Biodiversity Journal, 2021, 12 (1): 235–244 https://doi.org/10.31396/Biodiv.Jour.2021.12.1.235.244

Revision of *Gibberula lucia* Jousseaume, 1877 and report of an allopatric sibling form (Gastropoda Cystiscidae)

Franck Boyer[1] & Walter Renda[2*]

[1]4, impasse Pasquier, 30190 Garrigues Sainte Eulalie, France; e-mail: franck.boyer7@orange.fr
[2] Via Bologna, 18/A, 87032 Amantea (Cosenza), Italy; e-mail: w.renda1@tin.it
[*]Corresponding author

ABSTRACT *Gibberula lucia* Jousseaume, 1877 (Gastropoda Cystiscidae) is revised, and the best conserved among the three MNHN syntypes is selected as lectotype. The typical form of *G. lucia* shows an original shell decoration made of continuous wavy axial lines. The distribution of this form seems to be restricted to the northwestern group and to the southern group of the Cape Verde Archipelago. A population showing interrupted axial lines is reported from Boa Vista and it looks as being perfectly similar to populations ranging off the Cap Vert Peninsula (Senegal) and off Fuerteventura (Eastern Canary Archipelago). Due to uncomplete documentation, the precise taxonomic status of this distinctive phena cannot be stated, at present, but despite its fragmented distribution, the concerned populations are united under the provisional term of *G.* cf. *lucia*, in the wait of further data.

KEY WORDS Anthropic introduction; Cystiscidae; *Gibberula*; phenetic variability; sibling species.

Received 11.11.2020; accepted 18.02.2021; published online 30.03.2021

INTRODUCTION

The *Gibberula* Swainson, 1840 (Gastropoda Cystiscidae) species detaining shells decorated of various patterns of axial wavy lines ("zic-zac" pattern) were characterized by Boyer (2004) as constituting a possible polyphyletic complex composed of several more or less autonomous species groups, most of them proving to have a wide intertropical distribution. Three species were reported to range off West Africa: *G. lucia* Jousseaume, 1877 described from the Cape Verde Archipelago, well-known from the Cap Vert Peninsula (Dakar, Senegal) and recently recorded from Fuerteventura (Eastern Canary Islands); *G. thomensis* (Tomlin, 1918) known as endemic species from São Tomé & Principe; and *G. almadiensis* Pin & Boyer, 1995 described from the Cap Vert Peninsula and apparently restricted to this area. Boyer considered *G. lucia* and *G. almadiensis* as being morphologically closer to the *G. oryza* group (revision in Gofas, 1990), whereas *G. thomensis* was considered as holding no close relative off West Africa. Boyer noted finally that these three species seem to have a narrow or a fragmented distribution, in the whole limited to insular or peninsular ranges, what is suggesting a relictual status within the West African Province.

Gibberula thomensis has been formally revised by Gofas & Fernandes (1988) and *G. almadiensis* has been described more recently with a rather consistant information. Despite a first review by Moreno (2012), the oldest described species *G. lucia* remains perfectly elusive in the Cape Verde Archipelago (only known by the type lot from Santa Luzia and by one shell from Santiago Island). A related population from the Senegal, despite being

abundant in shallow water of the Cap Vert Peninsula, was never documented accurately, the succinct elements given by Pin & Boyer (1995) playing just as a rough comparison with the deeply-distinctive *G. almadiensis*. In the course of the study applied to this question, the authors discovered that a discriminatory chromatic feature of the shell remained hidden to previous students, which feature allows to distinguish the nominal *G. lucia* ranging in the Cape Verde Islands from the population of *G.* cf. *lucia* ranging off the Cap Vert Peninsula. This distinctive shell decoration feature occurring in the population from Senegal is also found in two shells recently collected in Boa Vista as well as in the population recorded from Fuerteventura (Engl et al., 2009; Hernández et al., 2011). This situation leads to reconsider the identity of the two phenae, and to tackle plausible hypothesis about their taxonomic and biogeographic status.

MATERIAL AND METHODS

The populations attributable to the typical form of *G. lucia* were studied through the type series preserved in the Paris Museum (Figs. 1–3) and through the single shell from Santiago Island collected by A. de Oliveira and reported by Moreno (2012) (Fig. 6). Any other record about this typical form was not found in the scientific literature as well as in the grey literature. We did not find any clue about such a form in the consulted European private collections devoting more especially to the Cape Verdian millimetric marine fauna and dealing with appropriated technics of sampling on hard bottoms (brushing on bag by snorkeling or by diving), such as for instance the collection of E. Rolán for the whole Archipelago, or the collections of J. Pelorce and of the first author for more focused samplings in Sal Island.

The related population from the Cap Vert Peninsula (Senegal) (Figs. 12–16, 18–26), provisionally named here as *G.* cf. *lucia*, was studied mainly through the samplings performed in the Dakar area by J. Pelorce, P. Petit de Voize, JL. Delemarre, G. Hervillard and the first author, and through a complete checking of the collection of the late M. Pin (Dakar). While waiting to verify the real extension of the distribution of this "continental form", a research was payed along several collections performed in Agadir (F. Swinnen, J.L. Delemarre, G. Hervillard and the first author), in Dakhla (J.L. Delemarre, G. Hervillard), in Nouadhibou (E. Rolán) and in the Bijagos Archipelago (J.L. Delemarre). The public collections of IFAN-Dakar and of the Paris Museum were studied on the same ground. Special investigations were payed about the possible occurrence of related forms in the Canary Islands, through the extensive collections saved for the whole Archipelago (J.M. Hernández, F. Swinnen) or for more focused fields such as Lanzarote (F. Sicilia Guillen, W. Engl and the first author).

