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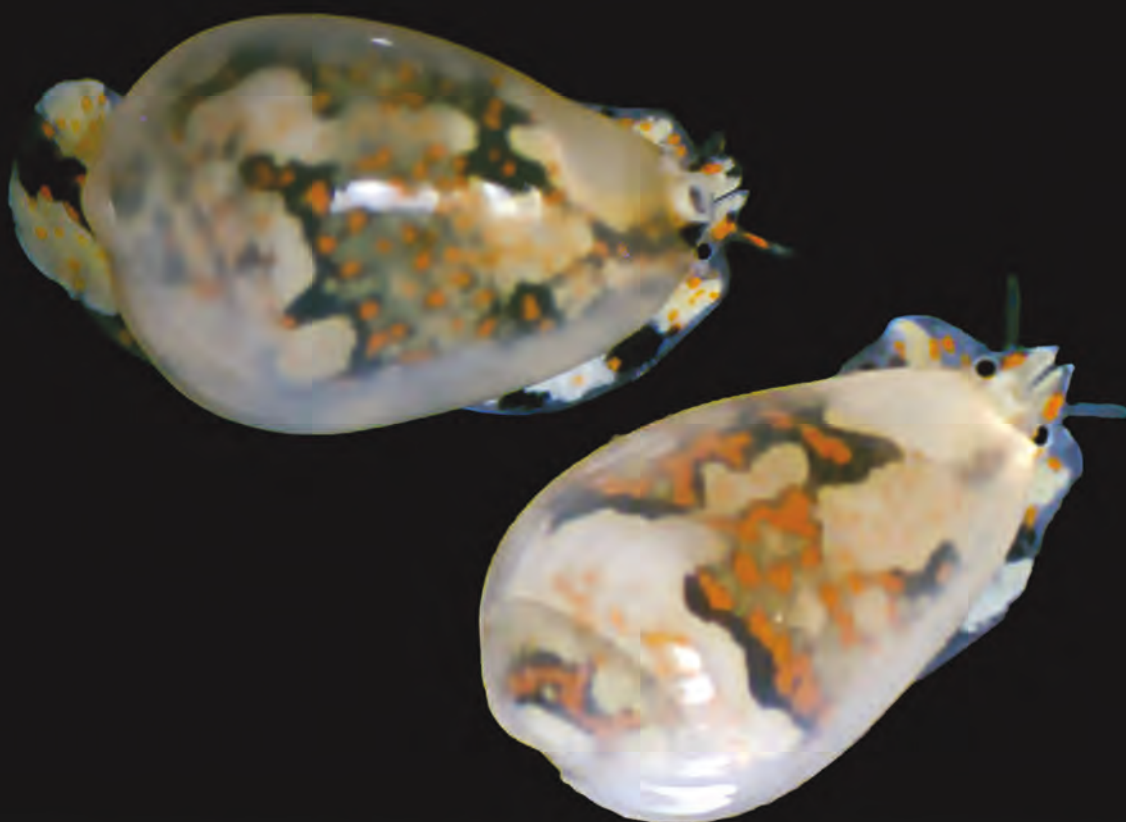
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**MONOGRAPH**

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**Revision of *Gibberula philippii* (Monterosato, 1878) in a populational approach (Gastropoda Cystiscidae)**



*Gibberula philippii* (Monterosato, 1878) - Scilla (Reggio Calabria, Italy) shallow water

## Revision of *Gibberula philippii* (Monterosato, 1878) in a populational approach (Gastropoda Cystiscidae)

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### ABSTRACT

The species *Gibberula philippii* (Monterosato, 1878) (Gastropoda Cystiscidae) is revised and one lectotype and six paralectotypes are appointed from a lot of Palermo belonging to the Monterosato Collection in the Civic Museum of Roma. Palermo is defined as the type locality of the species. The phenetic variability of *G. philippii* (shell morphology and animal chromatism) is displayed and commented through numerous specimens from various localities of the Mediterranean Sea and a sample from the Ibero-Moroccan Gulf (Casablanca). *Gibberula cristinae* with this populational approach is synonymous with *G. philippii*. In the present state, no sibling species is detected within the Mediterranean *G. philippii* group of forms and *G. philippii* is considered as a polymorphic species. The alleged complex of sibling species of *G. philippii* described recently from the Canarian Archipelago is discussed as a comparative case. The populational approach and the extensive study of the phenetic variability is argued to offer high benefits by itself in malacology studies and to contribute highly to the efficiency of integrative taxonomy.

### KEY WORDS

*Gibberula*; Mediterranean Sea; type material; phenetic variability; shell morphology; animal chromatism; sibling species; populational approach; polymorphism.

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### INTRODUCTION

The species *Gibberula philippii* (Monterosato, 1878) (Gastropoda Cystiscidae), described from Palermo, is a tiny microgastropod looking to be ubiquitous in the infralittoral Mediterranean but presenting the paradoxical character of remaining poorly defined from a taxonomic point of view as well as from a naturalist point of view.

As a matter of fact, the taxonomy of *G. philippii* is based on a reference given by Philippi (1844) about a population from Mediterranean Sea regarded as belonging to a species previously described from Cuba by Pfeiffer (as *Marginella minuta* Pfeiffer, 1840) and the original Mediterranean material

of Monterosato was not consulted up to recent times. On the other hand, the populations usually recognized as *G. philippii* show very variable features for both their shell morphology and their animal chromatism.

The occurrence of a complex of sibling species related to *G. philippii* was suspected since a long time. In his foundational revision work about the Mediterranean *Gibberula*, Gofas (1990) tackled this point about the high variability observed for the soft parts chromatism of the species, but on the ground of self-observation of populations from the Strait of Gibraltar, Gofas finally stated on the occurrence of a simple “polychromatism within a

same species”, possibly “controlled by a simple genetic factor”. More recently, Tisselli et al. (2009) described as new species *G. cristinae* Tisselli, Agamennone et Giunchi, 2009 a sibling form of *G. philippii* studied from Scilla, in the southeastern corner of the Tyrrhenian Sea. The species *G. simonae* Smriglio, 2003, described from the border of the Tunisian Plateau (100 m depth), was not compared to *G. philippii* nor attributed to any species group, and the two other tiny *Gibberula* described from Mediterranean Sea, *G. turgidula* (Monterosato in Locard & Caziot, 1900) and *G. jansseni* van Aartsen, Menkhorst et Gittenberger, 1984, both are waiting for a full revision and for a discussion about their possible relationship with *G. philippii*.

The only formal attempt of taxonomic revision of *G. philippii* until now was performed by Gofas (1990) in the frame of his general revision of the *Gibberula* from Mediterranean Sea. Gofas (1990) not being able to consult the original material of *G. philippii*, gave a summary description of the species and illustrated it by three shells from Ceuta (Northern Morocco). Gofas (1990) recognized that the variability of the shell morphology does not correlate with the variability observed in the animal chromatism, but he did not picture nor comment the variability of the shell morphology and the studied material (live specimens as well as empty shell) seems to have been rather limited, at least from a geographical point of view. Overall, Gofas (1990) made the drawings of three quite homogeneous shells from Ceuta and the colour sketches of four live specimens from the same area. In these conditions, the variability at work in the Mediterranean species *G. philippii* cannot be considered.

From their side, Tisselli et al. (2009) founded their new species *G. cristinae* on specimens collected at 42 m off Scilla and they compared them to only one specimen attributed to *G. philippii*, moreover collected at 38 m in non-syntopical conditions. Tisselli et al. (2009) attributed also contrasted habitats to both species, but they compared the habitat reported for their type-population from 42 m off Scilla (“rough substrate with faint or lacking traces of silt”) with a “biocenosis of photophilic algae” said to be associated by Gofas (1990) to *G. philippii* from a level of 9–12 m (locality not specified). In fact, Gofas (1990: 129–131) did not attribute any special habitat to *G. philippii*, and on the

contrary he insisted on the fact that the habitat of *G. philippii* observed in Ceuta “does not seem to be defined by much strict criteria, neither from a bathymetric aspect nor from that of the substrate” (Gofas, 1990: 134).

The identity of *G. philippii* and the real status of the form *G. cristinae* deserve to be fully investigated, and in the considered case a methodic study of the variability of both the shell morphology and the animal chromatism based on large-scale documents seem to be required for testing the “limit of the species” and the structure of their variations.

Two factors allow to deepen the revision of *G. philippii* and the possible occurrence of a group of sibling species matching this form:

- the Monterosato collection is now accessible for study in the Roma Museum (MCZR) and it has been subject recently to a first presentation by Apolloni et al. (2018). We obtained the access to the Monterosato collection to view the original lots of *G. philippii*;

- in the last 30 years, the sampling of Mediterranean micro-gastropods became a routine practice among the collectors, and the available documentation about this fauna increased a lot in public and private collections. The present authors had the opportunity to document extensively the morphologic variability of the shells and the chromatism of the soft parts in various populations linkable to *G. philippii*, on the ground of their own samplings and of the contribution of numerous European scholars.

Based on such premises, the intention of the present article is to reshape the taxonomic revision of *G. philippii* on the ground of a population-based approach. Various documentation was consulted about populations from the whole Mediterranean Sea (map in Fig. 1), with numerous stations from the Northwestern Basin, some from the Ionian Sea and Southern Aegean, and few from the Gulf of Gabès (Southern Tunisia). A sample from the Ibero-Moroccan Gulf (Casablanca, 50–60 m) tentatively attributed *G. philippii* was also studied.

## MATERIAL AND METHODS

A populational approach seems to be the most adapted to the study of such kind of species-group in the biogeographical and taxonomical conditions



Figure 1. Map of the localities referred for the illustrated specimens. 1: Casablanca; 2: Getares; 3: Sotogrande; 4: West Ibiza; 5: Giens (Port du Niel, Almanarre, La Baume); 6: Sainte-Maxime (Beauvallon, Les Sardaunaux); 7: Saint-Raphael (Rade d'Agay); 8: Propriano; 9: Sapri; 10: Scilla; 11: Messina (Villaggio Pace, Lago Faro); 12: Palermo; 13: Ustica; 14: Taormina; 15: Catania; 16: Marzamemi; 17: Lazzaro (Lazzaro Town, Capo dell'Armi); 18: Kerkennah Islands; 19: Karpathos Islands.

explained above. It consists in documenting the characters variability at work in numerous individuals within various populations representative of the distribution of the considered morph, and to correlate together the variability of the characters under study. In the present state, we shall restrict to the observation and checking of both shell morphology and animal chromatism characters. This approach implies to represent the considered form through a large picture of the variability at work, within local populations as well as between them.

In the contemporary studies of marine malacology, the populational approach remains rarely used, including about the presentation of the prevailing phenetic variability. In most cases, the variability factors are tackled very quickly and rarely illustrated, described and analyzed, depriving themselves of an important taxonomic determination tool.

This situation induces a collective lack of experience and of methods in the practical study of the variability in marine malacology. The present authors chose to experiment a number of processes

which seem to work in the considered case, focusing on the variability of the shell morphology due to the high number of shells at disposal and to their relatively easy exploitation. Our attempts about morphometric measures, tabs and diagrams as well as combined analysis of the multifactorial values did not procure intelligible and convincing results, so we made the choice to display directly representative samples illustrating as best as possible “the irreducible variability of Life” in the case of the *G. philippii* morph, asking for a special involvement of the reader about comparing morphologic disparities. The animal chromatism has been less systematically documented and only in some of the referred populations, so the number of individuals displayed in our iconography will be much lower than for the shell morphology.

The original material of Monterosato was studied in the Civic Museum of Roma (MCZR) and the specimens belonging to the lots from Palermo (7 specimens) and from Messina (8 specimens) were photographed and documented. The type ma-



terial status can only be confirmed for the lot from Palermo, whereas the status of the other lots remains unsure. As detailed below, a lot of 8 specimens belonging to the Coen Collection and reported from Palermo (Mienis, 1976) is conserved in the Jerusalem University (HUJ), but neither the loan of the lot nor the photographs of the specimens and of the labels were obtained.

Among the massive material under study, we chose to display morphologic series of local samplings according to the following criteria:

- selection of samplings with good number of specimens of acceptable quality representing different Mediterranean, putting aside the lots with low number of specimens, or with specimens of bad quality, or the lots that could be redundant with selected samplings from the same region;

- within these selected samplings, presentation of pictures for a representative set of specimens: at least four specimens are displayed for each sampling, if the size of the lot is limited or if the morphologic variability is low; up to high number of specimens when the lots are composed of many individuals and when many contrasting shapes are occurring with or without possible intergrades;

- in each local series displayed in our plates, we made sure that the selection of pictured shells is representative of the morphologic forms encountered in the lot, and each form or variant was represented in a similar proportion than the real proportion constated in the lot;

- the presentation of the plates is organized according to a geographic cline, for the Northwestern Basin to the Southern and Eastern localities, in view to make easier a “geographical view” on the morphologic variability. The sample from Casablanca (Western Morocco) is illustrated at the beginning of the southern series, after the Western Ionian Sea and before the Gulf of Gabès. The population from Karpathos Island (Dodecanese Archipelago, Southern Aegean) is displayed in last position. Within each lot, the presentation is made according to a random distribution, since the presentation of progression series would be not only very subjective and more or less conditioned by a typologic minding, but overall because the variability observed in *G. philippii* proves to be multifactorial and rebellious to any linear display;

- in view to make easier the comparison of the features for the reader, each shell specimen is de-

picted at the same height in the plates and with about the same plano-ventral orientation.

In several stations (mainly from the Andalusia southern tip, the Spanish Levante, the central French Riviera, and Sapri, Scilla, Lago Faro and Catania in southern Italy) live specimens were observed and documented (photos or colour drawings; field notes). In most cases, the variability of the animal chromatism was compared to the variability of the individual shell morphology. The results of this comparative duty are not displayed, since any kind of correlation was not constated between both ranges of variability. A few number of representative colour patterns observed in the field is presented.

