Figs 1-9)

Cardita hebertiana d'Orbigny A, 1850a : 130-131, n° 32 (partim).

Autres références

Cardita hebertiana d'Orbigny – d'Orbigny A, 1850b : 293, n° 32 (partim). – d'Orbigny A, 1852 : 696 (partim). – Gabb, 1861 : 161. – Pictet & Campiche, 1866 : 341, n° 29. – Greppin, 1866 : 140. – Greppin, 1867 : 112. – Meunier, 1875 : 65. – Hébrard, 1883 : 222, n° 13. – de Grossouvre, 1901 : 139 (*Cardita heberti* de Grossouvre, 1901 [non Terquem, 1855] est une émendation injustifiée). – Meunier, 1912 : 182. – Abrard, Joleaud & Lemoine, 1927 : 392. – Vincent, 1930 : 83. – Bignot & Geyssant, 1997 : 15. – Pacaud & Merle, 2002 : 595 (partim).

Baluchicardia hebertiana (d'Orbigny) – Chavan, 1950 : 72, fig. 1-2.

Localité type : Vertus (Marne), Maastrichtien (Crétacé supérieur).

Matériel type : Lectotype (empreinte externe) désigné ici, MNHN.F.R63240 (coll. d'Orbigny). Paralectotypes, 5 ex. (empreintes externes), MNHN.F.R63241, A46194, A46195, A46243 et A57275.

Diagnose originale : « *Espèce quadrangulaire, renflée, ornée d'environ 26 grosses côtes rayonnantes, saillantes, carénées, pourvues dessus d'une série de tubercules, et latéralement d'une saillie longitudinale. Déterminée [par C. d'Orbigny] sous le nom de Cardium porulosum* ».

Dimensions : Lectotype, diamètre umbono-ventral : env. 19,0 mm. Diamètre antéro-postérieur : env. 21,0 mm. Paralectotype MNHN.F.R63241, diamètre umbono-ventral : env. 23,0 mm. Diamètre antéro-postérieur : env. 25,0 mm. Paralectotype MNHN.F.A46194, diamètre umbono-ventral : env. 26,0 mm. Diamètre antéro-postérieur : env. 28,0 mm.



Fig. 1. Localisation géographique des gisements étudiés.

Paralectotype MNHN.F.A46195, diamètre umbono-ventral : 14,0 mm. Diamètre antéro-postérieur : env. 15,0 mm. Paralectotype MNHN.F.A46243, diamètre umbono-ventral : 26,0 mm. Diamètre antéro-postérieur : 28,0 mm. Paralectotype MNHN.F.A57275, diamètre umbono-ventral : env. 11,0 mm. Diamètre antéro-postérieur : env. 14,0 mm.

Autre matériel examiné : Vertus (Marne), Maastrichtien (Crétacé supérieur), 3 ex. (empreintes externes) MNHN.F.A57131, A57132 et A57133 (leg. Merle).

Discussion.

Le matériel type de *Cardita hebertiana* d'Orbigny A, 1850 est ici restreint aux seuls spécimens provenant de Vertus (Marne). Il est constitué par des empreintes externes de faces dorsales de 4 valves gauches et de 2 valves droites, incomplètes, dont les caractéristiques concordent bien avec la description de l'auteur, notamment lorsqu'il écrit : « [...] ornée d'environ 26 grosses côtes rayonnantes, saillantes, carénées, pourvues dessus d'une série de tubercules, et latéralement d'une saillie longitudinale », allusion aux côtes tripartites ornant la surface externe de la coquille.

Remarques : Le matériel de Meudon (Hauts-de-Seine) assigné par Charles D'ORBIGNY (1836 : 284 ; 1838 : 128) à *Cardium porulosum* correspond à *Venericor duponti* (Cossmann, 1908) décrit ci-après. *Cardita heberti* de Grossouvre, 1901 [non Terquem, 1855] est une émendation injustifiée de *Cardita hebertiana* d'Orbigny, 1850. Le nom *Cardita heberti*, introduit par TERQUEM (1855 : 302, n° 32, pl. 20, fig. 10), n'est pas un homonyme primaire plus récent de *Cardita hebertiana* d'Orbigny, 1850 (orthographe variante), malgré la dédicace à Edmond Hébert. L'émendation de DE GROSSOUVRE (1901 : 139) est donc non seulement injustifiée mais également inopportune car elle provoque une homonymie secondaire qui n'a pas lieu d'être.