In the whole, numerous lots of empty and live shells collected specimens were studied from the Cap Vert Peninsula (hard bottoms: 0–4 m by snorkeling and 5–40 m by diving; soft bottoms : 3–17 m by dredging), but no further specimens were found from other continental localities out of the Dakar area. However, a lot of three fresh adult shells from Fuerteventura perfectly matching the shell features of the Dakar population was examined in the Collection JM Hernández (lot labelled as ex-Manuel Bermejo Pérez, Las Palmas de GC) (Fig. 17). According to the late JM. Hernández (pers. comm.), M. Bermejo collected in Fuerteventura several beached empty shells attributable to *G.* cf. *lucia*, but the sampling circumstances were not reported (grouped spots or general distribution, number of specimens, one-time findings on a single stay or recurrent samplings along time, etc).

The live specimens collected off the Cap Vert Peninsula were sampled in sandy weeds/moss on rocks or in fine gravels among detritic/mixed environments, from the low tide line in protected places (from N'gor and Les Almadies northwards to Bel-Air and Gorée Island southwards), down to lower infralittoral by diving (station Petit Thiouriba, 33 m). Only one unfresh shell and few worned shells were collected by dredging on soft bottoms in the Bay of Gorée (southern side of Dakar, 5–17 m) and along the Petite Côte (Central Senegal, 3–8 m). Live animals from various stations of the Cap Vert Peninsula were drawn by the first author during his collecting stays in Dakar along the period 1995–2000.

The photography of the lectotype of *G. lucia* has been performed by Benoît Fontaine (MNHN). The colour drawings of specimens of *G.* cf. *lucia* were performed in the field by the first author. The original photos dedicated to this article were performed by the second author, as well as the Photoshop skills

allowing to reveal the accurate dorsal decoration of the lectotype of *G. lucia* and of the shells from Boa Vista, while increasing the contrast and the density in a monochrom picture.

ABBREVIATIONS AND ACRONYMS. CFB: collection F. Boyer, Garrigues Sainte Eulalie (France); CJH: collection J.M. Hernández, Galdar (Spain); CJP: collection of Jacques Pelorce, le Grau-du-Roi (France); MNHN: Muséum national d'Histoire naturelle, Paris (France); NMR: Natural History Museum, Rotterdam (Netherlands); ad: adult; juv: juvenile; L: shell length; sh: empty shell; spm: live collected animal; stn: station.

RESULTS

Systematics

Familia CYSTISCIDAE Stimpson, 1865
Subfamilia PERSICULINAE Coovert et Coovert, 1995
Genus *Gibberula* Swainson, 1840
Type species (M): *Volvaria oryza* Lamarck, 1822

Gibberula lucia Jousseaume, 1877 (Figs. 1–6).
Gibberula lucia sp. nov. in Jousseaume, 1877 (1876), 269–270, pl. V, figs. 11–13.

TYPE MATERIAL. Three syntypes in MNHN (lot MNHN–IM–2000–635), all ranging 3.5 mm in length size. The best conserved of the syntypes is here selected as lectotype (Figs. 1–3), due to its more legible shell decoration.

OTHER MATERIAL EXAMINED. Only the picture of the shell collected by A. Oliveira in Praia, Santiago Island (here in Fig. 6), and displayed as "*G. lucia*" by Moreno (2012: fig. 4). In a letter from May 2007, Alvaro de Oliveira informed the first author of the finding of this shell, sampled from pebbles in shallow water (0.20 m).

DESCRIPTION. Original description (Jousseaume, 1877: 269–270): "*Long., 3 mm; larg., 2 mill.; épaiss. 1 ½ mill. Coquille ovale, lisse, luisante et un peu transparente, sa couleur d'un corné blanc jaunâtre, est ornementée de linéoles très-fines, ondulées et rougeâtres. Ces linéoles sont toujours plus larges et plus apparentes sur le milieu du dernier tour où elles formenti comme des chevrons dont le sommet est tourné du côté du bord columellaire; à l'extrémité antérieure elles sont beaucoup plus finement encore apparentes alors que près de la suture elles sont à peine perceptibles et manquent même dans la plupart des individus. La spire, composée de 3 tours ½, forme à l'extrémité postérieure un petit mamelon lisse et luisant, entouré à la base d'un petit anneau brunâtre; les sutures sont obturées par un enduit vitreux assez épais; l'ouverture, placée sur le côté droit de la face inférieure, a la forme d'une fente allongée et étroite, s'élargissant un peu en avant où elle se termine en une large gouttière sur les bords de laquelle on aperçoit de chaque côté deux petites tâches d'un blanc jaunâtre. Son bord externe, épais au milieu et aminci, aux extrémités, est crénelé intérieurement de dents si petites, que la loupe est nécessaire pour les distinguer; Le bord columellaire, arqué et calleux, est divisé en avant par deux plis obliques, épais et saillants, et en arrière de denticules d'autant plus saillantes qu'on se rapproche d'avantage des plis antérieurs*".

COMPLEMENTARY DESCRIPTION. The Jousseaume's description (1877) is compatible with the three shells conserved in the MNHN collection. However the outline of these shells looks as "*oval-cylindrical*" better than simply "*oval*", and the lectotype here selected (Figs. 1, 2) is perfectly representative from this point of view. The axial lineoles are more or less blurred in the type specimens, due to their status of beached shells, and at first sight these lineoles seem to be discontinuous, running mostly on the central part of the body whorl as spiral series of thick chevrons, and being faintly suggested on the anterior part of the dorsum by few diagonal dashes. But increasing the contrast and the focus of the pictures (Fig. 3), these lineoles show to be continuous axial zic-zac lines, running from just below the lower suture down to the base of the shell. The "*two little yellowish white patches*" reported by Jousseaume as ranging "*on each side of the basal gutter*" (siphonal notch) must correspond to the light browny-orange marks visible respectively at left of the first columellar plait and at the base of the labial keel. The length size of the shell is given by Jousseaume as measuring 3 mm, but the three syntypes proves to size 3.5 mm in length. We emphasize that speaking about the distal parts of the lineoles under the sutures, Jousseaume explains that "*they even lack in most of the individuals*". This expression suggests that more than three specimens were studied for the descrip-

tion of the species. Even if very roughly performed, the type figures (Figs. 4, 5) display very distinctive axial lineoles running all along the last whorl, however much less sinuous than in the lectotype. Due to the limited gears and skills for magnification at that time, the representation of the decoration of a such tiny shell can be affected by a touch of "*artistic licence*", the intention being not to reproduce the real pattern of decoration but better to illustrate the notion of axial zic-zac lines running all along the last whorl.