The origin of the material consulted in the frame of this study and of the used documentary contributions are given in the Acknowledgements.

**ABBREVIATIONS & ACRONYMS.** CAV: Collection A. Villari (Messina, Italy). CDS: Collection D. Scuderi (Catania, Italy). CFB: Collection F. Boyer (Garrigues Sainte Eulalie, France). CFG: Collection F. Gubbioli (Marbella, Spain). CFR: Collection F. Roncone (Cosenza, Italy). CPM: Collection P. Micali (Fano, Italy). CSB: Collection S. Bartolini (Firenze, Italy). CWR: Collection W. Renda (Amantea, Italy). CGH: Collection G. Hervillard (Maisons-Alfort, France). CJLD: Collection JL Deleamarre (Nantes, France). BEL: Benthic Ecology Laboratory, Messina University (Messina, Italy). HUI: The Hebrew University of Jerusalem (Israel). ICZN: International Code of Zoological Nomenclature. MCZR: Museo Civico di Zoologia, Roma (Italy). MNHN: Muséum national d'Histoire naturelle, Paris (France). MZB: Museo di Zoologia di Bologna (Italy). ZMA: Zoologische Museum Amsterdam (Netherlands).

ad = adult ; coll = collection; fig = figure; ibid = ibidem / same reference; id = idem / identical; juv = juvenile; L = length size; pl = plate; sh = shell; spm = specimen.

Referable collections for the illustrated specimens. MCZR: Figs. 4–19. MNHN: Figs. 21–24; 29–32. MZB: Figs. 27–28. BEL: Figs. 165–172; Figs. 229–240. CAV: Figs. 173–196; 205–207; 209–216. CDS: Figs. 245–246. CFB: Figs. 33–92; Figs. 304–307. CFG: Figs. 25–26. CFR: Figs. 93–104; 109–112; 217–224. CPM: Fig. 208. CSB: Figs. 113–164; 272–303. CWR: Figs. 105–108; 197–204; 225–228; 241–255; 311–313. CGH & CJLD: Figs. 256–271.

## RESULTS

### Systematics

Superfamilia MURICOIDEA Rafinesque, 1815

Familia CYSTISCIDAE Stimpson, 1865

Genus *Gibberula* Swainson, 1840

Type species: *Gibberula zonata* Swainson, 1840, by monotypy (= *Volvaria oryza* Lamarck, 1822).

***Gibberula philippii*** (Monterosato, 1878), Figs. 5–20, 33–205, 209–270, 272–313.

*Marginella minuta* Pfeiffer, 1840 in Philippi, 1844: 197, pl. 17, fig. 23.

*Marginella philippii* Monterosato, 1878: 109.

TYPE MATERIAL. Lectotype MCZR here designed (Figs. 5, 6), L = 3.45 mm, Palermo. Seven paralectotypes MCZR here designed (Figs. 7–12), L = 2.44 mm to 3.50 mm, same lot. One of the paralectotypes (not illustrated) is very damaged and its identification is reserved.

In his original definition of the species, Monterosato (1878) gives “*Med. e Adr.*” [Mediterraneo e Adriatico] as distribution range of the species, and “*Pal !*” [Palermo !] as implicate type locality. Among the lots of *G. philippii* examined in the Monterosato collection, only this lot of 8 shell specimens is labelled as coming from Palermo (label in Fig. 3: with the same exclamation point), whereas the four other lots are respectively said to come from Ognina, south of Siracusa (two lots: Arenella, Ognina: 38 sh., Ognina: 1 sh.), Taranto (one lot of 15 sh.) and Messina (one lot of 8 sh.). Since nothing is proving that any of these lots was examined by Monterosato at the time of the species description, they just can be accepted as author’s specimens. The lot from Messina (label in Fig. 4) presenting the best state of conservation in its whole, we are displaying it extensively (Figs. 13–20).

So the lot of 8 shells labelled from Palermo in the Monterosato Collection must be considered as the only certified type-lot. The designation of the lectotype (Figs. 5, 6) is based on its approximate similarity with the type figure recognized in Philippi’s (1844) (Fig. 2), showing the same subcylindrical outline and a moderately thickened upper labrum. The designation of a lectotype is justified by the fact that the status of the type lots as

well as the identity of the specimens really taken in account by Monterosato for his description is not evident in the present case. Several lots considered to come from the Monterosato collection are stored in MCZR, one lot said to come from Monterosato is stored in HUJ, and the Monterosato material is known to have been widely spread in private or public collections, for instance in MNHN. On the other hand, the species looks to be pretty variable by itself, and a certain variability is also represented in the MCZR lot from Palermo. In these conditions, basing on the ICZN rules (Art. 74.1.1 about lectotype designation, and the Recommendation 7G of F.W. Schultes about the revisor’s duty), the designation of a lectotype is required.

Appolloni et al. (2018) consider all the lots attributable to *G. philippii* in the Monterosato Collection as “Type material”, under the number reference MCZR–M–17193. In the absence of concrete demonstration about this point, we prefer to consider that the lot from Palermo is at present the only one for which the status of type material can be founded on a solid ground. As a matter of fact, we do not have any clue about what were the lots in the hands of Monterosato at the time of the description of *Marginella philippii*, except with a very high probability for the lot labelled from Palermo. Appolloni et al. are displaying (2018: Figures 23 E–F) the pho-



Figure 2. Figure of *Marginella minuta* Pfeiffer, 1840 in Philippi (1844: plate 17, fig 23) = Type-figure of *Gibberula philippii* (Monterosato, 1878).

tos of a specimen belonging to the lot from Palermo (herein pictured in Figure 8), flanked by the labels of the lots respectively given from Messina (Figure 3) and from Taranto.

A lot of 8 shells belonging to the Coen Collection and probably coming from Monterosato (Appolloni et al., 2018) is reported from HUI by Mienis (1976: 8) as “syntypes” of *G. philippii*. We did not obtain the loan or photos of this lot of specimens and of the labels, so we cannot confirm the status of the considered specimens as possible “syntypes” (potential paralectotypes) or as author’s specimens. The mention made of “Palermo” by Mienis might refer to the original “type locality” reported by the original description, but we are not sure that such a locality mention is corresponding to an original label joined to the HUI lot.

**OTHER MATERIAL EXAMINED.** Shell documentation: lots from Getares, Bay of Algeciras (Figs. 33–40); Sotogrande, south of Estepona (Figs. 41–48); West Ibiza (no Figure); Giens, south-east of Toulon: Port du Niel (Figs. 49–52), La Baume (Figs. 53–60); Sainte-Maxime: Beauvallon (Figs. 61–68), Les Sardaunx (Figs. 69–80); Saint-Raphaël: Rade d’Agay (Figs. 81–88); south-west Corsica: Propriano (Figs. 89–92); Piombino (no Figure); Elba (no Figure); Sapri (Figs. 93–108); Scilla (Figs. 109–172); north of Messina: Villaggio Pace (Figs. 173–196), Lago Faro (Figs. 197–204); Cefalù (no Figure); Ustica (Fig. 205); Taormina (Figs. 209–216); Catania (no Figure); Marzamemi (Figs. 217–224); Lazzaro, south of Reggio di Calabria (Figs. 225–228), Capo dell’Armi (Figs. 229–240); Crès, Croatia (no Figure); Malta (no Figure); Casablanca, Western Morocco (Figs. 241–255); Kerkennah Islands, Gulf of Gabès (Figs. 256–271), Djerba Island, Gulf of Gabès (no Figure); Karpathos Island,

Dodecanese Archipelago (Figs. 272–303); southeastern Turkey (no figure); Cyprus (no figure).

**Animal documentation.** West Ibiza (Fig. 304); Giens, l’Almanarre (Fig. 305–306), la Baume (Fig. 307), Catania (Fig. 308, 309); Cataluna (Fig. 310); Lago Faro, north of Messina (Fig. 311); Scilla (Figs. 312, 313).

**DESCRIPTION.** Original description: The original definition of *Marginella philippii* given by Monterosato (1878: 109) must be reported extensively: “*M. philippii*, Monts. = *M. minuta*, Ph. (non L. Pfeiff., *ch’è di Cuba*). *Med. e Adr. Monstr. contraria. Pal !*”.

The mention “*Monstr. contraria*” is simply referring to the occurrence of teratologic specimens presenting a left-handed aperture (senestral specimen).

In an evident way, Monterosato is referring to the factual description of Philippi (1844) given for what the later recognized as the Mediterranean population of “*Marginella minuta* Pfeiffer”. We report extensively the Philippi’s words (1844: 197): “3. *Marginella minuta* Pfeif. Tab. XXVII. F. 23 - *M. testa minima, obovata, alba; spira brevi conica; columella recta, quadriplicata. M. minuta Pfeiffer In Wiegmann. Arch. 1840. p. 259. Praecedente rarior, etiam in Mari Antillarum. Testa modo 1 1/3 ‘longa, itaque praecedente dimidio minor, cui similima, sed forma latior est; apertura ratione testae latior, denticuli labri minores. – A M. clandestina spira conica exserta, etsi brevi differt, nec non magnitudine majore*”.

The first line of the description is not a Pfeiffer’s citation (1840: 259) but an interpretation made by Philippi (1844), so it must be associated to the last paragraph, constituting both together the original description of *M. philippii* Monterosato, 1878, as



Figure 3. Label of type material of *M. philippii* Monterosato, 1878, lot from Palermo, MCZR, Monterosato collection.

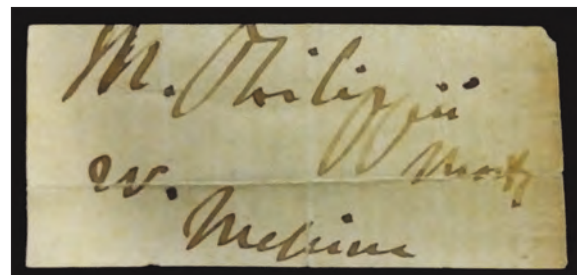
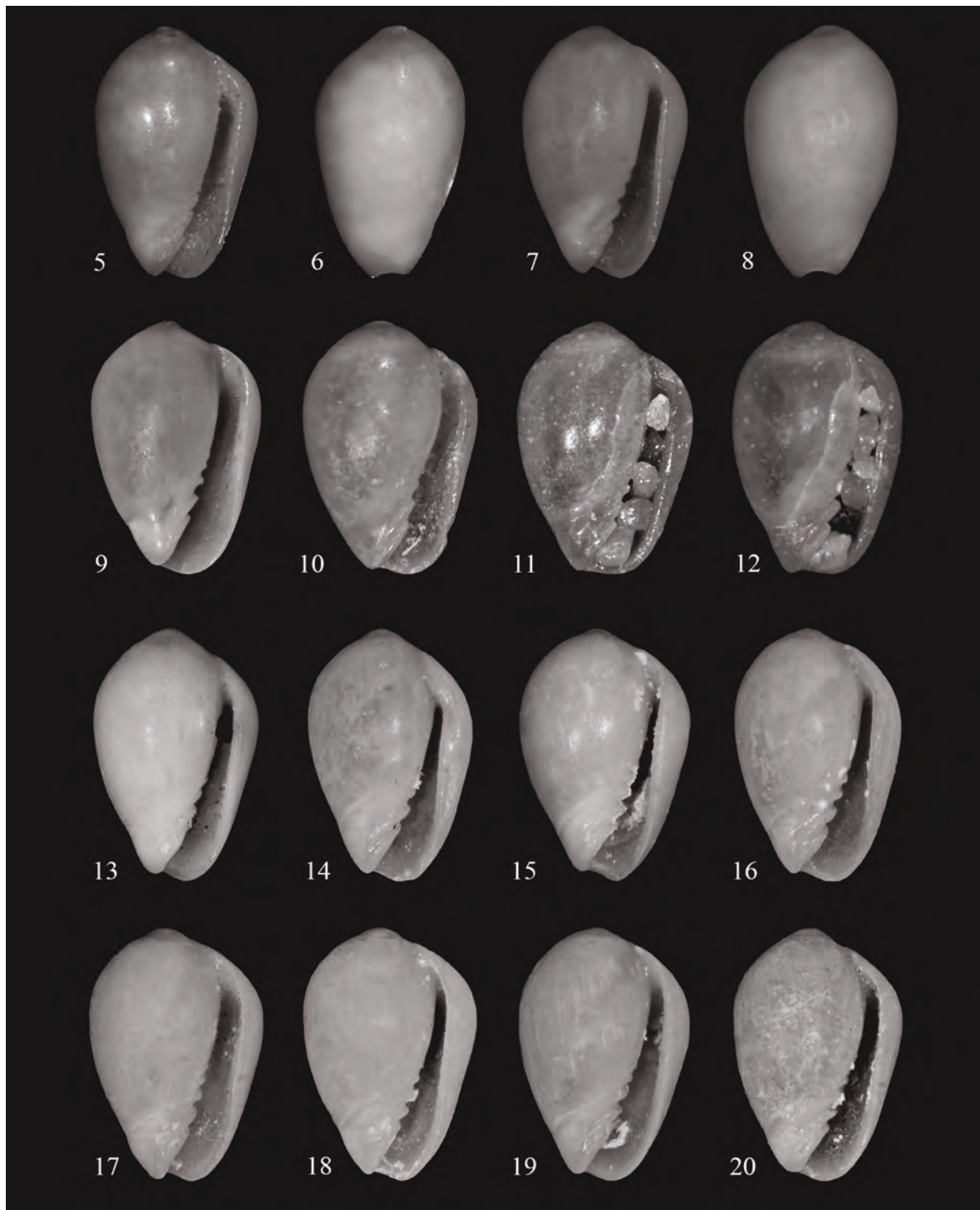


Figure 4. Label of type material of *M. philippii* Monterosato, 1878, lot from Messina, MCZR, Monterosato collection.