Sous-Famille Venericardiinae

Genre **Venericor** Stewart, 1930

Espèce type : *Venericardia planicosta* Lamarck, 1801
par désignation originale

Origine : Lutétien (Éocène moyen), bassin de Paris

Venericor duponti (Cossmann, 1908)
(Pl. 1, Figs 10-11)

Venericardia duponti Cossmann, 1908 : 52-53, pl. 5, fig. 12-17 et pl. 6, fig. 1-3.

Synonymie

Cardium porulosum sensu d'Orbigny C, 1836 : 284. – sensu d'Orbigny C., 1838 : 128 [non Solander in Brander, 1766].

Cardita hebertiana d'Orbigny A, 1850a : 130-131, n° 32 (partim). – d'Orbigny A 1850b : 293, n° 32 (partim). – Pacaud & Merle, 2002 : 595 (partim).

Venericardia erugata Cossmann, 1908 : 53-54, pl. 6, fig. 4-8.

Venericardia (Cardita) multicostata imbricatiformis Krach, 1969 : 50-51, pl. 10, fig. 5-6.

Venericor aff. *duponti* Rosenkrantz, 1970 : 435.

Venericor sp.1 Petersen & Vedelsby, 2000 : 69-71, fig. 104A-B.

Autres références

Venericardia duponti Cossmann – Vincent, 1930 : 82, pl. 4, fig. 13. – Gardner & Bowles, 1939 : 161, 168-169. – Panteleew, 1974 : 45.

Venericardia (Venericor) duponti Cossmann – Stewart, 1930 : 153. – Stenzel et al., 1957 : 102.

Venericardia planicosta duponti Cossmann – Chavan, 1936a : 116. – Chavan,

1936b : 2-4, fig. 1-4. – Rutsch, 1936 : 198.

Megacardita (Venericor) planicosta duponti (Cossmann) – Glibert & Van de Poel, 1973 : 31.

Venericardia (Venericor) planicosta duponti (Cossmann) – Anderson, 1974 : 166, pl. 7, fig. 5-7. – Villatte, 1977 : 153-154.

Venericardia erugata Cossmann – Lazar, 1965 : 103-104, pl. 8, fig. 11. – Moroz, 1972 : 58-59, fig. 13, fig. 11.

Venericardia (Cardita) erugata Cossmann – Krach, 1969 : 51, pl. 9, fig. 4.

Matériel type : Lectotype (IRScNB 1879) et paralectotypes (IRScNB 1880-1884) de *Venericardia duponti* Cossmann, 1908. – Lectotype (IRScNB 1885) et paralectotypes (IRScNB 1886-1887) de *Venericardia erugata* Cossmann, 1908.

Localité type : Mons (Belgique), Danien (Paléocène inférieur).

Matériel examiné : Meudon (Hauts-de-Seine), Danien (Paléocène inférieur), empreinte externe d'une valve droite, MNHN.F.A46193 (coll. d'Orbigny). – Obourg (Belgique), 5 ex., MNHN.F.J15675 et J15676 (coll. Cossmann) ; 2 ex. juvéniles (= *Venericardia erugata* Cossmann, 1908, MNHN.F. J15677 (coll. Cossmann)).

Dimensions : Diamètre umbono-ventral : env. 37,0 mm. Diamètre antéro-postérieur : env. 42,0 mm.