Animal unknown.

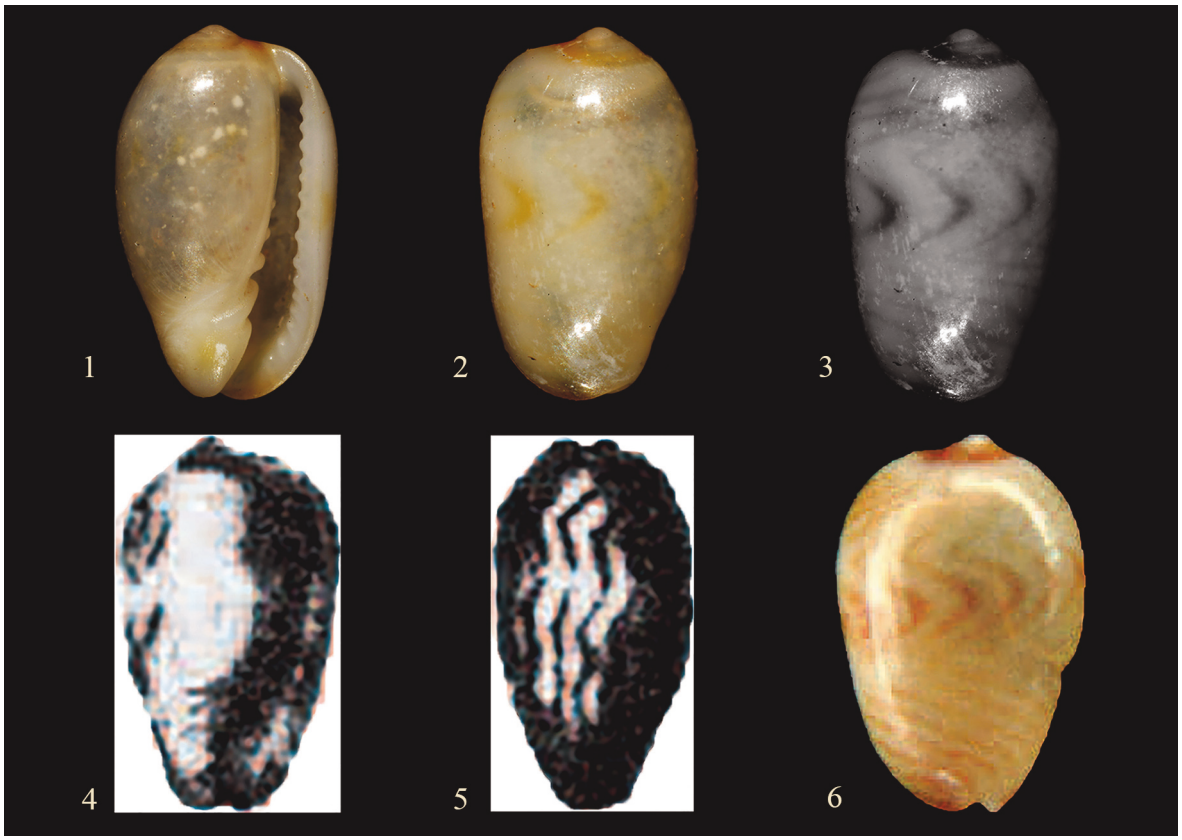
TYPE LOCALITY. "*Sainte-Lucie, archipel du Cap Vert*".

HABITAT. Unknown.

DISTRIBUTION. The species *Gibberula lucia* Jousseaume, 1877 is known from two localities in the Cape Verde Archipelago: the Island of Santa Luzia (northwestern group) for the type lot collected by Louis Bouvier and Léon de Cessac during the trips they performed at the end of the years 1860's (Laine, 2018); Praia in Santiago Island (southern group) for the shell collected by A. Oliveira (Fig. 6). The decoration pattern and the general shell morphology are similar in the lectotype from Santa Luzia and in the specimen from Santiago, even if this late specimen presents a more inflated and rounded shell outline. The two populations are considered as conspecific.

Despite rather frequent samplings of micro-molluscs performed through beachcombing, snorkeling or diving in several of the Cape Verde Islands by European collectors and students along the last 45 years (mostly in Sal and Boa Vista, but also in São Vicente and in Santiago), the species is remaining very elusive in the Archipelago and this leads to suppose that either *G. lucia* is ranging in the upper infralittoral (0–20 m) but is naturally rare in the nature, or better is ranging on hard bottoms in the lower infralittoral (20–40 m).

The scarcity of the records for the typical form of *G. lucia* does not allow to state on its real ge-