Figures 5–20. Original material of *Marginella philippii* Monterosato, 1878 in MCZR, Coll. Monterosato, Reg. Numb. MCZR–M–17193, lots from Palermo and Messina. Figs. 5, 6: Lectotype MCZR, L = 3.45 mm, Palermo; Figs. 7, 8: Paralectotype 1 MCZR, L = 2.80 mm, Palermo; Fig. 9: Paralectotype 2 MCZR, L = 3.50 mm, Palermo; Fig. 10: Paralectotype 3 MCZR, L = 3.10 mm, Palermo; Fig. 11: Paralectotype 4 MCZR, L = 2.87 mm, Palermo; Fig. 12: Paralectotype 5 MCZR, L = 2.44 mm, Palermo; Fig. 13: spec. auct., L = 3.34 mm, Messina; Fig. 14: id., L = 3.00 mm, Messina; Fig. 15: id., L = 2.82 mm, Messina; Fig. 16: id., L = 2.87 mm, Messina; Fig. 17: id., L = 3.15 mm, Messina; Fig. 18: id., L = 3.20 mm, Messina; Fig. 19: id., L = 3.25 mm, Messina; Fig. 20: id., L = 3.35 mm, Messina.



follow: “*M. testa minima, obovata, alba; spira brevi conica; columella recta, quadriplicata. Testa modo 1 1/3 “longa, itaque praecedente dimidio minor, cui simillima, sed forma latior est; apertura ratione testae latior; denticuli labri minores. – A M. clandestina spira conica exserta, etsi brevi differt, nec non magnitudine majore”*”.

The figure of a Sicilian specimen pictured by Philippi (1844: pl. 17, fig. 23) must be as well considered as the type figure of *M. philippii* Monterosato (Fig. 1).

COMPLEMENTARY DESCRIPTION. The description elements given by Gofas (1990) bring important complements to the original description of *G. philippii*. About the shell (Gofas, 1990: 129): “*Coquille atteignant 3 mm dans sa plus grande dimension, translucide. Labre très renflé dans sa partie antérieure, denticulé intérieurement*”.

The reference made to “*a labrum much bulging in its anterior part*” is a simple misspelling: in fact a common feature of the species is to present a much bulging posterior labrum (instead of “anterior”). The very simplified diagnosis given by Gofas (1990) for the shell of *G. philippii* is overall reflecting the high variability of the shell morphology occurring in this species and the difficulty of painting faithfully an overall picture of the natural morphological cline. The “*bulging posterior labrum*” proves to be an important feature for the characterization of the shell of *G. philippii*, as this feature is fully expressed in the vast majority of the specimens observed in each of the studied populations, and expressed in a more moderate way in about all the other specimens, very few fully adult specimens showing a non-bulging posterior labrum. This feature is also original among the tiny white-shelled *Gibberula* from the Mediterranean Sea and from the Northeastern Atlantic Ocean (Gofas, 1990, and pers. obs.).

About the animal chromatism (Gofas, 1990: 129, 131): “*Tête et pied coloré de noir, jaune pâle et orange. La coloration du pied fait alterner des zones ou amas de taches noires avec des taches jaunes; l'ensemble est parsemé de gros points orange plus nombreux vers l'avant et vers l'arrière. Trois types chromatiques du manteau interne ont été observés à Ceuta: de larges plages irrégulières, vertes bordées de noir avec de grandes taches orangées, le tout sur un fond jaune crème (pl. 2, b) une réticulation noire dense, sur un fond vert avec des*

*taches oranges éparses et quelques taches crèmes (pl. 2, c, d) plus rarement, seulement des taches orange sur fond crème (pas de pigment noir ni vert, pas de noir non plus sur le pied) (pl. 2, e)”*”.

TYPE LOCALITY. Implicitly given as “*Pal !*” in Monterosato (1878: 109), here explicitly defined as Palermo, Northern Sicily.

DISTRIBUTION. *Gibberula philippii* seems to range throughout the whole Mediterranean Sea, but its occurrence remains to be documented in Northern Adriatic, Northern Aegean Sea, Lybian and Egyptian coasts. A sample collected in live conditions from off Casablanca in 50–60 m is tentatively attributed to *G. philippii* (Figs. 241–255), but this depth is unusual for the species, and *G. philippii* remains documented from the rest of the Ibero-Moroccan Gulf as well as from Southern Morocco. The identity of the similar morphs reported from the Canary Islands is discussed in the Remarks.

HABITAT. *Gibberula philippii* is reported from hard bottoms, generally on short algae and moss mixed with fine sediments and detritus, from shallow water (low tide level in protected places) down to about 40–50 m. Shells are commonly reported from circalittoral levels (40–200 m), but the occurrence of live populations lower than 40–50 m remains to verify.

REMARKS. About the taxonomy of *G. philippii*. Recognizing a new species in the Mediterranean population previously reported by Philippi as belonging to the Caribbean “*M. minuta Pfeiffer*”, Monterosato did not simply propose any “replacement name”, but he defined an original Mediterranean endemic species, basing the identity of his new species on the study of his own material. Consequently this material must be considered as type material and as contributing to the definition of the species, besides the description and the figure given by Philippi, here considered respectively as original description and original figure of Monterosato. On the other hand, the corresponding Mediterranean material studied by Philippi must be considered as being lost: P. Bouchet did not find it in the Berlin Museum (Gofas, 1990: 129), the Museum of Santiago-de-Chile did not locate possible lots in the early 2000's on the request of the present second author, and Coan & Kabat (2017: 186) do not report any possible lots referring to “*M. minuta*” in the

Philippi's collections after their own deeper inquiries.

About the phenetic variability of the species.

1°- Shell variability.

The high plasticity of the shell morphology of the species is quite well-represented in the type material, especially through the three best conserved specimens: the rather subcylindrical lectotype (Figs. 5, 6) with a first columellar plait which appears as thin, short and strait, the two central plaits much oblique and poorly produced, and the upper plaits very faint and poorly distinct (Fig. 1); the rather massive paralectotype 1 with thick and bulging posterior labrum, and the aperture well-flaring in its anterior part (Figs. 7, 8); the subtriangular paralectotype 2 (Fig. 9) with four well-produced and moderately oblique columellar plaits, the anterior one is long and rather sinuous and the start of a fifth plaits forming a small angular liration. It is important to note that in paralectotypes 1 and 2 the upper part of the labrum is slightly raising with a sharp border and tends to wrap over the upper aperture, making a small saddled-shaped notch at the level of the labrum insertion on the last whorl. The paralectotypes 3, 4 and 5 (Figs. 10–12) are displaying more rounded outlines and swollen tops, with various height level of the labrum insertion, the paralectotypes 4 and 5 both show a wide aperture, heavy parietal callus and produced thick columellar plaits. However, we note that no labial teeth are distinctly visible in the type lot, whereas this features is reported by Gofas (1990) as being usual. The posterior half-part of the labrum is much more bulging in the paralectotype 1 (Figs. 7, 8) than in the rest of the type lot.

The Author's specimens from Messina in the Monterosato Collection (Figs. 13–20) look slightly less variable as far as the shell outline is concerned, showing for the most an outline comparable to the paralectotypes 1, 2 or 3 (Figs. 7–10). The base of the labrum runs well below the level of the body keel (Figs. 12–14) or it is facing the keel (Fig. 16). The columellar plaits can be thin and poorly produced (Fig. 12) like occur in the lectotype (Fig. 5) or rather much produced (Fig. 15). The labrum shoulder can be receding (Fig. 13) or slightly produced (Fig. 15), but any of these eight specimens hold a high upper labrum wrapping over the aperture making a saddle notch at the top of the anal canal. On

the other hand, we observe that in this lot all the intergrades are represented through contrasted features. An exception must be made for the labial teeth, which are represented as thin and short on the central part of the inner border in the specimen of Figure 14, whereas the seven other specimens of this lot show to be deprived of visible labial teeth. A fifth columellar plait occurs in the specimen of Figure 16 in the same way than in the lectotype (Fig. 4), but this feature is suggested by a very faint pleat in specimens of Figs. 15 and 17–19.

The variability at work in the selected series displayed in Figs. 33 to 303 can be summarized as follow.

The shells from Getares, Bay of Algeciras (Figs. 33–40) show a moderate range of variation, with an outline generally inflated and often with a rather marked saddle at the top end of the anal canal (Figs. 34, 35, 40) less frequently a receding shoulder with a very faint saddle or not saddle at all (Figure 38). The spire ranges from well-produced (Fig. 33) to rather low and domed (Fig. 38) or very low with a teat-like apex (Fig. 39). The columellar plaits are much varying in number (from 3.5 to 4.5 plaits) and in shape (more or less produced, with the first plait short and strait like in Fig. 37 or long and concave like in Fig. 38). Labial teeth are often suggested, or even well-marked (Figs. 36, 38), but the labrum can be smooth as well (Figs. 35, 40). Even if less numerous in our sampling, the shells from Sotogrande (a station located 20 km northeast of Getares, out of the Bay of Algeciras) present more or less the same range of variability (Figs. 41–44).

The shells from Port-du-Niel (Presqu'île de Giens, central part of the southern coast, lowest French Riviera) show a wider range of variability and deeper contrasts in several features (Figs. 45–48, 49–52); several shells present a subcylindrical outline with a receding upper labrum (Fig. 50) or a raised one (Fig. 52). In extreme forms, the spire can be very domed, the labrum poorly thickened along all its length, and up to 6 columellar plaits can be present (Fig. 48). In some case, the anal canal and the saddle show to be much notched (Fig. 46), the base much narrowed (Fig. 47), the columellar plaits very strong (Figs. 48, 49) and the labial teeth well-produced (Fig. 51).

The shells pictured from other stations of the French Riviera (La Baume, northeast of the Presqu'île de Giens; Beauvallon and Les Sardinaux,

respectively south and north of Sainte-Maxime; Rade d'Agay, east of Saint-Raphael) and of Corsica (Propriano, southwest of the island) present overall the same range of variability than the shells observed in Port-du-Niel (Figs. 53–92), even when they come from a smaller sampling (Propriano, Figs. 89–96).

The specimens from Sapri (Eastern Tyrrhenian Sea) show a special high number of strong, thick and rather inflated shells (Figs. 93–104), mostly presenting a produced labrum with a distinct saddle (except in Figs. 95–96). The upper labrum is much reflected and wraps towards the aperture in some cases (clearly in Fig. 97, a bit less in Fig. 93).

As far as the Western Mediterranean is concerned (except the undocumented coasts of the Maghreb), the most contrasted shell morphologies for the *G. philippii* morph are found in Scilla (Southeastern Tyrrhenian Sea, in the surrounding area of the Strait of Messina: Figs. 109–172): the outline ranges from clearly subcylindrical (Fig. 114) to much biconical (Fig. 127) or even oval or suboval (Figs. 109, 111, 113, 116) with all kind of intergrades collected in sympatry. Besides a majority of shells showing a receding shoulder and no saddle (or a very faintly notched one), some shells present a well-wrapping upper labrum and a well-notched saddle (Figs. 114, 118, 120, 122, 167, 169). However, the proportion of “saddled shells” seems to be less important in Scilla than in Sapri. The shape and thickness of the labrum and the shape and number of columellar plaits look matching the variability observed in the fauna from the French Riviera. Most of the shells from Scilla present smooth linner labrum or very poorly suggested teeth, the presence of well-marked small teeth occurring in a few number of specimens (Figs. 113, 118, 120, 124, 132, 154, 171).

The variability range observed in the lots from Villaggio Pace and Lago Faro (stations located at the Northwest entrance of the Strait of Messina: Figs. 173–202) looks similar to the range observed in the population from Scilla, even if the shells with highly produced labrum and well-marked saddle are represented in lower proportion than in Scilla. The variability observed from the eastern coast of Sicily (Taormina and Marzamemi) looks similar to the patterns observed in Southeastern Tyrrhenian Sea, even if slight differences seem to occur between these two stations. The shells from Taormina (Figs. 209–216) appear generally as more rounded, whe-

reas the shells from Marzamemi (Figs. 217–224) show a rather more heterogenous morphology. A comparable situation seems to occur at the southern tip of Calabria, where the shells from Lazzaro (Figs. 225–228) display a rather more disparate morphology, whereas the shells from the close station of Capo dell'Armi (Figs. 229–240) present more often a biconical outline.

Overall, the bigger lots of *G. philippii* tend to present a wider range of shell variability, but this situation may simply result from a pure artefact, as the occurrence of “marginal” or “uncommon” forms is more probable when a more important number of individuals is checked at the scale of a station. If we consider the influence of such an artefact on the appreciation of the natural variability, we can consider that the variability of the shell morphology of *G. philippii* looks as pretty constant all along the species range distribution in the Western Mediterranean Sea and in the Western Ionian Sea.

