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Notes on the columbellid fauna from the infralittoral and circalittoral levels of the Canary Islands

Notas sobre los columbelidos del infralitoral y circalitoral de Canarias

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ABSTRACT

The columbellid species found in the infralittoral and the circalittoral off the Canary Islands and attributed to the genera *Columbella*, *Mitrella*, *Anachis*, *Parvanachis*, *Zafra* and *Nassarina* are discussed. Taxonomy, phenetic variability and range of distribution of the species are commented.

Mitrella turbita (Duclos, 1840) is confirmed to be found off Gran Canaria, and it is recorded for the first time from Fuerteventura. *Nitidella ocellina* Nordsieck, 1975 and *Pusionella scripta* Nordsieck, 1975 are considered as junior synonyms of *Mitrella broderipi* (Sowerby, 1844). A slender "deeper form" of *Mitrella broderipi* is recorded from the Canary Islands and it is showed to belong to the morphologic variability of the species. The overall morphologic similarity with *Mitrella broderipi* and the presence of the same array of chromatic variation leads to make the hypothesis that *Anachis avaroides* Nordsieck, 1975 might be a ribbed variation of *M. broderipi*. The occurrence of *Mitrella bruggeni* van Aartsen, Menkhorst and Gittenberger, 1984 is confirmed in the Canary Islands, with a stout shelled "shallow form", similar to the populations found in Mediterranean, and a slender "deeper form" restricted to the Canary Islands. *Buccinum canariense* d'Orbigny, 1839 is stated to be a junior synonym of *Mitrella ocellata* (Gmelin, 1791).

The Caribbean species *Parvanachis obesa* (C. B. Adams, 1845) is recorded from the harbour of Santa Cruz de Tenerife. This occurrence is interpreted as resulting from an accidental human introduction, but the maintaining of the discovered population remains to be confirmed. Conversely, the Indo Pacific species *Zafra exilis* (Philippi, 1849) is confirmed to occur all around Gran Canaria and possibly to be settling in Tenerife, as a case of successful introduction by the naval traffic. The documentation at hand leads to consider that failed introductions may be frequent, as resulting directly from the contemporary maritime economy. *Nassarina rietae* Segers and Swinnen, 2004 is considered as a possible endemic from the Canary Islands.

The presence of axial ribs is showed to be very variable within a species like *M. turbita* or within a species-group like the *M. broderipi / M. avaroides* one. As a result, the separation between the *Mitrella* group and the *Anachis* group on the basis of the lack or of the presence of axial ribs is appreciated as being artificial. This point is proposed as an argument for a reviewing of the supraspecific classification of the Columbellidae.

RESUMEN

Se discuten las especies de la familia Columbellidae presentes en el infralitoral y el circalitoral de Canarias, atribuidas a los géneros *Columbella*, *Mitrella*, *Anachis*, *Parvanachis*,

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Zafra y Nassarina, poniendo especial énfasis en su táxonomía, variabilidad fenética y distribución de las especies.
Se confirma la presencia de *Mitrella turbita* (Duclos, 1840) en Gran Canaria, y se cita por primera vez en Fuerteventura. Se considera *Nitidella ocellina* Nordsieck, 1975 and *Pusionella scripta* Nordsieck, 1975 como sinónimos posterior de *Mitrella broderipi* (Sowerby, 1844). Una forma alargada, de profundidad, de *Mitrella broderipi* se cita de Gran Canaria y se demuestra su pertenencia a la variabilidad morfológica de la especie. Asimismos, la semejanza de sus características morfológicas y la presencia en ambas del mismo rango de variaciones cromáticas nos hace pensar que *Anachis avaroides* Nordsieck, 1975 podría ser una variedad con costillas de *Mitrella broderipi*. Se confirma la presencia de *Mitrella bruggeni* van Aartsen, Menkhorst and Gittenberger, 1984 en Canarias, con dos formas, una forma rechoncha, de aguas someras, similar a las poblaciones del Mediterráneo, y una forma esbelta, de aguas profundas, restringida a Canarias. Se considera *Buccinum canariense* d'Orbigny, 1839 como sinónimo posterior de *Mitrella ocellata* (Gmelin, 1791).
La especie del Caribe *Parvanachis obesa* (C.B.Adams, 1845) se cita en aguas someras de Santa Cruz de Tenerife. Esta presencia es interpretada como resultado de una introducción humana accidental, pero el mantenimiento de la población descubierta, queda pendiente de confirmar. Se confirma la presencia de la especie indo-pacífica *Zafra exilis* (Philippi, 1849) en toda Gran Canaria y su posible establecimiento en Tenerife, como un caso de introducción exitosa, debido a la actividad industrial. La documentación disponible, nos conduce a pensar que introducciones fallidas de especies son probablemente frecuentes, como resultado directo de la economía marítima contemporánea. Se considera *Nassarina rietae* Segers and Swinnen, 2004 como una posible especie endemica de las Canarias.
Se muestra que la presencia de costillas axiales es muy variable dentro de especies como *M. turbita* o en el complejo *M. broderipi / M. avaroides*. Como resultado, la separación entre el grupo *Mitrella* y *Anachis* en base a la ausencia o presencia de costillas axiales, parece ser artificial. Esto se propone como argumento para un replanteamiento de la clasificación supraespecífica de los Columbellidae.

KEY WORDS: *Columbellidae*, taxonomy, phenetic variability, distribution, deep forms, sibling species, introduced species, Canary Islands.
PALABRAS CLAVE: *Columbellidae*, taxonomía, variabilidad fenética, distribución, especies gemelas, especies introducidas, Islas Canarias.

INTRODUCTION

Whereas the Columbellidae from the Mediterranean have been the subject of recent works of revision (VAN AARTSEN, MENKHORST AND GITTENBERGER, 1984; LUQUE, 1986; CHIARELLI, MICALI AND QUADRI, 2003), so much attention has not be given to the species from Northeast Atlantic.

The illustrated catalogue of NORDSIECK AND GARCÍA-TALAVERA (1979) on the species from the Canary Islands is the only attempt to present a general view of a local columbellid fauna within this area, through the picturing and the comment of 14 morphospecies. The recent list of Columbellidae published by HERNÁNDEZ OTERO, GARCÍA-TALAVERA AND HERNÁNDEZ GARCÍA (2003) in the frame of the Biota project (Inventory of the Canarian marine fauna) gives 11 taxa, of whose only 6 are quoted by NORDSIECK AND GARCÍA-TALAVERA (1979). This simple fact shows how much controversial remains the taxonomy of the local columbellids.

The limited scope of this article is to summarize the present knowledge on the columbellid fauna from the infralittoral and upper circalittoral levels of the Canary Islands (about 0-100 m), with a special point on the taxonomy of species

and genera, on their phenetic variability and on their range of distribution. The genera *Amphissa* H. and A. Adams, 1853 and *Astyris* H. and A. Adams, 1853 are both recorded from the Canary Islands by NORDSIECK AND TALAVERA (1979) through 3 specific taxa which are considered by RADWIN (1978 b) as corresponding to 2 controversial amphiatlantic species from deep waters of Northern Atlantic. Due to their status of bathyal species, the study of these Canarian items are out of the scope of the present article.

Despite the opinion of RADWIN (1978 a) about the limited conception of the genus *Anachis* H. and A. Adams, 1853, implied by Tate´s selection of the type species *Columbella scalarina*, the use of this taxon is preferred here to the use of the more recent genus *Costoanachis* Sacco, 1890 which does not resolve the issue of the wide morphologic disparity at work in the complex of axially ribbed spindle-shaped columbellids. The other genera are used following the RADWIN's position (1977, 1978 a, 1978 b).

This study is based principally on the observations and on the collection of both authors, on the M. Bermejo collection deposited in Museo Canario (Las Palmas, Gran Canaria), and on the private collections of W. Engl and of F. Swinnen.

The term of "sibling species" is used in the trivial sense of "species sharing very similar features" (KNOWLTON, 1993).

Abbreviations:

sh: shells.
many sh: > 20 sh.
CVI: Cape Verde Islands.
Fu: Fuerteventura
GC: Gran Canaria;
Go: La Gomera
Hi: El Hierro
La: Lanzarote
Pa: La Palma
Ma: Madeira
Te: Tenerife
WS: Western Sahara
MNHN: Muséum National d'Histoire Naturelle, Paris.
SMF: Senckenberg Museum, Frankfurt.
FBC: F. Boyer Collection.
FSC: F. Swinnen Collection.
JHC: J. Hernandez Collection.
MBC: M. Bermejo Collection, Museo Canario, Las Palmas.
WEC: W. Engl Collection.

SYSTEMATIC PART

Family COLUMBELLIDAE Swainson, 1840
Genus *Columbella* Lamarck, 1799

Type species by monotypy: *Voluta mercatoria* Linnaeus, 1758.

Columbella adansoni Menke, 1853 (Fig. 1)

Material examined: Ma: 1 sh, 9-12 m, JHC. Hi: 1 sh, 5-12 m, JHC. GC: many sh, 0-90 m, JHC (Fig.1); many sh, 0-3 m, FBC. La: many sh, 0-3 m, FBC. Fu: 12 sh, 0-60 m, JHC.

Taxonomy: Attributed for a long time to the non-planktotrophic species *Columbella rustica* (Linnaeus, 1758) and more specially to the morph *C. striata* Duclos, 1835 (for instance in NORDSIECK AND GARCÍA-TALAVERA, 1979), the *Columbella* species distributed in the Canary Islands has been recently demonstrated to belong to the planktotrophic sibling species *C. adansoni* Menke, 1853, described from the Cape Verde Islands (MOOLENBEEK AND HOENSELAAR, 1991). *C. adansoni* was pictured in NORDSIECK AND GARCÍA-TALAVERA (1979) as "*C. rustica striata* Duclos, 1835" and also as "*Columbella spec.*" for a tall-spired form (subadult shell).

The belonging of *C. adansoni* to the genus *Columbella* is not suspicious, as its shell morphology is very close to that of

the type species *C. mercatoria* (Linnaeus, 1758).

Distribution: *C. adansoni* was said to be restricted to the Macaronesian Islands by MOOLENBEEK AND HOENSELAAR (1991), whereas C. *rustica* was said to be restricted from Mediterranean to Senegal. OLIVERIO (1995) enlarged the distribution of *C. adansoni* to the remainder of the West African Province, this distribution being confirmed from Sierra Leone to Central Angola by ROLÁN AND RYALL (1999).

The distribution of C. *adansoni* in Canary Islands is general, from low tide level to 90 m. The species is especially abundant under boulders in shallow water.

Remarks: The complex *C. rustica* / *C. adansoni* has been cited (for instance in THORSON, 1949) as a classic example of poecilogony (intraspecific variation in the mode of larval development) in molluscan gastropods.

MOOLENBEEK AND HOENSELAAR (1991) stated the presence, in the Macaronesian *C. adansoni*, of a multispiral protoconch indicating a planktotrophic development and, in the Mediterranean and North West African *C. rustica*, of a paucispiral protoconch indicating a "direct development" (more exactly it is intracapsular metamorphosis).

The electrophoresis analysis performed by OLIVERIO (1995) confirmed the separation of both species at the genetic level, the initial divergence being estimated from about 2 millions years. OLIVERIO (1995) emphasizes that "this time can be correlated to the onset of glaciations, and especially with their extension to southern regions". This could explain the present distribution of *C. rustica*, which may have reached its full intracapsular development during a glacial isolation stage within Mediterranean, before to extend to the North West African coasts, while *C. adansoni* remained protected from the cold Canary current in the offshore Macaronesia Islands.