Discussion. *Venericor duponti* (Cossmann, 1908), confondue avec *Cardium porulosum* Solander in Brander, 1766 par Charles D'ORBIGNY (1836 : 284 ; 1838 : 128) et avec *Cardita hebertiana* par Alcide D'ORBIGNY (1850a : 130-131, n° 32), se distingue immédiatement par ses dimensions plus importantes, par ses larges côtes aplaties, aux crénelures effacées et séparées par de profondes rainures. Par conséquent, l'exemplaire de Meudon de la collection d'Orbigny, identifié par erreur à *C. hebertiana*, permet de signaler la première occurrence dans le bassin de Paris de l'espèce du Danien de Mons (Belgique). MAKARENKO (1970 : 81) place en synonymie de *Cardita volgensis* Barbot de Marny, 1874 l'espèce de Mons. Ceci dit, nous suivons VILLATTE (1977 : 153-154) qui remarque à juste titre que Makarenko insiste bien sur le fait que les côtes de l'espèce du Paléocène d'Ukraine sont tripartites sur les coquilles juvéniles, ce que montre la coquille figurée par cet auteur (1970 : pl. 12, fig. 1). Les coquilles du Danien de Mons ne présentent, à aucun stade de croissance, ce type de sculpture. Par ailleurs, nous n'avons pu consulter le travail original de Barbot de Marny et nous ne pouvons être certains que les auteurs russes (NETSCHEV, 1897 : 75, pl. 3, fig. 1-2 ; ARCHANGELSKY, 1904 : 81-82, pl. 4, fig. 1-2 ; MOROZ & JERMOKHINA, 1991 : 10, pl. 1, fig. 6) interprètent correctement l'espèce du Paléocène du Caucase. Nous conservons donc pour la coquille du Danien de Mons et de Meudon le nom *Venericor duponti* (Cossmann, 1908). Les coquilles du Paléocène de la Péninsule de Nuussuaq (Groenland) assignées à *Venericor* aff. *duponti* par ROSENKRANTZ (1970) ou à *Venericor* sp.1 par PETERSEN & VEDELSBY (2000) sont très probablement des synonymes de l'espèce de Mons. Par ailleurs, la coquille décrite par KRACH (1969 : 50-51 : pl. 10, fig. 5-6) des argiles paléocènes de Blizne et de Płosina (Pologne) sous le nom de *Venericardia (Cardita) multicostata imbricatiformis*, ne présente aucune différence appréciable avec l'espèce de Mons ; nous considérons ce taxon comme un synonyme subjectif plus récent de *Venericor duponti* (Cossmann, 1908).

Genre **Venericardia** Lamarck, 1801

Espèce type : *Venus imbricata* Gmelin, 1791 par désignation subséquente (Schmidt, 1818)

Origine : Lutétien (Éocène moyen), bassin de Paris



Venericardia elisabethae nov. sp.

(Pl. 1, Figs 14-15)