In the lower infralittoral levels of Ustica Island (Southern Tyrrhenian Sea) very disparate shell morphologies are commonly found, matching more or less closely the “*G. philippii* group of form”, even among small samples. Besides specimens matching the most common shell morphology found in *G. philippii* with thick shell, heartshaped outline, low conical spire and much bulging posterior labrum (Fig. 205) three much contrasted and atypical forms with no evident intergrades in most cases are found:

- squat, inflated, subcylindrical shells with very attenuated spire and poorly thickened labrum (Fig. 206), matching closely the shell morphology known from the types of *G. turgidula* (Monterosato in Locard & Caziot, 1900) (Figs. 21, 22 and 23, 24: respectively lectotype and paralectotype MNHN). *G. turgidula* is known to be ranging at circalittoral levels, from about 40 to 200 m, but it remains badly documented and poorly defined in the present state, a rather important shell variability seeming to occur out of its “typical form” (pers. obs.). Moreover, shells usually attributed to *G. philippii* but matching closely the “typical features” of *G. turgidula* are quite often observed in stations from the infralittoral of Western Mediterranean and Western Ionian Sea. For instance the shells from Figs. 47, 114, 177 and 227 look as intergrading between the “most common form” of *G. philippii* and the types of *G. turgidula*;



- narrow, light, slender suboval shells with low spire and smooth labrum, poorly thickened in its medium part (Fig. 207), matching closely the shell morphology known from the species *G. jannseni* Aartsen, Menkhorst & Gittenberger, 1984 (Figs. 25, 26: topotype). Since its description it was said that *G. jannseni* was only ranging in the shallow waters of the Strait of Gibraltar, but effectively the species remains badly documented for its real bathymetry, for its geographical distribution (at least along the coasts of the Maghreb) and for its shell variability. Boyer & Renda (2018: 28–29) considered that the distribution of *G. jannseni* or of a sibling species might reach the northern Sicilian coasts. Even if uncommon, some specimens attributed to *G. philippii* are intergrading with *G. jannseni*, as for instance the shell from Fig. 174;

- heart-shaped, near to subpyriform shells, with a low conical spire and a labrum well-thickened in its medium part, with fine labial teeth (Fig. 208), intergrading between the typical form of *G. philippii* and the shell morphology of *G. simonae* Smriglio, 2009 (holotype in Figs. 27, 28), described from a lot of shells sampled at 100 m off Sfax on the border of the Tunisian Plateau. Since its description *G. simonae* was not subject to further records, so its general bathymetry, its distribution and its shell variability remains unknown. Based on its holotype and paratypes, *G. simonae* is mainly differing from the *G. philippii* range of variability by its labrum moderately thickened in its medium part and not at all in its upper third part. Shells attributed to *G. philippii* and intergrading more or less with *G. simonae* (such as specimens from Fig. 62 or Fig. 94) look to be uncommon at infralittoral levels of Mediterranean Sea. A possible synonymy with *G. philippii* is considered as uncertain.

In these conditions, we name provisionally our three “*contrasted and atypical forms*” as *G. cf. turgidula* (Figure 206), *G. cf. jannseni* (Figure 207) and *G. cf. simonae* (Figure 208). The first of them is very probably a specimen of *G. turgidula*, seeming to reach lower infralittoral in some places where upwelling currents occur (small islands, straits, etc) living in partial sympatry with *G. philippii*. The second form is more dubious and requires deeper investigations: even if very probably not belonging to *G. philippii*, it might be either an oval variant of *G. jannseni* or a narrow specimen of *G. simonae*, or simply to belong to an undescribed

species related to one of them. The third form is doubtfully belonging to *G. simonae* and is more probably a marginal form of *G. philippii*. In the present state it seems that such a shell morphology was not found out of its type locality from the mid-circalittoral of Eastern Tunisia (type series collected as empty shells). Although these various elements do not draw by themselves the contours of the shell variability range in *G. philippii*, they suggest that any overlapping of the respective shell variability ranges is evidenced between *G. philippii* and well-defined species from the considered area.

The specimens studied from off Casablanca (50–60 m) and provisionally attributed to *G. philippii* (Figs. 241–255) were clearly dredged in live conditions and their poor variability is probably resulting from the sampling of a cluster of closely related individuals dwelling on a very narrow bottom. In many respects, this form is very coherent with the forms observed from Western Mediterranean, even if presenting a slightly more shouldered outline with a lower spire, sometimes stepped or mamillated, sometimes depressed with bulging apex: even if less frequent, such kind of variations in the spire can be found however in several populations, for instance in the populations from Southern Andalucia (Getares and Sotogrande: Figs. 33–48). The recorded depth is unusual for live collected specimens of *G. philippii*, the real shell variability in this geographic settlement cannot be considered as seriously documented, and the animal chromatism was not observed, so it to be seems prudent to define provisionally this population as *G. cf. philippii*.

The shell variability of the populations of *G. philippii* studied from the Kerkennah Islands (Figs. 256–270) looks very similar to what is known from the Western Basin and from the Ionian Sea. A sub-cylindrical specimen of the same size found in the Kerkennah samples belongs clearly to another species. For its general outline, the angular shoulder of its labrum with stepped and not-notched top, its very straight and vertical lip and its thicker and less oblique columellar plaits, it differs greatly from *G. philippii* and it looks as very similar to *G. epigrus* Reeve, 1865, known from Southern Andalucia and the Strait down to Central Senegal (pers. obs.), and also documented from the Gulf of Gabès (Cecalupo, Buzzuro & Mariani, 2008: plate 64, Figs. 30, 31, and pers. obs.). This specimen differs from the sympatric

*G. epigrus* by its much smaller size (2.35 mm instead of 4.0 to 6.0 mm), its vitreous material (instead of opaque material in *G. epigrus*) and the total absence of colour decoration (instead of orange banding in *G. epigrus*, not always expressed). The specific identity of this specimen is uncertain: it must be clearly separated from *G. philippii*, and it looks closer to *G. epigrus*, however with some restrictions. So in the present state it seems appropriated to define it as *G. cf. epigrus*. That is an original case of a tiny *Gibberula* species clearly differing from *G. philippii* in the shallow waters of the Mediterranean Sea, out of the Strait of Gibraltar.

The shell variability observed from Karpathos Island (Figs. 272–303) is about as much important as the variability observed in Scilla, but with an evident tendency to frequent slender or subcylindrical shells. All the intergrades with the typical form of *G. philippii* prove to occur in Karpathos, but the most cylindrical shells from this island have been considered to belong to a lessepsian species, as *G. cf. olivella* Cossignani, 2001 by Micali et al. (2017: Fig. 11). The same form is documented from Corfù as *Gibberula* sp. by Romani, et al. (2017: Figs. 7E–F). In fact *G. olivella*, described from Mogadishu, Somalia, has a much oval shell and a shorter and thinner second columellar plait. It is based on a probably subadult shell with a thin regular labrum, showing no tendency to lip thickening at its upper third part. Overall, the subcylindrical specimens from Karpathos have nothing to deal with *G. olivella* and they are matching *G. philippii* for their principal shell features. The “cylindrical tendency” in the populations of *G. philippii* was only observed until now from Eastern Ionian to Dodecanese Islands, but not from Western or Central Mediterranean, and it testifies to the occurrence of geographical morphologic tendencies in *G. philippii*, possibly reflecting relative populational autonomy.

## 2°- Animal variability

The variability of the animal chromatism of *G. philippii* is illustrated in two ways: the representation of crawling animals by coloured drawings (Figs. 304–309) or by photographs (Figs. 301–313), and the display of specimen shells with preserved dry animals visible by transparency (various Figs. 81–112 and 161–240).

The most common chromatic pattern is well-

illustrated in Figures 310–313 by four specimens observed respectively from Catalonia (Fig. 177), off Lago Faro, at the northwestern entrance of the Strait of Messina (Figure 178) and Scilla, located on the eastern side of the Strait entrance (Figures 179–180). The foot decoration is characterized by about six large whitish clouds along each lateral side, with a cluster of black spots in the intervals, and a moderate number of small orange dots spread over the white clouds as well as over the intervals. A white zone stretches over the head axis, with an orange spot at the base of the short tentacles, which can bear possible tiny whitish and orange dots or dashes. The tip of the short siphon is milky white, with possible tiny orange dots. Under the dorsal part of the last whorl, two mains milky white zones occur: the upper one leans below the suture with a protruding finger pointing down to the center of the last whorl; the lower one is made of two jointed big white patches: one at right-hand corresponding to the basal part of the siphon, the other one (as “lateral patch”) ranging a bit upper at left-hand and coming at the finger’s tip level. The perimeter of these white zones is bordered by an irregular deep black fringe, but very narrowed or absent above the “lateral patch”. The rest of the interval or “crevices” between the white zones shows a light green ground. Under the spire is seen a whitish bulk bearing a black transversal crevice more or less fragmented. In most specimens belonging to this “common form” (Figs. 310, 312), big orange dots are more or less clustering over black and the green shades crevices under the body whorl like under the spire, whereas smaller and lighter orange dots rang over the white zones. In other specimens (Figs. 311, 313) the orange spots are better medium-sized and more uniformly spreading over the whole mantle. In some specimens, the white zones ranging on the foot and on the inner mantle turn to be light-yellowish. Despite this slight variation in the size and distribution of the orange spots, the “common pattern” of the animal chromatism looks surprisingly constant in all the observed population, besides three principal chromatic variants presenting a less current occurrence.

These three principal chromatic variants are here characterized through a series of drawings (Figs. 304–309) made from populations of Ibiza (Fig. 304), Presqu’île de Giens (Figs. 305–307)

and Catania (Figs. 308, 309): the “white variant” (Fig. 304) is principally characterized by a more important surface of the white zone, the intervals or crevices are very narrow and often coloured in very dull shades (very thin black marks, yellowish cream ground instead of greenish, small orange dots limited to the crevices); the «yellowish variant» (Fig. 306) does not show evident white zones, but better an uniform yellowish (sometime yellow-green) ground with a constellation of more or less spread orange spots; the «melanistic variant» (Figs. 305, 309) shows very fragmented and narrowed white (or light-yellowish) zones, most of the surface of the inner mantle is blackish with fragmented green spots (Fig. 242) or greenish with thick deep black borders (Figure 309), the orange spots is very few and small. In Figs. 307–308 are presented for comparison the drawings of two live specimens belonging to the “common pattern”: we can observe that the “artistic licence” allowed, to the draftmen, to harm the fidelity of the drawings, as the characteristic components of this chromatic pattern are neither highlighted by these drawings nor by the photographs from Figs. 310–313. Overall, the various specimens presented in Figs. 81–112 and 161–240 with animal chromatism visible by transparency can be linked to the “common pattern” or to one of these three variants.

The observation of such “chromatic variants” may suggest the occurrence of syntopic sibling species. But in the present case, various kinds of intergrading chromatisms are found (cf. in Figs. 81–112 and 161–240) and any correlation was not found between the animal chromatism and the shell morphology in each population observed. So the interpretation of the form *G. philippii* as constituting a possible set of sibling species is rejected in the present state.

#### About the hypothesis of a *G. philippii* complex of sibling species.

1° - About *G. cristinae* Tisselli, Agamennone et Giunchi, 2009

As summarized in our Introduction, this species was described on the ground of specimens collected off Scilla at 38–44 m (holotype MNHN and 244 paratypes) and of few specimens collected off Lampedusa at 46 m (6 paratypes) and on Banco Skerki, Egadi Islands, at 37 m (3 paratypes). Tis-

selli et al. (2002: 51–52) illustrate the holotype (here as Figs. 29–32) and two paratypes collected in the same sampling off Scilla (42 m), looking very homogeneous and possibly belonging to the same clutch, as well as a “specimen” from the Banco Skerki presenting no affinities with the type specimens from Scilla and with the definition of the species. The shell morphology of *G. cristinae* is mainly characterized by a rather inflated subpyriform outline, a very low blunted spire, a poorly thickened posterior labrum with a rather high and wrapping upper part making a saddle at the top of the anal canal, low denticles on the inner labial wall, inboard of the labial cutting edge, and the presence of five columellar plaits (in fact 5 in the holotype, but 6 in paratype n° 1 and 4 in paratype n° 2). As reported previously, only one specimen of *G. philippii*, presenting a much triangular outline and a much bulging posterior labrum, is illustrated (Tisselli et al., 2009, Figs. 49, 50), but these authors consider that *G. cristinae* is different from *G. philippii* on the basis of its more “ovoid” outline, the saddle formed at the upper tip of the labrum and the presence of 5 (versus 4) columellar plaits. *G. cristinae* is said to be living in lower infralittoral (38–44 m in Scilla) whereas *G. philippii* would be restricted to upper infralittoral (9–12 m, referring to Gofas, 1990). Self-contradicting this supposed gap in the bathymetric distribution, the unique specimen of *G. philippii* presented by Tisselli et al. (2009, Figs. 49, 50) proves to be a fresh specimen collected at 38 m off Scilla.

In fact, the form *G. cristinae* fully belongs to the variability range of *G. philippii*, as evidenced by our plates where all kinds of intergrades are proved to occur between the “typical form” of *G. philippi* (corresponding to the morphology of the holotype) and the “typical form” of *G. cristinae* (both “typical forms” being represented by the respective holotypes: Figs. 5, 6 and Figs. 29–32). All the intergrades between the “triangular forms” and the “subpyriform shapes” are represented in the populations we studied from Scilla (4 stations from 5 to 45 m) as well as for the height of the spire, the thickness of the posterior labrum, the shape of the upper labrum, the occurrence of a more or less notched saddle and the number of columellar plaits. Some of the specimens from Scilla illustrated in our plates could match the features attributed to the “*G. cristinae* form” (for ins-



tance Figs. 114, 122, 140, 147, 167–168, 169) whereas other specimens could be considered as less clearly attributable to this form (for instance Figs. 117 or 171). Shell specimens attributable to the “*G. cristinae* form” are found at various shallow depths in several localities studied in this work, for instance in Getares (Figs. 34 and 40), Port du Niel (Figures 45 and 46, less clearly Figs. 49 and 52), les Sardaïaux (Fig. 75), Rade d’Agay (Fig. 83, less clearly Fig. 87), Sapri (Figs. 97–100), Villaggio Pace (Fig. 178), Taormina (Figs. 209, 210 and 215–216), Lazzaro (Fig. 227). In other localities represented in our plates, the occurrence of specimens matching the “*G. cristinae* form” is less evident (Sotogrande, La Baume, Beauvallon, Propriano, Lago Faro, Marzamemi, Capo dell’Armi) even if various intergrading forms are represented.

As far as the animal chromatism is concerned, the “*G. cristinae* form” does not differ from the range of variability observed in *G. philippii*: even limiting the demonstration to specimens fully matching the “*G. cristinae* shell diagnosis”, the “common white and green pattern” is observed in a specimen from Taormina (Figs. 209, 210, collected at 16 m) whereas the usual “melanistic form with large orange spots” is observed in a specimen from Scilla (Figs. 167, 168, collected at 45 m).