It must be noted that the sibling species C. *rustica* and *C. adansoni* are presently separated only on the basis of their respective protoconch and of their genetic distance, but they remain to be fully studied in other ways, specially concerning the variability of the shell morphology, the external features and the anatomy of the soft parts, the ontologic development at the juvenile stage and the general behaviour at the adult stage.

A superficial examination of the animals of *C. adansoni* in Canary Islands (milky white to creamy white ground, with zones flecked of deep white dots, large golden brown to amber patches, small rounded yellowish operculum with black axis, scalloped by a deep yellow-orange line in its anterior part and by a black line in its posterior part) did not allow to recognize any significant difference with regard to the animals of *C. rustica* examined by the authors from Mediterranean and from Senegal.

Genus *Mitrella* Risso, 1826

Type species by subsequent designation (Cox, 1927:28): *Mitrella flaminea* Risso, 1826 [= *Mitrella scripta* (Linnaeus, 1758)].

Mitrella cf. *minor* (Scacchi, 1836) (Figs. 3, 57)

Columbella minor Scacchi 1836

Material examined: Siracusa: 2 sh, 100 m, JHC. Malaga: 12 sh, 80 m, JHC. Marbella: 3 sh, 30-40 m, FBC. Algeciras: 3sh, 18-22 m, FBC. Ma: 1 sh, 80 m, FSC. Pa: 4 sh, 80 m, WEC; 4 sh, 60-100 m, FSC. GC: many sh, 12-520 m, JHC (Figs. 3, 57); 10 sh, 34-200 m, FBC. La: 1 sh, FSC. WS: many sh, 30-83 m, JHC; 12 sh, 30-60 m, FBC.

Taxonomy: In the recent literature, the attribution of *Columbella minor* Scacchi, 1836 to the genus *Mitrella* Risso, 1826 is generally preferred to the use of the

genus *Columbellopsis* Bucquoy and Dautzenberg, 1882, specially created for giving a distinct status to *C. minor*. In fact, *C. minor* presents original morphologic features in the anterior part of its shell, with a narrow and sinuous siphonal canal, a small triangular aperture and a very concave left side of the base. These features are clearly divergent from the ones found in the other *Mitrella* species ranging in the Lusitanian Province, especially from the Mediterranean *M. scripta* (Linnaeus, 1758), type species of *Mitrella*. The genus *Mitrella* being applied to a vast array of shell morphologies and being still waiting for a general revision, it seems that the conservative way is more appropriate in the present case and we propose to keep the generic taxon *Mitrella* for the placement of *Columbella minor*.

LUQUE (1986) reports some differences between the shells from Canary Islands attributed to "*Mitrella minor*" and those from Mediterranean, western Iberian Peninsula and northwest Morocco. The shells from Canary Islands are said to show a somewhat different colour pattern and a lower number of spiral striae at the base of the last whorl. On this ground, LUQUE remains reserved on the specific attribution of the Canarian population, which is described as a new taxon in a companion paper by BOYER AND ROLÁN (2005). *M.* cf. *minor* from the Canary Islands is reported and pictured as "*Mitrella svelta* (Mtrs) Kobelt 1901" in NORDSIECK AND GARCÍA-TALAVERA (1979). *M. svelta* is a misspelling for *M. spelta* (Kobelt, 1893), considered to be a dubious species by VAN AARTSEN *ET AL.* (1984), possibly matching the shallow Mediterranean morph *M. lanceolata* (Locard, 1886) belonging to the *M. scripta* complex.

Distribution: *Mitrella minor* sensu lato is distributed in Mediterranean and from Vigo to northern Senegal. It is widely distributed in Canary Islands from 30 to about 500 m, apparently on soft and detritic bottoms.

Remarks: The animals observed from the Canary Islands are mottled of brown and flecked of deep white dots on a whitish ground (Fig. 57). This colour pattern is very similar to the one observed in specimens from Algeciras. The oval operculum is light yellowish.

Mitrella pallaryi (Dautzenberg, 1927) (Figs. 2, 58)

Pyrene pallaryi Dautzenberg, 1927

Material examined: Marbella: 4 sh, 70-80 m, FBC. Alboran Island: 1 sh, 20 m, JHC. Pa: 15 sh, 150-250 m, FBC. Go: 1 sh, JHC. Te: 2 sh, 60-100 m, JHC. GC: many sh, 60-520 m, JHC (Figs. 2, 58). La: 1 sh, 46-50 m, WEC. WS: 1 sh, 58 m, JHC.

Taxonomy: *Pyrene pallaryi* Dautzenberg, 1927 is placed in *Mitrella* by all the recent authors. The use of the taxon *Pyrene* is certainly unappropriate in the present case, as the type species *Pyrene punctata* (Bruguière, 1789) has an ovate outline, a somewhat turbinate top, a narrow accent-shaped aperture and very strong basal cords.

P. pallaryi shares most of the classic shell features of *Mitrella* except for its large size and for its turriculated spire. However, we propose to keep the species in *Mitrella*, following the last reviewers (LUQUE, 1986; ROLÁN AND TRIGO, 2000) and in the wait of a general re-assessment of this group.

M. pallaryi is pictured under its right specific name by NORDSIECK AND GARCÍA-TALAVERA (1979), but associated to the unusual subgenus *Paratilia*.

Distribution: The species is known to range in circalittoral and upper bathyal from Galicia and Mediterranean to northern Angola, comprising the Açores, Madeira and the Canary Islands, but it may be a discontinuous distribution, records being lacking south

from Senegal to Congo (ROLÁN AND TRIGO, 2000).

The species is widely distributed in Canary Islands from 50 to about 500 m, apparently on soft and detritic bottoms.

Remarks: The animals observed from the Canary Islands are whitish, mottled of reddish brown spots and patches (Fig. 58). The sole is clearer. The operculum is subtranslucent, faintly square, with a brownish violet patch, "Y" shaped at its center.

LUQUE (1986) and ROLÁN AND TRIGO (2000) gave details about the shell, the protoconch, the operculum and the radula in populations from continental Spain and from Angola. The multispiral protoconch has 3 to 3.5 smooth whorls, and the species is considered to have a planktotrophic development (ROLÁN AND TRIGO, 2000). As expected in such a case, *M. pallaryi* looks as being very constant in its whole range of distribution.

Mitrella turbita (Duclos, 1840) (Figs. 4-6)

Columbella (Seminella) rac Dautzenberg, 1891

Material examined: GC: 2 sh, 10-15 m, WEC (Figs. 4-6). Fu: 3 sh, 0 m, MBC.

Taxonomy: *Mitrella rac* (Dautzenberg, 1891) was named from a material collected in Dakar, Senegal, after a non-binomial name given by Adanson. The species named by DAUTZENBERG (1891) is accurately described and pictured, and it corresponds to one of the most abundant and distinctive species of *Mitrella* found about the Peninsula of Cap Vert. However PELORCE AND BOYER (2005) have shown that the name *Mitrella turbita* (Duclos, 1840) has precedence and must be used as the valid name for this taxon.

The few shells found in Canary Islands (Figs. 4-6) match perfectly the material studied from Dakar. It must be noted that most of the shells wear strong sinuous axial ribs at the center of the last whorl and strong spiral cords at the base of the last whorl. As such, *M. turbita* might be interpreted as an intergrade between the genera *Mitrella* and *Anachis*. *M. turbita* is not recorded neither pictured by NORDSIECK AND GARCÍA-TALAVERA (1979).

Distribution: The species is well-known from the Peninsula of Cap Vert (Senegal), as restricted to different kinds of hard bottoms from 0 to 40 m. It was observed in Cape Blanco (northern Mauritania) by E. Rolán (pers. comm.), and it was recorded from Gran Canaria through one sampling in ALONSO AND JIMÉNEZ MILLÁN (1979). Its presence in Gran Canaria and in Fuerteventura is confirmed here by 2 new findings. This thermophilic species is probably restricted to the tepid shallow water ranging off these two islands and it

(Right page) Figure 1. *Columbella adansoni*, 16 mm, 12 m, Sardina, Gran Canaria, JHC. Figure 2. *Mitrella pallaryi*, 15 mm, 232 m, off Tasarte, Gran Canaria, JHC. Figure 3. *Mitrella* cf. *minor*, 11 mm, 150 m, off North West Gran Canaria, JHC. Figures 4-6. *Mitrella turbita*. 4, 5: 8.4 mm, 10-15 m, Gran Canaria, WEC; 6: 9.1 mm, 10-15 m, Gran Canaria, WEC. Figures 7-9. *Mitrella bruggeni*. 7: 12 mm, low tide, Orzola, Lanzarote, WEC; 8, 9: 9 mm, 1 m, Isla de Lobos, Fuerteventura, JHC. *(Página derecha) Figura 1.* Columbella adansoni, *16 mm, 12 m, Sardina, Gran Canaria, JHC. Figura 2.* Mitrella pallaryi, *15 mm, 232 m, off Tasarte, Gran Canaria, JHC. Figura 3.* Mitrella *cf.* minor, *11 mm, 150 m, off North West Gran Canaria, JHC. Figuras 4-6.* Mitrella turbita. *4, 5: 8.4 mm, 10-15 m, Gran Canaria, WEC; 6: 9.1 mm, 10-15 m, Gran Canaria, WEC. Figuras 7-9.* Mitrella bruggeni. *7: 12 mm, marea baja, Orzola, Lanzarote, WEC; 8, 9: 9 mm, 1 m, Isla de Lobos, Fuerteventura, JHC.*


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seems to reach there the northern limit of its distribution.

Despite the fact that *M. turbita* has not been recorded from Western Sahara until now, it must be noted that this area remains very poorly sampled as far as hard bottoms are concerned, and there is no concrete reasons, in the present state, to believe that the scarce populations of *M. turbita* in the Canary Islands are only relics of an older expansion of the species during a past warmer period, or even resulting from an accidental introduction coming from the human industry.

Remarks: Only dead shells have been collected in Canary Islands, so the animal in these populations was not compared with the animals from Senegal documented by the authors. However the few shells studied from Canary Islands match perfectly the most common shell morphology and colour pattern found in *M. turbita* off the Peninsula of Cap Vert.

