New records of *Calliotropis* (Gastropoda: Chilodontidae) from central eastern Atlantic

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KEYWORDS. Gastropoda, Chilodontidae, Solariellidae, *Calliotropis*, *Solariella*, central eastern Atlantic.

ABSTRACT. A total of 10 species, most of them previously known as '*Solariella*' and living in the central eastern Atlantic, are discussed, briefly characterized and illustrated.
Solariella rudecta, *S. mogadorensis*, *S. talismani*, *S. valida*, *S. effossima*, *S. vaillanti* and *S. ambigua* are assigned to the genus *Calliotropis*.
The true identity of shells labelled '*Solariella rhina*' in various collections is established to be *Calliotropis infundibulum* (Watson, 1879).
New records are listed for *Calliotropis infundibulum*, *C. talismani*, *C. valida*, *C. vaillanti* and *C. ambigua*. The presence of the two American species *C. ottoi* and *C. globosa* in eastern Atlantic needs confirmation.
A key to central eastern Atlantic *Calliotropis* species is proposed.

RESUME. Un total de 10 espèces, la plupart connues auparavant en tant que '*Solariella*' et vivant dans l'Atlantique central oriental, sont examinées, brièvement caractérisées et illustrées.
Solariella rudecta, *S. mogadorensis*, *S. talismani*, *S. valida*, *S. effossima*, *S. vaillanti* et *S. ambigua* sont placées dans le genre *Calliotropis*.
La véritable identité de spécimens classés comme '*Solariella rhina*' dans diverses collections se révèle être en fait *Calliotropis infundibulum* (Watson, 1879).
De nouvelles stations sont enregistrées pour *Calliotropis infundibulum*, *C. talismani*, *C. valida*, *C. vaillanti* et *C. ambigua*. La présence des deux espèces américaines *Calliotropis ottoi* et *C. globosa* en Atlantique oriental demande confirmation.
Une clé de détermination des espèces de *Calliotropis* de l'Atlantique oriental central est proposée.

INTRODUCTION

Literature refers from time to time to *'Solariella'* species from subtropical and tropical eastern Atlantic, mainly off former French Western Africa (we will consider here an area from off Portugal to Angola). However, these species are in fact poorly known, probably because some of them are of small size or also because they are living at great depth. Moreover, some species are only known from the type material or even only from the original description. Finally, some of these species are not *Solariella* species at all and are indeed, among others, *Calliotropis* species.

Historical expeditions in this area are the English expeditions of the Lightning and Porcupine, conducted from 1868 to 1878, the French expeditions of Travailleur and Talisman that were led from 1880 to 1883, and the scientific campaign of the Prince of Monaco, with the Hirondelle and Princesse Alice ships, that were carried out from 1885 to 1915.

A bit later, Gruvel sampled off Mauritania and Senegal (1904, 1908) and off the African coasts, from Senegal to Congo (1909–1910).

Jeffreys (1878–1885) reported on the sampling from the Lightning and Porcupine, with the description of some *Solariella* species. Major works publishing the results of the Prince of Monaco's expeditions are the ones of Dautzenberg and H. Fischer (1896, 1906). Locard (1897) reported in another major work the expeditions of Travailleur and Talisman. Dautzenberg alone (1889, 1925, 1927) continued to report the results of the Prince of Monaco's expeditions.

These three authors described many new species in their works, with the genera used in these times. Particularly, many species were described as *Solariella* species, the genus seeming a quite generic term.

Later, Nicklès (1950) identified the known marines species of Western and Equatorial Africa. He described no new species, but gave a valuable account of the western African species that were still poorly known. Only two *Solariella* species were mentioned and none were indeed *Calliotropis*.

In the more northern part of the studied area, the MNHN carried out in 1971 the expedition Biaçores in and off Azores with J. Forest as Principal Investigator. This expedition sampled 21 littoral and 260 deep-water stations. The material (in MNHN) has never been reported.

From 1976 to 1986, the Rijksmuseum van Natuurlijke Historie (NNML) led the CANCAP-project, a large programme of biogeographically oriented marine research in the south eastern part of northern Atlantic. Seven campaigns (CANCAP-I to VII) were carried out, visiting a large area covering Azores, Madeira Archipelago, the Moroccan shelf, Canary Islands, Mauritanian coasts, Senegal and the Cape Verde Islands. Van der Land (1987) listed the stations of the whole CANCAP-project. Most resulting zoological samples are kept in the National Museum of Natural History of Leiden.

Nordsieck (1968, 1982) listed *Solariella* species of the European seas; this is a valuable check list of all available names, but its author doesn't separate *Calliotropis* from true *Solariella* species or others. Regarding non *Calliotropis* species, Rubio & Rolán (1997) moved some of them from the genus *Solariella* into the genus *Lirularia*. They based their opinion on the study of protoconch, radula and epipodial tentacles. Rolán, Hernandez and Deniz (2005) added two new species of true *Solariella* to the list. Ardovini and Cossignani (2004) published a book about West African Seashells while Rolán (2005) published recently a book about the Cape Verde Islands; these authors mentioned some known *Solariella* species of these area, without new species nor new assignment to different genera.

In the present paper, the authors focus on available material labelled as '*Solariella*' and coming from central eastern Atlantic, mainly western African areas, whose careful study shows that these species are obviously not *Solariella* but *Calliotropis*. The results of these investigations are reported here with illustrations, when possible, of types or representative specimens.

Abbreviations

Repositories

MNHN: Muséum national d'Histoire naturelle, Paris, France – repository for material of TRAVAILLEUR 1882, TALISMAN 1883 and Mission Biaçores campaigns.
MOM: Musée Océanographique de Monaco, Monaco – repository for material of PRINCESSE-ALICE II campaign.
BMNH: Natural History Museum, London, England.
NNML: Nationaal Natuurhistorisch Museum Leiden, The Netherlands – repository for material of CANCAP-II & III campaigns.
USNM: National Museum of National History, Smithsonian Institution, Washington, U.S.A.
ZSM: Zoologische Staatssammlung, München, Germany – repository for material of METEOR 36 campaign.

Other abbreviations

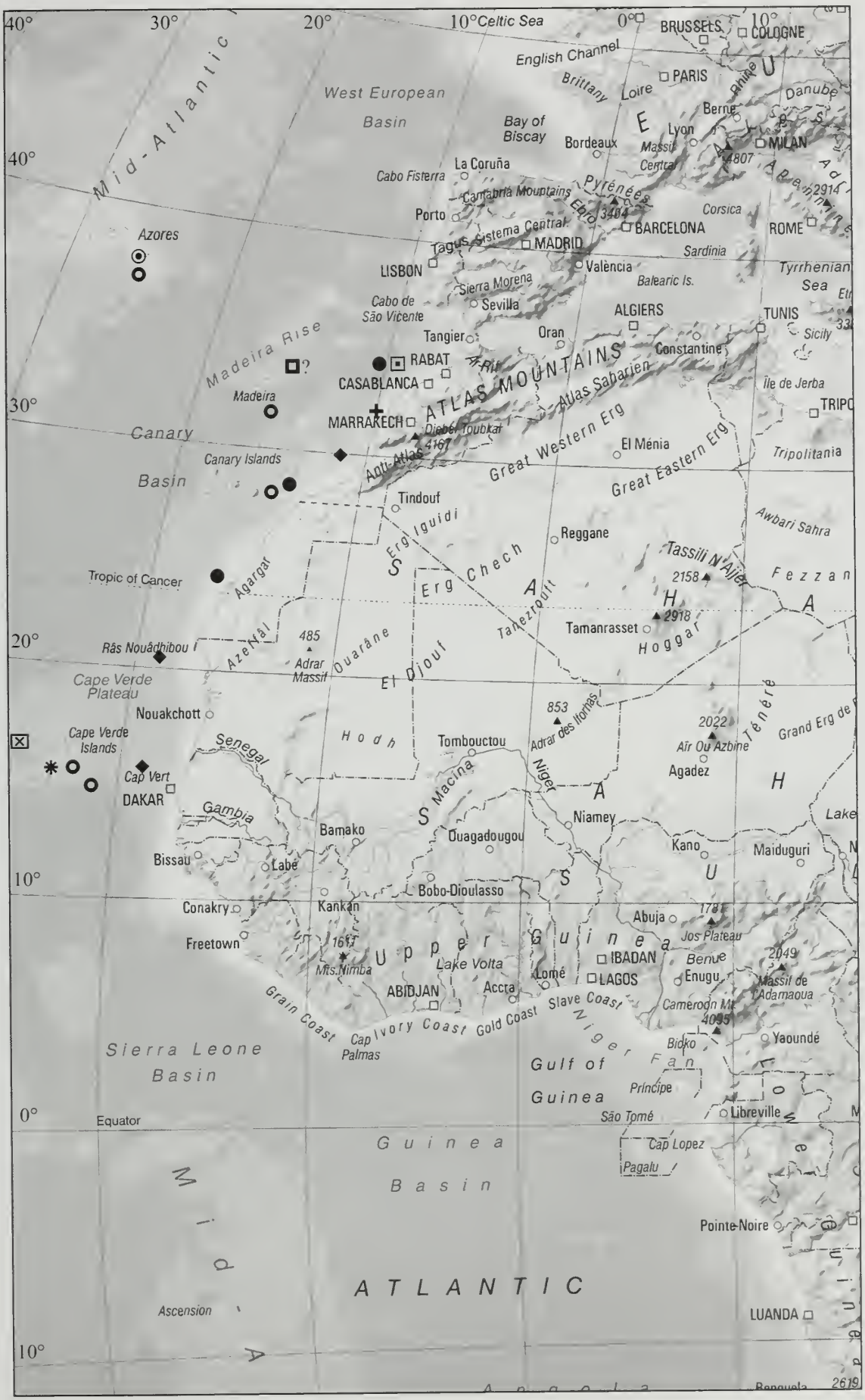
H: height
W: width
P1, P2, P3, ...: primary cords (P1 is the most adapical)
S1, S2, S3, ...: secondary cords (S1 is the most adapical)
stn: station
lv: live-taken specimens present in sample
dd: no live-taken specimens present in sample
sub: subadult specimen
juv: juvenile specimen
col: private collection

Remark about the distribution ranges

Regarding the extension of the distribution of known species, the range is taken from the internal intervals of the two extremes values.

KEY TO SPECIES

It is easy to distinguish, among the studied species, those that belong to the genus *Calliotropis* Seguenza, 1903, although it is not really easy to give it an operational straightforward definition, because there are in this genus many variations regarding the height of the spire and the presence or absence of umbilicus. But, considering the type species, one can characterize *Calliotropis* by a nacreous layer apparent on the whole surface, a rather small number of granular or nodular spiral cords on the whorls (that is, 3 or 4 primary cords, sometimes up to the same number of secondary cords), a small number of similar cords on the base and often an umbilicus without spiral cord or with up to 3 or 4 spiral cords inside.
We give here a keys system to help to distinguish the Atlantic species studied in this paper (excluding the doubtful *C. globosa*). Criteria used are mainly the shape of the shell and the number (sometimes also the strength or the weakness) of cords on the last whorl, on the base and inside the umbilicus.



Map 1 : Records of cited *Calliotropis* species – ◆ : *C. infundibulum*; ⊡ : *C. rudecta*; ✚ : *C. mogadorensis*; ● : *C. talismani*; ✱ : *C. valida*; ☒ : *C. effossima*; ⦿ : *C. vaillanti*; ○ : *C. ambigua*; ◘ : *C. ottoi*.

Key to *Calliotropis* species of eastern Atlantic area
(numbers of spiral cords refers to the last whorl of teleoconch)

1. spire high elevated 2
– spire moderately high or weakly depressed 4
2. 4 spiral cords, cords similar in size, 1 spiral cord inside umbilicus ..... *C. rudecta* [p.25]
– 3 spiral cords 3
3. nodules of P2 stronger than nodules of other cords ..... *C. ottoi* [p.20]
– spire a bit more elevated, nodules of P1 the strongest ..... *C. infundibulum* [p.24]
4. shape slightly coloeconoidal, P2 the strongest, 1 cord inside umbilicus ..... *C. mogadorensis* [p.25]
– shape conical or cyrtoconoidal 5
5. distance between P1–P2 two times greater than distance between P2–P3 ..... *C. talismani* [p.26]
– P1, P2 et P3 more or less evenly distributed 6
6. spire rather depressed 7
– spire moderately high 8
7. nodules of cords more or less similar in size ..... *C. valida* [p.26]
– size of nodules decreasing from P1 to P3 ..... *C. effossima* [p.27]
8. nodules of P1 sharp, rather small, sometimes 1 weak cord inside umbilicus ..... *C. vaillanti* [p.28]
– nodules of P1 blunt, rather strong, less numerous, 2 or 3 umbilical cords ..... *C. ambigua* [p.28]

SYSTEMATICS

We follow here the classification of Bouchet & Rocroi (2005), where Calliotropini, earlier treated as a tribe of Trochidae (Hickman & McLean, 1990), are now ranked as a subfamily of family Chilodontidae.

Superorder **VETIGASTROPODA** Salvini–Plawen, 1980
Superfamily **SEGUENZIOIDEA** Verrill, 1884
Family **CHILODONTIDAE** Wenz, 1938
Subfamily **CALLIOTROPINAE** Hickman & McLean, 1990
Genus ***Calliotropis*** Seguenza, 1903
Type species: *Trochus ottoi* Philippi, 1844 (by original designation) – Pliocene–Pleistocene, Italy.

Calliotropis ottoi (Philippi, 1844)
Figs 29-33

Trochus ottoi Philippi, 1844: 227, pl.28, fig. 9.
Basilissa ottoi – Martens & Thiele, 1904: 126, pl.IV, fig. 18.
Lischkeia ottoi – Abbott, 1974: 39, fig. 265.
Calliotropis ottoi – Warén, 1991: 56, fig. 1B.
Calliotropis (Calliotropis) ottoi – Quinn, 1979: 7, figs 5–6.
Lischkeia (Calliotropis) ottoi – Nordsieck, 1982: 15, pl.7, fig. 10.100.
Lischkeia ottoi – Abbott, 1991: 37.

Type material. No types located (lost ?).

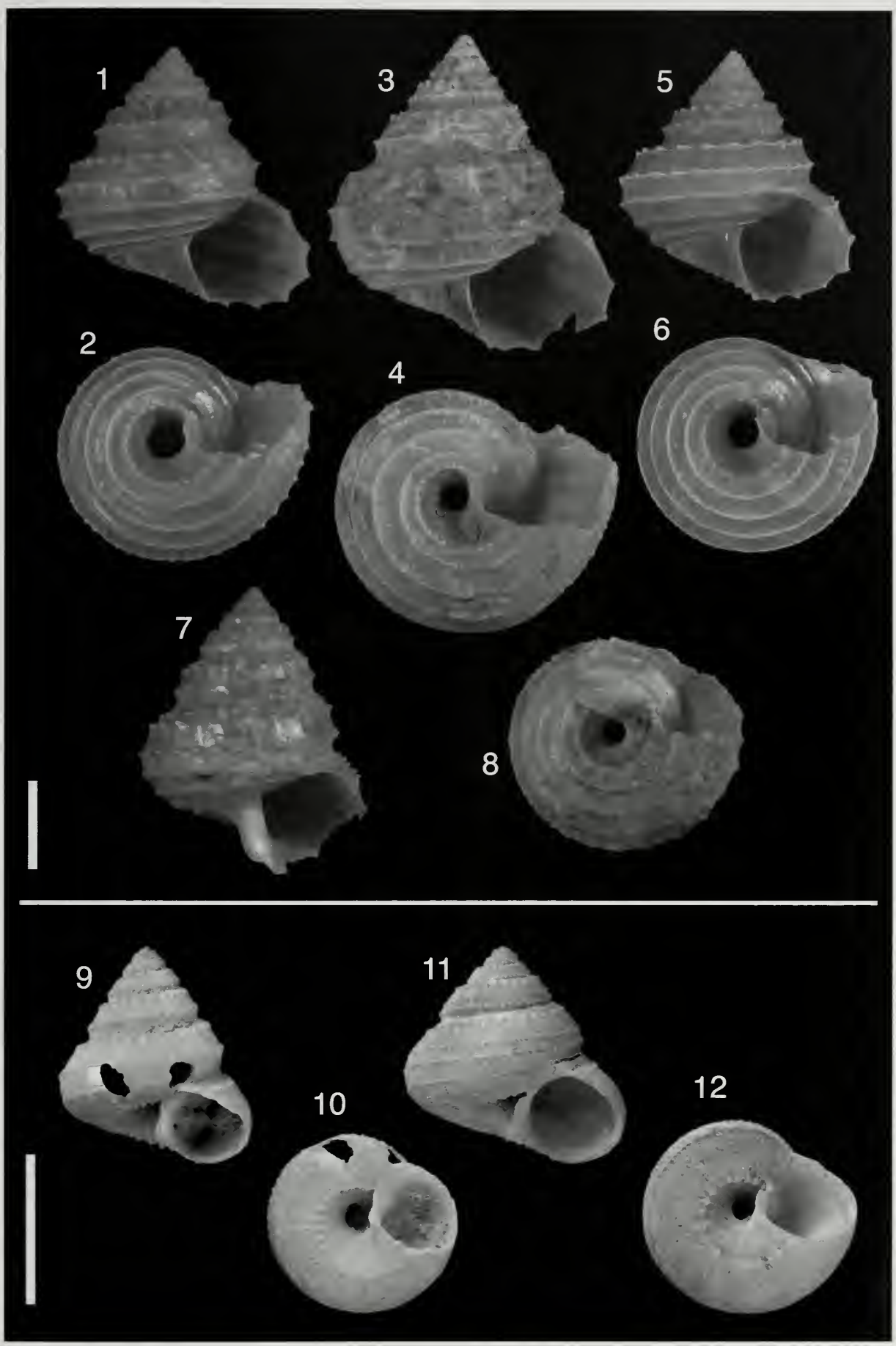
Type locality. Mediterranean Sea, Pleistocene.