For all these reasons, following a model of population approach, we propose the synonymy of *G. cristinae* with *G. philippii*.

## 2°- Species group and phyletic affinities

As a matter of fact, the statistical distribution of the shell morphology of *G. philippii* as well as the distribution of its animal chromatism are strictly conforming to a “random pattern” testifying to the specific unity of the morph at a high degree of likelihood. The occurrence of a complex of sibling species matching the morph *G. philippii* would be most probably detected either by an “uniform pattern of distribution” or by an “aggregated pattern of distribution”, which are not suggested by our results. So, such a “complex of sibling species” is not confirmed in the present state for Mediterranean waters. Beyond the high phenetic variability documented through the shell morphology and the animal chromatism, no autonomous form is detected and all kinds of inter-

grades are represented in the populations (however in a more evident way for the shell morphology than for the animal chromatism). Thus, the reasonable inference is to consider *G. philippii* as a polymorphic species, better than as a complex of sibling species. Naturally this conclusion is hypothetical and provisional, as must be all the taxonomical statements, and further studies dealing with additional features (for instance with the radular pattern or with the anatomy of the alimentary canal) may allow to detect cryptic species not separable on the simple ground of phenetics among the *G. philippii* morph.

On the other hand, Gofas (1990: 129–133) stated on the occurrence of a “*G. philippii* species group” including the Mediterranean species *G. philippii*, *G. jansseni* and *G. turgidula*. Gofas did not define this “species group” more deeply, and his criteria seem to reside principally in the shared features of small sizes and undecorated shells. However, the data at hand do not allow to confirm these three species as constituting an evident natural clade of closely related species. The animal chromatism of *G. jansseni* presents green shades like in the most usual colour phase of *G. philippii*, but this colour feature is often associated to tiny vitreous *Gibberula* populations observed from throughout the world (pers. obs.), and the animal chromatism of *G. turgidula* remains unknown whereas the variability of its shell morphology remains to be documented. *G. simonae* being only known from its type material and in absence of any documentation about its animal chromatism, it must be considered also for now as belonging simply to the “group of tiny *Gibberula* from Mediterranean”, which is waiting for a full study. The present authors undertook a work about the shell variability of *G. turgidula* in Western Mediterranean.

The occurrence of a “*G. philippii* species group” at a general scale is not excluded, at least as phenetic category if not as phyletic clade, but it clearly deserves deeper investigations. The point was tackled incidentally by the first author in previous works (Boyer, 2003, 2014 & 2017).

## 3°- The *G. philippii* morph in the Canary Islands

Ortea & Moro (2017, 2020) described through two articles a series of height different *Gibberula*

species, defined on the ground of their shell morphology and of their animal chromatism, all matching closely the phenetic variability here documented for the Mediterranean *G. philippii*. However, any documented comparison with *G. philippii* is not proposed in these two works, and the height different forms are based on a scarce material and on limited observations: three of these so-said species were collected in only one specimen, another species in two specimens, and the four other species in several (8 to 14) specimens but even in this case the number of live specimens really observed for the animal chromatism is not reported and the shell variability is not displayed. Furthermore, any of these so-said species was not collected syntopically with brother species, but only as individual or in conspecific groups. So any field comparison was not really applied. The study does not give an idea of the range of variability of these different forms and it does not prove that evident gaps are occurring between the different forms displayed. As a matter of fact, the shell variability of these forms looks to be much lower than the morphologic variability observed in the Mediterranean populations of *G. philippii*, and the various chromatic patterns displayed by the animals of these Canarian forms are compatible with the chromatic phases observed from the Mediterranean *G. philippii*. So in the present state, the occurrence of a real radiation of sibling species belonging to the *G. philippii* species group is not proved from the Canary Islands, and deeper studies are required. The only concrete argument in favor of a specific diversification in the Canarian Archipelago is the comparison of a radular plate of *G. judithae* with a radular plate of *G. estherae* (Ortea & Moro, 2017: figures 1A–B), these plates looking as being pretty different. However the shape of the radular plates in the cystiscids is proved to be quite variable, specially depending on the maturity of the specimens, so a deepened inquiry about the radulae in this group of forms and their variability is needed. In the present state, no robust clue allows to decide between the contrasted hypothesis of a radiation of multiple sibling species of *G. philippii* in the Canarian Archipelago, or of a single variable species possibly conspecific with the Mediterranean *G. philippii*. Naturally, as in the Mediterranean Sea, the presence of cryptic twin species or neospecies can occur.

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We are obliged to many students and collectors, who helped us in the course of this work in various ways, especially concerning the documentation about the high morphologic disparity occurring in *Gibberula philippii*. We cannot cite all of them but they know how grateful we are. We listed only the collection references for the material illustrated in this article (see in Material & Methods). The photographic credits and the artwork contributions are listed below. We are indebted to M. Appolloni (MCZR) for his welcome and help about consulting the types collection of Monterosato, to A. Bonfitto (MZB) for sending the type figures of *G. simonae*, and to S. Giacobbe (BEL) for the loan of material and for his constant support. Special thanks are due for the valuable material and documents loaned by S. Bartolini (Firenze, Italy), A. Raveggi (Firenze, Italy), F. Roncone (Cosenza, Italy) and A. Villari (Messina, Italy), which allowed comparisons at great scale about populations from Eastern Tyrrhenian, Ionian Sea and Dodecanese Archipelago, and to J.L. Deleamarre, G. Hervillard, J. Pelorce and A. Hoarau which procured material from unusual places of Southern France and Corsica, Northern Sicily, Illyrian shores and the Gulf of Gabès. We also would like to thank Mrs Romina Leo (Copertino, Italy) for helping with the English translation of the text. Special acknowledgements are due to Italo Nofroni (Roma, Italy) and to Luigi Romani (Capannori, Lucca, Italy) for reading our initial manuscript and for useful remarks.

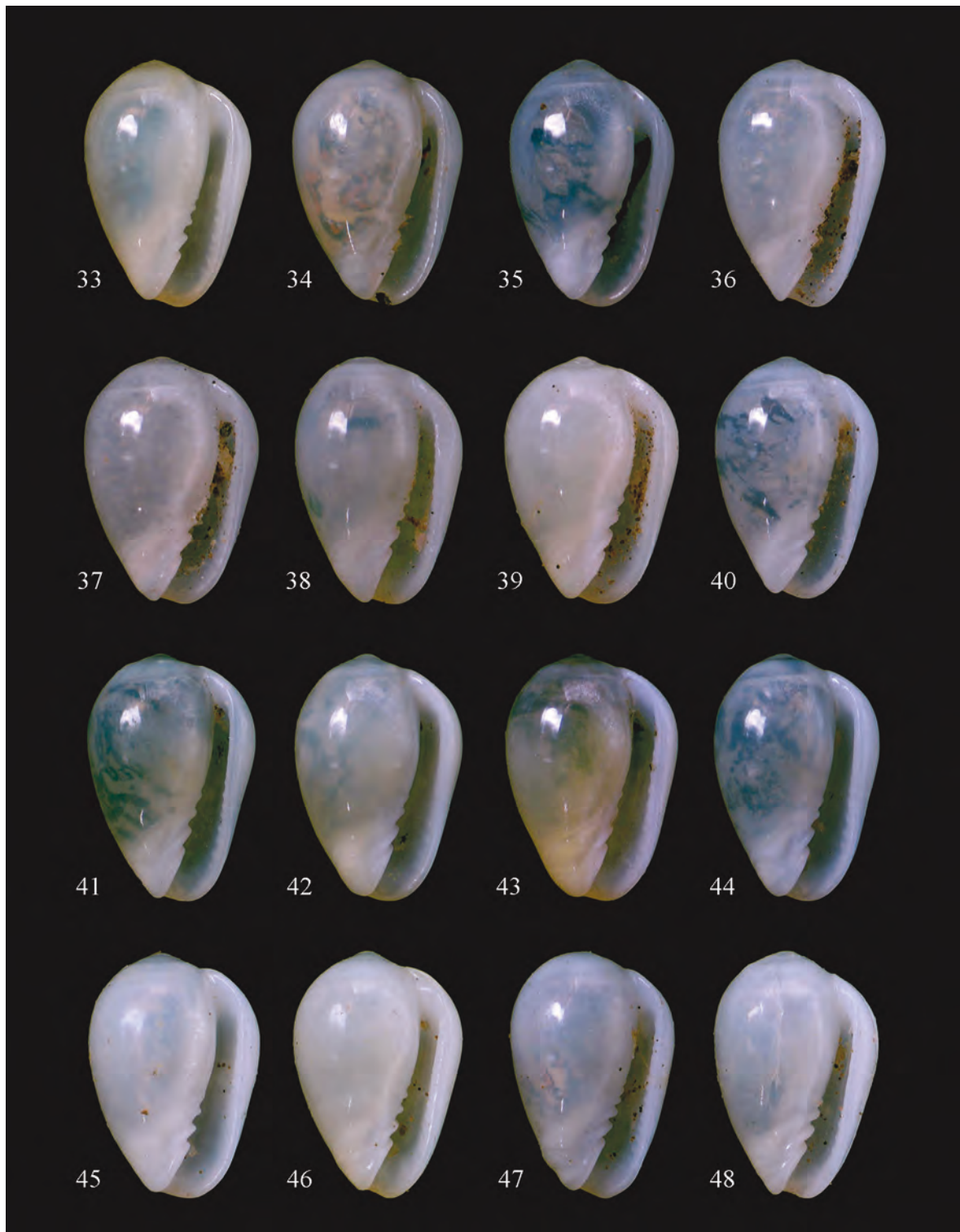
**Photographic credits:** All the photos were performed by the second author, except for the following pictures: Figures 21, 22 = B. Fontaine, MNHN; Figures 23, 24 = M. Caballer, MNHN, Recolnat 2014; Figures 25, 26 = F. Gubbioli (Alboran Shells); Figures 27, 28 = C. Smriglio, MZB, 20034; Figures 29, 30 = M. Caballer, MNHN, Recolnat 2014; Figures 31, 32 = T. McCleery, MNHN 2011. Fig. 310 = [www.cibsub.cat](http://www.cibsub.cat)

**Artwork:** The drawings of live animals were performed by the first author (Figs. 241–244) and by D. Scuderi (Figs. 245–246). The pictures optimization and the plates mounting were arranged by the second author.

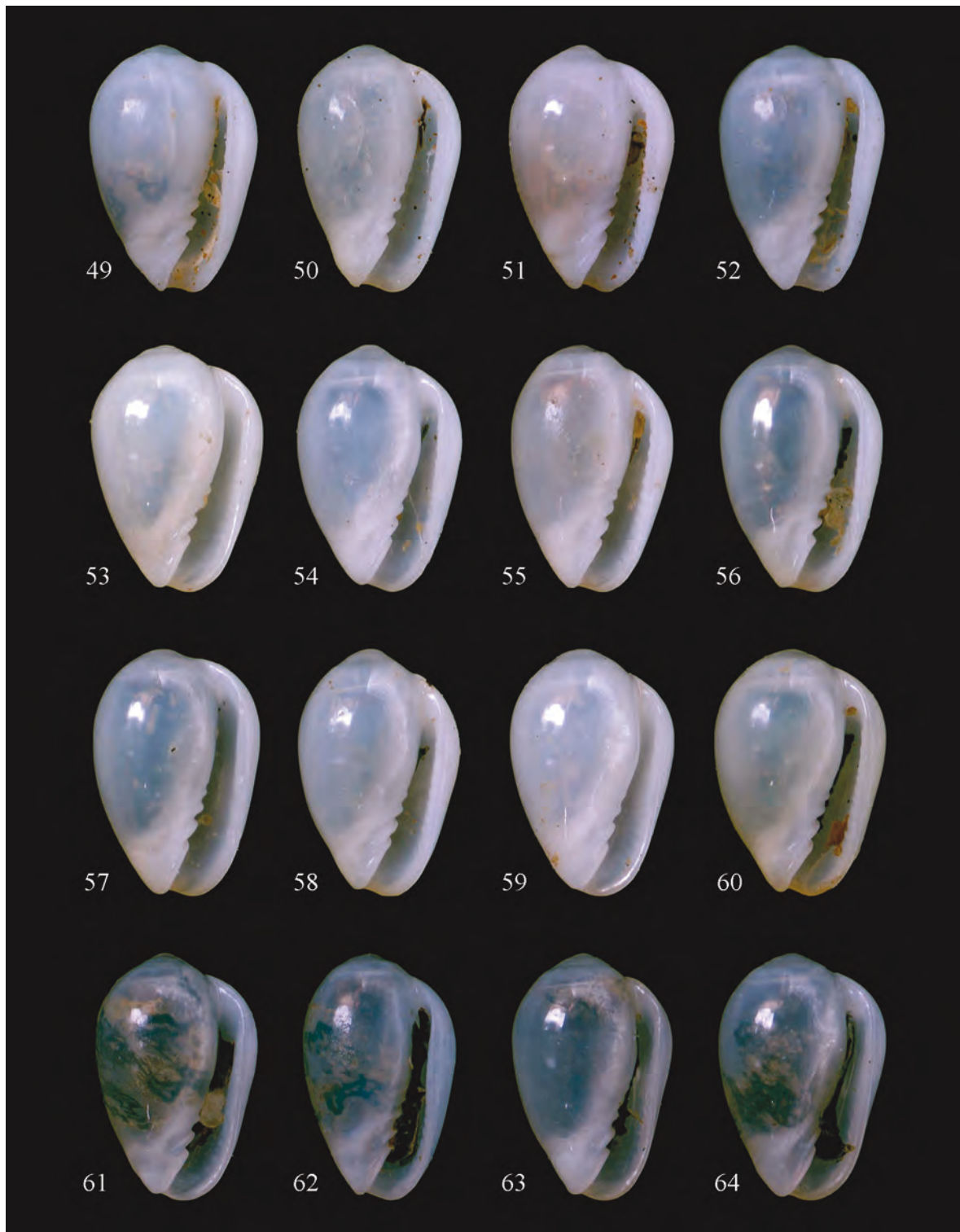


Figures 21, 22. *Gibberula turgidula* (Monterosato in Locard & Caziot, 1900), lectotype MNHN, Coll. Locard, L = 2.20 mm, Palermo. Figures 23, 24: id., paralectotype MNHN, Coll. Locard, L = 2.50 mm, Palermo. Figures 25, 26. *G. jansseni* Aartsen, Menkhorst et Gittenberger, 1984, Coll. F. Gubbioli, L = 2.30 mm, Getares. Figures 27, 28. *G. simonae* Smriglio, 2003, holotype MZB-14684, L = 2.0 mm, off Sfax, 100 m. Figures 29, 30. *G. cristinae* Tisselli, Agamennonae et Giunchi, 2009, holotype MNHN, L = 2.47 mm, Scilla, 38-44 m. Figures 31, 32: same spm, SEM photography.