Mitrella broderipi (Sowerby, 1844) (Figs. 10-18, 28-30, 40, 59)

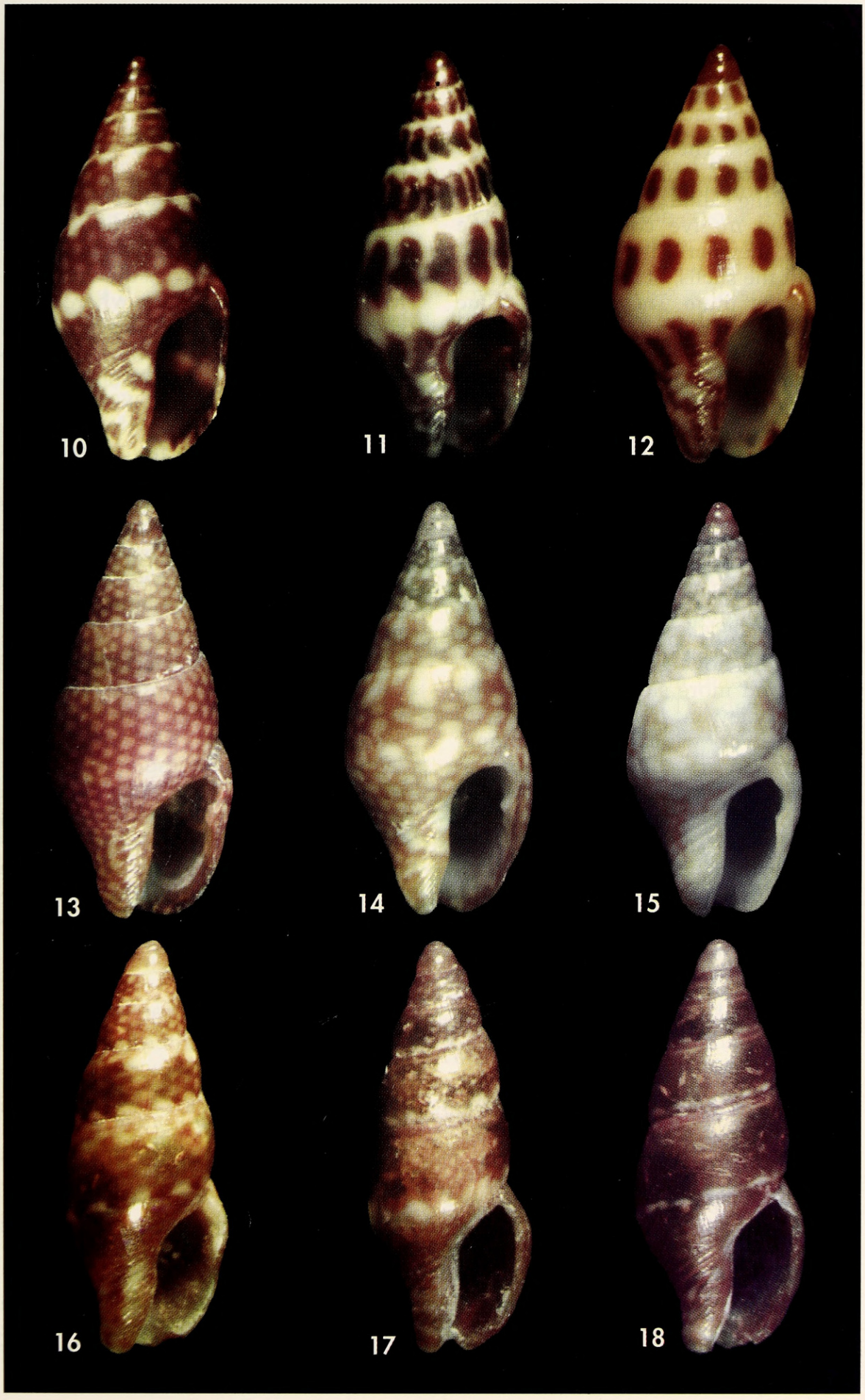
Columbella broderipi Sowerby, 1844

Material examined: "Shallow form": Málaga: 8 sh, 10 m, JHC. Estepona: 4 sh, 1-2 m, FBC. Algeciras: many sh, 1-3 m, FBC. Cádiz: 5 sh, 0 m, JHC. Ceuta: 3 sh, 0 m, JHC. Alborán Island: 18 sh, 20 m, JHC. Ma: 7 sh, 15-30 m, FSC. Selvagen Grande: many sh, FSC. Pa: 2 sh, FSC. GC: many sh, 0-135 m, JHC (Figs 12, 29, 30, 59); many sh, 0-3 m, FBC (Figs. 10, 11, 13, 14); many sh, 0-15 m, FSC; many sh, MBC. La: 19 sh, 0-2 m, JHC; many sh, 1-3 m, FBC; many sh, MBC; many sh, FSC. Fu: many sh, 0-2 m, JHC; 1 sh, 0 m, FBC (Fig. 15); many sh, MBC.
"Deep form": Hi: many sh, 30-60 m, WEC (Figs. 16-18, 28). Go: many sh, 12 m, WEC. GC: 1 sh, 90-96 m, JHC (Fig. 40). La: 9 sh, 46-80 m, WEC; many sh, 30-50 m, FSC.

Taxonomy: *M. broderipi* (Sowerby, 1844) was revised by VAN AARTSEN *ET AL.* (1984) and by LUQUE (1986), with a distribution limited to the Alboran Sea, the Ibero-Moroccan Gulf and one finding at a great depth in Açores (DAUTZENBERG, 1927: 87). This last record is dubious and seems better to be a misidentification of *Astyris profundi* (Dall, 1889) from the lower circalittoral and the bathyal of Northern Atlantic (ABBOTT, 1974). The phena *M. broderipi* is in fact common in the Canary Islands, but known under the junior name of *Nitidella ocellina* Nordsieck, 1975, generally placed in *Mitrella*. In the same time than *M. ocellina*, was also described *Pusionella scripta* Nordsieck, 1975, which belongs with evidence to the range of variability of the same species. NORDSIECK AND GARCÍA-TALAVERA (1979) did not use longer the taxon "*P. scripta*", and they pictured 3 shells of *M. broderipi* under the name of "*N. ocellina*". Both taxa *N. ocellina* Nordsieck, 1975 and *P. scripta* Nordsieck, 1975 are proposed here as junior synonyms of *M. broderipi*.

Distribution: The species is confirmed to range on hard bottoms from the Alboran Sea and the Ibero-Moroccan

(Right page) Figures 10-18. *Mitrella broderipi*. 10: 6.4 mm,1-2 m, Arinaga, Gran Canaria, FBC; 11: 6.2 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 12: 7 mm, 12 m, Gando, Gran Canaria, JHC; 13: 6,2 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 14: 6 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 15: 6.9 mm, low tide, Granillo, Fuerteventura, FBC; 16: 5 mm, 30-55 m, Hierro, WEC; 17: 5.2 mm, 30-55 m, Hierro, WEC; 18: 5.1 mm, 30-55 m, Hierro, WEC.
(Página derecha) Figuras 10-18. Mitrella broderipi. *10: 6.4 mm,1-2 m, Arinaga, Gran Canaria, FBC; 11: 6.2 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 12: 7 mm, 12 m, Gando, Gran Canaria, JHC; 13: 6,2 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 14: 6 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 15: 6.9 mm, marea baja, Granillo, Fuerteventura, FBC; 16: 5 mm, 30-55 m, Hierro, WEC; 17: 5.2 mm, 30-55 m, Hierro, WEC; 18: 5.1 mm, 30-55 m, Hierro, WEC.*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Gulf to Madeira and the Canary Islands. In this last place, shallow water populations (0-15 m) and deeper water populations (12-60 m) show distinct shell morphologies.

Remarks: The populations from shallow water inhabiting the Alboran Sea and the Canary Islands have been compared in live conditions by the authors: they perfectly match in all features of the shells, of the soft parts and of the operculum. They show the same range of variability for the shell morphology and colour pattern, and for the chromatism of the soft parts. The animals from the Canary Islands are brownish to jet black (with blue shades in this case) with whitish tips. Limited zones are flecked of deep white dots (Fig. 59). The sole is whitish to jet black. The operculum is subtranslucent, faintly square or more tear-shaped, with a dark patch at its center.

The populations from the Canary Islands ranging in deeper water (Figs. 16-18, 28) show generally a smaller, lighter and more slender shell with a dull chromatism, a higher spire with more convex whorls and a thinner labrum than in shallow water populations (Figs. 10-15, 29, 30). However, some intergrades can be found (Fig. 40), mostly from mid-infralittoral level (shallow form, deep form, and intergrades are found in the lot from La Gomera, WEC, collected in 12 m), with similar protoconch and shell morphology. As a matter of fact, the shell material found in shallow water (0-3 m) and the one from deeper water (30-60 m) present a real unity. The animals from deeper water were not examined and the chromatism of their soft parts remains unknown.

It must be noted that the shell material collected under 10 m. in Alboran Island (10-20 m) and in Madeira (15-30 m) does not differ from the "shallow form" found everywhere, whereas the shell material from the Canary Islands found under 10 m represents mostly the "deeper form" (12 m in La Gomera) or is exclusively composed by it (30-60 m in Hierro and Lanzarote).

On the ground of the elements at hand, there is no reason to state on a distinct taxonomic status of the "deeper form" of *M. broderipi* from the Canary Islands, and the transformation of the shell morphology with the depth can be interpreted as a phenetic adaptation to different abiotic constraints (or a simple variation randomly selected), genetically fixed but submitted to casual reproductive mixing with "shallow water" populations. This point deals with the important question of the drift of the genetic pool in such condition and of the degree of genetic exchanges between shallow and deeper populations. That refers to the topic of the "deep forms" status in marine gastropods, which waits for further investigations.

Mitrella bruggeni van Aartsen, Menkhorst and Gittenberger, 1984 (Figs. 7-9, 37-39, 41-45, 55, 56)

Material examined: "Shallow form": Malaga: 5 sh, 10 m, JHC. Algeciras: 2 sh, 1-3 m, JHC (Fig. 55); 16 sh, 1-3 m, FBC. Cadiz: 5 sh, 0 m, JHC. Ceuta: 1 sh, 0 m, JHC. Alboran Island: 5 sh, 20 m, JHC. Ma: many sh, FSC. Selvagen Grande: 1 sh, 0 m, MNHN. Te: 2 sh, 1-2 m, FSC; 3 sh, 0 m, MNHN. GC: 3 sh, 0-2 m, JHC; 1 fragment, 0 m, FBC. La: 19 sh, 0-2 m, FBC; 3 sh, 0-2 m, WEC; many sh, FSC. Fu: 8 sh, 0-2 m, JHC (Figs. 8, 9). 1 sh, MBC (Fig. 7).
"Deep form": Hi: 27 sh, 30-55 m, WEC (Figs. 37-39); GC: 5 sh, 15-90 m, JHC (Figs. 43-45, 56) La: 8 sh, 8-30 m, FBC; 15 sh, 46-50 m, WEC (Figs. 41, 42); 5sh, FSC. Fu: 1 sh, 0 m, JHC; 1 sh, BMC.

Taxonomy: Despite the statement of LUQUE (1986), *Mitrella bruggeni* van Aartsen, Menkhorst and Gittenberger, 1984 has priority over the name *M. maldonadoi* Luque, 1984, issued in an abstract (LUQUE, 1984) which does not match the requirements of the Code of Nomenclature.

The shallow form of the species is easily distinguished from its relatives in Alboran Sea as well as in the Canary Islands, due to its ventricose body whorl, its regularly arched outer lip with subequal labial denticles extended on the inner wall, its slender pyramidal spire, and its bulbous stepped protoconch (Figs. 55-58). *M. bruggeni* differs from *M. turbita* by its stepped unicoloured browny to whitish protoconch instead of domed whitish protoconch with a light purple tip, the 6 whorls of its teleoconch instead of 5, its wide oval aperture instead or longer, narrower, rather rectangular and slightly comma-shaped, its 4 to 6 plaits on a very convex columellar callus instead of 2 to 4 plaits on a poorly convex callus, its subequal labial teeth instead of a much stronger tooth just below a small upper one, its poorly marked spiral cords at the base of the shell instead of strongly marked, and its less incised siphonal canal. Even if most of the shells of *M. turbita* show sinuous axial ribs at the mid-part of the last whorl, some specimens do not hold and they are similar to *M. bruggeni* from this point of view. Very few shells of *M. bruggeni* from Canary Islands and some more from Mediterranean present a colour pattern of white ocelles and axial stripes on a reddish-brown ground comparable to the common "reticulated pattern" found in *M. turbita*.

M. bruggeni might be a possible junior synonym of *M. coccinea* (Philippi, 1836). The topic was tackled but not resolved by PALMERI (1987) and CHIARELLI, MICALI AND QUADRI (2003), and it is under study by the second author.

