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The genus *Granulina* (Marginellidae) in the Canary Islands

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KEY WORDS: Marginellidae, *Granulina*, Lusitanian Province, Canary Islands, new species.

ABSTRACT The species of the genus *Granulina* (Gastropoda: Marginellidae) from the Canary Islands are revised, and discussed in the context of the apparent assymetrical diversity displayed on each side of the Strait of Gibraltar.
The animal of *Granulina guancha* (d'Orbigny,1840) is described, and informations are given on the habitat and the distribution of the species. A new species (*Granulina canariensis* n.sp.) is described from the mid shelf.

RIASSUNTO Sono esaminate le specie del genere *Granulina* (Gastropoda: Marginellidae) dalle Isole Canarie (Spagna). Si discute anche l'apparente asimmetria faunistica ai due lati dello Stretto di Gibilterra. Si suggerisce che il maggior numero di specie noto per il Mediterraneo sia il risultato di maggiori e più approfonditi studi in quest'area.
Si descrive l'animale di *Granulina guancha* (d'Orbigny,1840) e vengono fornite informazioni su habitat e distribuzione nota della specie. Una nuova specie, *Granulina canariensis* n.sp., è descritta dalla zona circalittorale.

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INTRODUCTION

In his revision of the genus *Granulina* in the Mediterranean and the Eastern Atlantic, GOFAS (1992) gave only two species occuring in the Ibero-Moroccan Gulf [*Granulina occulta* (Monterosato, 1869) and *Granulina minusculina* (Locard, 1897)] and one species occuring in the Canarian Archipelago [*Granulina guancha* (d'Orbigny, 1840)].

Granulina occulta is said to be a mid to deep shelf species, which extends also to the whole of the Mediterranean, and *Granulina minusculina* is said to be a bathyal species, living down to 1.300 m and extending also to the Western Mediterranean. *Granulina guancha* was presented by Gofas without comment about living populations and bathymetric distribution.

Gofas did not quote any other known populations of *Granulina* for all the northwest African coasts from Western Morocco to Western Sahara, and just recorded shallow and deep species from Mauritania and further south. No further species of *Granulina* is recorded in the literature, as far as the Atlantic side of the Lusitanian Province is concerned.

On the other hand, Gofas scored four species ranging along the inner Mediterranean Sea and two species restricted to the Strait of Gibraltar. More recently, four new species were described from Central Mediterranean and Alboran Sea (SMRIGLIO & MARIOTTINI, 1996 and 1999; SMRIGLIO, MARIOTTINI & RUFINI, 1998; LA PERNA, 1999) and reported from circalittoral and bathyal levels.

Even if these last four species are waiting for a revision including the study of intraspecific variability, the genus *Granulina* can be appreciated as very well-represented in Mediterranean, compared to the apparent poor incidence reported from the adjacent Atlantic. However, this impression could derive from very unequivalent efforts of observation and sampling, as the recent discoveries in Mediterranean are coming from areas especially well-sampled and studied over the last twenty years (Central Mediterranean and the Strait), while the Atlantic side of the Lusitanian Province has been much less sampled during the same period.

Taking into account the wide considered area, from Cape St Vincent (South Portugal) to Cape Blanco (Western Sahara), the record of a so-called restricted number of species from the northwest African shelf can be considered as unseemly, compared to the relatively large number of species of *Granulina* recorded from the adjacent Mediterranean. The comparison of the respective real diversity of *Granulina* in both areas is relevant from a biogeographical point of view. It is to be verified whether there is a spatial continuity of the specific diversity in this genus all along the Lusitanian Province, or if a special increase (or maintenance) of the diversity in Mediterranean occured whilst the diversity was maintained (or reduced) in Northwestern Africa, for example through severe environmental events such as during the last glaciations.

This paper is devoted to a study of the genus *Granulina* in Canary Islands, and conceived as a contribution to the necessary reevaluation of the specific diversity of *Granulina* along the Lusitanian Province.

MATERIAL AND METHODS

Abbreviations Used

IRSNB: Institut Royal des Sciences Naturelles de Belgique, Brussels.

MNHN: Muséum National d'Histoire Naturelle, Paris.

NNM: Nationaal Natuurhistorisch Museum, Leiden, the Netherlands.