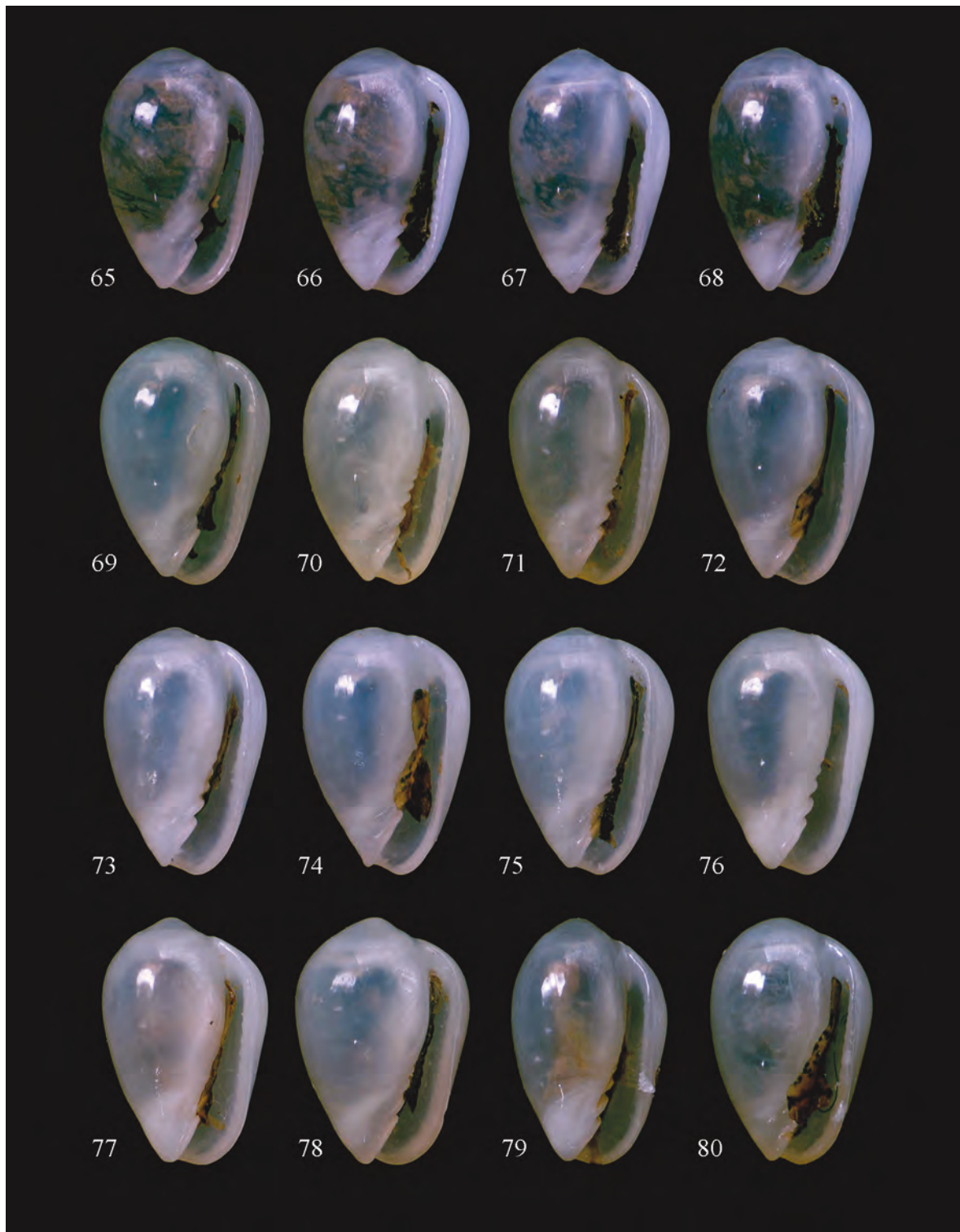




Figures 33–40. *Gibberula philippii*, Getares, shallow water, L = 2.75 mm. Fig. 34: id., L = 3.20 mm. Fig. 35: L = 2.85 mm. Fig. 36: L = 2.90 mm. Fig. 37: L = 2.75 mm. Fig. 38: L = 2.70 mm. Fig. 39: 2.75 mm. Fig. 40: L = 2.75 mm. Figures 41–44. *G. philippii*, Sotogrande, shallow water. Fig. 41: L = 2.80 mm. Fig. 42: L = 2.75 mm. Fig. 43: L = 2.60 mm. Fig. 44: L = 2.85 mm. Figures 45–48. *G. philippii*, Port du Niel, shallow water. Fig. 45: L = 2.65 mm. Fig. 46: 2.90 mm; Fig. 47: L = 2.90 mm; Fig. 48: L = 2.75 mm.

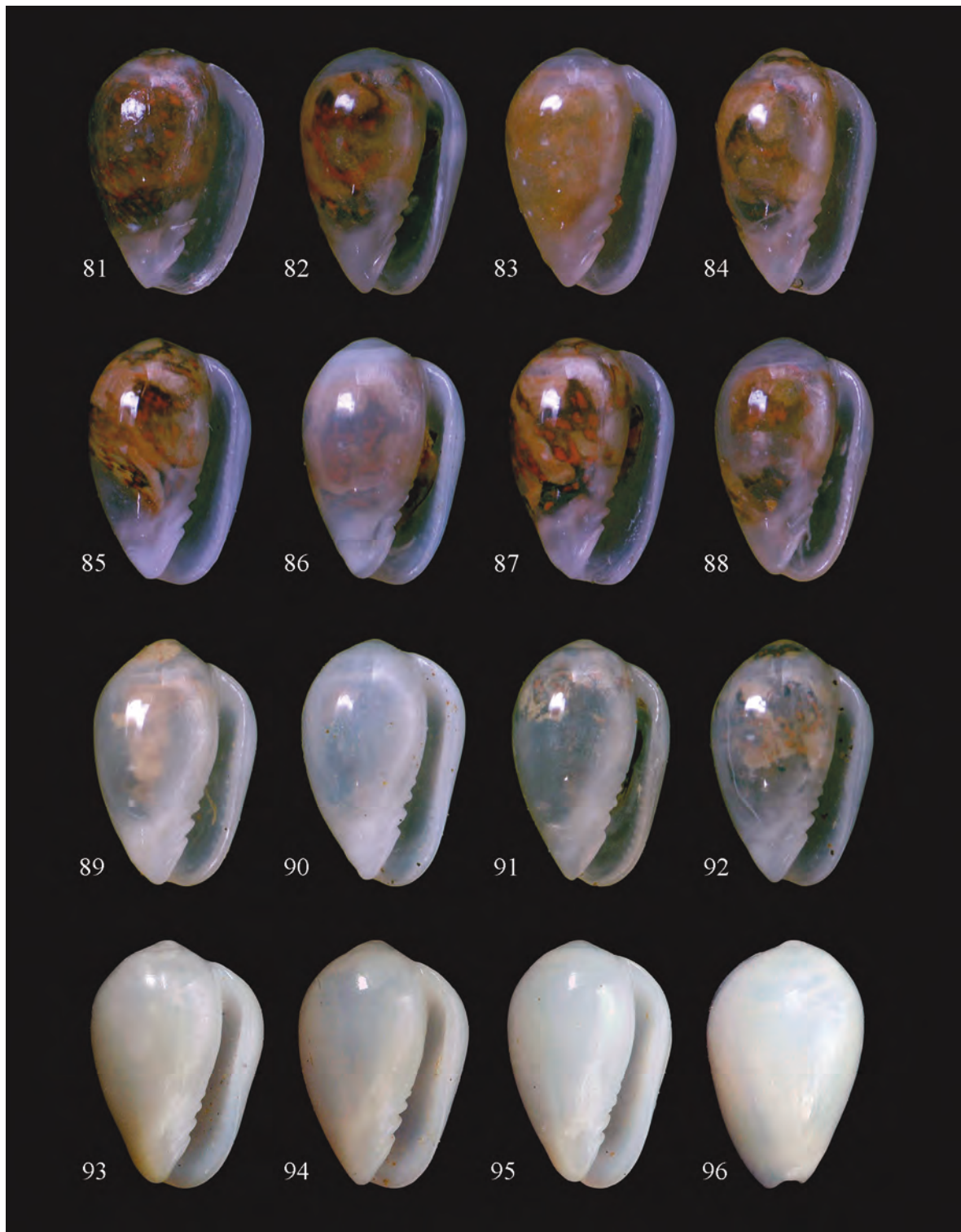


Figures 49–52. *Gibberula philippii*, Port-du-Niel, shallow water. Fig. 49: L = 3.00 mm. Fig. 50: L = 2.80 mm. Fig. 51: L = 2.80 mm. Fig. 52: L = 2.80 mm. Figures 53–60. *G. philippii*, La Baume, shallow water. Fig. 53: L = 2.45 mm. Fig. 54: L = 2.50 mm. Fig. 55: L = 2.45 mm. Fig. 56: L = 2.45 mm. Fig. 57: L = 2.45 mm. Fig. 58: L = 2.45 mm. Fig. 59: L = 2.45 mm. Fig. 60: L = 2.45 mm. Figures 61–64. *G. philippii*, Beauvallon, shallow water. Fig. 61: L = 2.35 mm. Fig. 62: L = 2.35 mm. Fig. 63: L = 2.35 mm. Fig. 64: L = 2.35 mm.

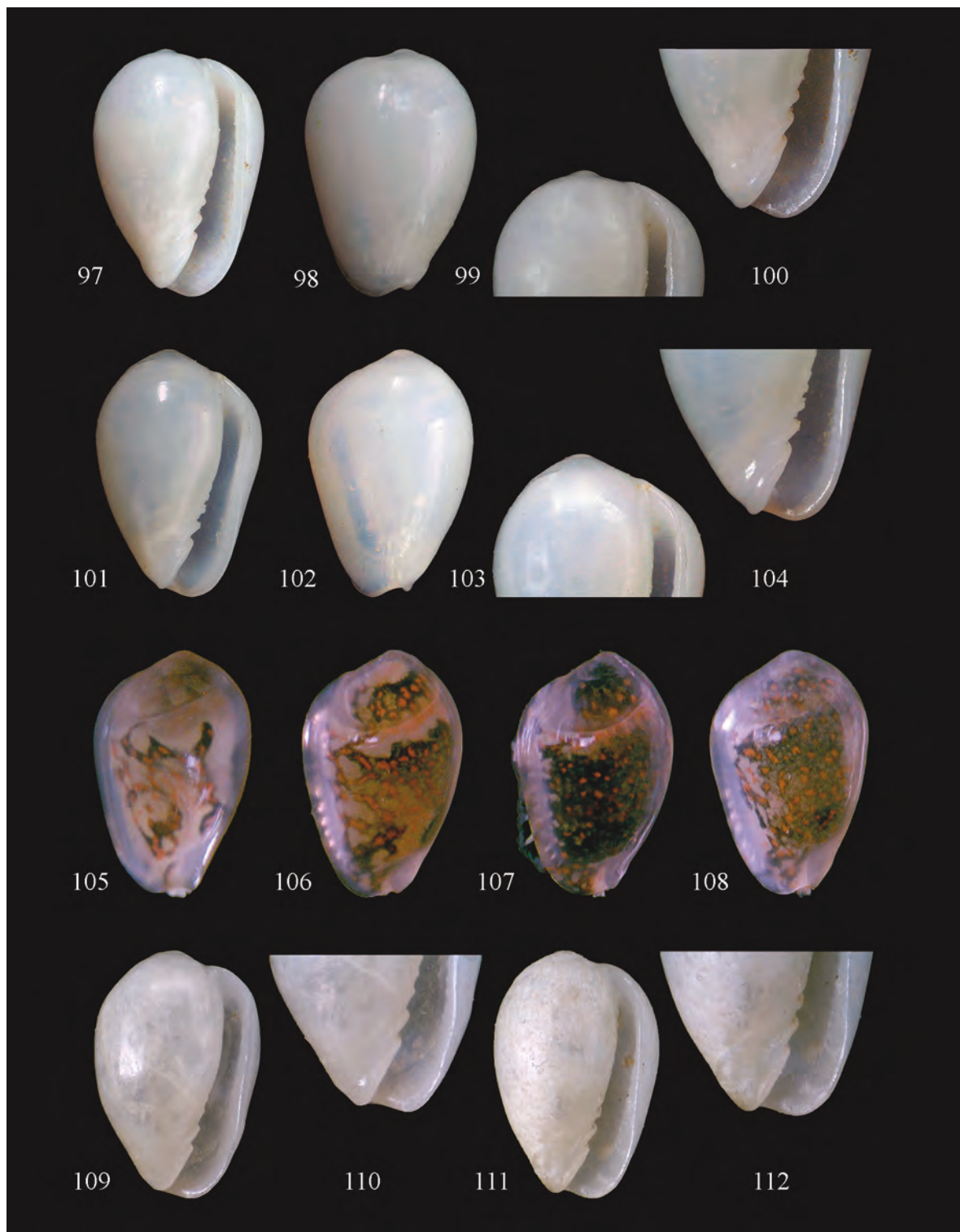


Figures 65–68. *Gibberula philippii*, Beauvallon, shallow water. Fig. 65: L = 2.35 mm. Fig. 66: L = 2.35 mm. Fig. 67: L = 2.35 mm. Fig. 68: L = 2.35 mm. Figures 69–80. *G. philippii*, Les Sardinaux, shallow water. Fig. 69: L = 2.60 mm. Fig. 70: L = 2.40 mm. Fig. 71: L = 2.40 mm. Fig. 72: L = 2.40 mm. Fig. 73: L = 2.65 mm. Fig. 74: L = 2.65 mm. Fig. 75: L = 2.65 mm. Fig. 76: L = 2.65 mm. Fig. 77: L = 2.75 mm. Fig. 78: L = 2.60 mm. Fig. 79: L = 2.50 mm. Fig. 80: L = 2.40 mm.