M. bruggeni is pictured by NORDSIECK AND GARCÍA-TALAVERA (1979) under the names of "*Mitrella decollata* (Brusina, 1865)" and of "*M. hidalgoi* Monterosato, 1889".

Distribution: The species ranges on hard bottoms in shallow water (0-3 m) from the Alboran Sea to the Ibero-Moroccan Gulf and from Madeira to the Canary Islands. In this last place, populations from deeper levels (8-90 m) present a smaller, lighter, and more slender shell.

Remarks: The populations from shallow water inhabiting the Alboran Sea and the Canary Islands (Figs. 7-9, 55, 56) have been compared in live conditions: they perfectly match together in all features of the shells, on the soft parts and of the operculum, and they show the same range of variability for the morphology and for the colour pattern of the shells as well as for the chromatism of the soft parts. The animal is light yellowish to light beige with sparse light brown patches on the foot and on the siphon. The sole is light yellowish. The head and tentacles are whitish. The forehead and the sides of the head have longitudinal light brown marks; the axis of the tentacles is light brown. The sole, the siphon and the tentacles are flecked of deep white dots. The oval operculum is light yellow amber.

The populations from the Canary Islands ranging in deeper water (Figs. 37-39, 41-45, 57, 58) have a small lanceolate and subtranslucent shell, showing a higher spire with more convex whorls and a thinner labrum than in shallow water populations. The deeper water form seems to have been confused until now by collectors with the sympatric *M. broderipi* (Fig. 40). However, some intergrades between the shallow and the deeper water forms of *M. bruggeni* can be found (Fig. 41), mostly from the middle levels (as most of the 8 shells from southeast Lanzarote, 8-30 m, FBC), and the general morphology of the shells and of the protoconchs are similar. The animals from deeper water were not examined and the chromatism of their soft parts remains unknown.

It must be noted that the shell material collected below 10 m in Alboran Island (10-20 m) does not differ from the "shallow form" (0-3 m) found everywhere, whereas the shell material from the Canary Islands found below 8 m (8-90 m) represents only the deeper form or intergrading morphs (found in 8-30 m as well as in 46-50 m). Few shells of the "deeper form" can be collected as beached material in Fuerteventura, together with shells of the "shallow form", without evident intergrades.

These elements do not allow to infer that two sibling species are represented here. From a general point of view, the situation is similar to the one found in *M. broderipi*, with a shallow form and a deeper form which seem to range according to a bathymetric cline, and to present a somewhat homogeneous morphology at the population level. The casual finding of shells of the "deeper form" at the shore level may come from accidental transports of live larvae or dead shells due to local hydrodynamic conditions, or to rejects of artisanal fisheries.

Mitrella ocellata (Gmelin, 1791) (Figs. 46-48)

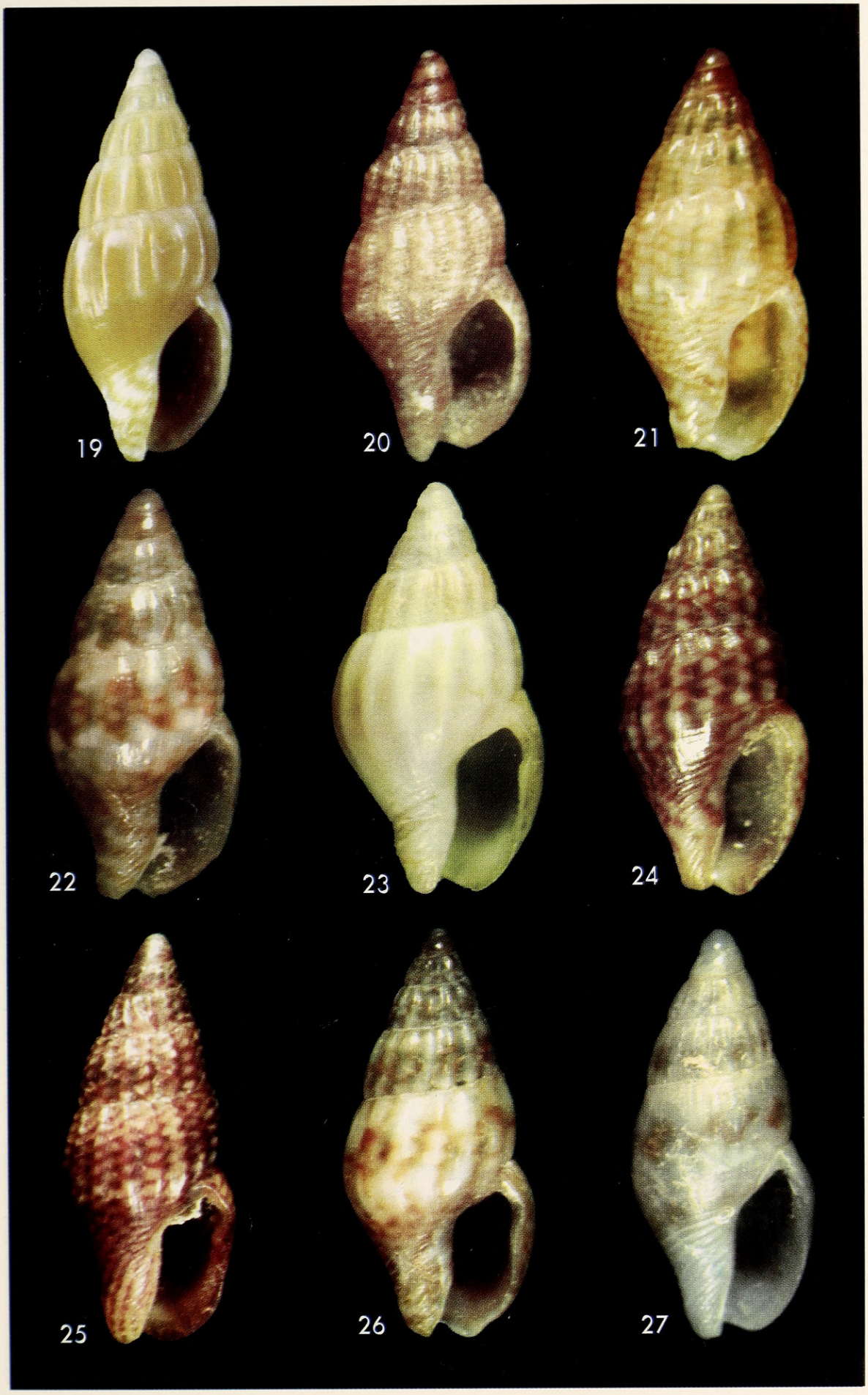
Voluta ocellata Gmelin, 1791

Material examined: Ma: 4 sh, 0-17 m, FSC. Te: many sh, 0 m, FBC (Fig. 46). GC: many sh, 0-8 m, JHC; 8 sh, 0-1 m, FBC (Fig. 47). La: 3 sh, 0 m, FBC (Fig. 48). Fu: many sh, 0 m, MBC.

Taxonomy: Depending on the authors, *M. ocellata* (Gmelin, 1791) is accepted as an amphiatlantic species or as a pantropical one, but the matter is still awaiting for further demonstration. The *M. ocellata* complex is discussed by RADWIN (1978 b), who cites several sibling forms described from various places in the Indo-Pacific and Panamic Provinces. At least one of these sibling forms, ranging in the Galapagos Archipelago, can be separated at the specific level on the ground of the characters of its lateral radular tooth. One of the original features of the shells, besides their original subrectangular aperture with strong labial denticles and their ocellated colour pattern, is the usual lack of the apex in the adult stage.

M. ocellata was described without original locality. RADWIN (1978 b) gave the Bahama Islands as subsequent type locality of the species. The sibling morph *M. cribaria* (Lamarck, 1822), frequently used in the literature for the populations ranging in Eastern Atlantic, was described from the Java Seas. The name *M. canariensis* (d'Orbigny, 1839), based on a shell from Tenerife belonging to the same complex *M. ocellata*, has not been used in the literature for the West African populations and rarely for the Canarian populations. The shell pictured in D'ORBIGNY (1839, pl. 6, figs. 35-37) as *Buccinum canariense* shows a morphology similar to that of *M. ocellata*, as far as the slender oval outline of the body whorl, the long pointed spire with flat to concave sides, the very acute apex, and the long narrow aperture are concerned. The dull shell decoration matches the ocellated pattern found in *M. ocellata*, as well as the alternate subequal white and dark subsutural square marks, and the dark spiral bands at the mid-part of the body whorl on a light chestnut brown ground. Despite the presence of the apex in the shell pictured in D'ORBIGNY (1839), which is generally removed in adult shells of *M. ocellata*, and despite the fact that the type material of

(Right page) Figures 19-27. *Anachis avaroides*. 19: SMF syntype (as "holotype"), 7 mm, Gran Canaria, SMF; 20: 4.6 mm, Sao Miguel, Açores, WEC; 21: 4.9 mm, 20 m, Funchal, Madeira, WEC; 22: 5 mm, 20 m, La Palma, WEC; 23: 5.4 mm, 20-30 m, San Sebastián, La Gomera, WEC; 24: 6 mm, 30-55 m, El Hierro, WEC; 25: 5.9 mm, 30-55 m, El Hierro, WEC; 26: 5.8 mm, 30-55 m, El Hierro, WEC; 27: 5 mm, 30-55 m, El Hierro, WEC.
(Página derecha) Figuras 19-27. Anachis avaroides. *19: syntype SMF (como "holotipo"), 7 mm, Gran Canaria, SMF; 20: 4.6 mm, Sao Miguel, Açores, WEC; 21: 4.9 mm, 20 m, Funchal, Madeira, WEC; 22: 5 mm, 20 m, La Palma, WEC; 23: 5.4 mm, 20-30 m, San Sebastián, La Gomera, WEC; 24: 6 mm, 30-55 m, El Hierro, WEC; 25: 5.9 mm, 30-55 m, El Hierro, WEC; 26: 5.8 mm, 30-55 m, El Hierro, WEC; 27: 5 mm, 30-55 m, El Hierro, WEC.*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B. canariense was not examined, there is no serious reasons to doubt about the identity of this taxon, considered here as junior synonym of *M. ocellata*. It must be noted that some adult shells of *M. ocellata* from Tenerife (G. Hervillard Collection) and from Dakar (FBC) were observed to have kept their apex. The fact that the type material of *B. canariense* was found "in roots of gorgonas, fished off the harbour of Orotava" (D'ORBIGNY, 1839) does not signify necessarily the occurrence of a deep water species. The very steep slopes encountered along the coasts of Tenerife cause currently the fall of live mollusca or of shells from shallow water to deeper levels.