Synonymie*Cardita hebertiana* d'Orbigny A, 1850a : 130-131, n° 32 (partim). – d'Orbigny A 1850b : 293, n° 32 (partim). – Pacaud & Merle, 2002 : 595 (partim).*Venericardia aizyensis* sensu Chavan, 1936b : 4, fig. 5-6. – sensu Glibert & Van de Poel, 1973 : 31 [non *Cardita aizyensis* Deshayes, 1858].**Matériel type** : Holotype (empreinte externe d'une valve gauche), MNHN.F.A09422 (coll. d'Orbigny). Paratype (empreinte externe d'une valve gauche) du Pont de Falaise, Montainville (Yvelines), MNHN.F.A46246.**Localité type** : Le Port-Marly (Yvelines), Danien (Paléocène inférieur).**Dimensions** : Holotype, diamètre umbono-ventral : env. 25,0 mm. Diamètre antéro-postérieur : env. 27,0 mm. Paratype, diamètre umbono-ventral : env. 34,0 mm. Diamètre antéro-postérieur : env. 36,0 mm.**Étymologie** : Espèce dédiée à Elisabeth Duquenne, attachée honoraire au MNHN, en remerciement pour son travail sur les collections de Paléontologie du Muséum.**Description**. Empreintes externes de faces dorsales. Coquille de taille moyenne, à test épais, orbiculaire, inéquilatérale, peu convexe. Côté antérieur assez court, côté postérieur très dilaté. Crochets gonflés. Lunule petite, à peine visible, enfoncée sous le crochet. Corselet non observable. Surface dorsale ornée de 31 côtes rayonnantes, tripartites, modérément saillantes, comportant une partie médiane étroite portant de petites crénélures arrondies, subimbriquées et des paracôtes à peine développées. Les côtes sont séparées par des intervalles profonds, un peu plus larges que les côtes et ornés de stries d'accroissement très serrées.**Discussion**. Cette espèce, confondue avec *Cardita hebertiana* par d'ORBIGNY A. (1850a : 130-131, n° 32), se distingue immédiatement par le nombre important de côtes ornant la surface dorsale. Elle en diffère également par son galbe orbiculaire, par ses côtes tripartites moins puissantes, plus étroites, ornées de petites crénélures arrondies et non de gros tubercules, par des paracôtes à peine développées.**Planche 1.****Fig. 1-9. *Glyptoactis (Baluchicardia) hebertiana*** (d'Orbigny A, 1850) du Maastrichtien (Crétacé supérieur) de Vertus (Marne), **1a**. Paralectotype MNHN.F.A46243 (coll. d'Orbigny), DUV : env. 26,0 mm., DAP : env. 28,0 mm. **1b**. Détail de l'ornementation du même spécimen. – **2**. Lectotype MNHN.F.R63240 (coll. d'Orbigny), DUV : env. 19,0 mm., DAP : env. 21,0 mm. – **3**. Paralectotype MNHN.F.R63241 (coll. d'Orbigny), DUV : env. 23,0 mm., DAP : env. 25,0 mm. – **4**. Paralectotype MNHN.F.A46194 (coll. d'Orbigny), DUV : env. 26,0 mm., DAP : env. 28,0 mm. – **5**. Paralectotype MNHN.F.A46195 (coll. d'Orbigny), DUV : 14,0 mm., DAP : env. 15,0 mm. – **6**. Paralectotype MNHN.F.A57275 (coll. d'Orbigny), DUV : env. 11,0 mm., DAP : 14,0 mm. – **7**. MNHN.F.A57133 (leg. Merle), DUV : 22,0 mm., DAP : env. 24,0 mm. – **8**. MNHN.F.A57132 (leg. Merle). Détail de la charnière. – **9**. MNHN.F.A57131 (leg. Merle), DUV : env. 15,0 mm., DAP : env. 18,0 mm.**10. *Venericor duponti*** (Cossmann, 1908) du Danien (Paléocène inférieur) de Meudon (Hauts-de-Seine), MNHN.F.A46193 (coll. d'Orbigny), DUV : env. 37,0 mm., DAP : env. 42,0 mm.**11. *Venericor duponti*** (Cossmann, 1908) du Danien (Paléocène inférieur) de Obourg (Belgique), MNHN.F.J15675 (coll. Cossmann), DUV : 30,6 mm., DAP : 39,0 mm.**12, 13. *Paraglans lydiae* nov. sp.** du Danien (Paléocène inférieur) du Port-Marly (Yvelines), **12**. Holotype MNHN.F.A46130 (coll. d'Orbigny), DUV : env. 13,0 mm., DAP : env. 15,0 mm., **13**. Paratype MNHN.F.R63242 (coll. d'Orbigny), DUV : env. 9,5 mm., DAP : env. 10,0 mm.**14. *Venericardia elisabethae* nov. sp.** du Danien (Paléocène inférieur) du Port-Marly (Yvelines), holotype MNHN.F.A09422 (coll. d'Orbigny), DUV : env. 25,0 mm., DAP : env. 27,0 mm.**15. *Venericardia elisabethae* nov. sp.** du Danien (Paléocène inférieur) du Pont de Falaise, Montainville (Yvelines), paratype MNHN.F.A46246, DUV : env. 34,0 mm., DAP : env. 36,0 mm. Moulages en élastomère de silicone des empreintes externes (sauf figure 11).