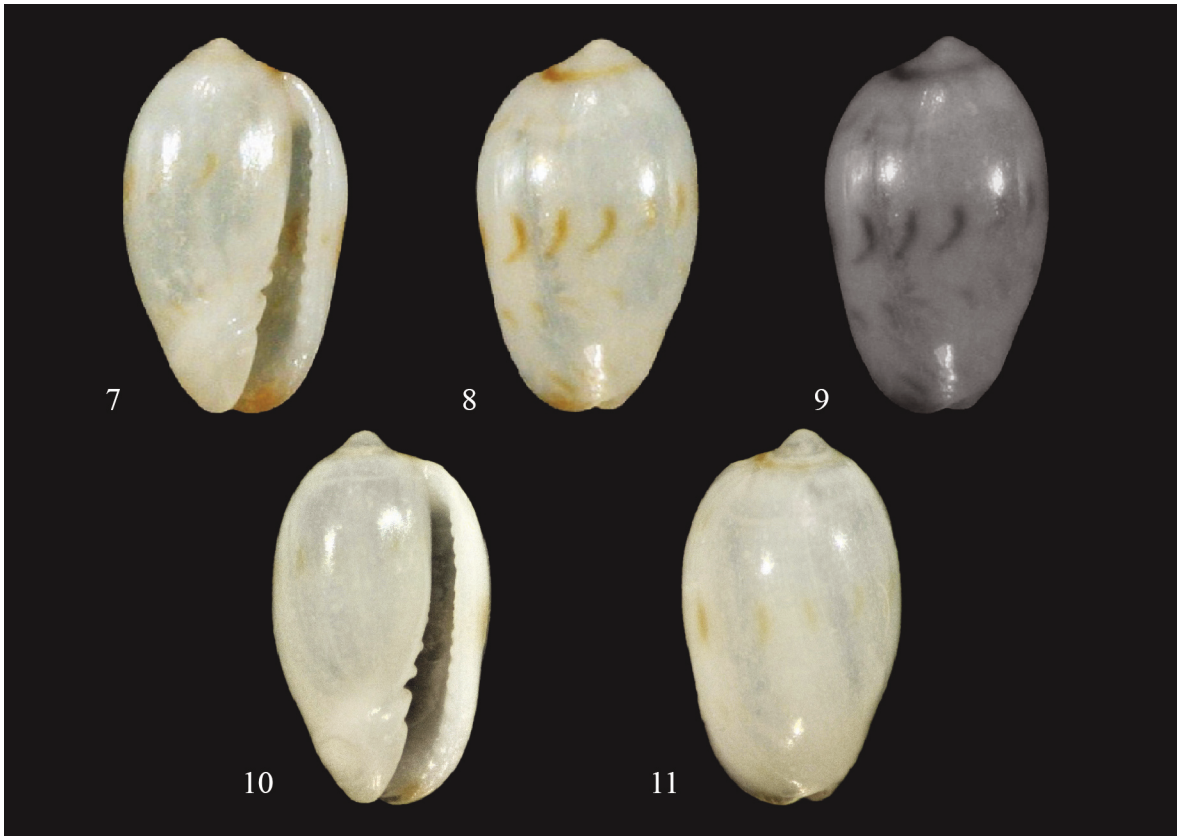
Figures 1–6. *Gibberula lucia*. Figs. 1–3: lectotype MNHN, "Sainte-Lucie, archipel du Cap Vert", L = 3.5 mm.; Figs. 4, 5: *G. lucia*, type figures. Fig. 6: *G. lucia*, Praia, Santiago Island, 0.20 m, illustrated in Moreno (2012: fig. 4), L = 4 mm.

ographiocal distribution, but considering the total lack of records for Sal, which was ever the most sampled place of the Archipelago, and the occurrence of a sibling form in Boa Vista (see below), a discontinuous distribution of the nominal *G. lucia* in the Archipelago could be infered. Such a discontinuous or patchy distribution is suggested by the results of Moreno & Burnay (1999: 120) for the *Volvarina* of the Cape Verde Islands. Based on the limited known data, *G. lucia* might be distributed most probably in the lower infralittioral of the northwestern group (Santo Antão, São Vicente, Santa Luzia and São Nicolau) and of the southern group (Brava, Fogo and Santiago), while lacking in the eastern group (Sal, Boa Vista and Maio).

Remarks. A sibling form of *G. lucia* showing an homogeneous and constant variant in shell decoration is found in Boa Vista, the Cap Vert Peninsula and Fuerteventura. It seems to be appropriated to describe it separately as distinct phena belonging to the *G. lucia* species group, under the designation of *G.* cf. *lucia* (next section).

Gibberula cf. ***lucia*** Jousseaume, 1877 (Figs. 7–26)

Material examined. NMR, Collection Joop Trausel (rec. August 2012): 2 ad. sh. (Figs. 7–11), Punta Antonia Beach, Boa Vista, Cape Verde Islands (3 mm and 3.2 mm). MNHN, Collection Marche-Marchad: 1 ad. sh., campaign Léon Cousin, stn LC 17, self-dredged at 22 m by Marche-Marchad (22–02–57), central Senegal. Collection J.L. Delemarre (Nantes): 3 ad. spm, Almadies (Dakar, Senegal), algues, leg. G. Hervillard; 2 ad. spm, idem, self-collected on 2004. Collection M. Pin (Dakar): 1 ad. spm, Petite Corniche (Dakar, Senegal), self-collected on 09–1993. CJP: 6 ad. spm., 1 juv. spm, 4 ad. sh., Madeleines Islands (Dakar, Senegal), 10–20 m, rocky bottoms with pockets of sands and shell rubble, self-collected by diving on 09–1995; 2 ad. spm, 1 ad. sh., 1 juv. sh., stn. Petit