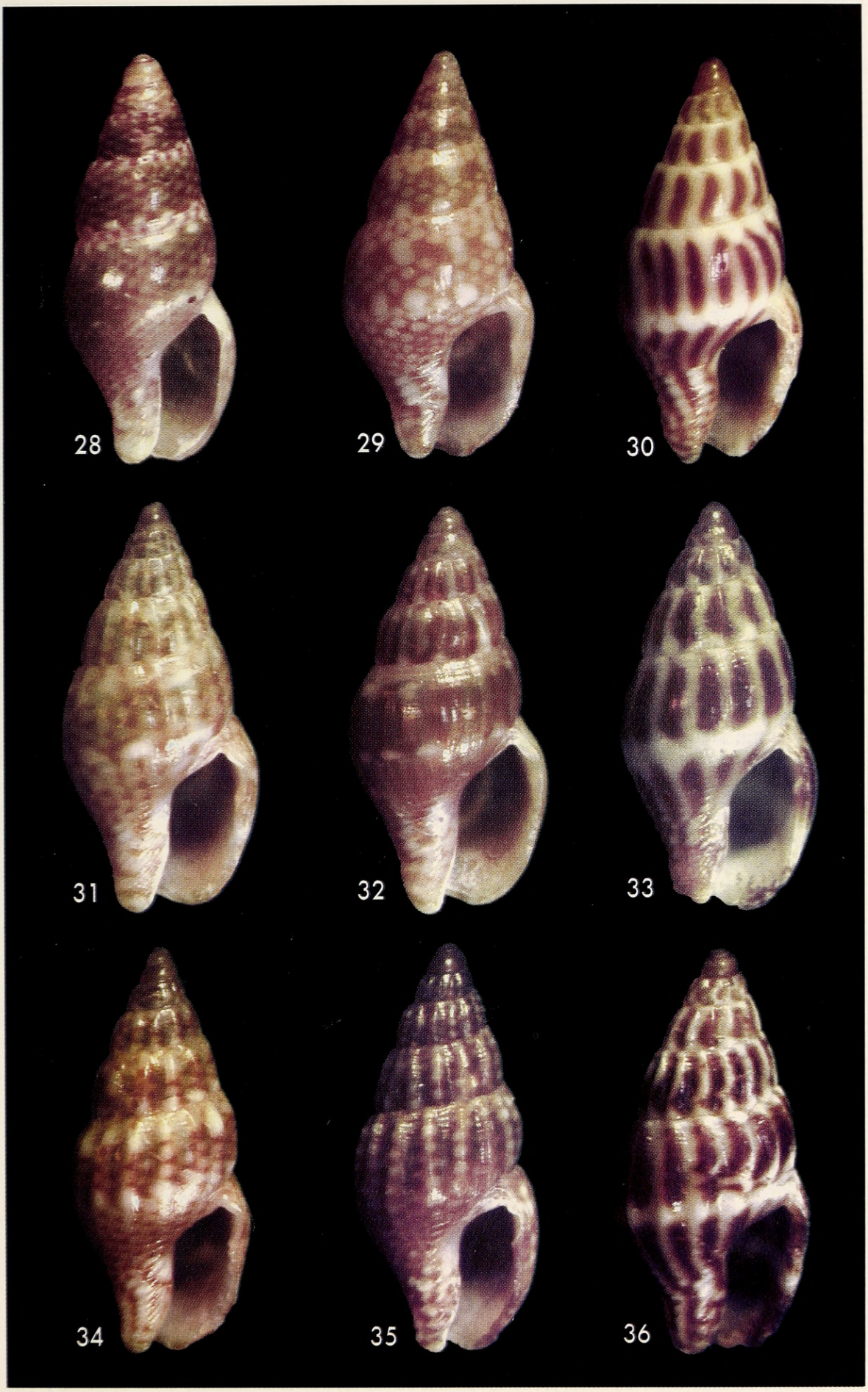
NORDSIECK AND GARCÍA-TALAVERA (1979) pictured as "*Nitidella ocellata* (Gmelin, 1889)" a shell matching the common form of *M. ocellata* found in Canary Islands (Figs. 46-48), itself perfectly similar, as far as the shell morphology and colour pattern are concerned, to the populations ranging in Cape Verde Islands, Senegal and Caribbean. On the same plate, NORDSIECK AND GARCÍA-TALAVERA (1979) pictured as "*Nitidella canariensis* (d'Orbigny, 1839)" a reddish shell with an intact apex and with dark spiral bands under the suture and at the mid-part of the last whorl. Even if uncommon, this form must be accepted within the natural variability of *M. ocellata*.

We propose to use provisionally the name *M. ocellata* for the whole Eastern Atlantic populations, thus accepting the possible occurrence of a united amphiatlantic species, and we propose to consider provisionally *B. canariense* d'Orbigny, 1839 as junior synonym of *M. ocellata*. However, the hypothesis of a sibling species in Eastern Atlantic waters, genetically and/or reproductively distinct from the Caribbean population, constitutes a possible alternative, due to the presence of a rather short protoconch (1.5 to 2.0 whorls with a coiled bulging top) supposed to be non-planktotrophic, that means having an intracapsular metamorphosis or a very short free-swimming larval stage (lecitotrophic non-feeding mode). Such a protoconch leads normally to a limited ability of dispersion, to a strong capacity of reproductive isolation and to the formation of distinct species at local or at regional scale. That is clearly the case in most of the *Mitrella* species known to us, which present both a short paucispiral protoconch and a limited distribution.

Distribution: The Eastern Atlantic populations of *M. ocellata* range on hard bottoms in very shallow water (intertidal to 3 m) from Açores to Madeira and the Cape Verde Islands, and from Western Sahara to Senegal. The species is distributed in the whole Canary Archipelago. It was not found in Agadir nor in Gambia (pers. obs.) or in Ghana (P. Ryall pers. comm.) and in the rest of the Gulf of Guinea (in the literature). The record from Santa Helena must be confirmed to deal really with the same species.

Remarks: The soft parts of the animals from the Canary Islands are dark tobacco brown, the whitish tip of the tentacles and few whitish zones on the foot or the head being flecked of deep white dots. The sole is whitish. The same chromatism of the animal was observed in the populations from Senegal.

(Right page) Figures 28-30. *Mitrella broderipi*. 28: 5.5 mm, 55-60 m, El Hierro, WEC; 29: 24: 6.5 mm, low tide, Caleta de Abajo, Gran Canaria, JHC; 30: 7 mm, 12 m, Gando, Gran Canaria, JHC. Figures 31-36. *Anachis avaroides*. 31: 6.1 mm, 55-60 m, El Hierro, WEC; 32: 5.5 mm, 55-60 m, El Hierro, WEC; 33: 5.6 mm, 55-60 m, El Hierro, WEC; 34: 6.7 mm, 55-60 m, El Hierro, WEC; 35: 6.1 mm, 55-60 m, El Hierro, WEC; 36: 5.4 mm, 55-60 m, El Hierro, WEC.
(Página derecha) Figuras 28-30. Mitrella broderipi. *28: 5.5 mm, 55-60 m, El Hierro, WEC; 29: 24: 6.5 mm, marea baja, Caleta de Abajo, Gran Canaria, JHC; 30: 7 mm, 12 m, Gando, Gran Canaria, JHC. Figuras 31-36.* Anachis avaroides. *31: 6.1 mm, 55-60 m, El Hierro, WEC; 32: 5.5 mm, 55-60 m, El Hierro, WEC; 33: 5.6 mm, 55-60 m, El Hierro, WEC; 34: 6.7 mm, 55-60 m, El Hierro, WEC; 35: 6.1 mm, 55-60 m, El Hierro, WEC; 36: 5.4 mm, 55-60 m, El Hierro, WEC.*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Genus *Anachis* H. and A. Adams, 1853

Type species by subsequent designation (Tate, 1868:13): *Columbella scalarina* Sowerby, 1832.

Anachis avaroides Nordsieck, 1975 (Figs. 19-27, 31-36)

Material examined: Açores: many sh, 0-15 m, FBC; 1 sh, 6 m, WEC (Fig. 20); 9 sh, 8 m, FSC. Ma: 2 sh, 9-12 m, JHC; 4 sh, 14-21 m, WEC (Fig. 21); many sh, FSC. Pa: 1 sh, 6 m, JHC (Fig. 22); 6 sh, 20-40 m, WEC; 2 sh, 40 m, FSC. Hi: 1 sh, 5-12 m, JHC; many sh, 30-60 m, WEC (Gigs 24-27, 31-36); many sh, FSC. Go: 4sh, 20-30 m, WEC (Fig. 33). Te: 2 sh WEC. GC: 1 sh, SMF syntype, stored as "holotype" (Fig. 19); 3 sh, 9-12 m, JHC. La: 1 sh, 46-50 m, FSC.

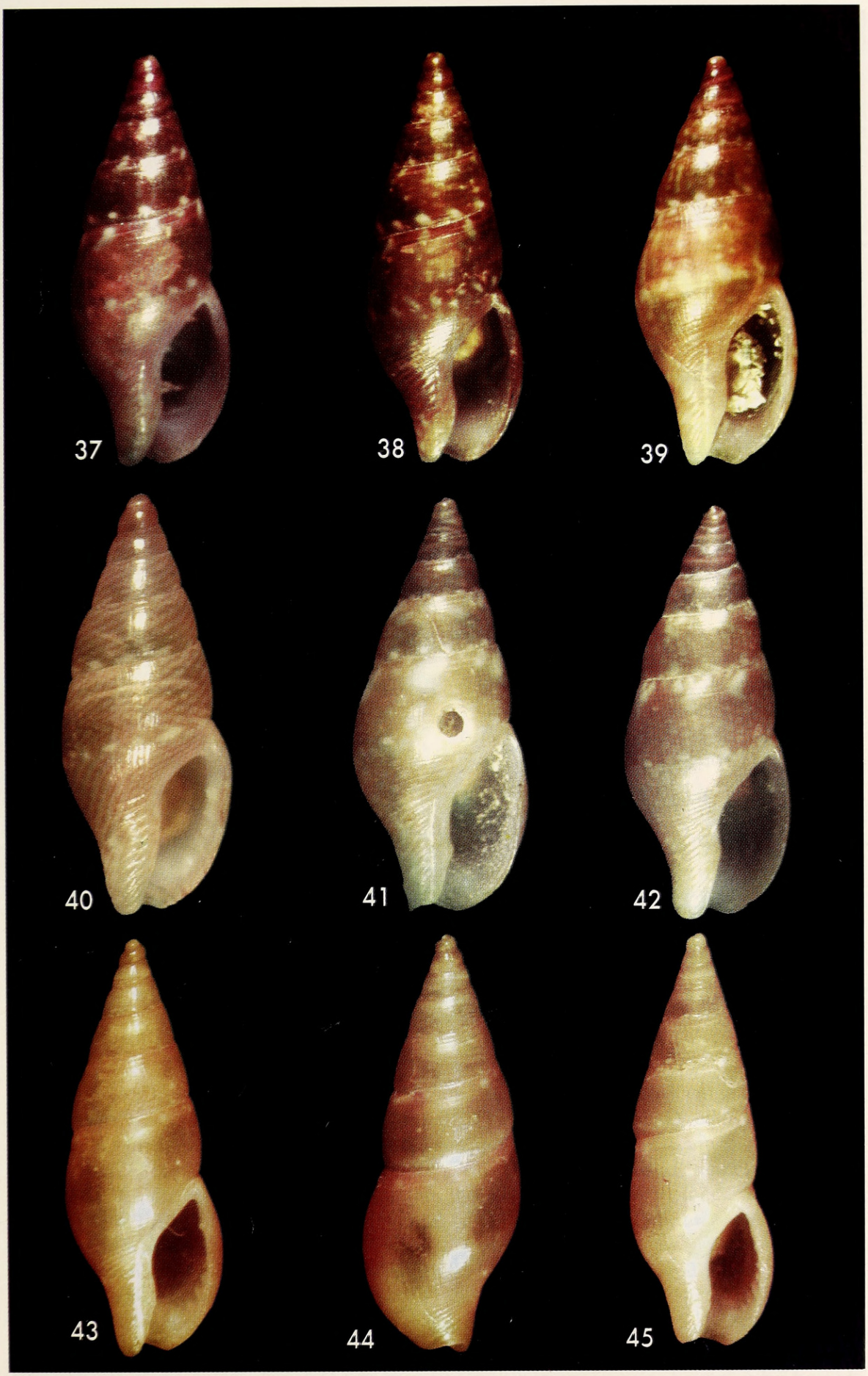
Taxonomy: *Anachis avaroides* Nordsieck, 1975 was described on the basis of a dark "grey brown" subadult shell of 6.5 x 2.5 mm (Nordsieck, 1975: 6, fig. 29), said to come from Las Palmas (Gran Canaria), and explicitely designated as holotype in the original description (referred as collection number Nr 73.35). The original description does not deal with any paratype and does not suggest the study of further shells. The shell stored as "holotype" in SMF (Fig. 19), labelled as coming from Gran Canaria with no register or collection number, measures 7.0 x 2.75 mm and presents a light orange colour ground. This shell has the same slender stepped spire than the type-figure, the same subadult outer lip and a similar macro sculpture of axial ribs and spiral cords at the base of the last whorl. Its colour pattern shows however a spiral decoration of white marks on the shoulder and on the spiral cords at the base of the last whorl, whereas the type-figure shows only a spiral row of white marks at the middle of the last whorl. So it can be stated that the so-said SMF "holotype" is not the holotype originally designated by Nordsieck (1975). As any revision or any new type designation did not occur about this topic, and in the wait of the possible rediscovery of the authentic holotype, it is felt to be more appropriate to consider the so-said SMF "holotype" as a simple syntype subsequently joined to the type lot by F. Nordsieck.