Material examined. Iceland. Off Stykkisholmur, Breidafjodur, 45–60 m, coll. F. Swinnen, 1 dd. – Off Hornafjordur, 60–70 m, coll. F. Swinnen, 2 lv sub. – **U.S.A.** Off Jamestown, Rhode Island, coll. F. Swinnen, 1 lv.

Distribution. North–western Atlantic (from Nova Scotia to off north Carolina), north–eastern Atlantic (from Iceland and Faeroe Is. to Azores and Madeira), Indonesia (Sumatra – doubtful), 85–1000 m, Sicily (Fossil).
Warén (1976) pointed out that the bathymetric ranges of the distribution are uncertain because authors made confusions with other species (for example, *C. regalis* (Verrill & Smith, 1880)). We never recorded this species in Azores nor in Madeira, where however it should be expected as a survivor of the deep–water Plio–Pleistocene fauna of the Sicily.

Plate 1. Figures 1–12. Scale bars: 5 mm

1-8. *Calliotropis "rhina"* (Watson, 1886) specimens that are indeed *C. infundibulum* (Watson, 1879).
1-2. MNHN, Atlantic Morocco, 2212 m [TALISMAN 1883, stn DR40], 17.2 x 16.0 mm; **3-4.** MNHN, Cape Verde Is., 3200 m [TALISMAN 1883, stn DR101], 23.5 x 20.3 mm; **5-6.** ZSM (19960312), off Mauritania, 2110 m [Meteor 36, stn 100], 15.2 x 13.9 mm; **7-8.** var. major, MNHN, Atlantic Morocco, 2210 m [TALISMAN 1883, stn DR38], 20.8 x 16.9 mm.
9-12. *Solariella rhina* (Watson, 1885), syntypes BMNH, Azores - photos taken by BMNH.
9-10. BMNH (1887.2.9.302–6), 8.5 x 7.5 mm; **11-12.** BMNH (1887.2.9.307), 8.2 x 8.5 mm.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Remarks. The main characteristics of this species are :
- height up to 10 mm, width up to 15 mm;
- a high spire, an almost conical shape, with up to 6 whorls;
- 2 granular cords P1 and P2 on spire whorls and an additional peripheral, granular spiral cord P3 on last whorl; P2 the strongest; axial ribs obsolete on last whorls;
- 4–6 granular spiral cords on the base, the innermost cord with strong nodules; interspace between cords two times as broad as cords;
- a rather narrow umbilicus with one granular spiral cord inside;
- a whitish silvery colour.

See Quinn (1979, figs 5–6) for another illustration.

"Calliotropis" rhina (Watson, 1885)
Figs 9-12

Trochus (Margarita) lima Watson, 1879: 703 (*non* Philippi, 1844).
Trochus (Margarita) rhina Watson, 1885: 80–81, pl.V, fig. 1 (*nom. nov.* for *T. (M.) lima* Watson, 1879).
Solariella rhina – Locard, 1897: 23, pl.XXII, fig. 25–28.
Calliotropis (Solaricida) rhina – Quinn, 1979: 13, fig. 27–28.
Solariella rhina – Nordsieck, 1982: 16, fig. 302.

Type material. 14 syntypes BMNH (1887.2.9.302–6, 1887.2.9.307, 1887.2.9.308–310, 18589.11.11.4–6).

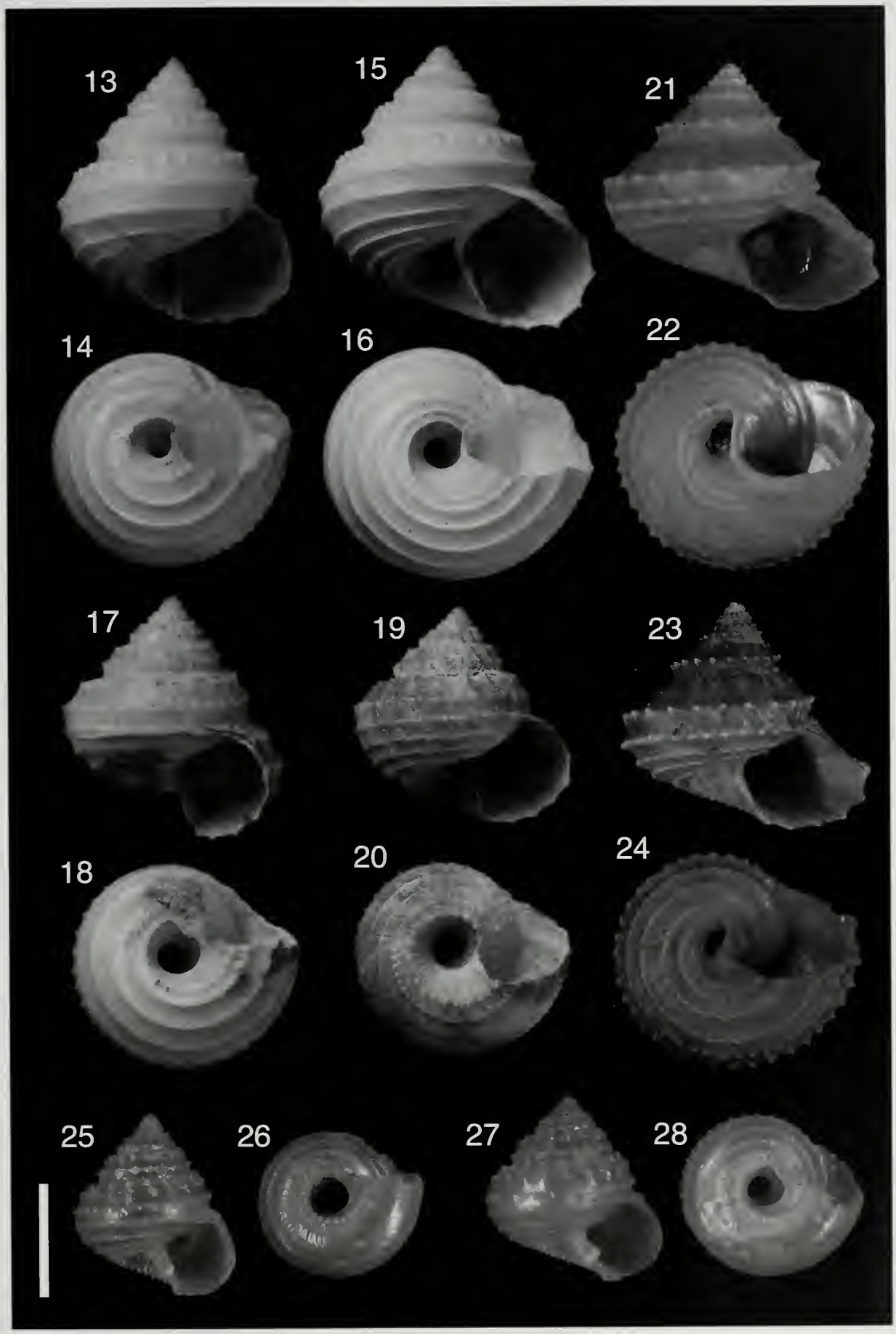
Type locality. Azores, 1829 m. Quinn (1979) noted that Watson selected no holotype and used as type locality the one of the largest BMNH syntype (Challenger stn 78); we do the same here.

Distribution. Azores, 800–1800 m (Locard); Atlantic Morocco, 2075–2212 m; off Senegal, 3200 m, and off Mauritania, 2110–2843 m.

Remarks. Quinn (1979) already pointed out the confusion surrounding Atlantic *Calliotropis* species as *C. aeglees* (Watson, 1879) or *C. rhina* (Watson, 1885). While its arguments about *C. aeglees* are certainly pertinent, it is clear that he never studied the types of *C. rhina* – "the syntypes are probably in the British Museum (Natural History)". They are indeed in the BMNH (14 syntypes), but we were very surprised to note that these shells, that are probably true *Solariella*, are very different from all the studied specimens coming mainly from MNHN or ZSM and labelled "*Solariella rhina* (Watson, 1885)".
We also noticed that much earlier, Locard (1897) mentioned *Solariella rhina* and gave an illustration of the form *major*; but he used only the illustrations of the Challenger report (Watson, 1886), of rather poor quality, to establish that the shells he had before him were *S. rhina*.
Because it is yet clear that the MNHN and ZSM shells labelled "*Solariella rhina*" are definitively not *S. rhina* and because they differ from all other known central eastern Atlantic *Calliotropis*, we looked for similar species from the central western Atlantic. The next table (Table 1) lists these species.
C. diomediae (Verril, 1880), of which the only illustration was found in the cards of Kaicher (1987), seems to match rather well with our name–lacking shells, except that it has a higher ratio H/W and much more thicker, more spaced and less numerous beads on the two most adapical spiral cords, these two cords being of the same size. In fact, it appeared quickly that all the misidentified specimens were indeed *C. infundibulum* (Watson, 1879).

Figures 13-28. Scale bar: 5 mm.

13-20. *C. infundibulum* (Watson, 1879), syntypes BMNH, Prince Edward Island – photos taken by Phil Hurst (BMNH).
13-14. BMNH (1887.2.9.328–9), 14.8 x 12.5 mm; **15-16.** BMNH (1887.2.9.328–9), 16.0 x 14.9 mm; 17-18. BMNH (1887.2.9.325–7), 12.0 x 11.9 mm; **19-20.** BMNH(1887.2.9.325–7), 10.9 x 10.7 mm.
21-24. *C. mogadorensis* (Locard, 1897).
21-22. Syntype MNHN, Atlantic Morocco, 912 m [TALISMAN 1883, stn DR36], 13.7 x 15.3 mm; **23-24.** MNHN, Atlantic Morocco, 1900 m [TRAVAILLEUR 1882: stn DR40], 12.5 x 13.7 mm.
25-28. *Calliotropis? globosa* Quinn, 1991, said to be from Madeira, south–east of Porto Santo, 790–840 m, B.Van Heugten coll.. **25-26.** 8.8 x 7.7 mm; **27-28.** 9.1 x 8.5 mm.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	spire	largest dimensions (mm)	spiral cords on whorls	spiral cords on base	umbilicus
C. regalis (Verrill & Smith, 1880)	moderately elevated, conical	14 x 15	3, subsutural cord thinner	5–6	wide, with 1 or 2 spiral cords within
C. aeglees (Watson, 1879)	moderately elevated, conical	7 x 7.5	3	3	wide
C. calatha (Dall, 1927)	variable : from moderately high to moderately depressed	10 x 13	2–3	3–4	wide, with a few thin spiral cords
C. lissocona (Dall, 1881)	elevated, conical	6 x 5	3, subsutural cord thinner	3	wide
C. actinophora (Dall, 1890)	moderately depressed	9 x 10	4, subsutural cord thinner	4	wide
C. diomediae (Verril, 1880)	elevated	23 x 18	3	4	moderately wide
C. infundibulum (Watson, 1879)	rather elevated	20 x 20	3, subsutural cord thicker	4	wide without cord inside

Table 1. *Calliotropis* from central western Atlantic : general features following literature

Calliotropis infundibulum (Watson, 1879)
Figs 1–8, 13-20

Trochus infundibulum Watson, 1879: 707–708.
Trochus (Margarita) infundibulum – Watson, 1885: 84–85, pl.V, fig. 5.
Solariella infundibulum – Dall, 1889: 380–381.
Solariella infundibulum – Dall, 1890: 349–352.
Solariella infundibulum – Abbott, 1974: 41, fig. 287.
Solariella infundibulum – Cernohorsky, 1977: 105, fig. 1.
Calliotropis infundibulum – Marshall, 1979: 531, figs 4E–G, 9C–F.
Calliotropis infundibulum – Kaicher, 1990: 5690.
Calliotropis infundibulum – Sasaki, 2000: 59, pl. 29, fig. 25.
Calliotropis infundibulum – Vilvens, 2004: figs 27–28.
Calliotropis infundibulum – Vilvens, 2007: figs 84–85.

Type material. 5 syntypes, BMNH (1887.2.9.325–7, 1887.2.9.328–9).

Type locality. Prince Edward Island (Indian–Atlantic Ridge area), 46°46'S, 45°31'E, 2514 m.
Material examined. Atlantic Morocco. TALISMAN 1883: stn DR38, 30°09'N, 11°41'W, 2210 m, 1 dd. – Stn DR40, 30°03'N, 11°42'W, 2212 m, 1 lv, 2 dd, 2 dd sub. – Stn DR42, 29°58'N, 11°41'W, 2104 m, 2 lv, 2 dd, 1 dd sub. – Stn DR43, 29°52'N, 11°44'W, 2075 m, 1 lv, 3 dd, 1 dd sub. – **Senegal (off Cap Vert).** TALISMAN 1883: stn DR101, 16°38'N, 18°24'W, 3200 m, 1 lv, 1 dd. – **Off Mauritania.** METEOR 36: stn 99, 21°36.2'N, 18°40.6'W, 2843 m, 2 lv. – Stn 100, 21°27.1'N, 18°16.1'W, 2110 m, 2 lv. – **Madeira.** South-east of Porto Santo, 32°26'N, 15°11'W, 790–840 m, F. Swinnen coll., 1 dd.

Distribution. Western Atlantic (from northern America to Brazil), 230–3259 m (Clarke, 1962), eastern Atlantic (Azores, 800–1800 m (Locard, 1898); Atlantic Morocco, 2075–2212 m; off Senegal, 3200 m, and off Mauritania, 2110–2843 m), Indian–Atlantic Ridge, 1965–2514 m (Watson, 1879); South Africa, 2750 m (Martens, 1903); Japan, 2000–2150 m (Higo et al., 1999); south-western Pacific, 2040–2315 m; New Zealand, 2080–2515 m (Marshall, 1979).

Remarks. This is an extension of this widespread species, known from western Atlantic to western Indo–Pacific.
The main characteristics of this *Calliotropis* species are :
- height up to 23.5 mm, width up to 20.3 mm;
- a high spire, an almost conical shape, with up to 7.5 whorls;
- 2 granular cords P1 and P2 on spire whorls and an additional peripheral, granular spiral cord P3 clearly visible on last whorl, the granules of the adapical cord being the strongest; axial ribs still visible near the granules;
- 4 thin granular spiral cords on the base, the innermost cord with strong nodules; interspace between cords three times as broad as cords;
- a broad umbilicus without spiral cord inside;
- a whitish silvery colour.

On some specimens, P1 may divide in two cords, giving three cords on last spire whorls instead of two

(this is the variety *major* of authors for "*Solariella rhina*").
The three examined syntypes registered as 1887.2.9.325–7 have a more depressed spire and a spiral cord P2 with thicker, less numerous, more spaced beads than the two syntypes registered as 1887.2.9.328–9. The labelled "*S. rhina*" specimens are intermediate between the two kinds of syntypes, with a rather elevated spire (as 1887.2.9.328–9 syntypes) and thick, isolated beads on P2 (as 1887.2.9.325–7 syntypes).

***Calliotropis rudecta* (Locard, 1897)**
Figs 48–49

Solariella rudecta Locard, 1897: 33–34, pl.I, figs 17–19.
Solariella rudecta – Nordsieck, 1982: 16, fig. 303.