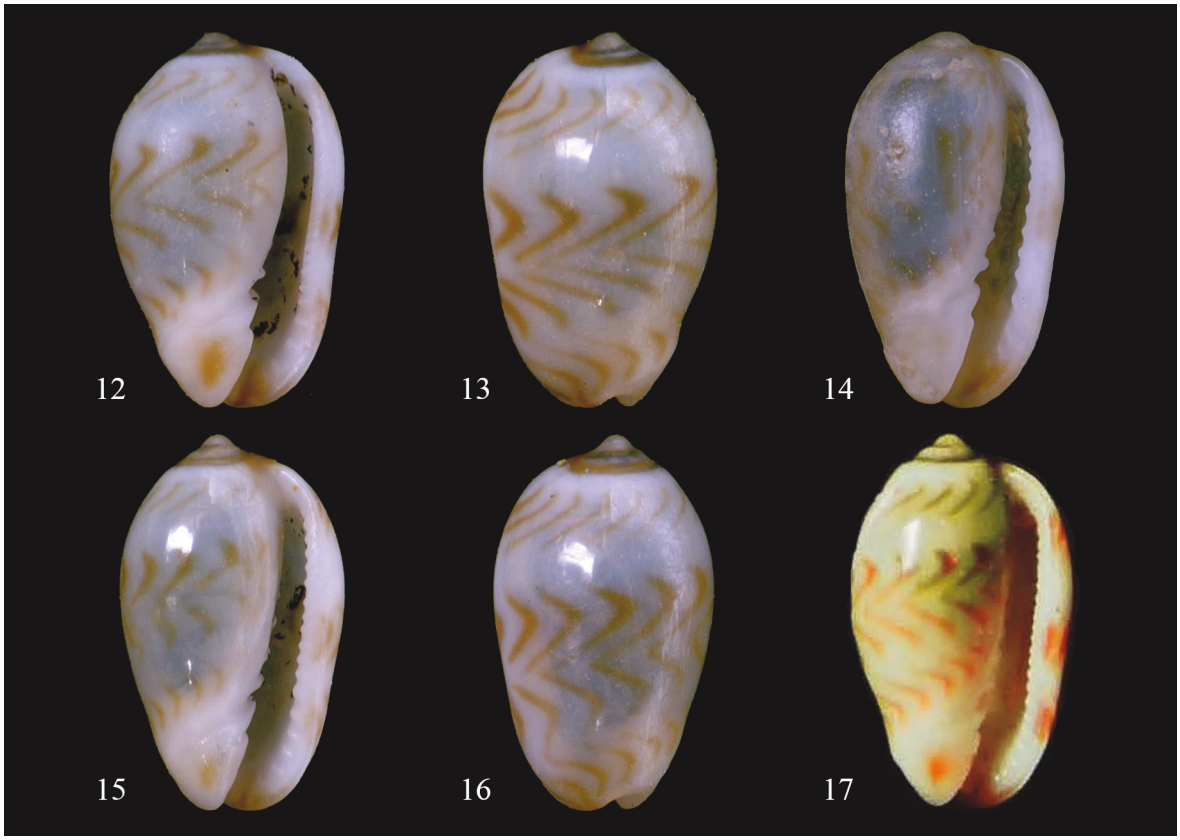


Figures 7–9. *Gibberula* cf. *lucia*, Punta Antonia Beach, Boa Vista, NMR 74121, L = 3.0 mm. Figures 10, 11: idem, L = 3.2 mm.

Thiouriba (Madeleines Islands, Dakar, Senegal), 33 m, self-collected by diving on 08–1998. CFB: numerous ad. and juv. spm; Les Almadies, Cap Vert Peninsula (Dakar, Senegal), 0–2 m (Figs. 18–19) ; numerous ad. and juv. spm, Présidence, Petite Corniche (Dakar, Senegal), 0.5 m (Figs. 12–16, 20–25); 1 ad. spm, Anse Bernard, idem, self-collected at low tide (Fig. 26); 1 ad. spm, Tacoma wreck, 10–13 m, east of Gorée Island, self-collected by diving on 09–1999; 3 ad. spm, Madeleines Islands (Dakar, Senegal), 10-20 m, self-collected by diving on 05–2000. CJH (ex-Bermejo): 3 ad. sh., Fuerteventura (Canary Islands, Spain), 6.3 mm (Fig. 17), 5.9 mm, 4.7 mm.

DESCRIPTION. Based on a population collected off La Présidence, Petite Corniche, Dakar, 0.5 m. Shell (Figs. 12, 13): subpyriform outline; short and bulbous pointing apex; aperture rather narrow, more widened in its lower half part; the two basal columellar plaits strong, thick and moderately oblique, the third plait small and quite horizontal, several other decreasing plaits/lirations on the inner wall, poorly or not visible in the aperture; labial lip slightly sinous, bearing tiny teeth; decoration of axial zic-zac lineoles on the last whorl, interrupted by a rather wide gap at the level of the upper quarter, and deeply blurred at the level the lower quarter; one browny-orange patch at left of the first columellar plait, and one browny-orange patch at the base of the labial wall; narrow browny spiral band at the base of the apex, and a wider browny spiral band at the base of the penultimate whorl. The variabilty of the shell features in this population at the adult stage is displayed through the Figs. 14–16.

Animal (Figs. 23–28): wide yellowish-white patches on the foot, with interspaced blackish streak, and scarce orange dots spread on and between the patches; milky-white siphon with few orange axial marks; hyalinous slit muzzle with whitish outer side wearing orange dots; central part of the slit surrounded by a yellowish zone, leaned