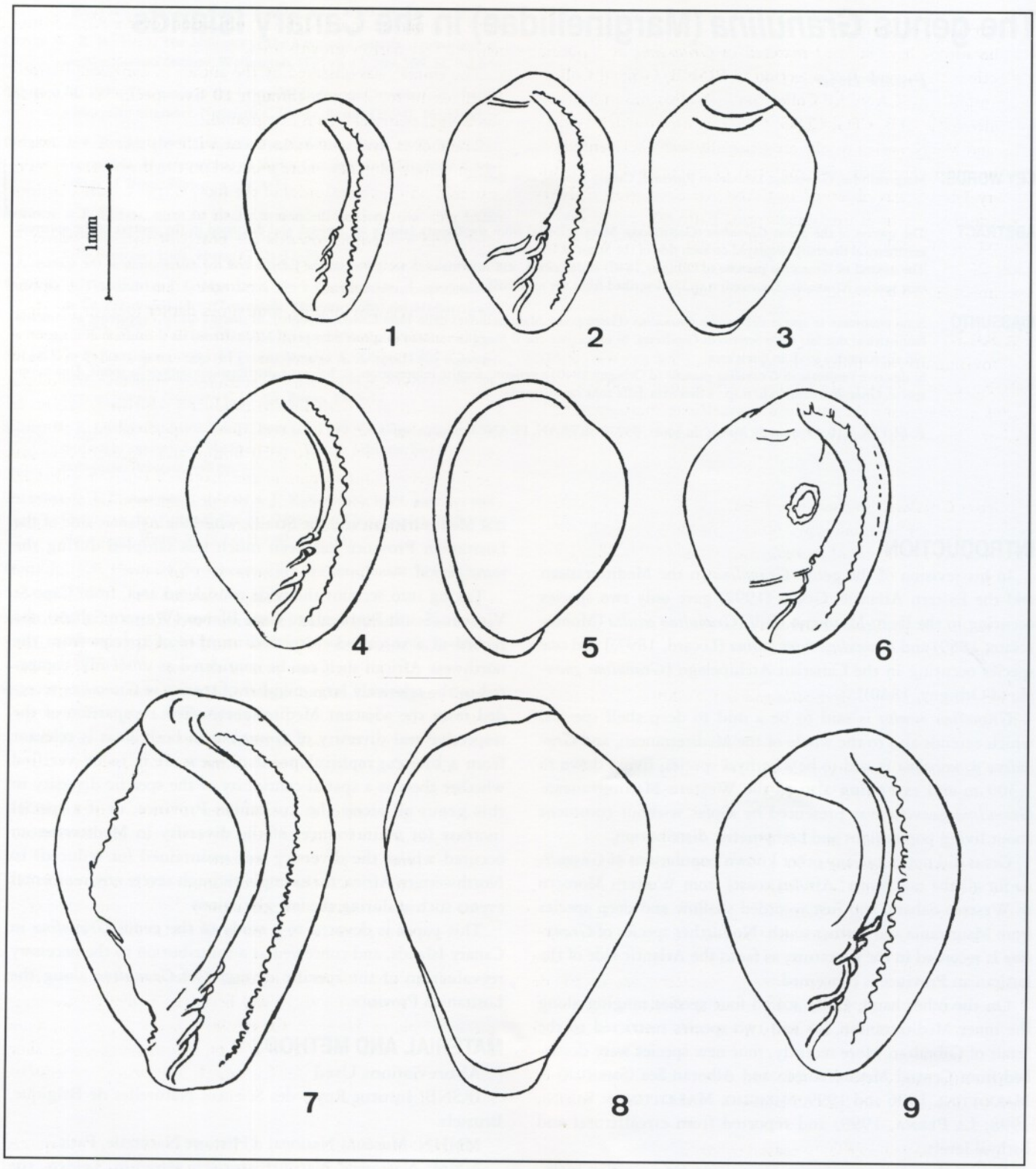
CFB: Collection Franck BOYER, Sevran, France.

CFG: Collection Franco GUBBIOLI, Marbella, Spain.

CFSG: Collection Francisco SICILIA GUILLEN, Arrecife, Lanzarote, Spain.

CFS: Collection Frank SWINNEN, Lommel, Belgium.

CWE: Collection Winfrid ENGL, Dusseldorf, Germany.