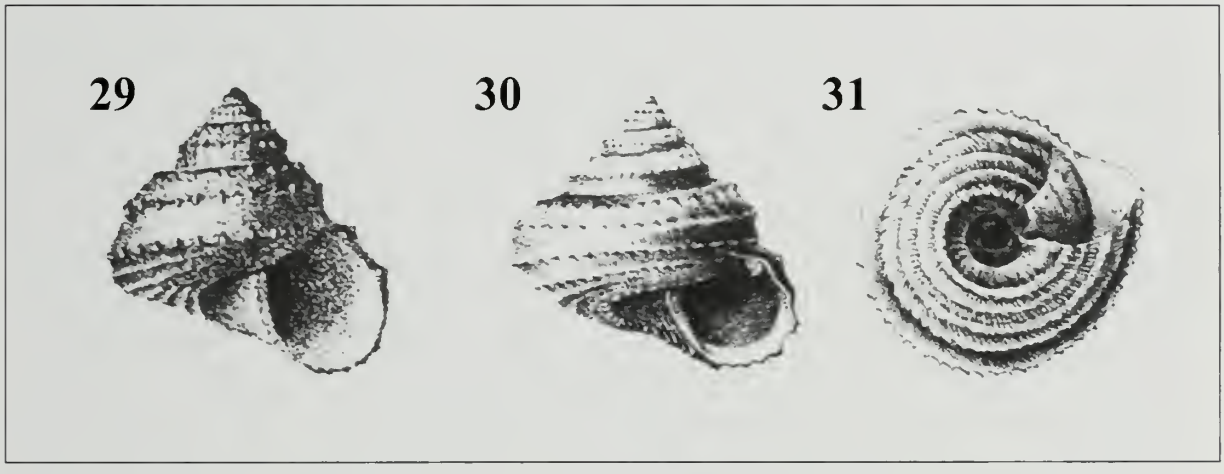
Type material. Holotype MNHN.

Type locality. Off western Morocco, 1900 m.

Material examined. Off Morocco. TRAVAILLEUR 1882: stn DR40, 33°09'N, 09°38'W, 1900 m, 1 dd (holotype).

Distribution. Only known from the type locality.

Remarks. The main characteristics of this species are :
- height 5 mm, width 3.5 mm;
- a high spire, a slightly coeloconoidal shape, with 5.5 whorls;
- 3 primary granular cords on spire whorls, 2 secondary cords S1 and S2 on last whorls and an additional peripheral, granular spiral cord P4 on last whorl; granules of cords sharp and similar in size: axial ribs visible, connecting nodules;
- 3 thin granular spiral cords on the base; interspace between cords two times as broad as cords;
- a deep, rather broad umbilicus with a spiral cord within;
- a beige colour.



Figures 29-31. *Calliotropis ottoi* (Philippi, 1844).

29. Illustration from the original description from Philippi (1844); **30-31.** Illustrations from Martens & Thiele (1904)

Calliotropis mogadorensis (Locard, 1897)
Figs 21–24

Solariella mogadorensis Locard, 1897: 24–25, pl.I, fig. 1–4.
Solariella mogadorensis – Nordsieck, 1982: 16, fig. 307.

Type material. 10 syntypes MNHN.

Type locality. Off western Morocco, 1900 m.

Material examined. Off Morocco. TRAVAILLEUR 1882: stn DR40, 33°09'N, 09°38'W, 1900 m, 1 dd (syntype MNHN). – TALISMAN 1883: stn DR34, 32°27'N, 09°55'W, 1123 m, 1 lv, 1 dd (syntypes MNHN). – Stn DR36, 31°34'N, 10°21'W, 912 m, 1 lv, 2 dd (syntypes MNHN). – Stn DR37, 31°31'N, 10°27'W, 1050 m, 4 dd (syntypes).

Distribution. Only known from type locality

Remarks. The main characteristics of this species are :
- height up to 13.5 mm, width up to 15 mm;
- a moderately high spire, a slightly coloeconoidal shape, with up to 7 whorls;
- 3 primary granular cords on spire whorls; P2 the strongest with sharp spaced nodules, P1 almost obsolete on last whorls, P3 with more crowed, smaller nodules than P2;

- 4 or 5 thin granular spiral cords on the base; interspace between cords about 1.5 times as broad as cords;
- a deep, broad umbilicus with a spiral cord inside;
- a silvery white colour.

Calliotropis talismani (Locard, 1897)
Figs 44–47

Solariella talismani Locard, 1897: 25–26, pl. 1, figs 5-8.

Type material. 2 syntypes MNHN.

Type locality. Off western Morocco, 1350 m.

Material examined. Atlantic Morocco. TALISMAN 1883: stn DR33, 33°31'N, 09°48'W, 1350 m, 1 dd (syntype MNHN). – CANCAP–II: stn 2.039, 28°02'N, 13°26'W, 1010 m, 1 dd. – **Western Sahara.** CANCAP–III: stn 3.107, 24°17'N, 16°49'W, 1000–1100 m, 1 dd. – **Canary Is.** CANCAP–II: stn 2.079, 28°01'N, 14°26'W, 870 m, 1 dd.

Distribution. Atlantic Morocco, 840–1350 m (Locard, 1898), western Sahara, 1000–1100 m, and Canary Is., 870 m.

Remarks. The main characteristics of this species are :
- height up to 8 mm, width up to 9 mm;
- a rather high spire, a more or less conical shape, with up to 5.5 whorls;
- 2 primary granular cords on spire whorls; nodules of P1 the strongest, spaced, nodules of P2 more crowed, smaller than nodules of P1; granular spiral cord P3 on last whorl, with small granules; distance between P1 and P2 1.5 to 2 times greater than distance between P2 and P3; axial sculpture obsolete;
- 4 thin granular spiral cords on the base; interspace between cords about 2 times as broad as cords;
- a deep, rather broad umbilicus without clearly visible spiral cord within;
- a silvery white colour.

Calliotropis valida (Dautzenberg & H. Fischer, 1896)
Figs 50–53

Solariella valida Dautzenberg & H. Fischer, 1896: 8–9, pl.III, figs 22–27.
Solariella valida – Dautzenberg & H.Fischer, 1906: 57–58, pl.III, figs22–27.
Solariella valida – Nordsieck, 1982: 16, fig 306.
Solariella valida – Rolán, 2005: 47, figs 107–108.

Type material. 63 syntypes MOM (INV-19940, INV-19941, INV-21029, INV-1725).

Type locality. Cape Verde Islands, 1311 m.

Material examined. Cape Verde Islands. PRINCESSE–ALICE II: stn 1193, 15°17'N, 23°01'45"W, 1311 m, 63 lv (syntypes MOM).

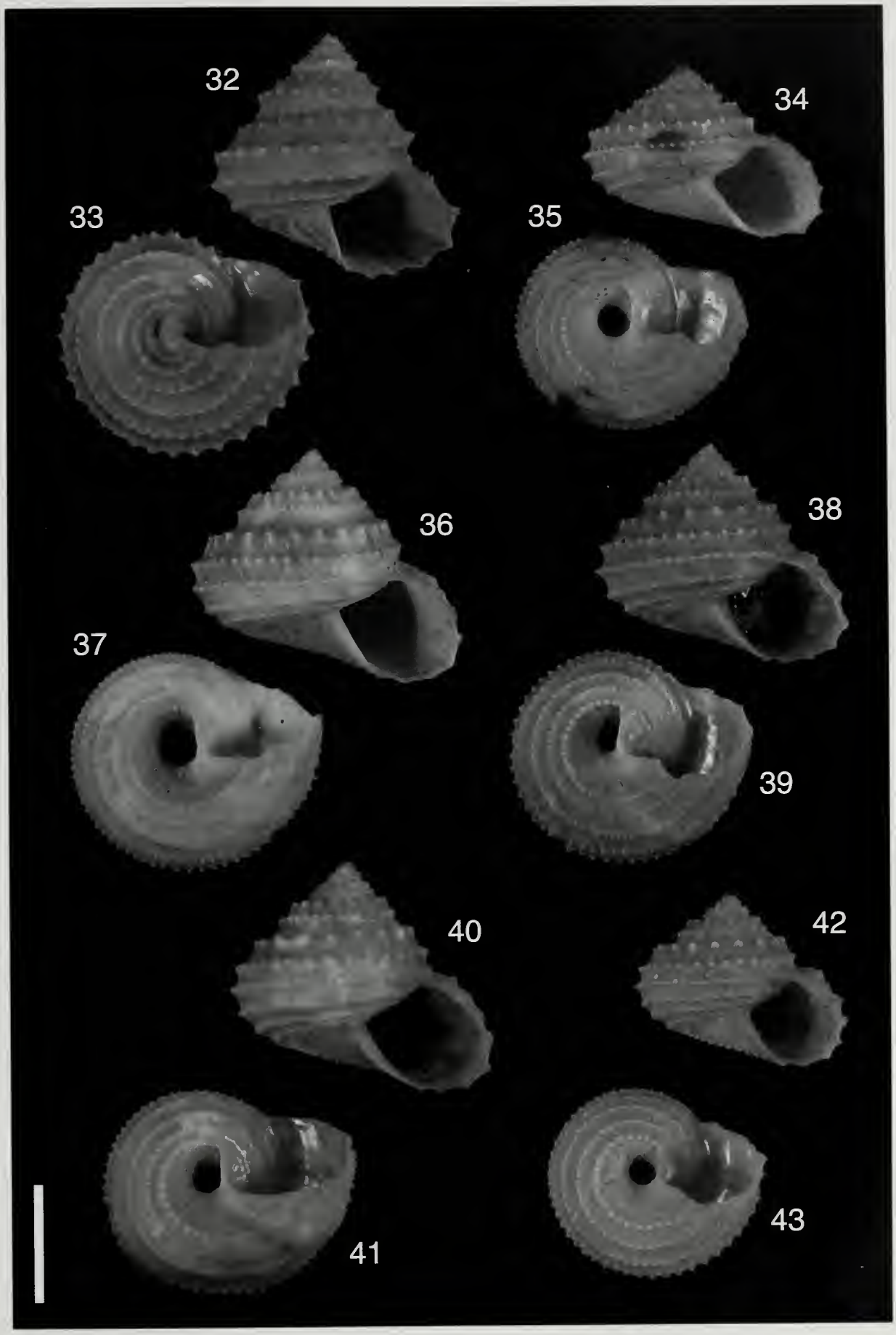
Distribution. Off Morocco (Nordsieck, 1982) and Cape Verde Islands, 1311 m.

Remarks. The main characteristics of this species are :
- height up to 15 mm, width up to 16 mm;
- a moderately high spire, a slightly cyrtoconoidal shape, with up to 6.5 whorls;
- 3 primary granular cords on spire whorls, similar in size; nodules of P1 and P2 strong, bluntly sharp, widely spaced; nodules of P3 a bit smaller, not sharp; S1 may be present at fifth whorl; axial sculpture obsolete as early as second whorl;
- 4 (sometimes 5) granular spiral cords on the base; interspace between cords about 1.5 to 2 times as broad as cords;
- a deep, rather broad umbilicus without spiral cord within;
- a silvery beige colour.

The numbers of station used here are the general ones, that is an incremental numbering across all the expeditions of the Monaco's Prince. The scientists of these campaigns used, before publication, a new numbering for each campaign (these numbers are used on labels of specimens), but they transformed for their paper the campaign numbers in general numbers, valid whatever the campaign they belonged to (Bruni, personal communication).

Figures 32-43. Scale bar: 5 mm.

32-33. *Calliotropis ottoi* (Philippi, 1844), Iceland, coll. F. Swinnen, 13.9 x 14.4 mm.
34-35. *C. effossima*(Locard, 1897), syntype MNHN, Cape Verde Islands, 550–760 m [TALISMAN 1883, stn DR113], 7.6 x 10.7 m.
36-39. *Calliotropis vaillanti* (P.Fischer, 1882), MNHN, Azores.
36-37. 1590–1665 m [Mission Biaçores, stn 179], 10.6 x 12.2 mm. **38-39.** 1200–1240 m [Mission Biaçores, stn 64], 9.8 x 11.0 mm.
40-43. *C. ambigua* (Dautzenberg & Fischer, 1896).
40-41. Syntype MOM (INV-19937), Azores, 1385 m [Princesse Alice, stn 46 (=553?)], 9.7 x 11.4 mm.
42-43. NNML, Cape Verde, 950–1040 m [CANCAP VI, stn 6–065], 6.7 x 8.4 mm.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Calliotropis effossima (Locard, 1897)
Figs 34–35

Solariella effossima Locard, 1897: 27–29, pl.1, figs 9–12.
Solariella effossima – Nordsieck, 1982: 16, fig. 309.
Solariella effossima – Rolán, 2005: 47, figs 109–110.

Type material. Holotype MNHN.

Type locality. Cape Verde Islands, 493–618 m.

Material examined. Cape Verde Islands. TALISMAN 1883: stn DR113A, 16°52'N, 25°11'W, 618 m, 1 dd (holotype).

Distribution. Off Morocco, 1900 m (Locard, 1898) and Cape Verde Islands, 618 m.

Remarks. The main characteristics of this species are :
- height up to 7.5 mm, width up to 10.5 mm;
- a moderately depressed spire, a slightly cyrtoconoidal shape, with up to 5.5 whorls;
- 2 primary granular cords on spire whorls; P1 the strongest with big, sharp, spaced nodules; P2 weaker than P1; P3 the weakest with more crowed, smaller nodules than P2;
- 4 thin granular spiral cords on the base, the innermost stronger; interspace between cords about 2 to 2.5 times as broad as cords;
- a deep, broad umbilicus with two or three thin spiral cords within;
- a light brownish colour.

Calliotropis vaillanti (P. Fischer, 1882)
Figs 36–39

Trochus vaillanti P. Fischer, 1882: 50.
Solariella vaillanti – Dautzenberg & H. Fischer, 1894: 477, pl. XX, fig. 12.
Solariella vaillanti – Locard, 1897: 27, pl. II, fig. 5–8.
Solariella vaillanti – Dautzenberg, 1927: 188, pl. V, figs 33–34;
Calliotropis vaillanti – Quinn, 1979: 9, figs 9–10.
Lischkeia (Calliotropis) ottoi vaillanti – Nordsieck, 1968: 19.
Solariella vaillanti – Nordsieck, 1982: 16, fig. 308.
Solariella vaillanti – Rolán, 2005: 47, figs 104–105, 111–112.

Type material. 5 syntypes MNHN.

Type locality. West of Portugal, 1224 m.

Material examined. Azores. Mission Biaçores: stn 64, 38°43'N, 28°29'W, 1200–1240 m, 1 d. – Stn 179, 38°05.5'N, 25°46'W, 1590–1665 m, 1 lv. – **Madeira.** SEPLAT Madeira: COV7, 769 m, coll. F. Swinnen, 2 dd sub, 3 dd juv.

Distribution. Off Portugal and western Spain, 1224–1674 m (Dautzenberg & Fischer, 1896), Azores 1240–1590 m (Locard, 1898), Cape Verde, 495–618 m (Locard, 1898); Madeira, 769 m.

Remarks. The main characteristics of this species are :
- height up to 10.5 mm, width up to 12 mm;
- a moderately high spire, a cyrtoconoidal shape, with up to 6 whorls;
- 2 primary granular cords on spire whorls; P1 the strongest with strong, sharp, spaced nodules; P2 weaker than P1; P3 the weakest with more crowed, smaller nodules than P2;
- 4 thin granular spiral cords on the base; interspace between cords about 1.5 to 2 times as broad as cords;
- a broad umbilicus, with gently sloping walls; sometimes a thin spiral cord within;
- a light brownish colour.