The original attribution of the species to the genus *Anachis* was clearly founded on the presence of strong spiral ribs. *A. avaroides* was compared by Nordsieck (1975) to the Caribbean *A. avara* (Say, 1822), which shows however a more spindle-shaped outline, a more pointed apex, less numerous axial ribs, a more slender aperture and a more vertical outer lip (Radwin, 1978 a: fig.3). Nordsieck and García-Talavera (1979) picture as *"Anachis avaroides* F. Nordsieck, 1975", a shell very similar to our Fig. 25. They also picture as *"Anachis atomella* (Duclos, 1840)" a shell which looks like a subadult of *A. avaroides*. The type of *A. atomella*, examined in MNHN, is a very different species belonging to the Indo Pacific Province.

Curiously, Nordsieck and García-Talavera (1979) do not give Gran

Figures 37-39. *Mitrella bruggeni*. 37: 6.6 mm, 30-55 m, El Hierro, WEC; 38: 7 mm, 30-55 m, El Hierro, WEC; 39: 6.6 mm, 30-55 m, El Hierro, WEC. Figure 40. *Mitrella broderipi*, 9 mm, 90-96 m, Arinaga, Gran Canaria, JHC. Figures 41-45. *Mitrella bruggeni*. 41: 7.9 mm, 46-50 m, Puerto del Carmen, Lanzarote, WEC; 42: 8.2 mm, 46-50 m, Puerto del Carmen, Lanzarote, WEC; 43, 44: 9 mm, 40-60 m, Puerto de La Luz, Gran Canaria, JHC; 45: 9 mm, 40-60 m, Puerto de La Luz, Gran Canaria, JHC.

Figuras 37-39. Mitrella bruggeni. *37: 6.6 mm, 30-55 m, El Hierro, WEC; 38: 7 mm, 30-55 m, El Hierro, WEC; 39: 6.6 mm, 30-55 m, El Hierro, WEC. Figura 40.* Mitrella broderipi, *9 mm, 90-96 m, Arinaga, Gran Canaria, JHC. Figuras 41-45.* Mitrella bruggeni. *41: 7.9 mm, 46-50 m, Puerto del Carmen, Lanzarote, WEC; 42: 8.2 mm, 46-50 m, Puerto del Carmen, Lanzarote, WEC; 43, 44: 9 mm, 40-60 m, Puerto de La Luz, Gran Canaria, JHC; 45: 9 mm, 40-60 m, Puerto de La Luz, Gran Canaria, JHC.*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Canaria in the distribution of *A. avaroides*, but only La Palma, Selvagen and Porto Santo (Madeira). It is suggested here that the type material of *A. avaroides* may well come from La Palma, where the species is abundant in moderate depths, better than from the type locality of "Las Palmas" (Gran Canaria), where the species looks as being very scarce and as ranging at deeper levels.

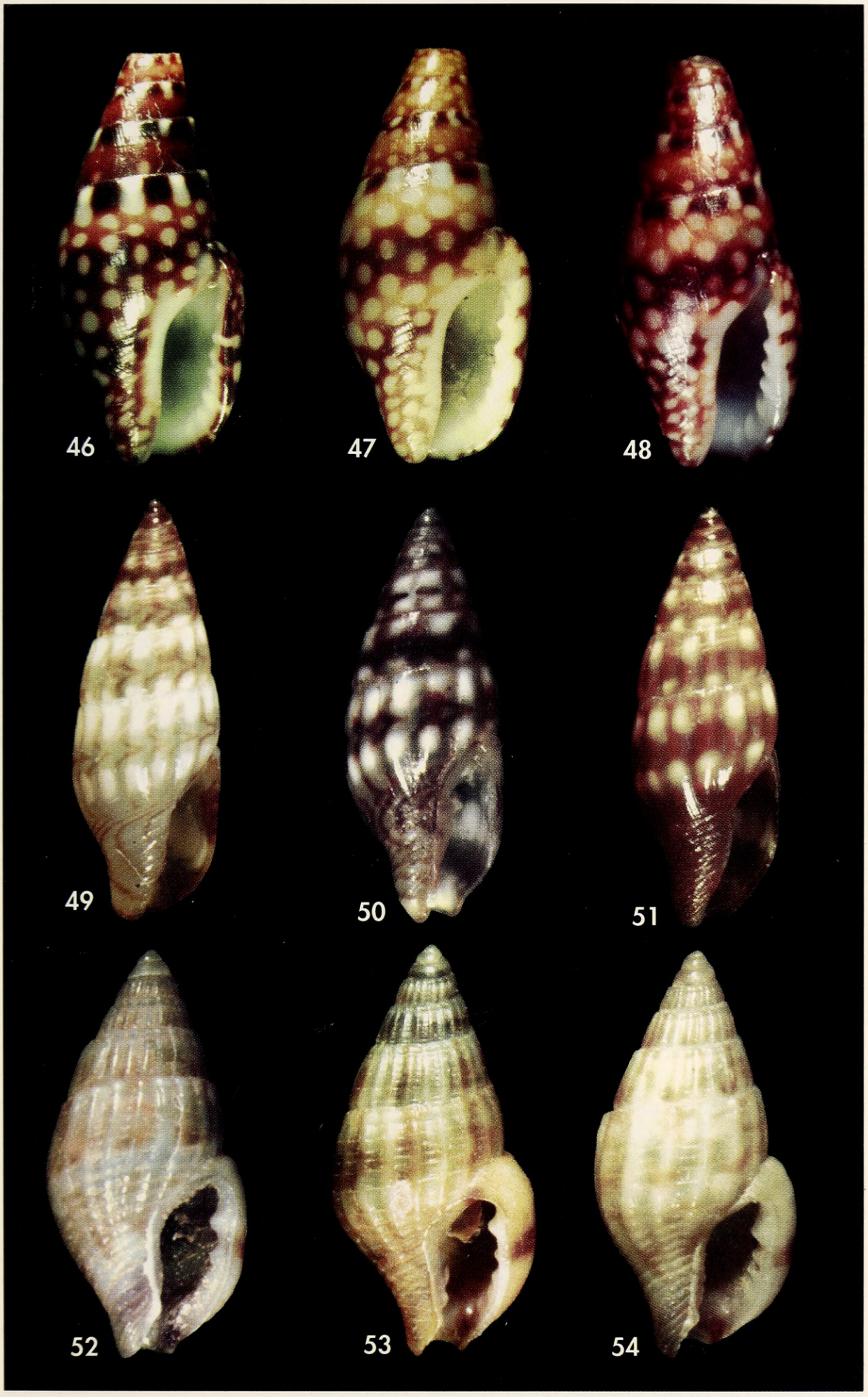
Distribution: The species is known from the Açores, Madeira, Selvagen Islands and the Canary Islands, but it is not recorded from the continental shelf. Off the Açores and Madeira, shells are commonly found in the beach drift or in moderate depths (0-20 m), whereas the species is generally found at deeper level in the Canary Islands (20-60 m), rarely in shallower water. It seems that the species is somewhat common in hard bottom environments off the western Canary Islands (lower infralittoral and upper circalittoral) but very uncommon in the central and eastern Canary Islands.

Remarks: *A. avaroides* shows as a rather variable phena. Most of the shells (Figs. 20-24, 26, 31, 34-36) are stout and thick, with strong axial ribs and a somewhat stepped outline. However, few shells show a more slender outline (Figs. 19, 25), sometimes with very faint axial ribs (Fig. 27) or just limited to the 2 or 3 first whorls (Figs. 32, 33). All the intergrades exist, even with *M. broderipi* which presents a similar range of variation of the shell outline and of the aperture (Figs. 10-18, 28-30, 40), and the same diversified patterns of the shell chromatism (Figs. 28-36). The protoconch is the same in *A. avaroides* and in *M. broderipi*.

Both phenae "*A. avaroides*" and "*M. broderipi*" have been collected together in several places, and each one looks as representing a tip of the morphologic cline of one single species. The matter remains however to be accurately verified. One of the most contradictory point lies in the fact that where *A. avaroides* is abundant (for instance in the lower infralittoral from Hierro), it is mixed with the slender "deeper form" of *M. broderipi* (Figs. 16-18) and the possible morphologic intergrades (Fig. 27) are very scarce and unclear. It must be noted that the slender "deeper form" of *M. broderipi* never suggests a tendency to axial ribbing, neither to the formation of fine spiral striae at the top of the whorls as it often occur in *A. avaroides*, even in poorly ribbed shells (Figs. 32, 33). That means that, in case where *A. avaroides* would be a "deep form" of *M. broderipi*, it would range in apparent syntopy (at least in Canary Islands) with another "deep form" of the same species without evident intergrade.

If we consider the phenetic complex "*M. broderipi / A. avaroides*" as a whole, it presents a much larger variability of the shell morphology and of the colour pattern in Madeira and in the Canary Islands (the highest variability being recorded from the western Canary Islands), whereas the populations from Alboran Sea (with only the *M. broderipi* shallow morph) and from the Açores

(Right page) Figures 46-48. *Mitrella ocellata*. 46: 9.2 mm, low tide, Tenerife, FBC; 47: 10.5 mm, low tide, Tarajalillo, Gran Canaria, FBC; 48: 10.2 mm, low tide, Tarajalillo, Gran Canaria, FBC. Figures 49-51. *Zafra exilis*. 49: 3.5 mm, 40 m, San Cristobal, Gran Canaria, J. Ferreiro Coll.; 50: 3,2 mm, 2-3 m, Pasito Blanco, Gran Canaria, FBC; 51: 3.5 mm, 40 m, San Cristobal, Gran Canaria, JHC. Figures 52-54. *Parvanachis obesa*. 52: 4.9 mm, 9 m, Santa Cruz de Tenerife, WEC; 53: 5.2 mm, 9 m, Santa Cruz de Tenerife, FSC; 54: 4.4 mm, 9 m, Santa Cruz de Tenerife, FSC.
(Página derecha) Figuras 46-48. Mitrella ocellata. *46: 9.2 mm, marea baja, Tenerife, FBC; 47: 10.5 mm, marea baja, Tarajalillo, Gran Canaria, FBC; 48: 10.2 mm, marea baja, Tarajalillo, Gran Canaria, FBC. Figuras 49-51.* Zafra exilis. *49: 3.5 mm, 40 m, San Cristobal, Gran Canaria, J. Ferreiro Coll.; 50: 3,2 mm, 2-3 m, Pasito Blanco, Gran Canaria, FBC; 51: 3.5 mm, 40 m, San Cristobal, Gran Canaria, JHC. Figuras 52-54.* Parvanachis obesa. *52: 4.9 mm, 9 m, Santa Cruz de Tenerife, WEC; 53: 5.2 mm, 9 m, Santa Cruz de Tenerife, FSC; 54: 4.4 mm, 9 m, Santa Cruz de Tenerife, FSC.*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(with only the *A. avaroides* morph) show as much less variable. If the specific unity of this complex would be confirmed in the future, the reduced variability occurring in Alboran Sea and in the Açores may result from a "founder effect". Further inquiries are required about this topic, and in the present state we feel more appropriate to consider *A. avaroides* as a possible sibling species of *M. broderipi*.