Figs. 1-9: Eastern Atlantic *Granulina*. 1: *Granulina guancha* (d'Orbigny). Lectotype (1.6 x 1.1 mm). Tenerife, in sands on the coast. BMNH. 2-3: *Granulina guancha* (d'Orbigny). Specimen (1.9 x 1.2 mm) from Lanzarote, Arrecife, El Reducto, 2 - 3 m. CFB. 4-5: *Granulina minusculina* (Locard). Lectotype (2.0 x 1.5 mm). West Morocco, 112 m. MNHN. 6: *"Marginella aliciae"*, manuscript name from Bavay. Cotype (1.95 X 1.65 mm). Off Portugal, Station Princesse Alice n° 2717/19.VII.08/750 m. Coll. Dautzenberg, IRSNB. 7-8: *Granulina canariensis* n. sp. Holotype (3.0 x 2.0 mm). Fuertaventura, off Puerto del Rosario, 100 m. MNHN. 9: *Granulina africana* Gofas. Holotype (2.6 x 1.8 mm). Senegal, off Gorée, 50 m. MNHN. Scale bar: 1 mm.

Sources of material

The author have studied material of *Granulina* in 3 public collections (Dautzenberg Collection in IRSNB, General Collection in MNHN, CANCAP Collection in NNM) and in 5 private collections (CFB, CFG, CFSG, CFS, CWE), in which Lusitanian and Macaronesian recolts are especially well-represented.

The most representative material of micro-molluscs from Canary Islands was observed in CANCAP Collection (NNM) with dead shells from dredgings (principally 60 to 240 m), in Collection W. Engl with dead shells sieved by diving (principally 20 to 40 m) and in the collection of the author with live specimens sieved by snorkeling (low tide level to 6 m).

RESULTS

Provisionally, we follow the position of LA PERNA (1999: 33), based on the external anatomy of the animals, and refer the genus *Granulina* to the family Marginellidae Fleming, 1828, rather than to the family Cystiscidae Coovert and Coovert, 1995.

Genus *Granulina* Jousseaume, 1888.

Type species by monotypy: *Marginella pygmaea* Issel, 1869, non Sowerby, 1846 (= *Marginella isseli* G. & H. Nevill, 1875). Red Sea.

Granulina guancha (d'Orbigny, 1840)
(Figs. 1-3)

Original reference: *Marginella guancha* D'ORBIGNY, 1840: 88, p6, figs. 32 - 34.

Type material: Lectotype designated and figured by GOFAS, 1992 (fig.1). BMNH 54.9.28.109.

Material examined - In CFB: Hierro, shallow water: 9 specimens. Hierro, La Restinga, 30 - 35 m, 04 - 99: 12 specimens (ex-CWE). Gran Canaria, Arinaga, 1 m, 11 - 98: 1 specimen. Lanzarote, Arrecife, El Reducto, 2 - 3 m, 06 - 99: 10 specimens (figs. 2-3). Lanzarote, Puerto del Carmen, 46 - 50 m, 03 - 97: 10 specimens (ex-CWE, Figs. 11, 12). Lanzarote, off Playa Blanca, 40 to 100 m: numerous shells. Fuertaventura, off Isla de Lobos, 60 to 100 m: 1 adult and 1 subadult shells.

In CWE: several lots of shells from infralittoral, sieved off Hierro and Lanzarote.

In Collection CANCAP (NNM): several lots of shells from circalittoral levels, dredged off Lanzarote and Fuertaventura.

Type locality: Tenerife, in coastal sands.

Description - GOFAS (1992:20) redescribed the shell accurately. Its principal distinctive characters are a somewhat slender outline, slightly rostrated posteriorly, with a slight break of the last whorl at the anterior quarter. Faint labial denticles. Outline of the labrum bevelled at the posterior third part. The general look is somewhat angular, due to several sharp breaks of the outline. A very fine microsculpture of intricated low granulations is apparent under high magnification (over x 80), additionally to very narrow growth lines.

The animal was observed by the author in Lanzarote (Arrecife, El Reducto, 2-3 m), through 10 live specimens sieved in short algal material on a rocky ground.

The foot is hyalinous-translucent with whitish to yellowish-cream cloudy blotches, more grouped on the mentum and more scattered on the lateral sides of the foot, except on the posterior third part which just bears a whitish to creamy yellow- orange axial band, widening towards the posterior tip. The center of the sole is decorated of very fine black flecks.

The head and tentacles are hyalinous-translucent, the siphon is creamy to creamy-orange, sometimes darker towards the tip.