Calliotropis ambigua
(Dautzenberg & H. Fischer, 1896)
Figs 40–43

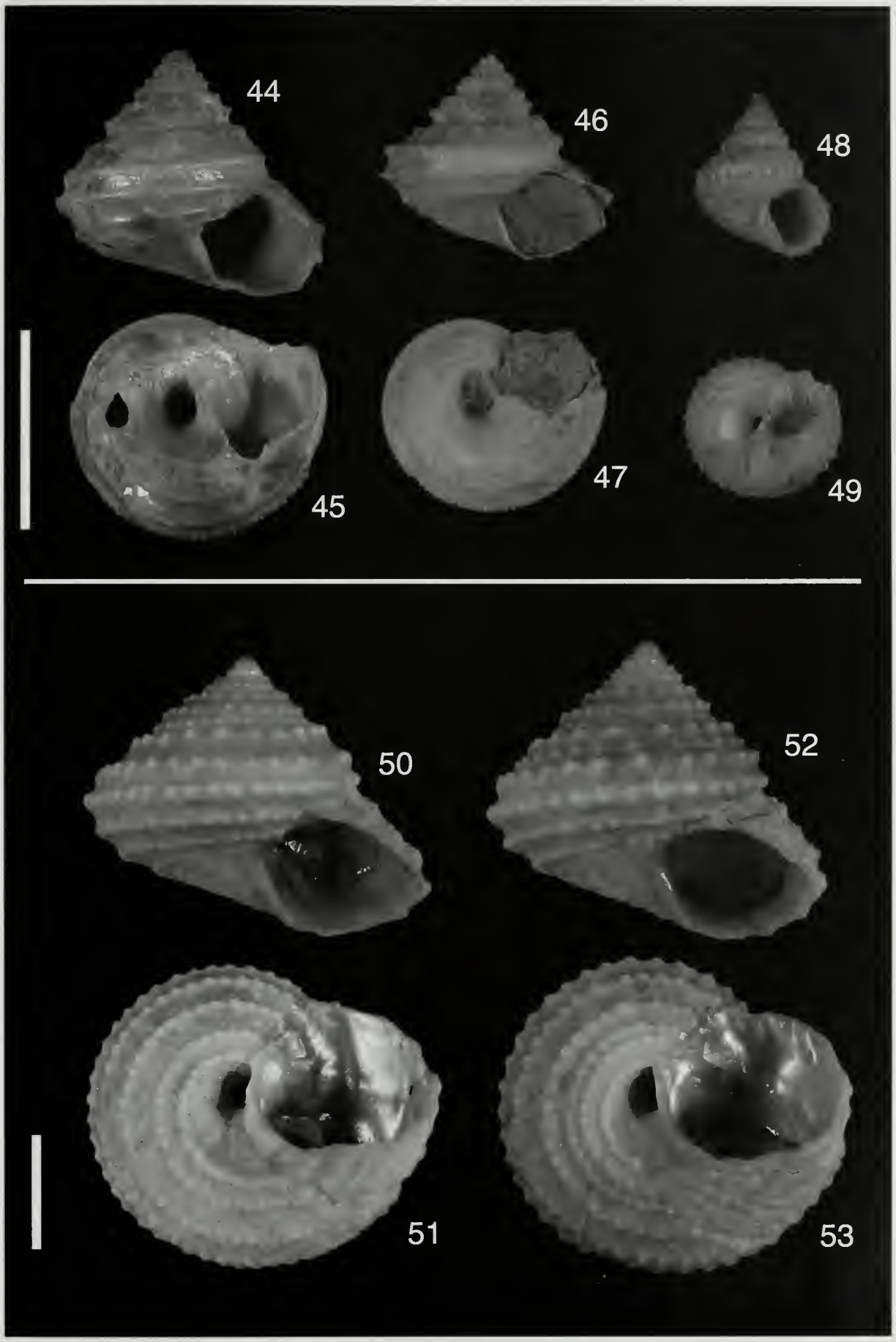
Solariella ambigua Dautzenberg & H. Fischer, 1896: 476–477, pl. XX, fig. 11.
Solariella ambigua – Dautzenberg & H. Fischer, 1897: 171.

Type material. 4 syntypes MOM (INV-19937, INV-21030).

Type locality. Azores, 1385 m.

Figures 44–53. Scale bars: 5 mm.

44–47. *Calliotropis talismani* (Locard, 1897).
44–45. Syntype MNHN, Atlantic Morocco, 1350 m [TALISMAN 1883, stn DR33], 7.9 x 8.9 mm;
46–47. NNML, Canary Islands, south Fuerteventua, Punta de Jundia, 870 m [CANCAP–II, stn 2.079], 5.2 x 5.6 mm.
48–49. *C. rudecta* (Locard, 1897), holotype MNHN, Atlantic Morocco, 1900 m [TRAVAILLEUR 1882, stn DR40], 4.3 x 3.5 mm.
50–53. *C. valida* (Dautzenberg & H.Fischer, 1896), syntypes MOM (INV-21029), Cape Verde Islands, 1311 m [PRINCESSE–ALICE II, stn 1193]. **50–51.**, 13.6 x 17.2 mm; **52–53.** 13.7 x 15.3 mm.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Material examined. Azores. PRINCESSE ALICE I: stn 553, 37°42'40"N, 25°05'15"W, 1385 m, 3 lv (syntypes MOM). – MNCN, 1250 m, 2 dd. – **Canary Islands.** CANCAP II: stn 2.082, 28°00'N, 14°26'W, 1130 m, 3 dd juv. – **Madeira.** CANCAP I: stn 1.031, 32°40'N, 16°43'W, 1085 m, 10 dd juv. – Stn 1.044, 32°42'N, 16°42'W, 815 m, 1 dd, 1 dd sub & 2 dd juv. – Stn 1.062, 32°40'N, 16°46'W, 680 m, 1 dd & 4 dd juv. – CANCAP III: stn 3.028, 33°01'N, 16°20'W, 740 m, 9 dd juv. – Stn 3.051, 32°40'N, 16°40'W, 1100 m, 3 dd juv. – **Cape Verde Islands.** CANCAP VI: stn 6.065, 15°58'N, 22°33'W, 950–1040 m, 2 lv.

Distribution. Azores, 454–1557 m (Dautzenberg & Fischer, 1896), Canary Islands, 1130 m, Madeira, 680–1100 m, Cape Verde, 950–1040 m.

Remarks. The main characteristics of this species are :
- height up to 9.5 mm, width up to 11.5 mm;
- a moderately high spire, a cyrtoconoidal shape, with up to 6 whorls;
- 2 primary granular cords on spire whorls; P1 the strongest with strong, rounded blunt, spaced nodules; P2 weaker than P1; P3 the weakest with more crowed, smaller nodules than P2;
- 4 thin granular spiral cords on the base; interspace between cords about 1.5 to 2 times as broad as cords;
- a broad umbilicus, with gently sloping walls; sometimes a 3 spiral cords within;
- a light brownish colour.

This species is clearly close to *C. vaillanti* (P. Fischer, 1882). Dautzenberg and Fischer (1896) seem to consider that the two species are the same in comments of their description of *C. valida* (1906). So did also Dautzenberg (1927) in his records of *C. vaillanti*. But, considering the available material, *C. ambigua* seems to be different in having larger, blunt (not clearly sharp), less numerous nodules on P1 (about 8 instead of about 10) and 3 spiral cords inside the umbilicus (instead of only one at the most).

Calliotropis globosa Quinn, 1991
Figs 25–28

Calliotropis globosa Quinn, 1991: 168–170, figs 7–8.

Type material. Holotype and 2 paratypes USNM (859419 & 859420); 2 paratypes Academy of Natural Sciences of Philadelphia – ANSP (383289), 2 paratypes Florida Marine Research Institute – FSBC I (39515), 2 paratypes Florida Museum of Natural History – UF (169956), 2 paratypes Museum of Comparative Zoology Harvard University – MCZ (302452), 2 paratypes American Museum of Natural History – AMNH (232160), 2 paratypes University of Miami – UMML (308358).

Type locality. Jamaica, *John Elliott Pillsbury* stn P–1262, 17°21.4'N, 77°34.8'W, 805–1089 m.

Material examined. Madeira. Said to be found at south–east of Porto Santo, 32°26'N, 15°11'W, 790–840 m, B. Van Heugten coll., 2 dd.

Distribution. Jamaica, Cuba and American coast, from Yucatan to Venezuela and Suriname, 700–1100 m (Quinn, 1991); Madeira, 790-840 m.

Remarks. The main characteristics of this species (following the original description) are :
- height up to 9.7 mm, width up to 8.7 mm;
- a high spire, a slightly cyrtoconoidal shape, with up to 6 whorls;
- 3 granular cords on spire whorls;
- 4 granular spiral cords on the base;
- a sigmoid columella with a median tooth;
- a broad umbilicus without spiral cord within;
- a white nacreous colour.

The fact that this western Atlantic species, of which we got only one single record of 2 dead specimens, belongs to eastern Atlantic malacofauna needs certainly confirmation.
On the other hand, the presence of such a median columellar tooth (that can be seen on the illustration of the holotype in the original description) is amazing for a *Calliotropis* species. Further studies could maybe lead to move this species into Seguenziidae Verrill, 1884.

ACKNOWLEDGEMENTS

We would like to thank P. Bouchet (Muséum national d'Histoire naturelle, Paris) for reading the manuscript, giving advice and access to the malacological resources of the MNHN. We also warmly thank V. Héros (MNHN) for her dynamic help in our search of types and various scientific papers.
Also especially, the first author would like to thank M.Bruni (MOM) for her careful work regarding types of Dautzenberg and H.Fischer.
We are very grateful to J.Goud (NNML), K.Way and A.McLellan (NMH), E.Rolán (MHNSC), E.Schwabe (ZSM) and O.Soriano (MNCN) for the loan of types and specimens belonging to their institutions, to F.Deniz, J.Hernandez–Otero and B.Van Heugten for the loan of specimens of their collections, and to P.Hurst and R.Miguez (BMNH) for the kind sending of photographs of *Calliotropis infundibulum* types.
And we thank A.Gittenberger (NNML) for providing documents about CANCAP–project and E.Rolán (MHNSC) for bibliographic help.

REFERENCES

Ardovini, R. & Cossignani, T. 2004. *West African Seashells*. L'informatore Piceno, Ancona. 319 pp.
Bouchet, P. & Rocroi, J.P. 2005. Classification and nomenclator of gastropod families. *Malacologia* 47(1–2): 1–397.

Abbott, R.T. 1974. *American seashells (2d edition)*. Van Nostrand Reinhold company, Inc. New York. 663 pp.

Abbott, R.T. 1991. *Seashells of the Northern Hemisphere*. Gallery Books, W.H.Smith Publishers, Inc. New York. 191 pp.

Cernohorsky, W.O. 1977. The taxonomy of some Southern Ocean mollusca mainly antarctic and subantarctic. *Records of the Auckland Institute and Museum* 14: 105-119.

Dall, W.H. 1889. Reports on the results of dredging under the supervision of Alexander Agassiz in the Gulf of Mexico and in the Caribbean Sea (1879-80), by the U.S. coast survey streamer "Blake"... *Bulletin of the Museum of Comparative Zoology at Harvard College*. XXIX Report on the Mollusca. Part II.- Gastropoda and Scaphopoda. XVIII:1-492, 40 pls.

Dall, W.H. 1890. Scientific results of explorations by the U.S. fish commission steamer Albatross. N° VII - Preliminary report on the collection of mollusca and brachiopod obtained in 1887-88. *Proceedings of the National Museum* XII(773): 219-362, pl. 5-14.

Dautzenberg, P. 1889. *Contribution à la Faune Malacologique des Iles Açores. Résultats des campagnes scientifiques accomplies sur son yacht par Albert Ier prince souverain de Monaco* 1: 1–112.

Dautzenberg, P. 1925. Mollusques nouveaux provenant des croisières du prince Albert 1er Monaco. *Bulletin de l'Institut océanographique* 457: 1–12.

Dautzenberg, P. 1927. *Résultats des campagnes scientifiques accomplies sur son yacht par Albert Ier, prince souverain de Monaco. LXXII. Mollusques provenant des campagnes scientifiques du prince Albert Ier de Monaco dans l'Océan Atlantique et le Golfe de Gascogne*. Imprimerie de Monaco, 400 pp.

Dautzenberg, P. & Fischer, H. 1896. Résultats des campagnes scientifiques de S.A. le Prince de Monaco. Dragages effectués par l' "HIRONDELLE" et par la "PRINCESSE–ALICE", 1888–1895. *Mémoires de la Société zoologique de France pour l'année 1896* 9: 395–498.

Dautzenberg, P. & Fischer, H. 1897. Dragages effectués par l'Hirondelle et par la Princesse Alice 1888–1895. *Mémoires de la Société zoologique de France pour l'année 1897* 10: 139–234.
Dautzenberg, P. et Fischer, H. 1906. Mollusques provenant des dragages effectués à l'Ouest de l'Afrique pendant les campagnes scientifiques du Prince de Monaco. 1: 1–112 (15 octobre 1889). *Résultats des campagnes scientifiques accomplies sur son yacht par Albert 1er, Prince souverain de Monaco* 32: 1–126.

Hickman, C.S. & McLean, J.H. 1990. Systematic revision and suprageneric classification of trochacean gastropods. *Natural History Museum of Los Angeles County Science Series* VI+169 pp.

Jeffreys J. G., 1878–1885. On the mollusca procured during the H. M. S. "Lightning" and "Porcupine" expedition. *Proceedings of the Zoological Society of London* – Part 6 (1883): 88–115 pl. 19–20.

Kaicher, S.D. 1987. Card catalogue of world–wide shells. Trochidae Part 4. Pack #50. Cards 5048–5153.

Land (van der), J. 1987. Report on the CANCAP–project fro marine biological research in the Canarian – Cape Verde region of the North Atalntic Ocean (1976–1986). Part I. List of stations. *Zoologische verhandelingen* 243: 1–94.

Locard, A. 1897. *Expéditions scientifiques du Travailleur et du Talisman pendant les années 1880, 1881, 1882, 1883. Mollusques testacés*. Tome 1: 1–516. Ed. Masson, Paris.

Locard, A. 1898. *Expéditions scientifiques du Travailleur et du Talisman pendant les années 1880, 1881, 1882, 1883. Mollusques testacés*. Tome 2: 1–515. Ed. Masson, Paris.

Marshall, B.A. 1999. A revision of the recent Solariellinae of the New Zealand region. *The Nautilus* 113(2): 4–42.

Martens, E. von, & Thiele, J. 1904 "1903". *Dis beschalten Gastropoden der Deutschen Tiefsee–Expedition, 1898–1899*. A. Systematisch–geographisher Teil. Wissenschaftliche Ergebnisse der deutschen Tiefsee–Expedition auf dem Dampfer "Valdivia" 1898–1899, 7(A): 1–146.

Nicklès, M. 1950. *Mollusques testacés marins de la côte occidentale d'Afrique*. Ed. P. Lechevalier. 269 pp.

Nordsieck, F. 1968. *Die europäischen Meeres–Gehäuseschnecken (Prosobranchia)*. Gustav Fischer Verlag, Stuttgart. 273 pp.

Nordsieck, F. 1982. *Die europäischen Meeres–Gehäuseschnecken (Prosobranchia)*. Gustav Fischer Verlag, Stuttgart. 539 pp.

Quinn, J.F. Jr. 1979. Biological results of the University of Miami deep–sea expeditions. The systematics and zoogeography of the gasteropod family Trochidae collected in the Straits of Florida. *Malacologia* 19(1): 1–62.

Quinn, J.F. Jr. 1991. New species of *Gaza*, *Calliotropis* and *Echinogurges* from the North–West Atlantic Ocean. *The Nautilus* 105: 166–172.

Rolán, E., Hernandez, J.M. & Deniz, F. 2005. Description of two new species of the genus *Solariella* (Gastropoda, Trochidae) from Canary and Mauritania. *Visaya* 1(5) : 4–11.

Rolán, E. 2005. *Malacological fauna from the Cape Verde archipelago*. Conchbooks, Hackenheim. 455 pp.

Rubio, F. & Rolán, E. 1997. A new species of *Lirularia* de la islas de Sao Tomé y Principe, Africa Occidental. *Iberus* 15(1): 23–29.

Thiele, J. 1925. Gastropoda der Deutschen Tiefsee–Expedition II Teil. *Wissenschaftliche Ergebnisse*

der deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898–1899, 17(2): 35–282.

Vilvens, C. 2004. Description of four new species of *Calliotropis* (Gastropoda: Trochidae: Eucyclinae: Calliotropini) from New Caledonia, Fiji and Vanuatu. *Novapex* 5(1):19–31.

Vilvens, C. 2007. New species and new records of *Calliotropis* (Gastropoda: Chilodontidae: Calliotropinae) from Indo-Pacific. *Novapex* 8(HS 5): 1–72.

Warén, A. 1976. New and little known mollusca from Iceland and Scandinavia. *Sarsia* 76: 53–124.

Warén, A. 1993. New and little known mollusca from Iceland and Scandinavia. Part 2. *Sarsia* 78: 159–201.

Warén, A. & Bouchet, P. 1991. Systematic position and revision of *Haloceras* Dall, 1889 (Caenogastropoda, Haloceratidae fam. nov.). *In*: Résultats des Campagnes MUSORSTOM, volume 7. *Mémoires du Muséum national d'Histoire naturelle* (A)150: 111–161.

Warén, A. & Bouchet, P. 1993. New records, species, genera and new family of gastropods from hydrothermal vents and hydrocarbon seeps. *Zoologica scripta* 22(1): 1–90.

Watson, R.B. 1886. Report on the Scaphopoda and Gasteropoda collected by HMS Challenger during the years 1873–1876. Report on the scientific results of the voyage of HMS Challenger, 1873–1876. *Zoology* 15: 1–680.