Figures 81–88. *Gibberula philippii*, Rade d'Agay, shallow water. Fig. 81: L = 2.60 mm. Fig. 82: L = 2.95 mm. Fig. 83: L = 2.60 mm. Fig. 84: L = 2.60 mm. Fig. 85: L = 2.60 mm. Fig. 86: L = 2.60 mm. Fig. 87: L = 2.50 mm. Fig. 88: L = 2.60 mm. Figures 89–92. *G. philippii*, Propriano, shallow water. Fig. 89: L = 2.65 mm. Fig. 90: L = 3.00 mm. Fig. 91: L = 2.65 mm. Fig. 92: L = 2.65 mm. Figures 93–96. *G. philippii*, Sapri, 25 m. Fig. 93: L = 3.20 mm. Fig. 94: L = 2.92 mm. Figs. 95, 96: L = 3.05 mm.



Figures 97–100. *Gibberula philippii*, Sapri, 25 m., L = 3.22 mm. Figs. 101–104: id., L = 3.05 mm. Figures. 105–108. *G. philippii*, Sapri, shallow water, live spm. Figures 109, 110: *G. philippii*, Scilla, 5 m, L = 2.50 mm; Figures 111, 112: id., L = 2.50 mm.



Figures 113–128. *Gibberula philippii*, Scilla. Fig. 112: 45 m, L = 2.50 mm. Fig. 114: L = 2.60 mm. Fig. 115: L = 2.80 mm. Fig. 116: L = 2.55 mm. Fig. 117: L = 2.70 mm. Fig. 118: L = 2.50 mm. Fig. 119: L = 2.60 mm. Fig. 120: L = 2.45 mm. Fig. 121: L = 2.60 mm. Fig. 122: L = 2.50 mm. Fig. 123: L = 2.60 mm. Fig. 124: L = 2.70 mm. Fig. 125: L = 2.60 mm. Fig. 126: L = 2.80 mm. Fig. 127: L = 2.60 mm. Fig. 128: L = 2.70 mm.



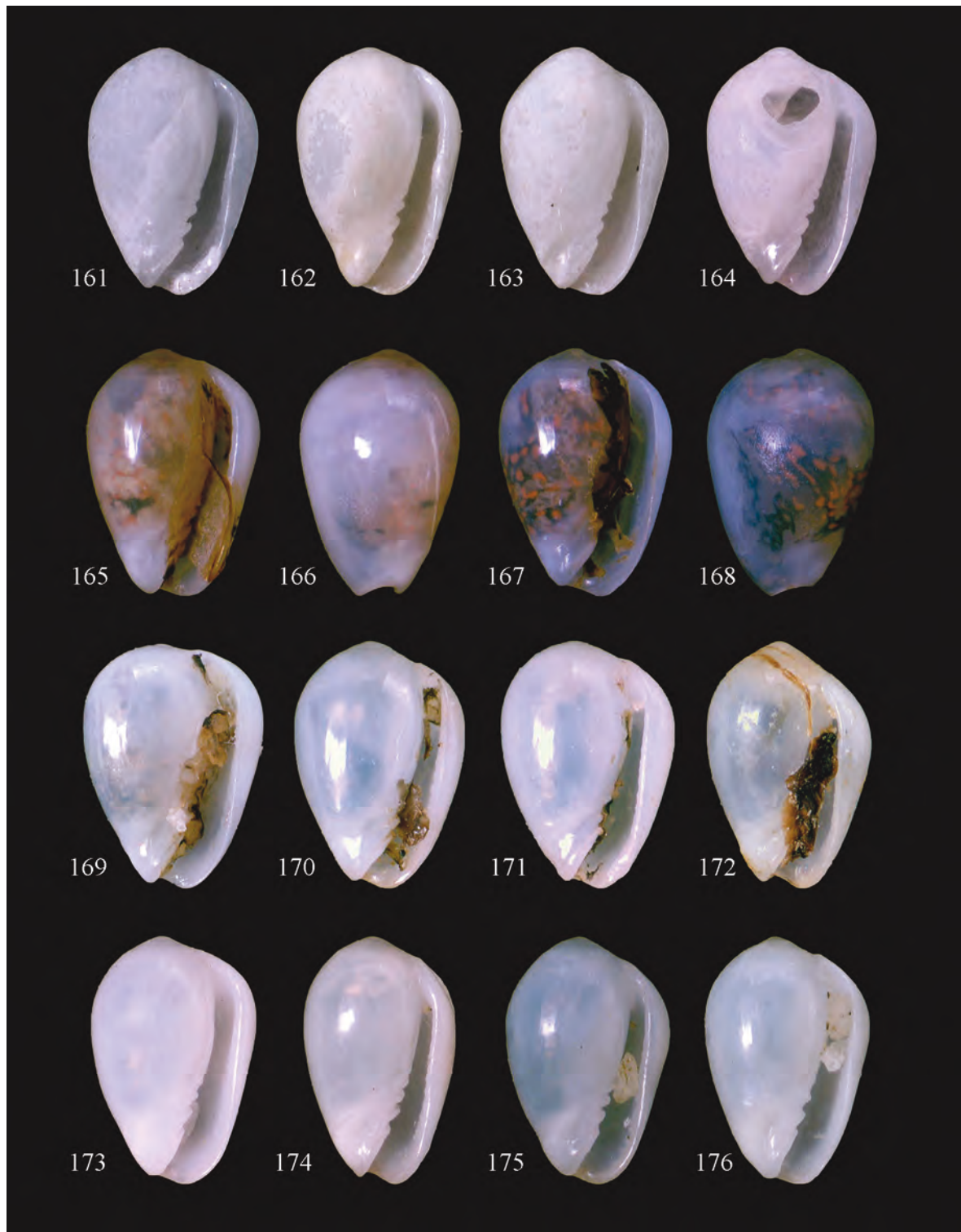


Figures 129–144. *Gibberula philippii*, Scilla, 45 m, Italy. Fig. 129: L = 2.70 mm. Fig. 129: 30: L = 2.65 mm. Fig. 131: L = 2.60 mm. Fig. 132: L = 2.60 mm. Fig. 133: L = 2.60 mm. Fig. 134: L = 2.75 mm. Fig. 135: L = 2.50 m. Fig. 136: L = 2.80 mm. Fig. 137: L = 2.70 mm. Fig. 138: L = 2.70 mm. Fig. 139: L = 2.85 mm. Fig. 140: L = 2.80 mm. Fig. 141: L = 2.70 mm. Fig. 142: L = 2.60 mm. Fig. 143: L = 2.75 mm. Fig. 144: L = 2.80 mm.

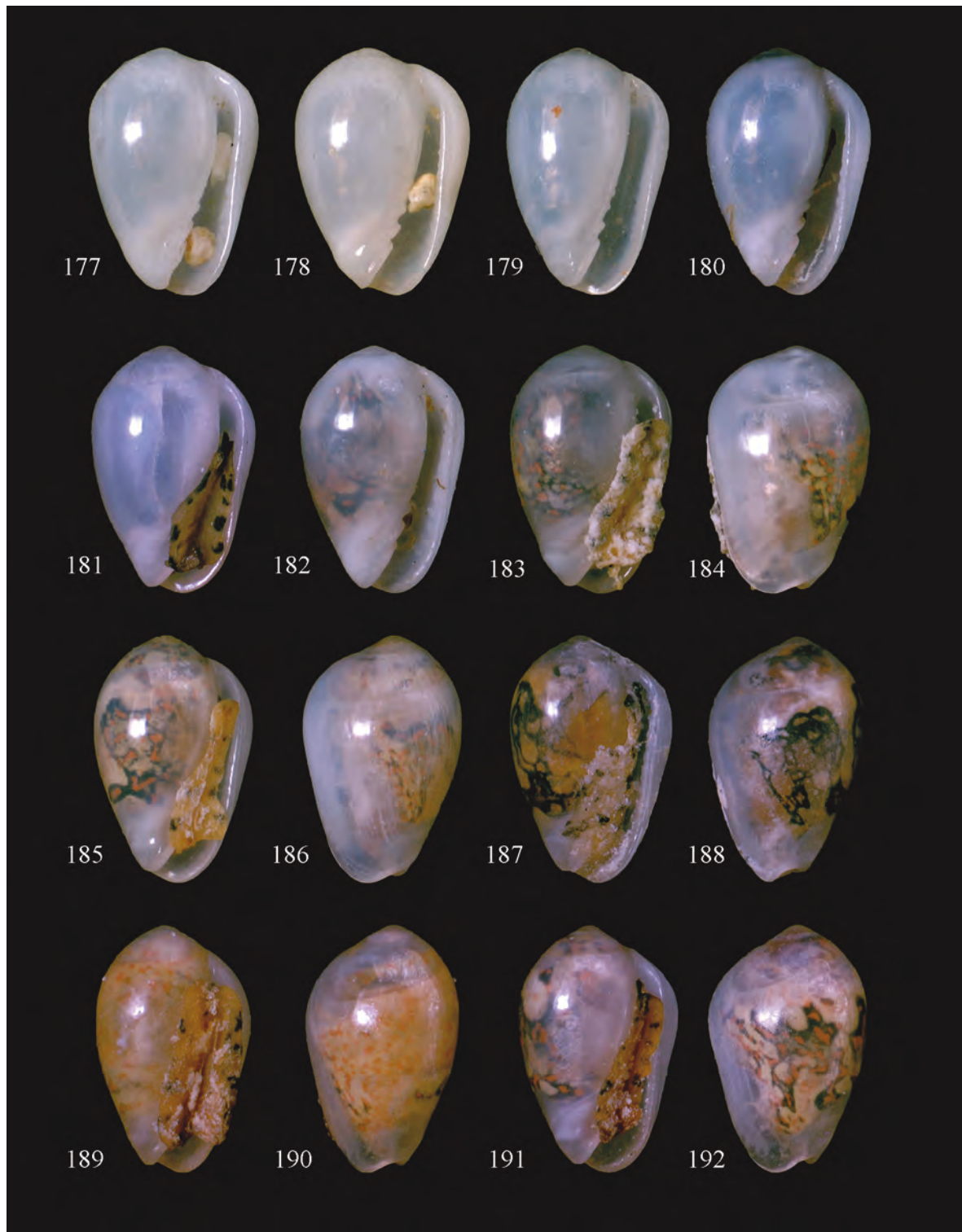




Figures 145–160. *Gibberula philippii*, Scilla, 45 m, L = 2.60 mm. Fig. 146: L = 2.80 mm. Fig. 147: L = 2.80 mm. Fig. 148: L = 2.70 mm. Fig. 149: L = 2.60 mm. Fig. 150: L = 2.80 mm. Fig. 151: L = 2.65 mm. Fig. 152: L = 2.55 mm. Fig. 153: L = 2.70 mm. Fig. 154: L = 2.55 mm. Fig. 155: L = 2.55 mm. Fig. 156: L = 2.80 mm. Fig. 157: L = 2.65 mm. Fig. 158: L = 2.60 mm. Fig. 159: L = 2.70 mm. Fig. 160: id., L = 2.80 mm.