Sous-Famille Carditesinae

Genre **Paraglans** Chavan, 1941Espèce type : *Cardium calcitrapoides* Lamarck, 1806
par désignation originale

Origine : Lutétien (Éocène moyen), bassin de Paris

Paraglans lydiae nov. sp.

(Pl. 1, Figs 12-13)

Synonymie*Cardita hebertiana* d'Orbigny A, 1850a : 130-131, n° 32 (partim). – d'Orbigny A 1850b : 293, n° 32 (partim). – Pacaud & Merle, 2002 : 595 (partim).**Matériel type** : Holotype (empreinte externe d'une valve droite), MNHN.F.R63242 (coll. d'Orbigny), paratype (empreinte externe d'une valve gauche), MNHN.F.A46130 (coll. d'Orbigny) et paratypes, 6 ex. (moules internes), MNHN.F.R63243 (coll. d'Orbigny).**Localité type** : Le Port-Marly (Yvelines), Danien (Paléocène inférieur).**Dimensions** : Holotype, diamètre umbono-ventral : env. 15,0 mm. Diamètre antéro-postérieur : env. 13,0 mm. Paratype, diamètre umbono-ventral : env. 10,0 mm. Diamètre antéro-postérieur : env. 9,5 mm.**Étymologie** : Espèce dédiée à Lydie Andries, attachée honoraire au MNHN, en remerciement pour son travail sur les collections de Paléontologie du Muséum.**Description**. Empreintes externes de faces dorsales. Coquille petite, quadrangulaire, inéquilatérale, relativement convexe. Côté antérieur assez court, côté postérieur très dilaté, presque rectiligne formant un angle voisin de 90° avec le bord postérieur. Crochets peu gonflés. Lunule lisse, large, ovale, peu saillante. Corselet non observable. Surface dorsale ornée de 25 côtes rayonnantes, étroites, portant de petites crénélures arrondies, subimbriquées, plus écartées et épineuses sur les dernières côtes dans la région postérieure, séparées par des intervalles un peu plus larges, ornés de stries d'accroissement très serrées.**Discussion**.Cette espèce, confondue avec *Cardita hebertiana* par d'ORBIGNY A. (1850a : 130-131, n° 32), se distingue immédiatement par ses dimensions moindres, par son galbe quadrangulaire, par

ses côtes étroites, non tripartites et par ses petites crénelures arrondies et épineuses sur les dernières côtes dans la région postérieure. Elle diffère de *Venericardia elisabethae* nov. sp. par sa taille plus petite, par le nombre inférieur de côtes ornant la surface dorsale (25 pour 31 côtes). Elle en diffère également par son galbe quadrangulaire et non orbiculaire, par ses côtes plus fines, non tripartites et par ses petites crénelures épineuses sur les dernières côtes dans la région postérieure. *Paraglans lydiae* nov. sp. diffère de *P. straeleni* (Chavan, 1936) du Danien de Mons (Belgique), seule autre espèce de *Paraglans* paléocène comparable, par ses dimensions moindres, par sa forme moins allongée, plus convexe, par son côté postérieur plus court, par sa lunule plus large, par ses côtes rayonnantes séparées par des intervalles un peu plus larges et moins profonds.

Remerciements

Les auteurs remercient Philippe Loubry (MNHN/CNRS) pour les photographies et l'infographie des planches, Alexandre Lethiers (UPMC) pour l'infographie de la carte de localisation et Philippe Richir (MNHN) pour la réalisation des moulages des spécimens de la collection d'Orbigny.