The phena *A. avaroides* has apparently never been collected in live conditions but only as shells.

Genus *Parvanachis* Radwin, 1968

Type species by original designation: *Buccinum obesum* C.B.Adams, 1845.

Parvanachis obesa (C.B.Adams, 1845) (Figs. 52-54)

Buccinum obesum C.B.Adams, 1845

Material examined: Te: 5 sh, 9 m, WEC (Fig. 52); 5 sh, 9 m, FSC (Figs. 53, 54).

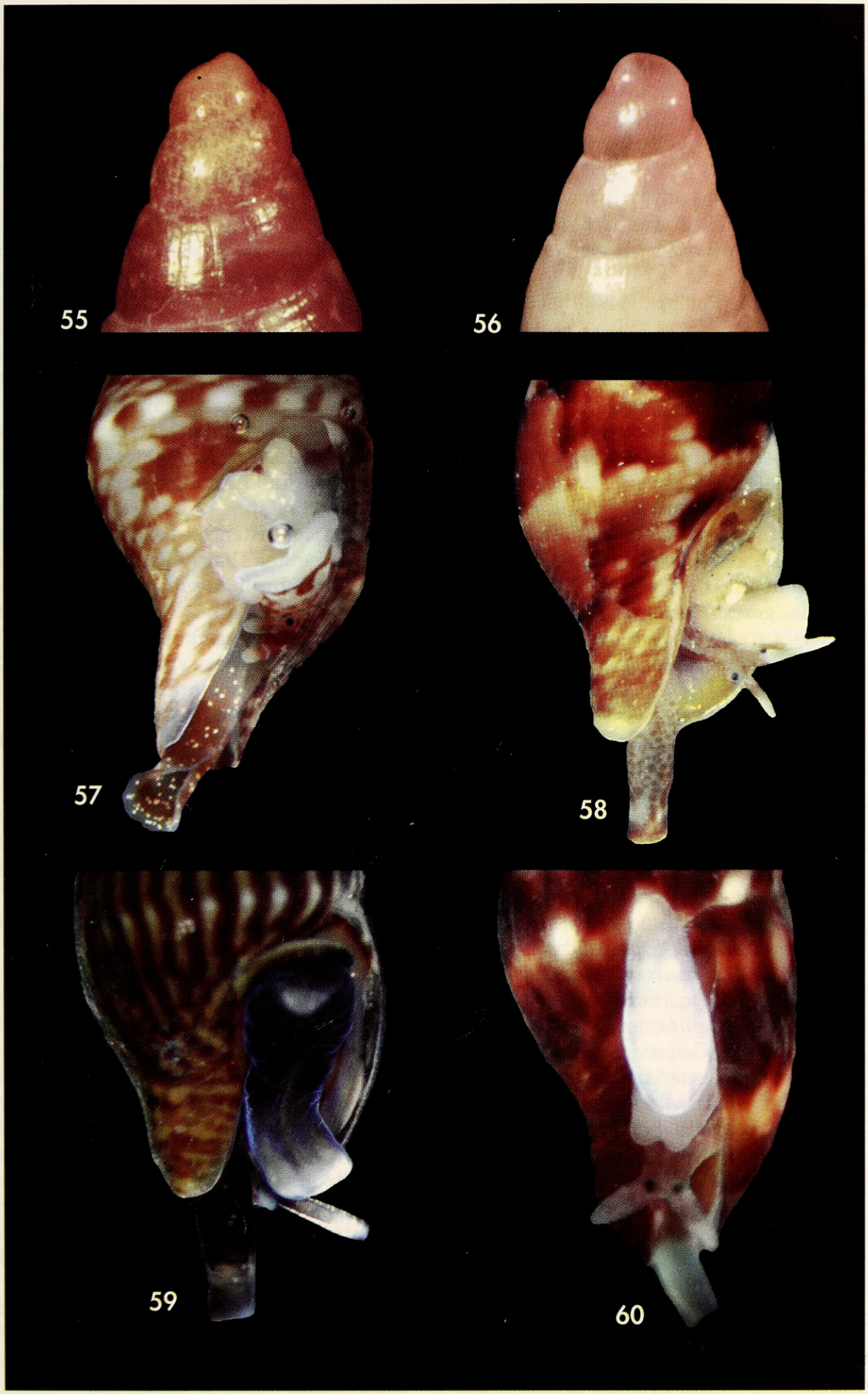
Taxonomy: *Parvanachis obesa* (C. B. Adams, 1845) was revised by RADWIN (1978 a) who characterizes the genus *Parvanachis* as gathering "the stout, prominently ribbed columbellids with inflated body whorl and heavily thickened, flaring apertural lips", all features well represented in *P. obesa*. Radwin stresses on the diagnostic feature represented by "the strongly down-hooked proximal cusp of the lateral radular tooth ", considered as typical of *Parvanachis*. In fact, *P. obesa* shows as very distinct from the *Anachis* species found in Eastern Atlantic, by its inflated body whorl, its lattice patterned sculpture, the rounded shape of the thick outer lip and the strong upper denticle.

The few shells found in the harbour of Santa Cruz de Tenerife do not differ from the shells found in Lesser Antilles. The presence of *P. obesa* in Eastern Atlantic was never recorded in the literature.

Distribution: The species was described from Jamaica and it is known to have a large range in Western Atlantic, from Maryland to central Uruguay, that means well beyond the limits of the Caribbean Province. In Eastern Atlantic, the species is only known from Tenerife where few shells were collected by diving in the harbour of the main town of Santa Cruz, at a depth of 9 m (1982-1983).

Remarks: This record of *P. obesa* in Tenerife clearly corresponds to an accidental introduction by shipping. Several of the shells being in very fresh condition, some with the dry animal inside, the presence of a live population is

Figures 55, 56. *Mitrella bruggeni*, protoconchs. 55: 1-3 m, Algeciras, Andalucía, JHC; 56: 40-60 m, Puerto de la Luz, Gran Canaria, JHC. Figure 57. *Mitrella* cf. *minor*, animal, shell length 10 mm, 150 m, off northwest Gran Canaria, JHC. Figure 58. *Mitrella pallaryi*, animal, shell length 14 mm, 200 m, off northwest Gran Canaria, JHC. Figure 59. *Mitrella broderipi*, animal, shell length 7 mm, 30 m, San Cristobal, off northeast Gran Canaria, JHC. Figure 60. *Zafra exilis*, animal, shell length 3 mm, 30 m, San Cristobal, off northeast Gran Canaria, JHC.
Figuras 55, 56. Mitrella bruggeni, *protoconchas. 55: 1-3 m, Algeciras, Andalucía, JHC; 56: 40-60 m, Puerto de la Luz, Gran Canaria, JHC. Figura 57.* Mitrella *cf.* minor, *animal, largo de concha 10 mm, 150 m, noroeste de Gran Canaria, JHC. Figura 58.* Mitrella pallaryi, *animal, largo de concha 14 mm, 200 m, noroeste de Gran Canaria, JHC. Figura 59.* Mitrella broderipi, *animal, largo de concha 7 mm, 30 m, San Cristobal, noreste de Gran Canaria, JHC. Figura 60.* Zafra exilis, *animal, largo de concha 3 mm, 30 m, San Cristobal, noreste de Gran Canaria, JHC.*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assumed. However, any new sampling was not recorded along the last twenty years, and it does not seem that the species has spread out in Tenerife or even survived in the harbour of Santa Cruz.

Genus *Zafra* A. Adams, 1860

Type species by monotypy: *Zafra mitriformis* A. Adams, 1860.

Zafra exilis (Philippi, 1849) (Figs. 49-51, 60)

Columbella exilis Philippi, 1849

Material examined: Te: 2 sh, 3-8 m, JHC. GC: 7 sh, 2-200 m, JHC (Figs. 51, 60); many sh, 2-3 m, FBC (Fig. 50); 1 sh, 40-60 m, J. Ferreiro Coll (Fig. 49).

Taxonomy: The species was cited and redescribed from the Red Sea by DRIVAS AND JAY (1997). Despite a somewhat variable decoration, the shell shows a very homogeneous morphology and cannot be confused with any of the other Indo Pacific *Zafra*.

The genus *Zafra* was revised by DRIVAS AND JAY (1990), but it remains a poorly characterized group, not clearly distinguished for instance from the genus *Seminella* Pease, 1868 and from the genus *Ascalista* Drivas and Jay, 1990.

Zafra exilis is recorded from Gran Canaria by SEGERS AND SWINNEN (2003) as the first mention of this Indo Pacific species in the Atlantic waters.

Distribution: *Z. exilis*, described from Aden, is endemic to the Red Sea and to the Gulf of Aden. First discovered as one shell in 1993 by P. Segers on the South East coast of Gran Canaria, and as live specimens in 2001 by A. M. Garcia at 5 m off Santa Cruz de Tenerife, the species is overall well settled in Gran Canaria, where live specimens were collected by both authors, by F. Swinnen and by J. Ferreiro, all around the island in shallow to deep waters.

Remarks: SEGERS AND SWINNEN (2003) explained that the perfect correspondence of the specimens collected in the Canary Islands with the material examined from the Red Sea leads to consider that the population from the Canary Islands comes from a human introduction.

We can add that this introduction is recent and that we are witnessing to the progressive settling of a new species in the Canary Islands. As a matter of fact, the species reaches shallow waters in its Indo Pacific distribution like in Canary Islands, where it constitutes currently dense settlements (for instance, at 2-3 m in algae on rocks in the small bay of Pasito Blanco and in the harbour of Arguineguin, southern Gran Canaria, FBC). So it is very unlikely that the settling of a population in Gran Canaria, where active collectors are sampling the shallow fauna regularly since the seventies, might remain undiscovered for a long. NORDSIECK AND GARCÍA-TALAVERA (1979) did not record the species and any of the assiduous collectors in the place (except P. Segers with one shell in 1993) did not find any trace of the species before the years 2000.

Because the international harbour of Las Palmas is the most evident place for an accidental introduction of such an exotic species (for example by cleaning the ballast tanks of trade ships), it can be assumed that the species has spread out from Las Palmas towards the northwestern and the southern tips of the Island. As the first discovery occurred in 1993 about 55 km south from Las Palmas, and considering the time required for the dispersion of a species supposed to have an intracapsular metamorphosis, it can be assumed that the introduction of the species dates about from the beginning of the eighties.

The animals from Gran Canaria are whitish with the nape and the sides of the foot light to dark brown (Fig. 60). The chromatism of the animals from Indo Pacific waters is unknown.