CLEMAM (taxonomic database of the European Marine Mollusca), Department of Systematics & Evolution of the Muséum national d'Histoire naturelle, Paris, France: http://www.somali.asso.fr/clemam (last visit : 9/12/2007).

NOVAPEX 9 (1): 33-40, 10 avril 2008

Evaluation et cartographie des stocks de coquillages comestibles dans la lagune de Bizerte (Nord de la Tunisie)

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MOTS CLES. lagune de Bizerte, coquillages comestibles, biomasses, abondances, distribution.

KEYWORDS. Bizerte lagoon, edible shellfishes, biomasses, abundance, distribution.

RESUME. Le présent travail s'intéresse à inventorier et à cartographier les espèces de coquillages comestibles et à estimer leurs biomasses respectives dans la lagune de Bizerte. Les opérations de prospections et de prélèvements des échantillons se sont déroulées pendant les mois d'août et de septembre 2002. Durant cette période, 181 stations ont été échantillonnées à l'aide d'une benne Van Veen, et par une quadra pour les stations côtières. On opère toujours 3 prélèvements par stations sur une surface totale de 0,3 m^2. L'inventaire de la faune malacologique nous a permis de recenser 11 espèces comestibles, 2 gastéropodes et 9 bivalves. Dans le présent travail, on s'est intéressé à l'étude de 3 espèces seulement qui sont les plus abondantes. Les calculs de biomasse ont montré que l'espèce *Flexopecten glaber* (Linné, 1758) est la plus abondante (10,32 10^6 individus), suivi par *Cerastoderma glaucum* (Poiret, 1789) (3,39 10^6 individus) et *Ruditapes decussatus* (Linné, 1758) (9,96 10^5 individus). La distribution de leurs abondances respectives a montré que l'espèce *Flexopecten glaber* est répartie sur presque toute la lagune.

ABSTRACT. In order to evaluate the edibles shellfish biomasses, the malacological associations and their distribution in Bizerte lagoon (North Tunisia) were studied. Prospections and sampling were carried out during August and September 2002. In this study, 181 stations were prospected and samples were taken in triplicates from a total surface area of 0.3 m^2 using a Van Veen grab and a quadra for the coastal stations.
The inventory of the malacological fauna in Bizerte lagoon showed a total of 11 edible species (2 gastropods and 9 bivalves). Among these species, *Flexopecten glaber* (Linné, 1758) is the most abundant (10,32 10^6 individus), then *Cerastoderma glaucum* (Poiret, 1789) (3,39 10^6 individus) and *Ruditapes decussatus* (Linné, 1758) (9,96 10^5 individus). Their abundance distribution demonstrated that *Flexopecten glaber* was present in all lagoon sampled stations.

INTRODUCTION

Les coquillages comestibles présentent un grand intérêt économique dans plusieurs pays du monde. Leur contribution au secteur de la pêche et de l'aquaculture ne cesse d'augmenter. En Tunisie, les coquillages exploités et exportés sont limités exclusivement à la palourde, *Ruditapes decussatus* (Linné, 1758). Plusieurs autres espèces de bivalves et de gastéropodes comestibles qui se prêtent bien à l'exportation sont présentes sur nos côtes (Azzouz, 1966 ; Zaouali, 1974, 1978, 1979 ; Belkhodja, 2003) mais ne font l'objet d'aucune exploitation. La lagune de Bizerte, située au nord de la Tunisie, est connue par des activités de pêche et de conchyliculture anciennes (El Bour, 1998) et importantes. C'est ainsi que plusieurs études faunistiques et malacologiques relatives à ce plan d'eau ont été effectuées (Zaouali, 1974, 1979, 1984 ; Belkhodja, 2003). Cependant, l'évaluation de la biomasse de ces coquillages potentiellement exploitables n'a jamais été réalisée.

L'objectif de ce travail est d'identifier et d'estimer les stocks de ces coquillages et de cartographier leurs abondances dans la lagune. Outre *Ruditapes decussatus* (Linné, 1758), deux autres espèces ont été étudiées : *Cerastoderma glaucum* (Poiret, 1789) et *Flexopecten glaber* (Linné, 1758). Ce choix d'espèces a été guidé par leur valeur commerciale à l'échelle de l'exportation.

Matériel et Méthode

Site d'étude

La lagune de Bizerte est située au nord-est de la Tunisie, à proximité de la ville de Bizerte (Fig.1). Elle s'inscrit au niveau de la latitude entre 37° 08' N et 37°16' N, et de la longitude entre 9°48'E et 9°56'E. Sa superficie est d'environ 130 km^2 (N-S, 11 km, E-O, 13 km). Sa profondeur maximale est de 12 mètres, au niveau du chenal artificiel qui relie l'arsenal de la ville de Menzel Bourguiba au canal de Bizerte. Ce chenal

est maintenu par des dragages car la majeure partie de la lagune a une profondeur qui varie entre 5 et 10 mètres (Mansouri, 1996). Dans sa partie ouest, la lagune de Bizerte est reliée au lac Ichkeul par l'oued Tinja. La lagune de Bizerte constitue un bassin récepteur du réseau hydrographique environnant dont le plus important est le lac Ichkeul, qui reçoit lui-même les déversements de quatre oueds (Zaouali, 1979).

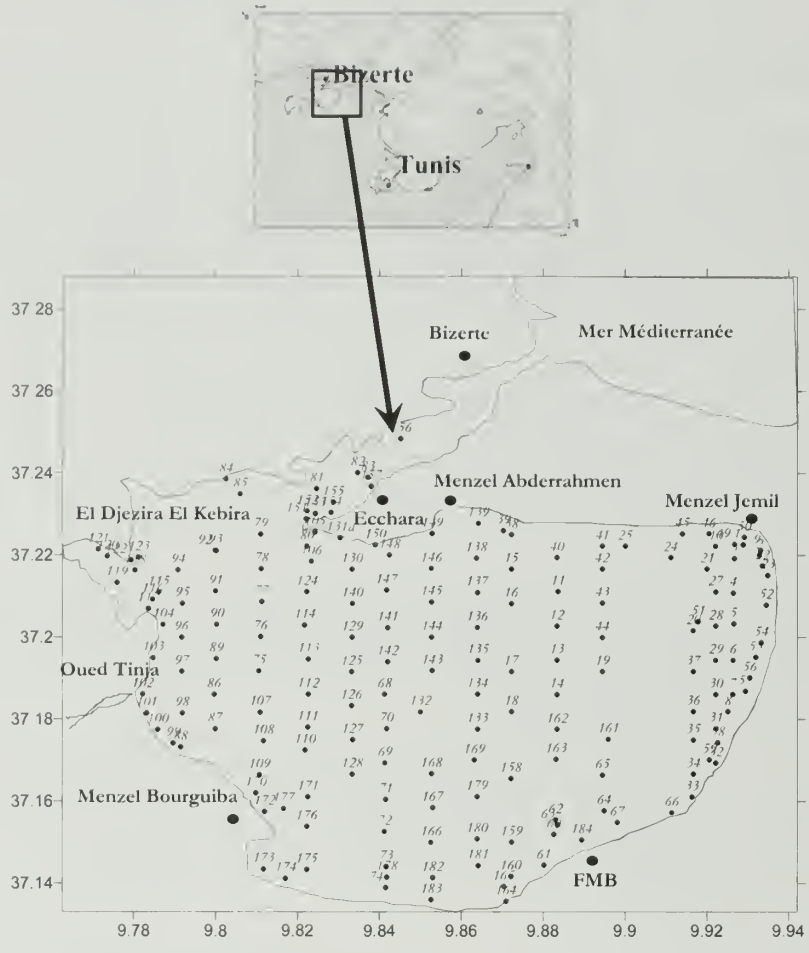

Figure 1 : Site d'étude et localisation des stations d'échantillonnage

Echantillonnage

Une campagne d'échantillonnage a été réalisée pendant les mois d'août et de septembre 2002. Les stations, au nombre de 181, sont positionnées à l'aide d'un GPS Garmin II plus. Elles sont fixées selon un échantillonnage systématique en quinconce. On a procédé à un quadrillage de la carte de la lagune de Bizerte en mailles carrées de 800 mètres de côté, sur lesquelles on a choisi les stations. Au cours de la campagne, ces stations ont été validées ou rectifiées suivant la réalité du terrain (Fig. 1). Les prélèvements ont été réalisés à l'aide d'une benne Van Veen de 0,1 m^2 et d'une pénétration dans le sédiment de 30 cm environ. Son efficacité dans différents sédiments a été testée (Christie, 1975). Dans chaque station, 3 réplicats au hasard sont échantillonnés avec une surface totale d'échantillonnage de 0,3m^2, ceci étant un nombre d'unité d'échantillonnage suffisant pour récolter une proportion importante d'espèces du fond (Mistri et al., 2001), soit au total un nombre de 540 prélèvements. Pour les stations côtières où les profondeurs sont très faibles, l'utilisation de la benne n'était plus possible. On a alors utilisé, un quadra de 30 x 35 cm et on a toujours procédé à 3 prélèvements jusqu'à une profondeur de pénétration de 30 cm. Le contenu de la benne a été tamisé dans l'eau de la lagune, à bord de la barque au moyen d'un tamis de mailles carrées de 2 mm de côté. Le refus, composé d'organismes de taille supérieure à 2 mm, est fixé au formol à 10 %. Chaque refus a passé par un tamisage hydraulique sur une colonne de trois tamis, permettant de fractionner l'échantillon suivant un critère dimensionnel pour faciliter le tri. Le refus de chaque tamis a été trié dans un bac. Les organismes ayant gardé l'aspect vivant sont conservés dans des piluliers

contenant de l'alcool à 70°. Pour chaque individu des espèces commercialisables, on a déterminé la longueur totale, qui correspond à la dimension maximale selon l'axe antéro-postérieur de la coquille pour le cas des bivalves, et à la dimension entre l'extrémité de l'apex et celle du canal siphonal dans le cas des gastéropodes, ensuite les spécimens sont pesés. Les mensurations et la pesée ont été effectuées respectivement à l'aide d'un pied à coulisse digital à 0,01 mm près et une balance de précision au 0,001g près. Plusieurs espèces à intérêt commercial ont été recensées [*Donax trunculus* Linné, 1758, *Hexaplex trunculus* (Linné, 1758), *Bolinus brandaris* (Linné, 1758), *Acanthocardia paucicostata* (Sowerby, 1841)]. Les espèces retenues dans cette étude sont les trois bivalves : *Flexopecten glaber*, *Cerastoderma glaucum* et *Ruditapes decussatus* (Figure 2), vu leur intérêt commercial et leur abondance.

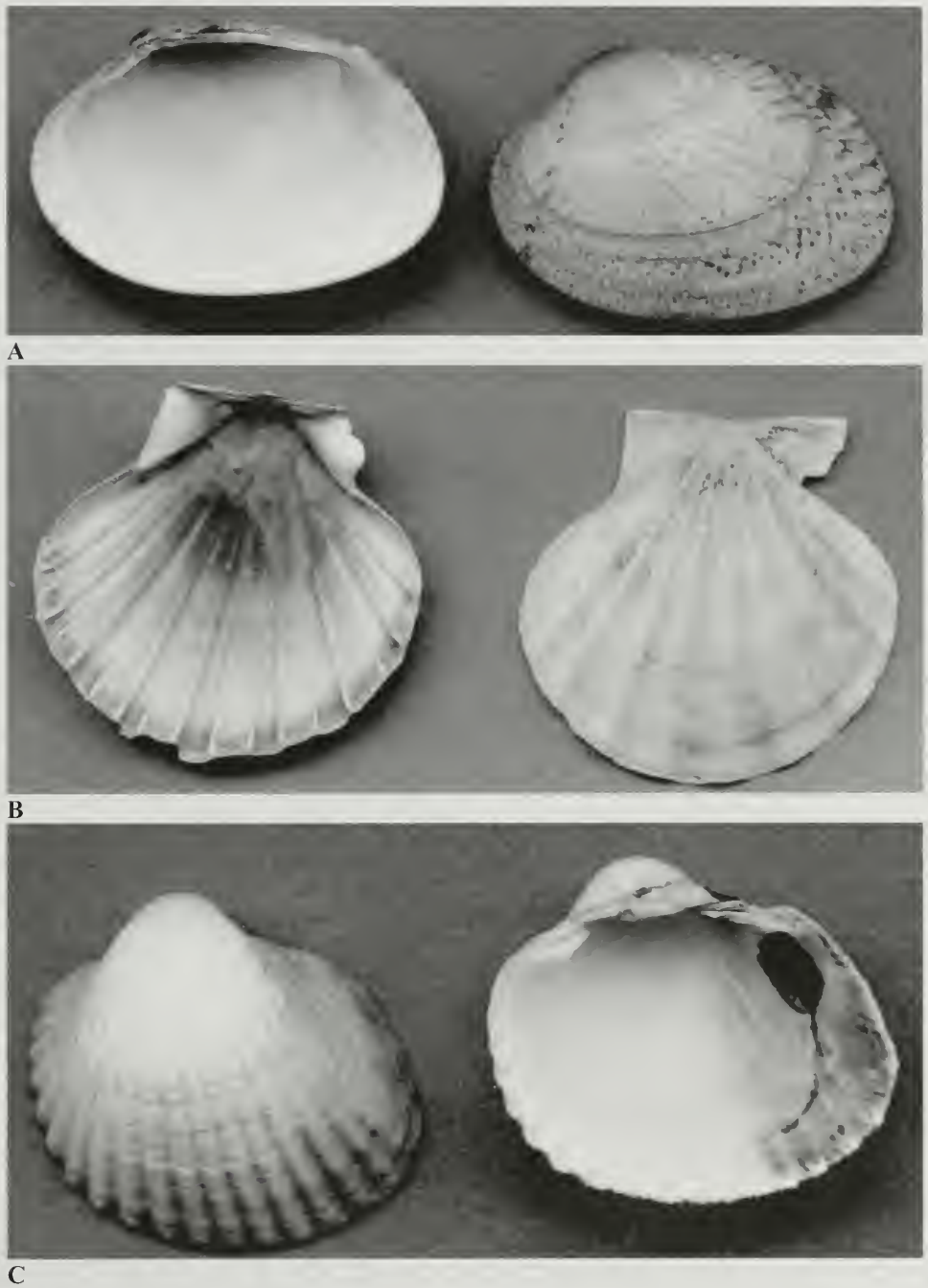

Figure 2: Photos des 3 espèces de bivalves étudiés. **A.** *Ruditapes decussatus* ((Linné, 1758), 38 mm; **B.** *Flexopecten glaber* (Linné, 1758), 43 mm; **C.** *Cerastoderma glaucum* (Poiret, 1789) 30 mm.

Analyse des données

Pour l'évaluation directe de l'abondance et de la biomasse des différentes espèces étudiées, on a eu recours à la méthodologie de Fifas, utilisée dans l'évaluation des stocks des bivalves présents dans le golfe normand-breton (Pitel et al., 2004) et dans l'évaluation du stock de palourdes du bassin d'Arcachon (Bertignac et al., 2001). Les estimations sont exprimées en termes d'abondance et de biomasse. L'abondance par station est désignée par T_i selon la relation suivante:

$$T_i = \frac{S}{s}\frac{1}{k_i}\sum_{j=1}^{ki} Cij \sum_{l=l\min}^{l\max} Xijl \qquad (1)$$

S: la surface de la station échantillonnée donnée par: $S = \pi \frac{D^2}{4}$

D: le diamètre du cercle d'activité de la barque autour des coordonnées du point moyen demandé (point théorique) ; ici, D= 4,55 m;
s: surface de l'unité d'échantillonnage;
k_i: nombre de replicats par station i (3 replicats par station);
C_{ij}: le rapport effectif capturé/effectif mesuré par station i et replicat j (ce rapport est toujours égal à 1 dans notre cas);
X_{ijl}: l'effectif mesuré par classe de taille l, station i et replicat j;
l_{max}: taille maximale et **l_{min} :** taille minimale.

Les résultats de l'abondance des trois espèces étudiées, *Flexopecten glaber*, *Cerastoderma glaucum* et *Ruditapes decussatus*, sont cartographiés au moyen du logiciel « Surfer.7 ».

L'abondance totale dans la lagune pour chacune des espèces étudiées, toutes classes de tailles confondues désigné par T, est donnée par:

$$T = \frac{S}{n.s}\sum_{i=1}^{n}\frac{1}{k_i}\sum_{j=1}^{ki} Cij \sum_{l=l\min}^{l\max} Xijl \qquad (2)$$

S: surface totale de la lagune de Bizerte (130 km^2);
s: surface de l'unité d'échantillonnage; la benne (0,125 m^2);
n: nombre de stations sur toute la lagune (181 stations).