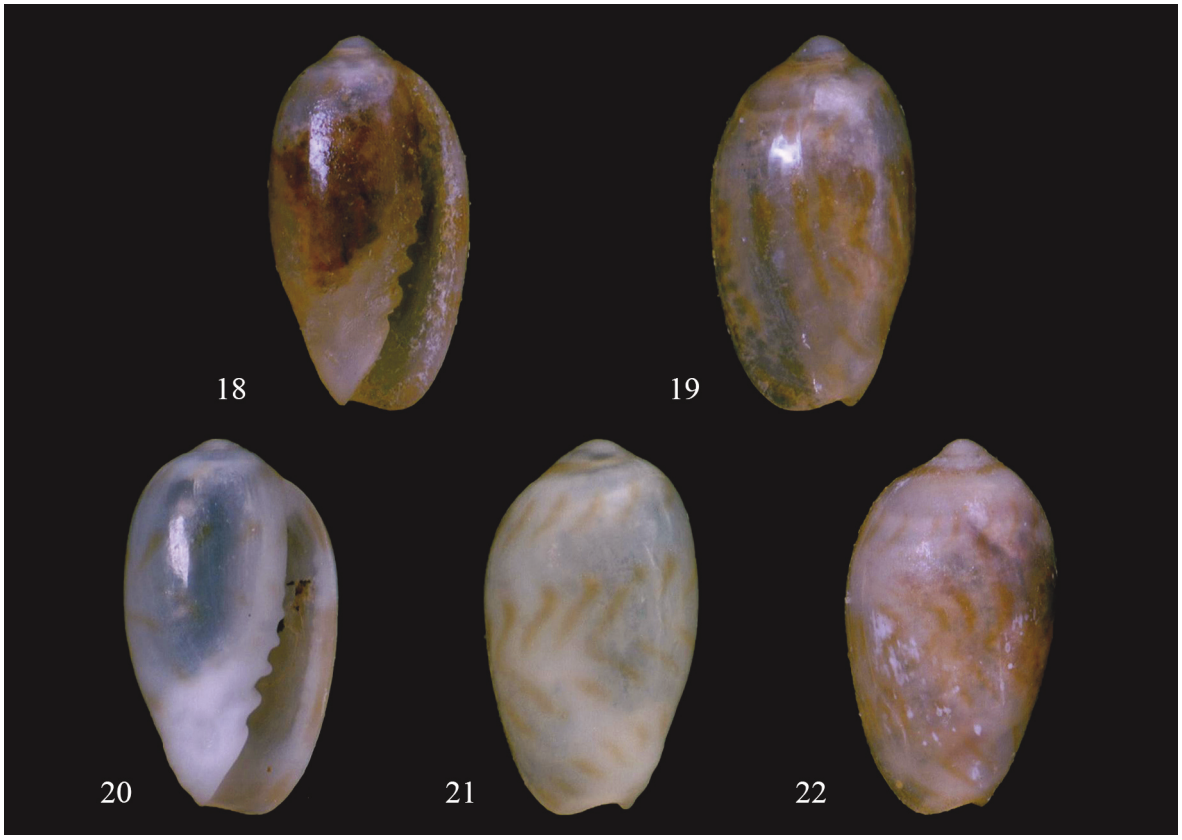
Figures 12, 13. *Gibberula* cf. *lucia*, Présidence, Petite Corniche, Dakar, 0.5 m, L = 4.35 mm, CFB; Figure 14. *G.* cf. *lucia*, same locality, L = 3.2 mm, CFB. Figures 15, 16. *G.* cf. *lucia*, same locality, L = 4.15 mm, CFB. Figure 17. *G.* cf. *lucia*, Lanzarote, as "*G. lucia*" in Hernandez et al. (2011: fig. 62 R), L = 6.3 mm.

on a blackish zone surrounding the eye: the tentacle wears a yellowish marks at its tip and another one at its base; a wide blackish zone at the central third part of the internal mantle, with whitish zones above and below, and medium-sized irregular yellowish patches spread over the whole internal mantle; light blackish zone below the bulging apex. The variability of the animal chromatism in this population is displayed through the Figs. 23–25. Details and displayed for a specimen collected in Anse Bernard, some 500 m south of La Présidence/Océanium (Figs. 26–28).

Habitat. In short algae, moss, fine gravels and rubble on hard bottoms.

In shallow water (0–2 m) all around the Cap Vert Peninsula (from Les Almadies to Petite Corniche) *G.* cf. *lucia* shows to be common and to live in colonies of rather numerous specimens (often a tenth under a boulder or a small stone), but in deeper waters (from 10 to 33 m) *G.* cf. *lucia* looks to be scarce in the field and to range mostly as individual or very small units of 2–3 specimens. So the shoreline of hard bottoms (boulders and rocks) seems to offer special conditions for higher demographic density to a species presenting better the features of an extensive distribution in most the infralittoral.

Distribution. The phena here names as *Gibberula* cf. *lucia* Jousseaume, 1877 is known to range off the Cap Vert Peninsula (Dakar area) from the tide level down to 33 mm. It was also reported recently from Fuerteventura (Eastern Canary Islands), but as discussed below this "northern population" (Fig. 17) may result from an anthropic introduction and the long-term settling remains to be verified. A third population matching the phena of *G.* cf. *lucia* is here reported from the Island of Boa Vista (eastern Cape Verde Islands), where two shells in rather good state (Figs. 7–11) were collected at the shoreline by Joop Trausel (NMR) in August 2012.



Figures 18–19. *Gibberula* cf. *lucia*, Les Almadies, Cap Vert Peninsula, 0-2 m, juv. spm, L = 2.3 mm, CFB. Figures 20, 21: *G.* cf. *lucia*, Présidence, Petite Corniche, Dakar, low tide, juv. spm, L = 2.25 mm, CFB. Figure 22 : idem, L = 3.25 mm, CFB.

REMARKS. *Gibberula* cf. *lucia* as autonomous taxon is simply based on the spiral gaps occurring in the zic-zac decoration of the shells. Even if apparently flimsy, this feature (overall the total gap at upper quarter) is absolutely constant in the populations studied from the Cape Verde Peninsula, from Fuerteventura and from Boa Vista, whereas the populations of the nominal form *G. lucia* ranging in the Cape Verde Archipelago (northwestern and southern groups) do show a shell decoration of continuous (non-interrupted) axial lineoles. On the other hand, no similar intraspecific variation is observed in other populations of zic-zac ornated *Gibberula* from Atlantic and Indo-West Pacific waters (Pin & Boyer, 1995; Boyer, 2003; 2004), so the feature of "*interrupted axial lineoles*" can be considered as resulting from a rather old genetic separation and as the reliable clue of a distinctive status for the populations here grouped as *G.* cf. *lucia*. For the rest, the variability observed in the shell morphology and in the shell decoration of *G. cf. lucia* is about the same than the variability observed in the Cape Verdian nominal *G. lucia*. In the population from the Cap Vert Peninsula, where a high number of individuals were observed, few specimens present at the adult stage (Fig. 14) the usual colour decoration of the juvenile stages (Figs. 18–22: irregular, poorly sinuous and roughly continuous lineoles, becoming progressively well-organized lineoles, with sharp zic-zac pattern and full gap at the upper quarter).