Genus *Nassarina* Dall, 1889

Type species by original designation: *Nassarina bushii* Dall, 1889.

Nassarina rietae Segers and Swinnen, 2004

Material examined: Pa: 1 sh, 42 m (paratype FSC).

Taxonomy: *Nassarina rietae* was described from 3 shells collected at 42 m off La Palma, Canary Islands. Any other record was not made about this species in the literature, and it was not found in the whole material studied in public and private collections.

N. rietae differs from the other *Nassarina* species from Western Atlantic (RADWIN, 1978 a) mainly in its rather wide subrectangular aperture with short and wide siphonal canal instead of small oval aperture with longer and narrow siphonal canal in Western Atlantic species. *N. rietae* differs from the *Nassarina* species from Senegal and Guinea Bissau (PELORCE AND BOYER, 2005) mainly in its stouter outline with much inflated whorls and in its few and very strong axial ribs with wide intervals.

Distribution: Only known from La Palma, type locality.

Remarks: *N. rietae* does not seem to belong to the Caribbean fauna, neither to the fauna from the West African Province. The single record from the isolated place of La Palma (SEGERS AND SWINNEN, 2004) suggests a local endemism better than the introduction of an Indo Pacific species. The issue remains however to be fully checked, as the hard bottoms from upper circalittoral were mainly uncollected off Canary Islands like off western Morocco and Western Sahara.

CONCLUSIONS

The columbellid fauna from the Canary Islands is made of an assemblage of species belonging to different biogeographic sets.

A first group comprises species restricted to the Lusitanian Province: *Mitrella broderipi* ranges principally from the Alboran Sea to the Canary Islands, being rare off Madeira and lacking in the Açores, whereas the closely related morph *Anachis avaroides* is restricted to the northern Macaronesian Islands (from the Açores to the Canary Islands), and *Mitrella bruggeni* ranges from the Canary Islands, northwest Morocco and Madeira to Alboran Sea, southern Italy and Tunisia (as *M. coccinea* in CHIARELLI, MICALI AND QUADRI, 2003).

A second group comprises species ranging from the latitudes of southern Morocco to a limited part of the West African province: the morph *Mitrella* cf. *minor* found off the Canary Islands extends to northern Senegal, and *Mitrella turbita* ranges from southern Canary Islands to central Senegal.

A third group comprises planktotrophic species presenting a wide but possibly fragmented distribution from the Lusitanian Province to the equatorial latitudes: *Columbella adansoni* ranging in the whole Macaronesian Archipelagos and from Sierra Leone to northern Angola, and *Mitrella pallaryi* ranging from Galicia and Mediterranean to Senegal and being found also in northern Angola. The case of *Mitrella ocellata*, ranging from Madeira to Senegal and possibly also in Santa Helena, is somewhat different, as the present distribution of this supposed amphiatlantic species may result from several different ways of spreading.

A fourth group is composed of supposed introduced species from

Caribbean or Indo Pacific origin, among which only *Zafra exilis* seems to have settled successfully. The positive record of two introduced columbellids species, the well-established *Zafra exilis* and the elusive *Parvanachis obesa*, tends to demonstrate that a high potential of introduction of tropical and subtropical species of Columbellidae occurs in the Canary Islands.

Two shells attributable to the Caribbean *Steironepion monilifera* (Sowerby, 1844) were observed in the F. Swinnen Collection, labelled as "Canary Islands, from fishermen". The poor precision of this datum and the fact that the species is not cited in the literature neither observed in other molluscan collection from the Canary Islands lead to consider this reference as not fully reliable. However, such an occurrence can be appreciated as perfectly plausible. It is possible that a local introduction of *S. monilifera* failed after few generations, like it seems to be the case for *P. obesa*. Such a situation of failed introductions can be expected as a current process, and the successful introductions, like observed with *Z. exilis*, are probably the less common result. The high frequency of accidental introductions of marine molluscs is probably under-estimated, but it can be reasonably considered as a direct by-product of the contemporary maritime economy.

The single case of possible columbellid endemism in the Canary Islands may be that of *Nassarina rietae* Segers and Swinnen, 2004, only known through 3 shells from La Palma. This finding suggests that lower infralittoral or upper circalittoral new species of Columbellidae may remain to discover off the Canary Islands, especially on hard bottoms in the most superficially explored areas, such as Fuerteventura or the lesser western Islands.

The cases of *M.bruggeni* and of the complex *M. broderipi / A. avaroides* require a clarification of the biologic status of the "deeper forms". The irregular distribution of our considered "deeper forms" (apparently absent, for instance, in the Alboran Sea) suggests that the influence of environmental factors such as the bathymetric pressure are not fully explicative of the morphologic differences at work. A relative genetic autonomy between shallow and deep populations seems to occur and would explain the relative homogeneity observed in each "bathymetric form" as well as the irregular bathymetric and geographic distributions of the morphs.

The case of *M. turbita* and of the complex *M. broderipi / A. avaroides* show that the genera *Mitrella* and *Anachis* are not separated by significant differences. The diagnostic value of the axial ribs is contested by its irregular presence in *M. turbita* and by the continuous morphologic cline represented by this feature in the complex *M. broderipi / A. avaroides*. The presence of spiral cords (irregularly represented in *A. avaroides*) and of spiral grooves (irregularly represented in *M. bruggeni*) seems to follow the same pattern. The poor reliability of these morphologic features as diagnostic criteria at the specific level leads to consider them as not reliable diagnostic criteria at the generic level.

This point must be considered like a complementary argument for a reviewing of the supraspecific classification of the Columbellidae, and like a guideline for the reinterpretation of the discriminating criteria within this family.

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BIBLIOGRAPHY

ABBOTT, R. T., 1974. *American Seashells*. Van Nostrand Reinhold Company, New York. Pp. 1-663.

ALONSO, M. R. AND JIMÉNEZ MILLÁN, F., 1979. Estudio sistemático y cuantitativo de moluscos del Norte de Gran Canaria (España).*Cuadernos de Ciencias Biológicas*, 2 (29): 105-115.

BOYER, F. AND ROLAN, E., 2005. About a sibling species of *Mitrella minor* (Scacchi, 1836). *Iberus*, 23 (2): 53-67.

CHIARELLI, S., MICALI, P. AND QUADRI, P., 2003. Note su alcune specie mediterranee del genere *Mitrella* Risso, 1826 (Gastropoda, Muricidae). *Bollettino Malacologico*, 38 (9-12): 171-183.

DAUTZENBERG, P., 1891. Voyage de la Goelette Melita aux Canaries et au Sénégal, 1889-1890. Mollusques Testacés. *Mémoires de la Société Zoologique de France*, 4: 16-65, pl. 3.

DAUTZENBERG, P., 1927. Mollusques provenant des campagnes scientifiques du Prince Albert Ier de Monaco dans l'océan Atlantique et dans le golfe de Gascogne. *Résultats des campagnes scientifiques Albert I*, 72: 1-401.

DRIVAS, J. AND JAY, M., 1990. The Columbellidae of Reunion Island (Mollusca: Gastropoda). *Annals of the Natal Museum*, 31: 163-200.

DRIVAS, J. AND JAY, M., 1997. On a collection of Columbellidae from the Red Sea. *Apex*, 12 (1): 27-30.

HERNÁNDEZ-OTERO, J. M., GARCÍA-TALAVERA,F. AND HERNÁNDEZ-GARCÍA, M., 2003. División Apogastropoda. En Moro, L., Martín J. L., Garrido and Izquierdo, I. (Eds): *Lista de especies marinas de Canarias (algas, hongos, plantas y animales)*. Dirección de Política Territorial y Medio Ambiente del Gobierno de Canarias. Pp. 83-91.

KNOWLTON, N., 1993. Sibling species in the sea. *Annual Review of Ecology and Systematics*, 24: 189-216.

LUQUE, A. A., 1984. El género *Mitrella* Risso, 1826 (Gastropoda, Columbellidae) en las costas del Sur de España. *Resúm. Com. V° Congr. Nac. Malacología*, Vigo, 6-9 Septiembre 1984, p. 13.

LUQUE, A. A., 1986. El género *Mitrella* Risso, 1826 (Gastropoda: Columbellidae) en las costas Ibéricas. *Bollettino Malacologico*, 22 (9-12): 223-244.

MOOLENBEEK, R. G. AND HOENSELAAR, H.J., 1991. On the identity of "*Columbella rustica*" from West Africa and the Macaronesian Islands. *Bulletin of Zoölogisch Museum*, 13 (6): 65-70.

NORDSIECK, F., 1975. Some trips to the Canary Islands. Part II.- Conchiglie delle Isole Canarie. *La Conchiglia*, 7 (75-76): 3-7, 22, pls. 3-5.

NORDSIECK, F., AND GARCÍA-TALAVERA, F. (1979). *Moluscos marinos de Canarias y Madeira (Gastropoda)*. Aula de Cultura de Tenerife, 208 pp., 46 pls.

OLIVERIO, M., 1995. Larval development and allozyme variation in East Atlantic *Columbella* (Gastropoda: Prosobranchia: Columbellidae). *Scientia Marina*, 59 (1): 77-86.

ORBIGNY, A. D. D', 1839. *Mollusques*. In WEBB, P. B. AND BERTHELOT, S., *Histoire Naturelle des Iles Canaries*, 2 (2): 1-117, pls I – VII B.

PALMERI, A., 1987. Prima segnalazione di *Mitrella bruggeni* per le acque Italiane. *Bollettino Malacologico*, 23 (11-12): 427-429.

PELORCE, J. AND BOYER, F., 2005. La famille Columbellidae (Gastropoda: Muricoidea) dans l'infralittoral de la Péninsule du Cap Vert (Sénégal). *Iberus*, 23 (2): 95-118.

PHILIPPI, R. A., 1849. Centuria tertia Testaceorum novorum. *Zeitschrift für Malakozoologie*, 6 (2): 17-26.

RADWIN, G., 1977. The family Columbellidae in the Western Atlantic. *The Veliger*, 19 (4): 403-417.

RADWIN, G., 1978 a. The family Columbellidae in the Western Atlantic. Part II a.-The Pyreninae. *The Veliger*, 20 (2): 119-133

RADWIN, G., 1978 a. The family Columbellidae in the Western Atlantic. Part II b.-The Pyreninae (continued). *The Veliger*, 20 (4): 328-344.

ROLÁN, E. AND RYALL, P., 1999. Il genere *Columbella* Swainson, 1840 (Gastropoda, Muricoidea) nell'Atlantico orientale. *La Conchiglia*, 30 (290): 57-58.

ROLÁN, E. AND TRIGO, J., 2000. New information about *Mitrella pallaryi* (Mollusca, Gastropoda). *La Conchiglia*, 297: 21-24.

SEGERS, W. AND SWINNEN, F., 2003. On the occurrence of *Zafra exilis* (Philippi, 1849) on the Canary Islands. *Gloria Maris*, 42 (4-5): 101-103.

SEGERS, W. AND SWINNEN, F., 2004. *Nassarina rietae*, a new species from the Canary Islands (Gastropoda, Prosobranchia). *Gloria Maris*, 43 (4): 15-19.

THORSON, G., 1950. Reproductive and larval ecology of marine bottom invertebrates. *Biological Reviews*, 25 (1): 1-38.

VAN AARTSEN, J. J., MENKHORST, H. P. M. G. AND GITTENBERGER, E., 1984. The marine mollusca of the Bay of Algeciras, Spain, with general notes on *Mitrella, Marginellidae* and *Turridae*. *Basteria*, supplt. n° 2: 1-135.