La biomasse totale dans toute la lagune toutes classes de tailles confondues, désignée par B, est exprimée selon l'équation suivante:

$$B = \frac{aS}{ns}\sum_{i=1}^{n}\frac{1}{k_i}\sum_{j=1}^{ki} Cij \sum_{l=l\min}^{l\max} X_{ijl}\ l^b \qquad (3)$$

S: surface totale de la lagune de Bizerte (130 km^2);
s: surface de l'unité d'échantillonnage ; la benne (0,125 m^2);
n: nombre de stations sur toute la lagune (181 stations);
a et b: coefficient de la relation taille-poids.

Pour l'évaluation des biomasses respectives des trois espèces, on a utilisé les paramètres a et b de la croissance relative qui existent dans la littérature selon l'équation **$Wt=a.Lt^b$**. A notre meilleure connaissance, il n'existe pas de travaux portant sur la croissance de *Cerastoderma glaucum* dans la lagune de Bizerte, on a dès lors établi la relation taille-poids à partir des échantillons récoltés.

Résultats

L'extrapolation par l'équation (3) nous a permis d'évaluer les biomasses de coquillages jugés commercialisables. Les paramètres de la croissance relative nécessaires à cet effet ont été calculés pour *Cerastoderma glaucum* seulement (Tableau 1). Le tableau 2 montre que l'espèce *Flexopecten glaber* est la plus abondante et la plus importante du point de vue de la biomasse suivie par *Cerastoderma glaucum* et *Ruditapes decussatus*.

Espèce	N	Equation	Lt (mm)	R	Travail
C. glaucum	647	$Wt=0,0002\ Lt^{3,0478}$	9,545	0,8412	Présent
R. decussatus	360	$Wt=1,317.10^{-4}\ Lt^{3,0784}$	32,19	0,9604	El Mnif (1995)
F. glaber	2085	$Wt=0,0001\ Lt^{3,068}$	7,54	0,96	Ben Nakhla (2002)

Tableau.1 : Equations liant la taille au poids
N : effectif ; R : coefficient de corrélation; Lt : taille moyenne dans l'échantillon.

Espèce	*Cerastoderma glaucum*	*Ruditapes decussatus*	*Flexopecten glaber*
Biomasse (en tonnes)	192,450	1,918	6597,323
Abondance (en nombre d'individus)	$3,39.10^6$	$9,96.10^5$	$10,32.10^6$

Tableau 2: Résultats de l'estimation des biomasses et des abondances totales

Les résultats de l'extrapolation de l'abondance par station ont permis de les cartographier et de déterminer leurs distributions dans la lagune. La cartographie des abondances indique que la palourde se rencontre dans le cordon littoral de la lagune avec en particulier deux régions à fortes concentrations (Fig. 3). Ces régions sont situées à l'ouest au voisinage de l'oued de Tinja et à l'est de la lagune où l'abondance dépasse 500 individus/m^2.

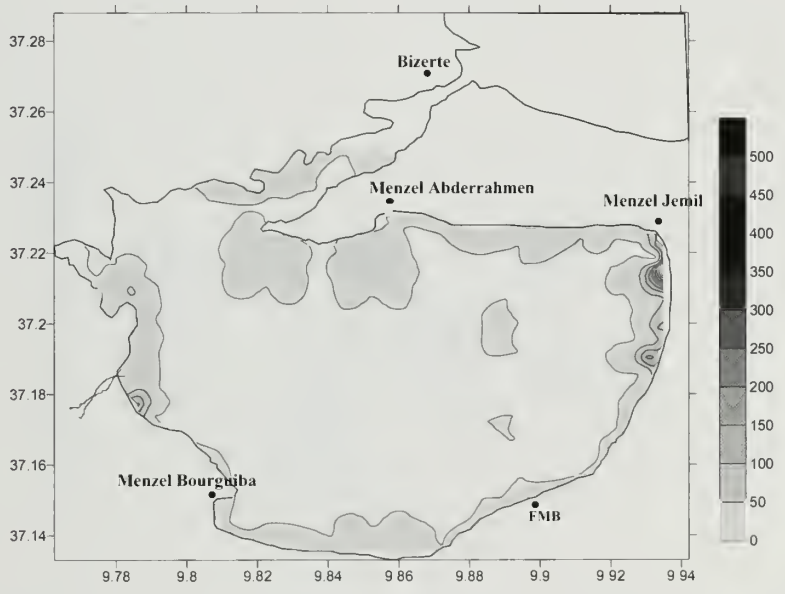

Figure 3: Distribution de l'abondance de *Ruditapes decussatus* (individus/m^2)

Les coques glauques, *Cerastoderma glaucum*, sont distribuées dans toute la zone de la lagune à l'exception de la zone centrale (Fig. 4.).

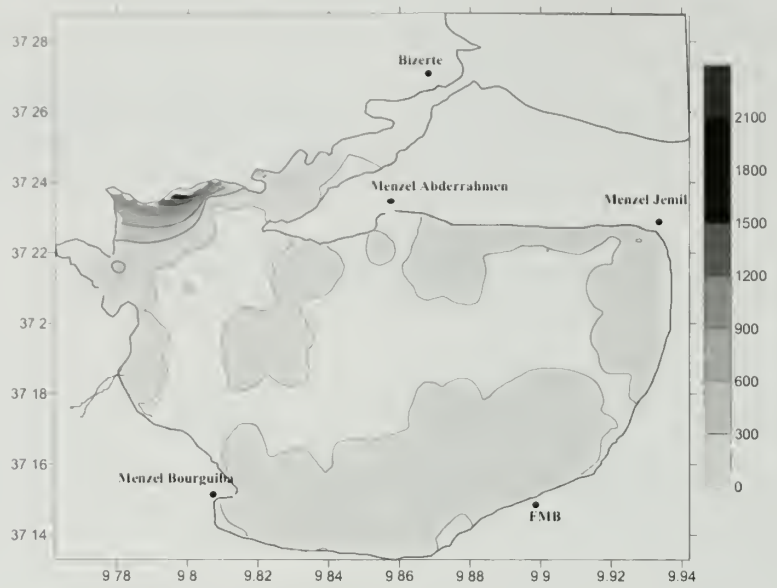

Figure 4 : Distribution de l'abondance de *Cerastoderma glaucum* (individus /m²).

La plus forte abondance est observée au nord ouest où elle dépasse 2100 individus/m^2. 73% de ceux-ci ont des tailles ne dépassant pas 10 mm.
Flexopecten glaber est distribuée sur presque toute l'étendue d'eau. Elle est la plus présente dans la lagune. On la rencontre au nord, au sud, à l'est, à l'ouest et au centre de la lagune ainsi qu'au niveau du canal qui relie la lagune de Bizerte à la mer. Elle est plus abondante au nord-est et au nord-ouest au niveau du canal de la navigation où les abondances dépassent 600 individus /m² (Fig.5).

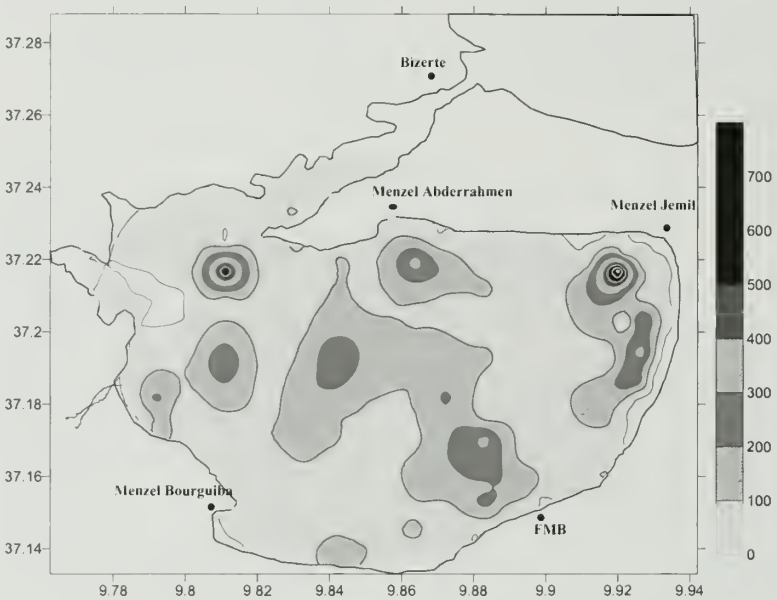

Figure 5 : Distribution de l'abondance de *Cerastoderma glaucum* (individus /m²).

Flexopecten glaber est très abondante dans la lagune de Bizerte mais la fréquence maximale par station est faible par rapport à celle de *Cerastoderma glaucum* (Tableau 3). En effet, la cartographie des abondances a montré que pour chaque espèce, il existe des zones préférentielles caractérisées par de fortes abondances.

Espèce	*F.glaber*	*R. decussatus*	*C. glaucum*
Ab/st(min-max)ind/m²	3,333 – 760	3,33 - 560	3,33 – 2443,33
Lt (min-max) mm	4,2 – 59,6	2,9 – 39,4	2 – 48,9
Nombre d'individus	4289	414	1410

Tableau 3 : Valeurs extrêmes estimées des abondances par station et des tailles des espèces étudiées

Discussion

Selon Medhioub (1993), la palourde est répartie sur tout le littoral du golfe de Gabès, dans la lagune de Tunis et dans la lagune de Bizerte avec une faible abondance. Cette localité est définie par cet auteur comme une zone pauvre en palourdes. En effet, la comparaison des résultats de l'abondance et de la biomasse avec ceux trouvées par Zamouri et al. (2005) a montré que *Ruditapes decussatus* est une espèce plus importante dans le lac nord de Tunis que dans la lagune de Bizerte (Tableau 2). La répartition des différentes espèces est liée à la nature du fond et l'hydrodynamisme de la lagune. La distribution de l'abondance de *Ruditapes decussatus* dans la lagune de Bizerte a montré que cette palourde est présente sur toute la frange littorale et dans le goulet, ce qui concorde avec les résultats de Belkhodja (2003). Cette répartition est à mettre en relation avec le type du substrat : la palourde est présente dans les zones à fort hydrodynamisme et dont la nature du sédiment est très hétérogène (Bouxin, 1936 ; Latrouite et al., 1976). Dans la lagune de Bizerte, cette espèce est présente sur les fonds vaso-sableux où la fraction sableuse est importante (Soussi et al., 1983 ; Hamdi et al., 2002 ; Belkhodja, 2003). *Cerastoderma glaucum* est une espèce paralique recensé par Frisoni et al (1986) au débouché d'oued Tinja et au nord-est et en faible abondance dans sa bande littorale est (Belkhodja, 2003). On a également rencontré cette espèce à l'est, à l'embouchure de l'oued Tinja, et dans quelques stations du nord de la lagune. Elle est aussi rencontrée au sud, et au niveau du canal de Bizerte. Les plus fortes abondances sont recensées au niveau d'El Jezira El Kabira qui correspond à une station côtière très abritée (accès à pied). Cette forte abondance dépassant 2400 ind/m² est dominée par des spécimens de petites tailles. En effet, la distribution de *Cerastoderma glaucum* suit un gradient de confinement croissant où l'augmentation de la densité engendre une diminution de la taille (Guerloget et al., 1983). Les cartes de distribution des abondances, nous permettent de constater que *Cerastoderma glaucum* cohabite avec *Ruditapes decussatus* et préfère les substrats sableux, sablo-vaseux et vaso-sableux. L'espèce la plus présente et la plus abondante dans le site d'étude est *Flexopecten glaber*. Elle est répartie sur toute la lagune ce qui confirme ainsi le travail de Ben Nakhla (2002). Les fortes abondances sont limitées au nord-est et à l'ouest au niveau du canal de navigation. La carte de distribution de cette espèce a montré qu'elle se trouve présente dans les faciès argilo-silteux et qu'elle se concentre sur les fonds argileux de la région centrale de la lagune et du canal de navigation (Soussi et al., 1983 ; Hamdi et al., 2002 ; Belkhodja, 2003). Belkhodja (2003) a aussi recensé cette espèce dans la zone centrale et à l'ouest de la lagune sur des fonds sablo-argileux et argileux riches en matières organiques. Elle est également retrouvée au nord-est de la lagune.

Conclusion

Ce travail nous a permis de déterminer les biomasses totales ainsi que les zones de distribution de trois espèces de bivalves qui possèdent un intérêt commercial, notamment au niveau de l'exportation. *Flexopecten glaber* possède la biomasse la plus importante, elle est suivie par *Cerastoderma glaucum* puis *Ruditapes decussatus*. Par ailleurs, elle se concentre principalement au nord-est et dans le canal de navigation, *C. glaucum* est plus abondante au nord-ouest alors que *R. decussatus* se trouve principalement à l'est et à l'embouchure de l'Oued Tinja.

Pour mieux préserver les stocks de ces coquillages, il faudrait suivre leur exploitation et déterminer les biomasses exploitables respectives. L'étude d'engins appropriés pour la pêche de *Flexopecten glaber* et *Cerastoderma glaucum* doit être programmée. En effet, si *Ruditapes decussatus* est pêché à pied au moyen d'une faucille dans la lagune de Bizerte, les deux dernières espèces ne sont le sujet d'aucune exploitation.

REMERCIEMENTS

Les auteurs tiennent à remercier l'équipage de l'INSTM pour leur aide inestimable apportée lors de l'échantillonnage.

REFERENCES

Azzouz, A. 1966. Etude des peuplements et des possibilités d'ostréiculture du lac de Bizerte. *Annales de l'Institut d'Océanographie et de Pêches Salammbô.* 15: 1-69.

Belkhodja, H. 2003. Contribution à l'étude de la faune malacologique de la lagune de Bizerte: Evolution et interaction avec le substrat. *D.E.A, Université 7 Novembre de Carthage, Institut National Agronomique de Tunis*, 100 pp.

Ben Nakhla, L. 2002. Contribution à l'étude biologique et à la valorisation du pétoncle *Flexopecten glaber* (Linnaeus, 1758) dans la lagune de Bizerte. *DEA Université 7 novembre de Carthage, Institut National Agronomique de Tunis*, 73 pp.

Bertignac, M., Auby, I., Sauriau, P.G., De Montaudois, X., Foucard, J & Martin, S. 2001. Evaluation des stocks de palourde du bassin d'Arcachon. *Rapport Institut Français de Recherche pour l'Exploitation de la MER.*, 35 pp.

Bouxin, H. 1936. Technique d'élevage de deux palourdes comestibles (*T. decnssatus* et *T. pullustra* Wood). *Revue des Travaux de l'Office des Pêches maritimes,* IX (1) 33: 101-112.

Christie, N.D. 1975. Relationship between sediment texture, species richness and volume of sediment sampled by a grab. *Marine Biology,* 30: 89-96.

El Bour, M. 1998. Historique. In: *Synthèse bibliographique sur le lac de Bizerte.* Projet Aquaculture 2001 INSTM/ IFREMER. Atelier lagune. 111 pp.

El Menif- Trigui, N 1995. La palourde *Ruditapes Decussatus* (Linné, 1758) des côtes Tunisiennes Biométrie, reproduction et impact de l'environnement sur la bioaccumulation en métaux traces. *Thése de troisième cycle*, faculté des sciences de Tunis, 261 pp.

Frisoni, G.F., Guerloget, O., Pertuisot, J.P. & Fresi, E .1986. Diagnose écologique et zonation biologique du lac de Bizerte. Applications aquacoles. *Rapport du projet MEDRAP : Regional Mediterranean Development of Aquaculture.* FAO: 41 pp.

Guerloget, O., Mayere, C. & Amanieu, M. 1983.La production malacologique d'une lagune méditerranéenne : L'étang de Prévost (Hérault, France). *Rapport de la Commission Internationale de la Mer Méditerranée:* 107-111.

Hamdi, H., Jedidi, N., Yoshida, M., Mosbahi, M. & Ghrabi, A. 2002. Quelques propriétés physico-chimiques des sédiments du lac Bizerte (Some physico-chemical properties of lake Bizerte sediments). In: *Study on the Environmental of Mediterranean Coastal Lagoons in Tunisia.* Initial Report: 49-54.

Latrouite, D. & Perdou, G. 1979. Bilan des essais d'élevage de la palourde sur le littoral Morbihannais. *Institut Scientifique des Travaux et de Pêches Maritimes*, 43 pp.

Mansouri, T. 1996. Application de la Télédétection et des systèmes d'informations géographiques à l'étude du fonctionnement hydrologique du lac de Bizerte et de son bassin versant. *D.E.A, Géologie appliquée à l'environnement, Université Tunis II Faculté des Sciences de Tunis*, 101 pp.