The discovery in Fuerteventura of shells attributed to "*G. lucia*" (but matching in fact the features of *G.* cf. *lucia*) is reported by Engl et al. (2009: 170), with the illustration of three specimens (id.: 43–45). "*Numerous specimens*" are said to have been found and to belong to the CJH collection (as "CHO"). The species is also supposed "*to result of accidental introduction in the Canary Islands by fishermen*". Hernández et al. (2011) confirm the same points and they picture the same three shells, but they precise that the species was found as "*numerous specimens in some places (as "algunas zonas") from Fuerteventura*". The first author examined the lot in CJH: in fact JM Hernández owned just a series of three shells (all pictured in Engl et al. (2009). As well as in Hernández et al., 2011) and he informed that he obtained them from M. Bermejo who collected the species by himself as beached shells in "*several places*" of Fuerteventura in the late 90's. JM. Hernández had no further informations about the precise places where the shells were collected, that means if all the findings were made in close vicinity altogether or in stations spread around the island. Furthermore, it seems that M. Bermejo did not explain precisely if his samplings were all performed during the same trip or if they occurred from several periods.

The fact that the species was never recorded from the Canary Islands (and also from the northwestern African coasts above the Cap Vert Peninsula) before its discovery by Bermejo in the years 1990's gives credit to the hypothesis that the species was accidentally introduced in this period**.** Even if they remain as scarce occurrences in the northwest African waters, such cases of anthropic introductions are more frequently reported since the years 2000's, for instance through the precarious introduction of *Parvanachis obesa* (C.B. Adams, 1845) in the harbour of Santa Cruz de Tenerife, or the lasting introduction of *Zafra exilis* (Philippi, 1849) in Gran Canaria (Hernández & Boyer, 2005). Furthermore, "*G.* cf. *lucia"* was never recorded from the close island of Lanzarote: it seems poorly likely that if naturally settled in the infralittoral of Fuerteventura any marine gastropoda would be unable to reach Lanzarote, and this island is one of the most sampled and studied place from the Canary Archipelago since more than a quarter century. In the whole, the hypothesis of a recent anthropic introduction of *G.* cf. *lucia* in Fuerteventura seems to be the most probable occurrence, through the transport of specimens in detritus, sediment rubble or wet nets by industrial trawlers or artisanal spanish fishermen which worked routinely along the coasts of Western Sahara but also of Mautitania and Senegal along the years 80's and 90's, and sometimes dropped off at Puerto Rosario or at Corallejo (eastern and northeastern Fuerteventura).

If such an "*introduction hypothesis*" seems to be the most probable one in the present state of the documentation, it must be considered with precaution: first of all, the fauna of micro-gastropods of the Canary Islands remained badly documented up to the recent years, especially concerning "*peripheral islands*" such as Fuerteventura, while Lanzarote, Gran Canaria and Tenerife were subject to many more sampling and identification efforts in the past. It seems for instance that no further report was made about the presence or the absence of *G.* cf. *lucia* in Fuerteventura until the Bermejo's find-

ings. No reliable inventory of the micro-gastropods of Fuerteventura was performed until now, and the works published by Engl et al. (2009), as well as by Hernández et al. (2011) can be considered as poorly documented for this place. We cannot totally rule out the hypothesis that *G.* cf. *lucia* was naturally settling in Fuerteventura before the Bermejo's findings. Furthermore, the hard bottoms of the northwestern African coasts between Agadir and Dakar remain about unsampled, and the occurrence of populations of *G.* cf. *lucia* in this range cannot be totally excluded, basing on the fact that *G*. cf. *lucia* as well as *G. lucia* seem to be naturally scarse in the field, out of local and accidental colonizations of protected rocky shores.

About the same questioning prevails concerning the settling status of the population of *G*. cf. *lucia* in Boa Vista, but in the present case the opportunities of accidental transport of specimens from Dakar to Boa Vista are lower, due to the very poor maritime traffic between the two places over the time. We observe also that the recent discovery of two specimens of *G*. cf. *lucia* in Boa Vista seems to match the rarity status displayed by *G. lucia* in the northwestern and the southern groups. So we must consider for now that Boa Vista belongs to the natural distribution of *G*. cf. *lucia*, in the wait of further documentation allowing to verify similarity or dissimilarity of the chromatism of the animals in the populations of *G*. cf. *lucia* distributed off Boa Vista and the Dakar area.

CONCLUSIONS

In the context of the intraspecific variability documented in the "*groups of ornated* Gibberula", the distinctive decoration feature observed in *G.* cf. *lucia* as well as the pattern of distribution observed could both be interpreted as robust clues of a distinctive status at the specific rank. Even if this hypothesis seems to be the most likely in the present state, to consider the phena *G*. cf. *lucia* as corresponding to a sibling species of the Cape Verdian *G. lucia* is however refrained in the wait of additional documentation about the chromatism of the animal in the nominal *G. lucia.* At the same time, a verification of the allopatric status of both forms in the Cape Verdian Archipelago would greatly reinforce the demonstration and would contribute to more firmly established conclusions.

The documentation at hand leads to consider that *G*. cf. *lucia* is factually distributed in the Dakar area (Cap Vert Peninsula), in Boa Vista (eastern Cape Verde Islands) and in Fuerteventura (eastern Canary Islands). The population from the Dakar area is documented since a rather long time and ever known as common in shallow waters of protected rocky places. No question about a possible anthropic introduction can be validly raised about this population, so it must be considered as native from the place. The settling status of the populations documented from Boa Vista and from Fuerteventura is more questionning, but in the present state the settling of these populations is objective, whereas their possible anthropic introduction remains speculative.