The internal mantle is light cream with orange dots, more or less large, dark and scattered. The external mantle is light creamy yellow-orange with few scattered orange dots around the superior part and with low to produced whitish pustules. In fact, the relief is made of a continuous superficial coat of hyalinous skin, of which the irregular bumps and digitations are just surimposed to whitish dots of the mantle. In these conditions, bumps play like lens over whistish dots and seem themselves to be of a whitish colour for the observer looking in a perpendicular view.

Around the edge of the mantle three zones of dense blackish flecks and medium to dark orange blotches and dots are arranged. Two of these blackish zones are bordering each of the lateral-anterior side of the edge. The third blackish zone is situated along the central posterior part of the edge, and shows a narrowed part towards the apical tip. These three zones may just look like straight bordering fringes along the edge in some specimens, but they also may be much wider and lay till the lateral half-side of the mantle when this one is completely recovering the shell.

No orange point or dot on the foot, head and siphon on the 10 live specimens examined from Arrecife, nor any blueish dot on the external mantle were observed.

As a matter of fact, the chromatism of the soft parts of *Granulina guancha* presents a pattern clearly distinct from that of all Mediterranean species, as figured in Gofas (1992, pl. I).

Habitat - Only observed in Gran Canaria and Lanzarote from short algal growth on rocks and boulders in shallow water, in protected places. However the species is known to be also found from deeper levels, to around 100 m, and seems to prefer short vegetation growing on detritic rough sediments, as deducted from dredged samplings.

Distribution - NORDSIECK & TALAVERA (1975: 155) quoted the species from Tenerife, Gomera, Lanzarote, Salvajes and Madeira. According to the present records, it is proposed to add Hierro, Gran Canaria and Fuertaventura to the distribution of *Granulina guancha*, which seems in fact to spread all along the Canarian Archipelago.

GOFAS (1992) noted that the occurrence of the species in Madeira and Islas Desertas has to be verified, as the shells coming from these places seem to be slightly more slender.

However, narrow and slender shells of *G. guancha* were also collected at circalittoral levels off southwest Lanzarote (CFB).

The occurrence of populations of *Granulina guancha* in shallow water (0-3 m) was observed to be very scarce in Gran Canaria as well as in Fuertaventura, and the research was only fruitful in very restricted areas of very protected places.

Remarks - The supposed level of frequency and abundance is commented in a very contradictory manner by D'ORBIGNY (1840: 88) and NORDSIECK & TALAVERA (1979: 155). In fact, these authors considered only shells sorted out from coastal sands. In such conditions the evaluation of frequency and abundance cannot be considered as reliable.

According to the studied material and labels, and to field observations of the author, it seems that the species avoids shallow water, except in accidental conditions, and prefers to live at deeper levels. The matter is however to be verified through extensive samplings on hard bottoms in shallow waters.

It is here stressed the fact that the *Granulina* species present very often a scattered pattern of settlement in shallow water, and that shallow populations can be locally abundant in a small protected area just for the duration of one season, then disappearing for several years. Other micromolluscs sharing the same habitat are able to remain present for longer periods (personal observations in Lesser Antillas, in Western Mediterranean and in Mascarene Islands).

Observed occurrences of *Granulina guancha* in shallow waters of the Canary Islands seem to confirm this pattern of very fragile populations and erratic settlement, as far as the shallow levels are concerned. This pattern would be coherent with a marginal status of the populations reaching the coastal levels. However, such a pattern remains to be fully described and explained.

Granulina canariensis **n.sp**
(Figs. 7-8, 10)

Etymology: from the geographical distribution of the species, throughout the Canary Islands.

Type material - Holotype (3 x 2 mm) deposited in the Paris Museum (MNHN) (figs.7-8), and 14 paratypes (L = 2.9 to 3.1 mm): trawled off Puerto del Rosario, Eastern Fuertaventura, 100m. All adult shells.

16 paratypes dredged off Isla de Lobos, North Fuertaventura, 60-100 m:13 adult shells (L = 2.8 to 3.15 mm), 1 subadult and 2 juveniles.

11 paratypes trawled off Peninsula de Jandia, South Fuertaventura, 100-125 m: 6 adult shells (L=2.9 to 3 mm) and 5 juveniles.

All paratypes in CFB.

Other material examined - Three drilled shells (1 adult and 2 subadults) in CWE, trawled in 1997 off Agaete, North -West Gran Canaria (28° 07' 03" N, 15° 50' 20" W), 180-240 m. 5 adult shells (1 intact, 3 drilled and 1 badly crabbed), in CFB (ex-CWE) trawled off SW of Fuertaventura (28° 09' 03" N - 14° 25' 20" W), 107 m, 10-97 (fig. 10). Several lots of shells from circalittoral levels in Collection CANCAP (NNM), dredged off Fuertaventura.