Références

- ABRARD, R., JOLEAUD, L. & LEMOINE, P. 1927. Sur les conditions de gisement du Montien du Port-Marly (Seine-et-Oise). *Comptes rendus hebdomadaires des séances de l'Académie des Sciences*, 185 (6) : 391-393.
- ANDERSON, H.J., 1974. Die Fauna der paläocänen Hückelhovener Schichten aus dem Schacht Sophia Jacoba 6 (Erkelenzer Horst, Niederrheinische Bucht). *Geologica et Paleontologica*, 8 : 159-192, pl. 4-10.
- ARKHANGUELSKY, A.D., 1904. Paleocenovye otlozeniâ Saratovskogo povol'z'â i ih fauna [Dépôts paléocènes de la région volgienne du gouvernement de Saratov et leur faune]. *Materialen zur Geologie Rußlands*, 32 : 1-207, pl. 1-12. [En Russe]
- BIGNOT, G., 1987. Les paléoenvironnements et les paléogéographies du bassin de Paris au Danien, d'après les Foraminifères du Mont-Aimé (Marne, France). *Revue de Micropaléontologie* 30 (3) : 150-176.
- BIGNOT, C. & GEYSSANT, J.R., 1997. Les Nautilés du Montien de Vigny (Val d'Oise, France). Remarques sur la faune associée. *Bulletin d'Information des Géologues du Bassin de Paris*, 34 (4) : 9-18, pl. 1, text-fig. 1-2.
- CHAVAN, A., 1936a. Sur les variations de *Venericardia planicosta*. *Compte rendu sommaire des séances de la Société Géologique de France*, 7 : 116-118.
- CHAVAN, A., 1936b. Les Carditidés du calcaire de Mons. *Bulletin du Musée royal d'Histoire naturelle de Belgique*, 12 (39) : 1-13.
- CHAVAN, A., 1950. Fossiles de Meulan (Seine-et-Oise), leur signification. *Compte rendu sommaire des séances de la Société Géologique de France*, 5 : 71-73, fig. 1-5.
- CHAVAN, A., 1969. *Superfamily Lucinacea; Family Carditidae*. In: MOORE, R.C. (éd.). *Treatise on Invertebrate Paleontology. Part N, Mollusca* 6, Geological Society of America and University of Kansas, Lawrence, pp. N583-N590.
- COSSMANN, M., 1908. Pélécypodes du Montien de Belgique. *Mémoires du Musée Royal d'Histoire Naturelle de Belgique*, 5 (3), Mémoire n° 19 : 1-76, pl. 1-8.
- DESOR, E., Sur le terrain danien, nouvel étage de la craie, *Bulletin de la Société Géologique de France*, 2 (4) : 179-182.
- FRENEIX, S., 1972. Les Mollusques bivalves crétacés du bassin côtier de Tarfaya (Maroc méridional). *Notes et Mémoires du Service Géologique du Maroc*, 228 : 49-255, pl. 1-18, text-fig. 1-48, tabl. 1-7.
- GABB, W.M., 1861. Synopsis of the Mollusca of the Cretaceous Formation, Including the Geographical and Stratigraphical Range and Synonymy. *Proceedings of the American Philosophical Society*, 8 (65) : 57-257.
- GARDNER, J. & BOWLES, E., 1939. The *Venericardia planicosta* group in the Gulf Province. *United States Geological Survey Professional Paper*, 189 F : 143-196, pl. 33-46.
- GLIBERT, M. & VAN DE POEL, L., 1973. Les Bivalvia du Danien et du Montien de la Belgique. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, 175 : 1-89, pl. 1-8.
- GREPPIN, J.-B., 1866. Tableau des terrains géologiques du Jura suisse. *Actes de la Société Jurassienne d'Émulation*, 17 : 131-153.
- GREPPIN, J.-B., 1867. *Essai géologique sur le Jura suisse*, HELG & BOÉCHAT, Delémont, 152 p.
- GROSSOUVRE, A., de 1901. Recherche sur la Craie supérieure. 1^{ère} partie : Stratigraphie générale. *Mémoires pour servir à l'explication de la Carte Géologique détaillée de la France*, 1013 p.
- GUERNET, C., 2016. Les ostracodes de la collection de P. Margerie et l'âge des couches à Laffittéines Mont-Aimé (bassin de Paris, France). *Geodiversitas* (accepté).
- GUILLEVIN, Y., 1976. *Le Montien du Bassin de Paris*, Thèse de 3ème cycle, Université Paris VI, 227 p. [Inédit]
- GUILLEVIN, Y., 1977. Contribution à l'étude des Foraminifères du Montien du bassin de Paris. *Cahiers de Micropaléontologie*, 4 : 1-79.
- HEASLIP, W.G., 1968. Cenozoic evolution of the alticostate *Venericards* in Gulf and East coastal North America. *Paleontologia Americana*, 6 (39) : 53-135, pl. 20-29, text-fig. 1-28.
- HÉBRARD, A., 1883. Excursions géologiques. 1. Excursion dans le calcaire pisolithique de Vigny. *Le Naturaliste. Journal des échanges et des nouvelles*, 5 (28) : 222-223.
- KRACH, W., 1969. Mollusca of the Babica Clays (Paleocene) of the Middle Carpathians. Par. 2. Pelecypoda (Mieczyki iłów Babickich (Paleocen) W Karpatach środkowych. Cz. 2. Pelecypoda). *Studia Geologica Polonica*, 29 : 1-79, pl. 1-12.
- LAZAR, E., 1965. Die Mollusken der Paläozän-Vorkommen von Waßmannsdorf (Brandenburg) und Ratheim (Niederrhein). *Abhandlungen des Zentralen Geologischen Instituts*, 1 : 95-126, pl. 8-9, 2 tabl.
- MEUNIER, S., 1875. *Géologie des environs de Paris ou Description des terrains et énumération des fossiles qui s'y rencontrent*, BAILLIÈRE, Paris, 510 p.