Medhioub, M.N. 1993. *La conchyliculture en Tunisie, Projet Tunis 192/002.* République Tunisienne, Ministère de l'Agriculture, Direction Générale de la Pêche et d'Aquaculture. PNUD/F.A.O.: 1-83.

Mistri, M., Rossi, R. & Fano, A. 2001. Structure and secondary production of a soft bottom macrobenthic community in a brackish lagoon (Sacca di Goro, north-eastern Italy). *Estnarine Coastal Shelfisheries Sciences*, 52: 605-616.

Pitel, M., Savina, M., Spyros, F. & Berthou, P. 2004. Evaluations locales des populations de bivalves dans le golfe normand-breton. *Rapport Institut Français de Recherches de la Mer, Direction des Ressources Vivantes RH.DT* 03-06: 44.

Soussi N., Levy, A. & Zaouali. J .1983. La lagune de Bizerte: Sédimentologie et écologie des foraminifères et mollusques testacés. *Notes Service Géologique de Tnnisie.* N°47: 27-40.

Zamouri-Langar, N., Charef A., Khazri, S., Haouas-Gharsallah, I. & Ben Maiz, N. 2005. Résultats préliminaires sur l'abondance et la biomasse des coquillages comestibles dans la lagune nord de Tunis. *6éme Congrès Maghrébin des Sciences de la Mer.* 41 pp.

Zaouali, J. 1974. Les peuplements malacologiques dans les biocénoses lagunaires tunisiennes. Etude de la biologie de l'espèce pionnière *Cerastoderma glaucum* Poiret. *Thèse de Doctorat de Sciences Naturelles.* Caen 345 pp.

Zaouali, J. 1978. Les peuplements malacologiques de la mer de Bou Grara. *Bulletin officiel Nationl de Pêche Tunisie.* 2 (2): 199-209.

Zaouali, J. 1979. Etude écologique du lac de Bizerte. *Bull. Bulletin officiel Nationl de Pêche Tunisie* 3 (2): 107-142.

Zaouali, J. 1984. La pêche dans les lagunes tunisiennes: le lac de Bizerte et la mer de BouGrara. In: *Etudes et Revues, CGPM-FAO*, 61(1): 297-346.

The genus *Afer* Conrad, 1858 (Gastropoda: Buccinidae), with descriptions of a new subgenus and a new species from western Africa

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KEY WORDS. *Afer*, *Streptosiphon*, Senegal, Mauretania, new subgenus, new species.

ABSTRACT. A remarkable species of *Afer* from Mauretania is described as new. The generic placement is based on protoconch morphology, which is identical to the other known *Afer* species. Conchological characteristics of the teleoconch whorl are peculiar and serve as the basis for the new subgenus *Praecantafer* subgen. nov. to accommodate the new species: *Afer* (*Praecantafer*) *echinatus* sp. nov. Species formerly assigned to *Streptosiphon* Gill, 1867 are confirmed as distinct from typical *Afer* Conrad, 1858 and the status of *Streptosiphon* is restored at the subgeneric level.

INTRODUCTION

The description of this new species is based on two specimens that were collected some 30 years apart. Both specimens originate from the by-product of fisheries surveys carried out on the rich bottoms of the coastal Sahara upwelling, extending from southern Morocco to Mauritania. The holotype was collected in 1982 onboard R/V *N'Diago* by Dr Bertrand Richer de Forges while he was working for the Centre National de Recherche Océanographique et des Pêches (CNROP) in Nouadhibou, Mauretania. The origin of the paratype is less precise. It was collected during a fishery survey carried in the 1950s onboard R/V *Président Théodore Tissier* by what was then the French Institut Scientifique et Technique des Pêches Maritimes (ISTPM); regrettably, the samples were incompletely labelled and the station data are lost, but we know that the survey sampled southern Morocco and/or Mauretania. Although the region is the target of intensive commercial fisheries, it has remained almost unexplored by academic research vessels, and the new *Afer* may be less rare than indicated by the finding of just two specimens in 30 years.

Abbreviations.

BM(NH): British Museum (The Natural History Museum), London, England
KBIN: Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels, Belgium
KF: Collection Koen Fraussen, Aarschot, Belgium.
KMMA: Klaipeda Maritime Museum and Aquarium, Klaipeda, Lithuania
MNHN: Muséum national d'Histoire naturelle, Paris.France
NMBE: Naturhistorisches Museum Bern, Bern, Switzerland
ZMA: Zoologisch Museum, University of Amsterdam, Amsterdam, Netherlands
ZMB: Museum für Naturkunde (Zoologisches Museum), Humboldt Universität, Berlin, Germany

SYSTEMATICS

BUCCINIDAE Rafinesque, 1815

Genus ***Afer*** Conrad, 1858
Afer Conrad 1858. Type species: "*Fusus afer* (Lamarck)" by original designation = *Murex afer* Gmelin, 1791 (type locality: "Habitat ad Senegal").

The genus *Afer* went through a confusing taxonomic history. It was placed in several families: "Fusidae" by Tryon (1881: 69, for *Afer afer*), Buccinidae by Tryon (1881: 99, for *Streptosiphon porphyrostoma*), "Vasidae" (now Turbinellidae) by Thiele (1931: 343) and Wenz (1941: 1306), Fasciolariidae by Abbott (1959: 15), Buccinidae by MacNeil (1960: 75, with *Siphonofusus* Kuroda & Habe, 1954 a synonym of *Afer*), Turbinellidae by Abbott & Dance (1986: 210) and Vaught (1989: 52, as a subgenus of *Tudivasum* Rosenberg & Petit, 1987). Not untill 2000 (Fraussen & Hadorn, 2000: 28-42), when the radulae of the known Atlantic species were prepared and the placement in Buccinidae confirmed.
The genus was used in a broad sence by Fraussen & Hadorn (2000: 28-42) and Monsecour & Monsecour (2005: 23-32), without subgeneric splitting. In the present study *Streptosiphon* is recognized as distinct from typical *Afer* and retracted from its synonymy. *Streptosiphon* is restored at the subgeneric level. In addition, *Praecantafer* subgen. nov. is described to accommodate the peculiar *Afer* (*Praecantafer*) *echinatus* sp. nov.
Still no opportunity has appear to study the radula of *Afer cumingi* (Reeve, 1844), a species from Japan and Taiwan. *A. cumingi* is conchologically similar to the

West African species, but the lower columellar tooth is folded in a particular way similar to the genus *Tudicla* Röding, 1798. Further study is needed to confirm the generic placement of this species.
In the present paper only the Recent species are discussed.
Wenz (1941) considered the following two fossil taxa as subgenera of *Afer*. Further study is required to either confirm their subgeneric status or to recognize them as distinct genera:
Hercorhyncus Conrad, 1868 (type species: *Fusus tippanus* Conrad, 1860) from the Cretaceous of the USA, placed in Vasidae, as subgenus of *Afer*, by Wenz, 1941; placed in Fusininae, by Sohl 1964a (220) & 1964b (376); placed in Fasciolariidae (Cretaceous Group) by Snyder (2003: 237).
Streptopelma Cossmann, 1901 (type species: *Peristernia linteus* Tate, 1888) from the Eocene of Australia, placed in Vasidae, as subgenus of *Afer*, by Wenz, 1941; placed in Fasciolariidae (Peristernia Group) by Snyder (2003: 311).

Diagnosis. Shell thick, solid. Shape broadly fusiform or slender, siphonal canal rather long, open. Protoconch typical, papilliform, higher than broad, whorls smooth and glossy. Teleoconch whorls usually with angular shoulder. Sculpture consisting of, usually dominant, spiral cords in combination with axial ribs. Aperture oval, columella curved, callus narrow and thin or broad and thick. Outer lip thick, usually with numerous internal knobs, occasionally smooth.
Radula typical buccinid. Central tooth with broad base (rather triangular or semi-oval), tricuspid. Lateral teeth with 3 pointed cusps, outermost cusp largest.

Comparison. The genus *Afer* is characterized by the multispiral, papilliform protoconch, higher than broad, smooth, glossy, with nicely rounded tip.
Serratifusus Darragh, 1969 (type species: *Fusus craspedotus* Tate, 1888, OD, from the Miocene of southeast Australia) differs in having a smaller protoconch with a deviated axis for the first whorl, an even longer siphonal canal which may be bended or torsed and a radula with more rectangular central cusp. The genus *Serratifusus* has, together with *Afer* (and especially its subgenus *Praecantafer* subgen. nov. described below), a quite columbariid shape: a rather short spire and a long siphonal canal.
Euthria M. E. Gray, 1850 (type species: "*Fusus lignarius* Chiaje", this is *Fusus lignarius* Lamarck, 1816, a junior synonym of *Murex corneus* Linnaeus, 1758, from Mediterranean Sea) has a similar radula and may have a similar shape and pattern but differs in having a smaller protoconch, usually a shorter siphonal canal and an outer lip which has a smooth inside or with lesser pronounced internal lirae.
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.

Range. West Africa, from Ivory Coast in the south (*A.* (*A.*) *afer*) to Morocco (Agadir) in the north (*A.* (*Streptosiphon*) *lansbergisi*). Maybe also West-Pacific [should "*Afer*" *cumingi* (Reeve, 1844) be shown to be referable to this genus].

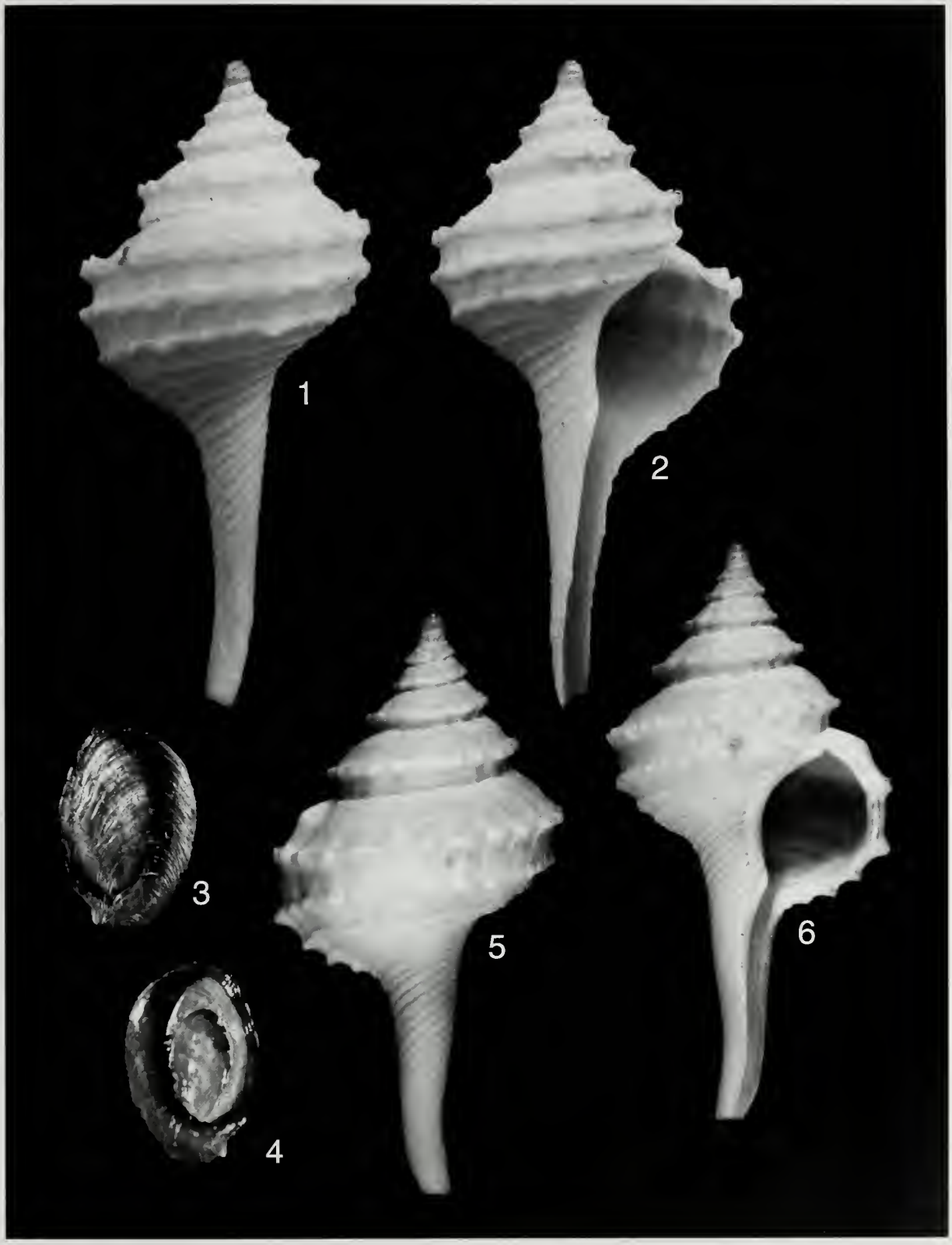
Subgenus ***Afer*** Conrad, 1858
Figs. 7-8

Diagnosis. Shell thick, solid. Shape from moderately slender with short spire to elongate with elegant spire, siphonal canal long, open. Protoconch typical for genus. Whorls with slightly angular shoulder, sculpture consisting of sharp spiral cords with broad interspaces and of narrow, rather sharp axial ribs. Aperture oval, columella gently curved, callus narrow and rather thin, outer lip thick with numerous internal knobs, edge sharp.
Radula typical buccinid. Central tooth rather triangular, base concave, top slightly elevated, tricuspid, cusps of equal size, central cusps eventually slightly larger. Lateral teeth with 3 pointed cusps, outermost cusp largest.

Comparison. The subgenus *Afer* is characterized by the sharp spiral sculpture and the narrow columellar lip. The radula of *A.* (*A.*) *afer* is similar to the radula of *Euthria cornea* (Linnaeus, 1758), as figured by Cooke (1917, fig. 1), with a rather triangular central tooth with concave base. For differences with *Streptosiphon* and *Praecantafer* subgen. nov. See comparisons under those subgenera.

Figures 1-6

1-6. *Afer* (*Praecantafer*) *echinatus* sp. nov.,
1-2. Mauretania, continental shelf, N. O. "N'diago" stn. 85, 20°07'N, 17°38'W, 200 m, holotype MNHN 9964, 26.7 mm; **3-4.** operculum of holotype; **5-6.** Dredged between Morocco and Senegal, R. V. "Président-Theodore-Tissier" cruise, paratype MNHN 9965, 29.5 mm.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Range. West Africa, mainly from Senegal. *A.* (*A.*) *afer* is known from as south as Ivory Coast. *A.* (*A.*) *pseudofusinus* is known from as north as northern Mauritania and from fisherman off the Canary Islands. The next two species are included in the subgenus.

Afer* (*Afer*) *afer (Gmelin, 1791)
Figs. 7-8

Murex afer Gmelin, 1791: 3558, sp. 129 (type locality: Senegal "Habitat ad Senegal").
The specimen figured by Adanson (1757, pl.8, fig.18 "Lipin") is considered the type. This specimen is probably lost.

Afer* (*Afer*) *pseudofusinus Fraussen & Hadorn, 2000

Afer pseudofusinus Fraussen & Hadorn, 2000: 32-34, figs. 1-3, 5-6 (type locality: continental shelf off Mauritania, Meteor stn. 60.78, 17°17' N, 16°28' W, 95 m deep).
Holotype MNHN 6315.

Subgenus ***Streptosiphon*** Gill, 1867
Figs. 9-10

Streptosiphon Gill, 1867: 152, as genus, type species by original designation: *Tudicla porphyrostoma* (Reeve, 1847).

Diagnosis. Shell thick, solid. Shape moderately slender with short, conical spire, siphonal canal long, open. Protoconch typical for genus. Whorls with slightly angular shoulder, smooth, sculpture consisting of fine spiral lines as interspaces and of broad, rather blunt axial ribs. Aperture oval, columella gently curved, callus broad and rather thick, forming a wide inner lip, outer lip thick with numerous internal knobs, edge sharp.
Radula typical buccinid. Central tooth broad, weakly curved, tricuspid, cusps of equal size. Lateral teeth with 3 pointed cusps, outermost cusp largest.

Comparison. *Streptosiphon* is characterized by its rather smooth shell and the broad columellar lip. The radula of *A.* (*S.*) *porphyrostoma* is similar to the radula of *Buccinulum vittatum* (Quoy & Gaimard, 1833) as figured by Cooke (1917, figs. 4-5) (his fig. 4 being forma *littorinoides*), with a broad, rather oval central tooth.
The subgenus *Afer* can be distinguished by its sharper spiral sculpture, its narrow inner lip (callus) and in having a radula with a more triangular central tooth with a more concave base and sharper edges. For differences with *Praecantafer* subgen. nov. see comparisons under that subgenus.