Type locality: Fuertaventura, Canary Islands.

Description - Shell very large sized for the genus, average length 2.9 mm, average width 1.9 mm. Pyriform and slightly slender outline.

The posterior rostrum is somewhat truncated and the anterior part is tapering, with a sharp break of the last whorl just before the base on the left side. Outline of the labrum is deeply arched in the upper part and nearly straight in the two anterior thirds, which bear more distinct small inner denticles (average number: 42).

Four columellar pleats, the two anterior ones larger and more oblique, well separated from the two posterior small ones that are shorter, clearly duplicated and more perpendicular to the columella.

A thick columellar callus covers the columella. This callus is more developed towards the posterior part and wraps the top of the shell, as a continuation of the labial margin.

A fine microsculpture of intricate low granulation, very similar to *Granulina guancha*, is apparent under high magnification.

The animal is unknown.

Habitat - Unknown, but a good proportion of fresh dead shells were found in fine sediments collected off Fuertaventura, suggesting that the species lives on soft bottom environments.

Distribution - Known from Fuertaventura and Gran Canaria from around 60-100 m to 180 - 240 m. Fuertaventura and Gran Canaria. Not recorded from Madeira, nor from the West African continental shelf.

Remarks - The available records from northern parts of Fuertaventura and Gran Canaria lead to infer that the species very probably occurs also in Lanzarote and Tenerife, and possibly in the western islands of the archipelago. The most directly comparable species for shell size is *Granulina africana* Gofas, 1992 (Fig. 9), which differs by the smaller (average length = 2.2 to 2.8 mm), thicker and more rounded shell, the less numerous but strong labial denticles (average number: 30), and the more spaced and larger first and second columellar pleats. *Granulina africana* is known from Senegal to Ivory Coast, at 32 to 150 m, whereas *Granulina canariensis* n.sp. is just known by now from Canary Islands, at similar depths.

In fact, these two species do not seem to be close phyletic relatives, and *Granulina canariensis* n.sp. appears to have a very distinctive shell morphology, with no equivalent in Atlantic waters. However, both species could occupy in their respective range of distribution the same environmental place, as both seem to live on soft bottom plains at circalittoral levels.

DISCUSSION AND BIOGEOGRAPHIC REMARKS

Inquiries led to establish the existence of two well-spread species in the Canary Islands, *Granulina guancha* d'Orbigny from 0 to 100 m and *Granulina canariensis* n.sp. from 60 - 100 m to 180 - 240 m. Both species may apparently live at the same level around 60 - 100 m , but they do not necessarely share the same habitat. The occurrence of these two species on the continental shelf of Southern Morocco and Western Sahara is not attested.

The identity of the shells recorded from Mauritania by Talavera (1975) as *Granulina guancha* remains to be verified, as more recent samplings off Mauritania in shallow (GOFAS, 1992; ROLÁN & FERNANDES, 1997) and deep waters (Coll. CANCAP III, 1978, NNM; CFG) did not confirm really the matter. The real identity of *Granulina cf. guancha* from Madeira remains to verify.

Taking in account the extensive material examined from Canary Islands, it is assumed that *Granulina guancha* and *Granulina canariensis* are the most abundant and widespread species ranging on mid and lower shelf of the Archipelgo. A future discovery of further species in Canarian waters from these levels remains possible, as some species of *Granulina* can have very sparse populations and limited number of individuals (personal observations of the author). For instance, a few number of shells showing a slender-ovoid outline and rather referable to *G. occulta* (figs. 11-12) are found at circalittoral levels off southwest Lanzarote, collected with other shells more or less intergrading with *G. guancha* (break of the outer lip profile and thickened central Labrum). The bathyal benthic microfauna of Canary Islands remains very poorly known, and the occurrence of species of *Granulina* at these depths is very probable.

Along the Ibero-Moroccan Gulf, the bathyal levels are said to be inhabited by *Granulina minusculina* (Locard, 1897), known to be living from 112 to 1285 m on muddy bottoms, and presenting a very different medium sized shell (length from 2 to 2.2 mm) with a very regularly rounded last whorl and a highly elevated top of the labrum (Figs. 4-5). The type locality of *Granulina minusculina* is "West of Morroco, 112 m" (Travailleur 1882, St. 34), but the southern limit of its distribution is unknown. The species is said to extend also to most of the western basin of Mediterranean, where several geographic variants (subspecies ?) could occur.