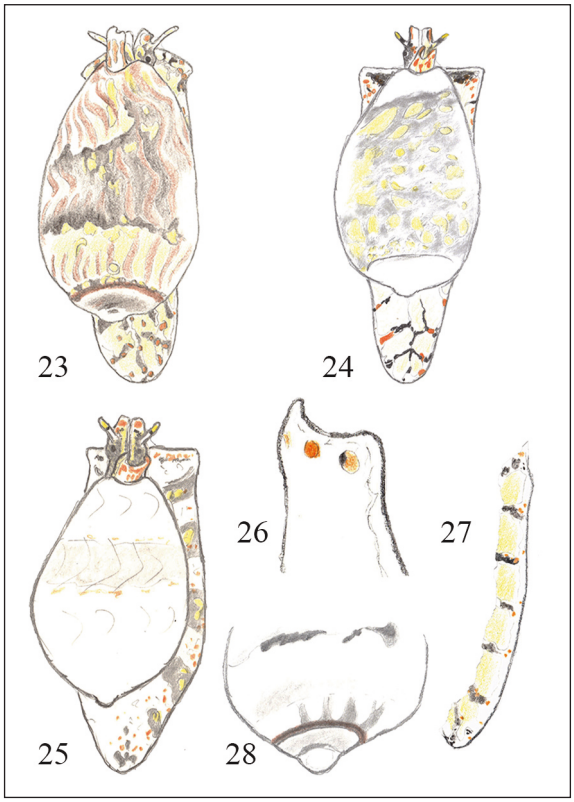


Figure 23. *Gibberula* cf. *lucia*, ad. spm, Présidence, Petite Corniche, Dakar, 0.5 m in algae/moss on rocks, CFB. Figure 24. *G.* cf. *lucia*, ad. spm, Présidence, Petite Corniche, Dakar (08-1996), low tide level , CFB. No report of the shell decoration. Figure 25. *G.* cf. *lucia*, ad. spm., Présidence, Petite Corniche, Dakar, 1 m by snorkeling on hard bottoms, CFB. Shell decoration summarily reported; Figures 26–28. *G.* cf. *lucia*, ad. spm., Anse Bernard, Dakar (04–1999), CFB: siphon (Fig. 26), lateral edge of the foot (Fig. 27), and posterior half-part of the shell (no report of the shell decoration) (Fig. 28).

The elusive presence of the nominal *G. lucia* in shallow water allows to consider that *G*. cf. *lucia* shares more often the same cryptic status, leading to rare and delayed discoveries at the littoral level, with the exception of more or less sustainable colonies ranging along sections of protected rocky shores, as occurring in the Dakar area and possibly occurred in Fuerteventura at least temporarily.

We observe that such a distribution scheme is coherent with the biogeographic pattern observed by Boyer (2004) for the populations of "*zic-zac ornated* Gibberula" ranging off West Africa: they are all located in insular and peninsular areas, and as such they look as vestigial remains of more widespread species complexes. Fragmented distributions occurring apparently in the species group *G. lucia* are compatible with this scheme, even if the present distribution of *G. lucia*, of *G*. cf. *lucia* and of their different populations results very probably from different historic events.

Further documentation about live populations from these different places will certainly allow to strenghten the taxonomic and biogeographic hypothesis.

ACKNOWLEDGEMENTS

We are indebted to the late Jose Maria Hernández (Galdar, Spain) and to the late Marcel Pin (Dakar, Senegal) for the access to their extensive collections of marine molluscs, and to Emilio Rolán (Vigo, Spain), Frank Swinnen (Lommel, Belgium), Jean-Louis Delemarre (Nantes, France), Gérard Hervillard (Maisons-Alfort, France), Jacques Pelorce (Le Grau-du-Roi, France) for the loan of diversified material of *Gibberula* species self-sampled in various places along the coasts of Northwestern Africa and the Macaronesian Archipelagos. Joop Trausel and Frans Slieker (NMR) kindly performed photos of the two specimens of *G.* cf. *lucia* collected by Joop in Boa Vista. As usual, Virginie Héros and Philippe Maestrati kindly allowed the access to the MNHN collections. Thanks to Alvaro de Oliveira (Gulpilhares, Portugal) for kind correspondance about his shell finding in Santiago Island.

REFERENCES

Boyer F., 2003. The Cystiscidae (Caenogastropoda) from upper reef formations of New Caledonia. Iberus, 21: 241–272.

Boyer F., 2004. Les groupes *Gibberula frumentum* (Sowerby, 1832) et *G. pulchella* (Kiener, 1834) dans l'Atlantique occidental. Novapex, 5: 33–42.

Engl W., Gómez R., Peñas A., Swinnen F., & Rolán E., 2009. New records of molluscs for the Canary Islands. Novapex, 10: 165–172.

Gofas S., 1990. Le genre *Gibberula* (Marginellidae) en Méditerranée. Lavori S.I.M., 23: 113–139.

Gofas S. & Fernandes F., 1988. The Marginellids of São Tomé, West Africa. Journal of Conchology, 33: 1–30.

Hernández J.M. & Boyer F., 2005. Notes on the columbellid fauna from the infralittoral and circalittoral of the Canary Islands. Iberus, 23: 69–93.

Hernández J.M., Rolán E., Swinnen F., Gómez R. & Pérez J.M., 2011. Moluscas y Conchas Marinas de Canarias. Coordinated by E. Rolán. ConchBooks Ed., 716 pp. + 1–40.

ICZN (International Commission on Zoological Nomenclature), 2020. https://www.iczn.org/ - last accessed December 2020.

Jousseaume F., 1877. Description de quelques mollusques nouveaux. Bulletin de la Société Zoologique de France, 1 (1876): 265–273, pl. V.

Laine A., 2018. Des naturalistes à la conquête de l'Afrique équatoriale. Savants, marchands et voyageurs du réseau Bouvier (1864–1900), 65–105. In Juhe-Beaulaton D. & Leblan V., Le spécimen et le collecteur. Savoirs naturalistes, pouvoirs et altérités (XVIII°–XX° siècles), MNHN-Archives, 27: 1–509.

Moreno D., 2012. The genus *Gibberula* (Gastropoda, Cystiscidae) in the Cape Verde Islands with the description of a new species. Iberus, 30: 67–83.

Moreno D. & Burnay L.P., 1999. The genus *Volvarina* (Gastropoda: Marginellidae) in the Cape Verde Islands. Journal of Conchology, 36: 83–124.

Pin M. & Boyer F., 1995. Three new species of Marginellas from the Dakar region (Senegal) (Gastropoda : Marginellidae). La Conchiglia, 275: 55–61.