Range. West Africa. *A.* (*S.*) *porphyrostoma* is known from Senegal. *A.* (*S.*) *lansbergisi* is known from Mauritania in the south, along Western Sahara, to Morocco (Agadir) in the north. The next two species are included in the subgenus.

Afer* (*Streptosiphon*) *porphyrostoma
(Reeve, 1847)
Figs. 9-10

Fasciolaria porphyrostoma Reeve, 1847: pl.5, sp.11 (type locality: "Eastern Seas" is erroneous).
Sometimes, and also by Reeve himself, referred to "Adams & Reeve, Voy.Sam.", meaning the publication of "The Zoology of the Voyage of H.M.S. Samarang" in 1848-1850. The author of this species however is Reeve, 1847.
Probable holotype in BM(NH), nr. 1875.12.10.163 (Delsaerdt, 1993: 91).

Junior synonym: *Tudicla recurva* A. Adams, 1854: 135-136, sp. 26, pl.28, fig.4 (type locality: "Senegal").
5 syntypes in BM(NH) nr. 1992158.

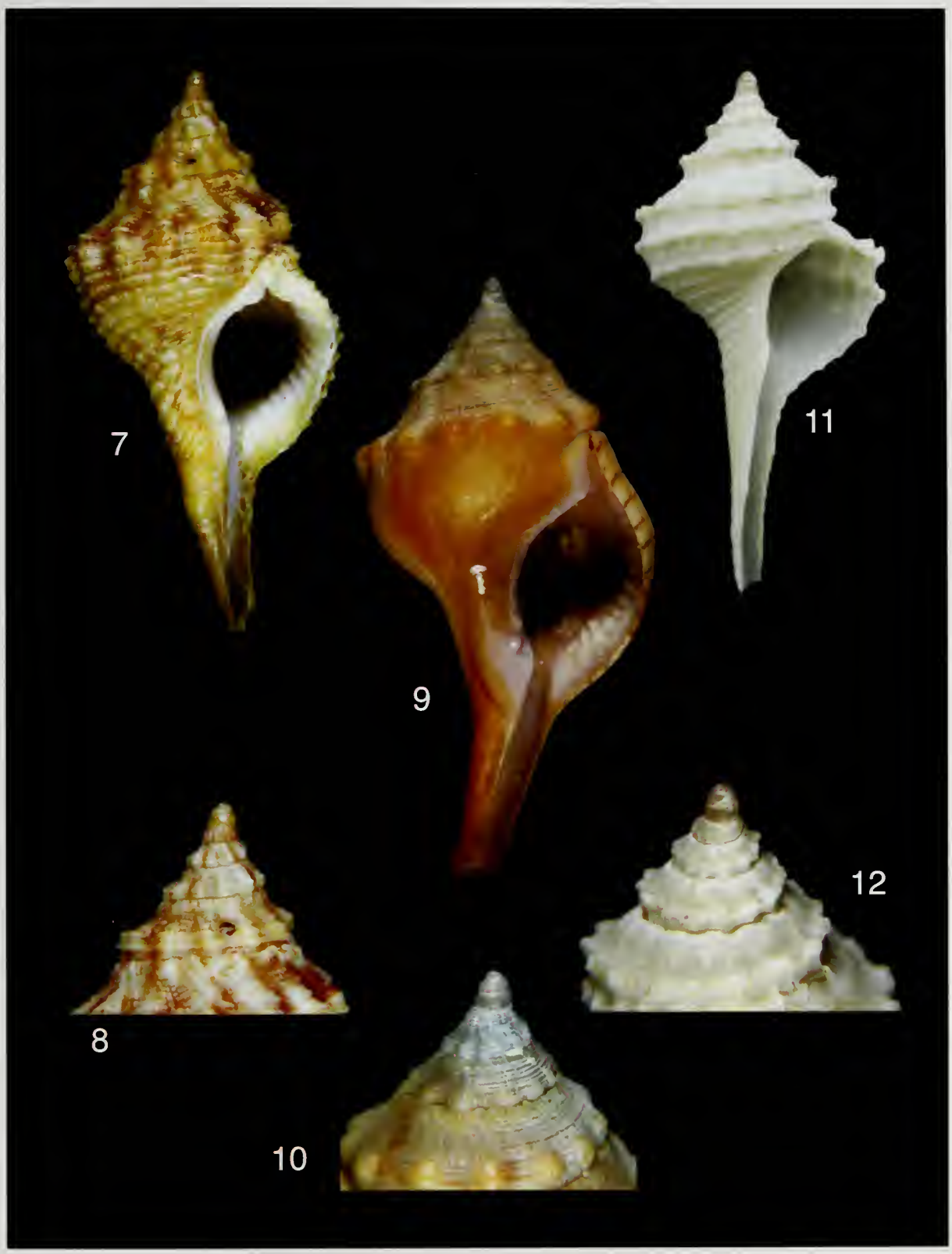
Afer* (*Streptosiphon*) *lansbergisi Delsaerdt, 1993

Afer lansbergisi Delsaerdt, 1993: 89-96, 5 figs. (type locality: "near the coast of Sierra Leone, in 15-40 m depth").
Holotype in KMMA, nr. KJM 7642

For the history of the confusion between *A. porphyrostoma* and specimens of *A. lansbergisi*, see Delsaerdt (1993: 92).

Figures 7-12

7-8. *Afer* (*Afer*) *afer* (Gmelin, 1791), 34.6 mm, Ø protoconch 1.5 mm, Gorée, Senegal, KF nr. 2959.
9-10. *Afer* (*Streptosiphon*) *porphyrostoma* (Reeve, 1847), 38.7 mm, Ø protoconch 1.7 mm, M' Bour, Senegal, 10-20 m, KF nr. 2360.
11-12. *Afer* (*Praecantafer*) *echinatus* sp. nov., holotype, 26.7 mm, Ø protoconch 1.3 mm, off Mauretania, 200 m, MNHN.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Praecantafer subgen. nov.

Type species. *Afer* (*Praecantafer*) *echinatus* sp. nov.

Diagnosis. Shell thin but solid. Shape columbariiform, spire rather short, siphonal canal long, straight, open. Protoconch rather papilliform, higher than broad, typical for genus. Whorls with angular shoulder. Sculpture consisting of at least 2 pronounced, peripheral spiral cords with broad interspaces. Spiral cords on base and siphonal canal weaker. Axial sculpture consisting of sharp spines on top of spiral cords. Aperture oval, columella gently curved, callus narrow and rather thin, outer lip usually thick without internal knobs, edge blunt.

Comparison. The subgenus *Afer* differs from *Praecantafer* in having a larger number of spiral cords, a shorter siphonal canal, an outer lip with internal lirae and a sharp edge. The subgenus *Streptosiphon* differs in having a smoother sculpture, a usually shorther siphonal canal, an outer lip with internal lirae and a sharp edge.

Range. Only known from the type species. Off West Africa, in deep water.

Etymology. *Praecantafer* subgen. nov. is named after the Latin expression *praecantare* (verb), meaning "bewitching" which refers to the enchanting shell.

Afer* (*Praecantafer*) *echinatus sp. nov.
Figs. 1-6, 11-12.

Type material. Holotype, 26.7 mm, Mauretania, continental shelf, N. O. "N'diago" campagne 1981 stn. 85, 20°07'N, 17°38'W, 200 m, MNHN 9964.
Paratype, 29.5 mm, R. V. "Président-Theodore-Tissier" cruise, dredged between Morocco and Senegal, MNHN 9965.

Type locality. Mauretania, continental shelf, N. O. "N'diago" campagne 1981 stn. 85, 20°07'N, 17°38'W, 200 m.

Range. Only known from the type material.

Description. Shell thin, fragile, up to 29.5 mm in length. Shape columbariiform, with broad, short spire, siphonal canal elongate. Aperture together with siphonal canal equal to or slightly longer than 2/3 of total shell length.
Protoconch big, rather papilliform, consisting of 2 1/2 smooth whorls, covered by minuscule holes. Diameter 1.3 mm, length: 1.6 mm. Transition to teleoconch abrupt, marked by a sharp edge.
Teleoconch consisting of 4 1/2 whorls. First 1/4 whorl well convex with 8 broad, weak, spiral cords, interspaces a fine groove. Remaining whorl suddenly becoming angulate, gradually stronger, forming a carina. Penultimate whorl with a second carina partly concealed under lower suture. Body whorl with 3 strong carinae which are ornamented with sharp axial lamellae and 12 smoother spiral cords of different strength on base and siphonal canal.
First 1/8 teleoconch whorl smooth, following 1/8 weakly waved. Further worls stringly knobbed on the carinae. Subsutural slope smooth, suprasutural part slightly waved.
Aperture round. Outer lip thin, simple, edge sharp. Columella smooth (holotype, subadult). Paratype with 2 small abapical columellar knobs, 1 small adapical columellar knob and some irregular lirae, columellar lip thin, sharp. Siphonal canal long, slender, open.
Operculum corneus, pale brown, ovate, nucleus terminal.
Animal and radula unknown.

Comparison. *Afer* (*Praecantafer*) *echinatus* sp. nov. is characterized by the columbariid shape with a long siphonal canal and a rather broad spire with sharp spiral cords and short spines.

Etymology. *Afer* (*Praecantafer*) *echinatus* sp. nov. is named after the Latin expression *echinatus* (adjective), meaning "with spines" or "spiny".

ACKNOWLEDGMENTS

I'm grateful to Jerry Harasewych (National Museum of Natural History, Smithsonian Institution, USA) for calling my attention to this new species, Philippe Bouchet and Virginie Héros (Muséum national d'Histoire naturelle, France) for the loan of the type material, Pierre Lozouet (Muséum national d'Histoire naturelle, France) for bibliographical help, Kevin Monsecour (Belgium) and Yves Terryn (Natural Art, Belgium) for digital photography and to David Monsecour (Belgium) for correcting the Engish text.

REFERENCES

Abbott, R. T. 1959. The family Vasidae in the Indo-Pacific. *Indo-Pacific Mollusca*, 1(1): 15-32.
Abbott, R. T. & Dance, S. P. 1986. Compendium of Seashells. A color Guide to More than 4200 of the World's Marine Shells. ed.3. Florida, American Malacologists, 411 pp.
Adams, A. 1854. Description of Thirty-nine New Species of Shells, from the Collection of Hugh Cuming, Esq. *Proceedings of the Malacological Society of London*, 22: 130-138.
Adams, H. & Adams, A. 1854. The Genera of Recent Mollusca; arranged according to their organization. 1 (1853). London, J. van Voorst, 484 pp

Adanson, M. 1757. Histoire naturelle du Sénégal. Coquillages. Paris, 275 pp

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 of London*, 7: 232-237.

Dall, W. H. 1918. Notes on *Chrysodomus* and other Mollusks from the North pacific Ocean. *Proceedings of the United States National Museum*, 54(2234): 207-234.

Darragh, T. A. 1969. A revision of the family Columbariidae (Mollusca: Gastropoda). *Proceedings of the Royal Society of Victoria*, 83(1): 63-119.

Delsaerdt, A. 1993. *Afer lansbergisi* a new species from western Africa. *Gloria Maris*, 31(6): 89-96.

Fraussen, K. & Hadorn, R. 2000. Transfer of *Afer* Conrad, 1858 to Buccinidae (Neogastropoda) with description of a new species from western Africa. *Gloria Maris*, 38(2-3) 1999: 28-42.

Gill, Th. M. D. 1867. On the genus *Fulger* and its Allies. *American Journal of Conchology*, 3(2): 141-152.

Gmelin, J. F. 1791, Caroli a Linné Systema Naturae. Ed. 13. Tom. 1, Vermes. Pars 6: Mollusca, p. 3021-3910.

Gray, M. E. 1850. Figures of molluscous animals selected from various authors. Vol. 4. Longman, Brown, Green and Longmans, London. 219 pp.

ICZN Opinion 489, 1957. Validation under the plenary powers of the generic name "*Turbinella*" Lamarck, 1799 (class Gastropoda), as the name for the sacred chank shell of India. Opinions and Declarations rendered by the International Commission on Zoological Nomenclature, 17(12): 157-178.

Kiener, L.-C. 1840. Spécies Général et Iconographie des Coquilles Vivantes, Comprenant la collection du Muséum d'Histoire naturelle de Paris, la collection Lamarck, celle du Prince Masséna et les découvertes récentes des voyageurs. Genre *Fuseau*. Paris, Rousseau, 62 pp.

Kobelt, W. 1875. *Tudicla porphyrostoma* und *recurva*. In: Kleinere Mittheilungen. *Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft*, 7(7-8): 58.

Lamarck, J.B.P.A. de Monet de 1816. Tableau encyclopédique et méthodique des trois règnes de la nature. 23, Mollusques et polypes divers. Paris. Pls. 391-488. (Plate descriptions by Bory de St.-Vincent).

Lamarck, J.B.P.A. de Monet de 1843. Histoire naturelle des animaux sans vertèbres, présentant les caractères généraux et particuliers de ces animaux, leur distribution, leurs classes, leurs familles, leurs genres, et la citation des principales espèces qui s'y rapportent. Ed.2 par Deshayes et Milne Edwards. Tome 9. Paris, Baillière, 725 pp.

Maltzan, H. von 1884. Diagnosen neuer Senegambischer Gastropoden. *Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft*, 16(5): 65-73.

Marche-Marchard, I. & Brébion, Ph. 1977. Sur un Buccinidé nouveau d'affinité miocène vivant au large du Sénégal. *Comptes-rendus Hebdomadaires des Séances de l'Académie des Sciences de Paris* (sér.D-339) 285(4): 339-342.

Monsecour, D. & Monsecour, K. 2005. An overview of the genus *Afer* Conrad, 1858 (Gastropoda: Buccinidae). *Neptunea*, 4(3): 23-32.

Nicklès, M. 1950. Mollusques Testacés Marins de la Côte Occidentale d'Afrique. Manuels Ouest-Africains, 2. Lechevalier. Paris.

Reeve, L. A. 1847. Conchologica Iconica: or, Illustrations of the shells of Molluscous animals, IV. Monograph of the genus *Fasciolaria*. London, Reeve & Benham, pl. 1-7.

Reeve, L. A. & Adams, A. 1848-1850. The Zoology of the Voyage of H.M.S. Samarang; under the command of Captain Sir Edward Belcher, C.B., F.R.A.S., F.G.S., during the years 1843-1846. 1-3. London, Reeve & Benham. 84 pp.

Röding, P. F. 1798. Museum Boltenianum sive Catalogus cimeliorum e tribus regnis naturae quae olim collegerat Joa. Fried Bolten, M.D.p.d. per XL. annos Proto physicus Hamburgensis, 2. Conchylia sive Testacea univalvia, bivalvia & multivalvia. Hamburgi, Trappii, 199 pp. Reprint 1906.

Rosenberg, G. & Petit, R. E. 1987. Ryckholt's Mélanges Paléontologiques, 1851-1862, with a New Name for *Tudicla* H. & A. Adams, non Ryckholt. *Proceedings of the Academy of Natural Science of Philadelphia*, 139: 53-64.

Snyder, M. A., 2003, Catalogue of the Marine gastropod family Fasciolariidae. *Academy of Natural Science of Philadelphia*, special publication 21: 1-431

Sowerby, G. B. II 1882. Monograph of the genus *Fasciolaria*. In. Thesaurus Conchyliorum or monographs of genera of shells, V (1887, parts. 37-44), part 37-38, containing the gen. *Latiaxis, Fasciolaria, Haliotis, Sigaretus, Janthina* (1882): 9-15, pl.1-4 (Thesaurus 424-427). London, Sowerby.

Thiele, J. 1931. Handbuch der systematischen Weichtierkunde, 1. Stuttgart, Verlag Gustav Fischer, 778 pp

Tryon, G. W. 1881. Manual of Conchology, structural and systematic, with illustrations of the species. 3, *Tritonidae, Fusidae, Buccinidae*. Philadelphia, Tryon, 310 pp.

Vaught, K. C. 1989. A classification of the living Mollusca. American Malacologists, Inc. 195 pp.

Wade, B. 1916. New genera and species of Gastropoda from the Upper Cretaceus. *Proceedings of the Academy of Natural Science of Philadelphia*, 68: 455-471.

Wenz, W. 1938-1944. Handbuch der Paläozoologie. 6, Gastropoda. Berlin-Zehlendorf, Verlag von Gebrüder Borntraeger, 1639 pp.