- MEUNIER, S., 1912. *Géologie des environs de Paris: description des terrains et énumération des fossiles qui s'y rencontrent, suivie d'un index des localités fossilifères*, BAILLIÈRE, Paris, 540 p.
- MOROZ, S.A. & JERMOKHINA, L.I. 1991. Vikopni molyuski paleotsenu Povolzhya. [Les mollusques fossiles du Paléocène de Povolzhye.] *Paleontologicheskii Sbornik*, 28 : 8-17, pl. 1-2.
- NETSCHEW, A., 1897. Fauna zocenovyh otlozenij na Volge mezdu Saratovym i Caricynym [Faune éocène du bassin de la Volga entre Saratov et Tsaritsyn]. *Trudy Obscestva Estestvoispytatelej pri Imperatorskom Kazanskom Universitete*, 32 (1) : 1-247, pl. 1-10. [En Russe]
- D'ORBIGNY A., 1850a. Note sur les fossiles de l'étage Danien. *Bulletin de la Société Géologique de France*, 2 (7) : 126-135.
- D'ORBIGNY, A., 1850b. *Prodrome de Paléontologie stratigraphique universelle des Animaux mollusques et rayonnés faisant suite au cours élémentaire de Paléontologie et de géologie stratigraphiques*, vol. 2, MASSON, Paris, 428 p.
- D'ORBIGNY, C., 1836. Note sur le terrain nouvellement découvert à Meudon. *Bulletin de la Société Géologique de France*, 7 : 280-291.
- D'ORBIGNY, C., 1838. *Bassin de Paris*. In: GUÉRIN, F.E.: *Dictionnaire pittoresque d'Histoire naturelle et des Phénomènes de la Nature, contenant l'histoire des Animaux, des Végétaux, des Minéraux, des Météores, des principaux phénomènes physiques et des curiosités naturelles, avec des détails sur l'emploi des productions des trois règnes dans les usages de la vie, les Arts et Métiers et les Manufactures*, Tome 7, Paris, p. 126-141.
- PACAUD, J.-M. & MERLE, D. 2002. Alcide d'Orbigny, un précurseur dans l'étude de la faune du Danien du Bassin de Paris (France) in Alcide d'Orbigny. 2. Voyageur naturaliste et systématique. *Comptes Rendus Palévol*, 1 (7) : 587-598, text-fig. 1-4.
- PANTELEW, G.S., 1974. *Stratigrafiâ i Dvustvorcatye Mollûski Datskih i paleocenovyh otlozenij Zakaspiâ (Stratigraphie et Mollusques bivalves des dépôts daniens et paléocènes de la région transcaspienne)*, Moscou, Izdatelstvo "Nauka", 152 p., 35 pl., 6 tabl. [En russe].
- PETERSEN G.H., & VEDELSBY, A., 2000. An illustrated catalogue of the Paleocene Bivalvia from Nuussuaq, Northwest Greenland: Their palaeoenvironments and the paleoclimate. *Steenstrupia*, 25 (1) : 25-120, fig. 1-202.
- PICTET, F.J. & CAMPICHE, G., 1866. *Description des fossiles des terrains crétacés des environs de Sainte-Croix, Troisième Partie*. In: *Matériaux pour la Paléontologie Suisse ou Recueil de monographies sur les fossiles du Jura et des Alpes*, Quatrième Série, GEORG, Genève, p. 341-409, pl. 128-130.