Several species described in the last times from Mediterranean seem to be very close with *Granulina minusculina*, and have been separated after subtle characters:

. *Granulina gofasi* Smriglio and Mariottini, 1996 - 300-600 m, Central Tyrrhenian.

. *Granulina melitensis* Smriglio, Mariottini and Rufini, 1998 - 70-250 m, Central Tyrrhenian, South Western Siciliy and Malta.

. *Granulina gubbiolii* Smriglio and Mariottini, 1999 - 300-350 m, North Western Alboran Sea.

The *Granulina minusculina* complex certainly deserves an accurate study as a phyletic group, including the chromastism of the soft parts, morphometric comparison of the shells and elements about distribution and sympatry.

While studying the Collection of Dautzenberg in IRSNB, the author discovered a lot of two shells of *Granulina cf. minusculina*, labelled as "*Marginella aliciae* Bavay. Au large du Portugal. Cotypes. Dautzbg" and "*Marginella* Pr Alice. Stn. 2717/19.VII.08/750 m au large du Portugal". One adult (Fig. 6: 1.95 x1.65 mm) and one subadult (2 x 1.45 mm) shells. Actually, Bavay never published this name, probably because he later discovered that the species was already described and named by Locard (1897). Even the adult specimen shows a less thickened labrum and a wider aperture than the lectotype of *Granulina minusculina* (Figs. 4-5, West of Morocco, 112 m). In fact, both specimens are closer with the type material of *Granulina gubbiolii* from Alboran Sea better than with the type material of *Granulina minusculina*, as pictured in GOFAS (1992) and in SMRIGLIO & MARIOTTINI (1999). In the present state, it is not possible to say whether *Granulina minusculina* and *Granulina gubbiolii* are both represented in Ibero-Moroccan Gulf as two sibling species, or if they just represent geographic variants of the same species.

The same kind of situation seems to occur with the taxon *Granulina occulta* (Monterosato, 1869): several related forms are represented in Mediterranean and in Ibero-Moroccan Gulf. The species *Granulina guttula* La Perna, 1999 was recently described from such a population (84 m, Eastern Tyrrhenian).

In fact, the lacking of reliable samplings and records along the Atlantic coast and shelf of Morocco seems to be the principal origin of an under-estimation of the real diversity of marine micro-molluscs in this area.

For example, the author found three different morphae of *Granulina* within a limited amount of sediment collected in beach drift along a small protected creek 10 kms NorthWest of Agadir (BouZellou quarry), West Morroco:

- 1 shell of *Granulina occulta* (slender Mediterranean form, large size).

- 2 shells of *Granulina torosa* Gofas, 1992, only known till now from Strait of Gibraltar.

- several smaller shells which could be dwarf specimens of *Granulina torosa* or an undetermined species.

Granulina occulta and *Granulina torosa* were only known from somewhat deep sublittoral levels. Depending on the conditions of their discovery in the vicinity of Agadir, these species probably inhabit a somewhat shallow level here (5-10 m ?).

As a matter of fact, 3 morphotypes of *Granulina* can be considered as new for Atlantic area of the Lusitanian Province, and provisionally attributed to the next taxa:

. *Granulina canariensis* n.sp. from Canary Islands, circalittoral,

. *Granulina gubbiolii* Smriglio and Mariottini (as *M. aliciae* Bavay, ms name) from Portugal, bathyal,

. *Granulina torosa* Gofas from Agadir, littoral.

These simple records greatly increase the number of morphotypes of *Granulina* known from the Atlantic part of the Lusitanian Province, and suggest that the specific diversity of *Granulina* occuring in this area is not necessarely lower than the diversity displayed in Mediterranean.

Deeper investigations are required along the whole sections of coasts and shelfs of Lusitanian Province, and about the natu-

Figs. 10-12. 10: *Granulina canariensis* n. sp. SW Fuertaventura, 107 m depth, CWE. 11-12: *Granulina* cfr *occulta* (Monterosato). Lanzarote, off Playa Blanca, 40-100 m depth, CFB. Scale bars: 1 mm (10), 500 µm (11-12).

ral variability of each population encountered (shell morphology and chromatism of the soft parts). On this basis, a more accurate knowledge of the actual diversity of the Lusitanian *Granulina* will be gained, and their respective biogeography and distribution could be tentatively interpreted.

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