- ROSENKRANTZ, A., 1970. Marine Upper Cretaceous and Lowermost Tertiary deposits in West Greenland. *Meddelelser fra Dansk Geologisk Forening*, 19 : 406-453.
- RUTSCH, R., 1936. Beiträge zur Kenntnis tropisch-amerikanischer Tertiärmollusken. Teil V, Ist *Venericardia beaumonti* auf die Oberkreide beschränkt ? *Eclogae Geologicae Helvetiae*, 29 (1) : 187-207, pl. 17.
- SCHMIDT, C.F., 1818. *Versuch über die beste Einrichtung zur Aufstellung : behandlung und Aufbewahrung der verschiedenen Naturkörper und Gegenstände der Kunst, vorzüglich der Conchylien-Sammlungen, nebst kurzer Beurtheilung der conchyliologischen Systeme und Schriften und einer tabellarischen Zusammenstellung und Vergleichung der sechs besten und neuesten conchyliologischen Systeme, welchen ein Verzeichniss der am meisten bekannten Conchylien angehängt ist, wie solche nach dem Lamarkischen System geordnet werden können*, Gotha, 252 p.
- SOLANDER, D.C., 1766. *Descriptiones Specierum*. In: BRANDER G., *Fossilia Hantoniensia collecta, et in Musaeo Britannico deposita*, London, p. 9-43, 9 pls.
- STENZEL, H.B., KRAUSE, E.K. & TWINING, J.T., 1957. Pelecypoda from the Type Locality of the Stone City Beds (Middle Eocene) of Texas. *The University of Texas Publication*, 5704 : 3-237, pl. 3-22.
- STEWART, R.B., 1930. Gabb's California Cretaceous & Tertiary Type Lamellibranchs. *Special Publications of the Academy of Natural Sciences of Philadelphia*, 3 : 3-314, pl. 1-17.
- TERQUEM, O., 1855. Paléontologie de l'étage inférieur de la formation Liasique de la province de Luxembourg (Grand-duché) et de Hettange, département de la Moselle. *Mémoire de la Société Géologique de France*, série 2, 5 (2) : 219-343, pl. 12-26. [Publié également par TERQUEM, O., 1855. *Paléontologie de l'étage inférieur de la formation Liasique de la province de Luxembourg (Grand-duché) et de Hettange, département de la Moselle*, Gide & Baudry, Paris, 125 p., 15 pls.]
- VILLATTE, J., 1977. Sur le Stratotype du Montien à Mons – Les Mollusques du sondage de Mons. *Mémoire pour servir à l'explication des cartes géologiques et minières de la Belgique*, 17: 26-220, pl. 1-11, 1 text-fig.
- VINCENT, E., 1930. Étude sur les Mollusques montiens du poudingue et du tuffeau de Ciplu. *Mémoires du Musée Royal d'Histoire Naturelle de Belgique*, 46 : 1-115, pl. 1-6, text-fig. 1-37.



Association Française de Conchyliologie