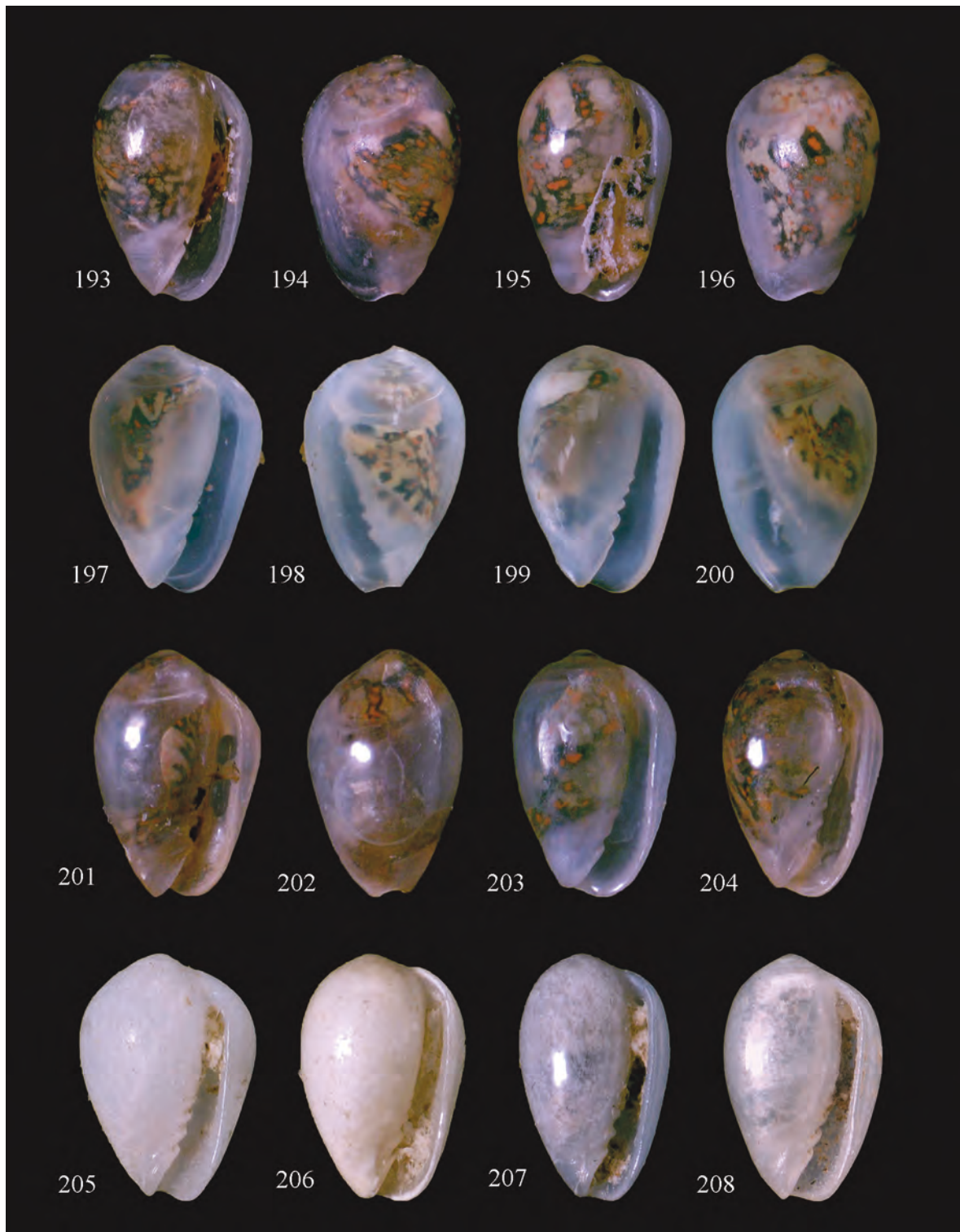


Figures 161–164. *Gibberula philippii*, Scilla, 45 m., L = 2.65 mm; Figure 162: id., L = 2.80 mm; Figure 163: id., L = 2.80 mm; Figure 164: id., L = 2.65 mm. Figures 165–168. *G. philippii*, Scilla, 12–16 m. Fig. 165, 166: L = 2.80 mm. Figs. 167, 168: id., L = 2.70 mm. Figure 169: *G. philippii*, Scilla, 24–33 m, L = 3.00 mm. Figures 170–172. *G. philippii*, Scilla, 12–16 m, L = 2.70 mm. Fig. 171: L = 2.65 mm. Fig. 172: L = 2.70 mm. Figures 173–176. *G. philippii*, Villaggio Pace, 7 m. Fig. 173: L = 2.85 mm. Fig. 174: id., L = 3.00 mm. Fig. 175: id., L = 2.90 mm. Fig. 176: id., L = 3.35 mm.



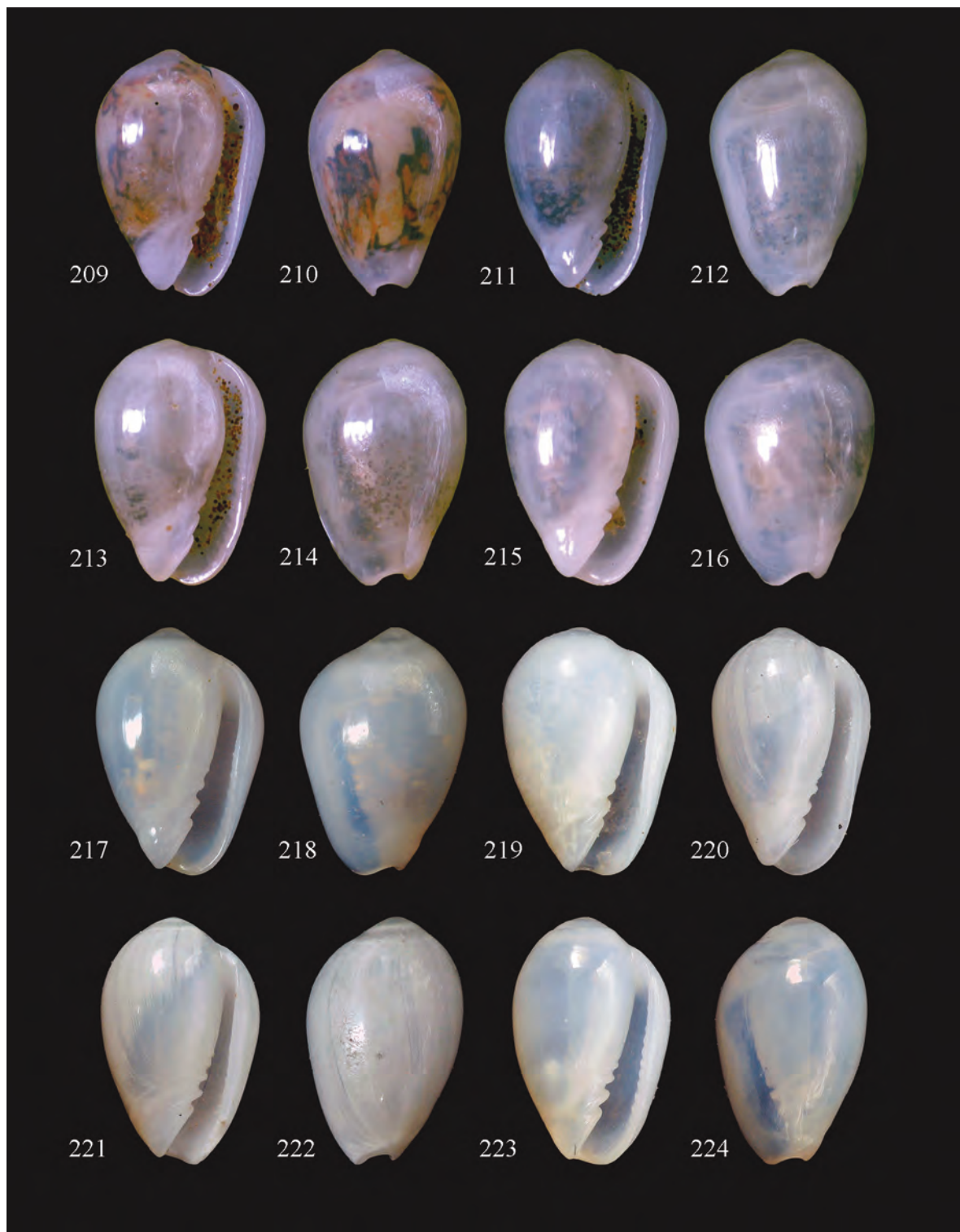
Figures 177–192. *Gibberula philippii*, Villaggio Pace, 7 m. Fig. 177: L = 2.85 mm. Fig. 178: L = 2.80 mm. Fig. 179: L = 2.70 mm. Fig. 180: L = 2.80 mm. Fig. 181: L = 2.80 mm. Fig. 182: L = 2.85 mm. Figs. 183, 184: L = 2.85 mm. Figs. 185, 186: L = 3.00 mm. Figs. 187, 188: L = 2.75 mm. Figs. 189, 190: L = 2.80 mm. Figs. 191, 192: L = 2.80 m.





Figures 193–196. *Gibberula philippii*, Villaggio Pace, 7 m. Figs. 193, 194: L = 2.60 mm. Figs. 195, 196: L = 2.85 mm; Figures 197–204. *G. philippii*, Lago Faro, shallow water. Figs. 197, 198: L = 2.65 mm. Figs. 199, 200: L = 2.70 mm; Figs. 201–202: L = 2.50 mm. Fig. 203: L = 2.60 mm. Fig. 204: L = 2.50 mm. Figure 205. *G. philippii*, Ustica, 35 m, L = 2.75 mm. Figure 206. *G. cf. turgidula*, Ustica, 35 m, L = 2.50 mm. Figure 207: *G. cf. jansseni*, Ustica, 35 m, L = 2.65 mm. Figure 208: *G. cf. simonae*, Ustica, 40 m, L = 2.10 mm.

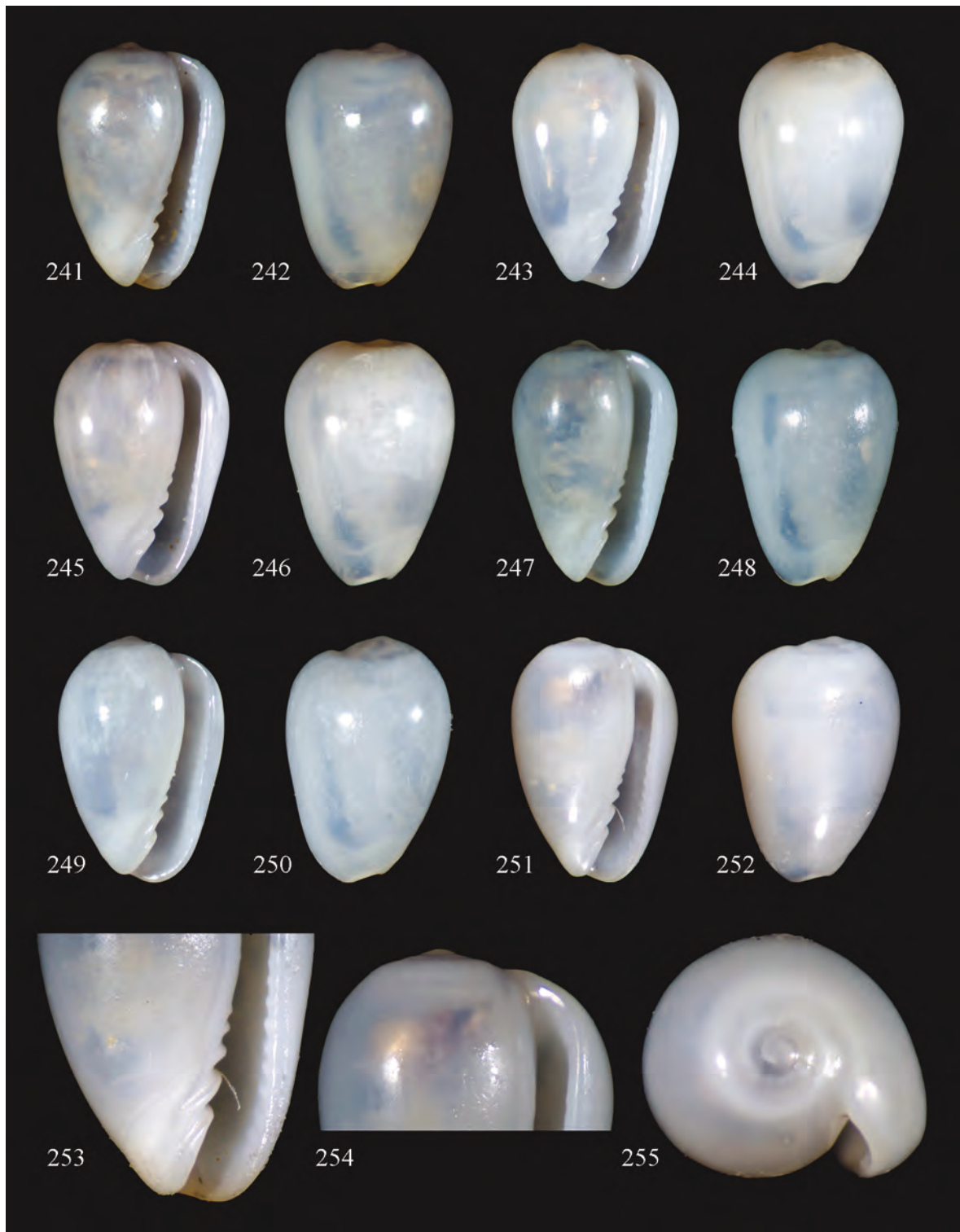




Figures 209–216. *Gibberula philippii*, Taormina, 16 m, L = 2.75 mm. Figs. 211, 212: L = 2.75 mm. Figs. 213, 214: L = 2.75 mm. Figs. 215, 216: L = 2.75 mm. Figures 217–224. *G. philippii*, Marzamemi, 4 m, L = 2.90 mm. Fig. 219: L = 2.95 mm. Fig. 220: L = 3.05 mm. Figs. 221, 222: L = 2.68 mm. Figs. 223, 224: L = 3.02 mm.



Figure 225–228. *Gibberula philippii*, Lazzaro, 52 m. Fig. 225: L = 2.75 mm. Fig. 226: L = 2.75 mm. Fig. 227: L = 2.80 mm. Fig. 228: L = 2.80 mm. Figures 229–240: *G. philippii*, Capo dell'Armi, shallow water. Figs. 229, 230: L = 2.50 mm. Figs. 231, 232: L = 2.50 mm. Figs. 233, 234: L = 3.00 mm. Figs. 235, 236: L = 2.50 mm. Figs. 237–240: L = 2.50 mm.



Figures 241, 255. *Gibberula* cf. *philippii*, off Casablanca, 50–60 m. Figs. 241, 242: L = 2.9 mm. Figures 243, 244: id., L = 2.9 mm. Figures 245, 246: id., L = 2.7 mm. Figures 247, 248: L = 2.6 mm. Figures 249, 250: L = 2.8 mm; Figures 251–255: id., L = 2.8 mm.





Figures 256–270. *Gibberula philippii*, Kerkennah Islands (Tunisia) 0–1 m. Fig. 256: L = 2.65 mm. Fig. 257: L = 2.05 mm. Fig. 258: L = 2.0 mm. Fig. 259: L = 2.0 mm. Fig. 260: L = 2.9 mm. Fig. 261: L = 2.5 mm. Fig. 262: L = 2.4 mm. Fig. 263: L = 2.8 mm. Fig. 264: L = 2.0 mm. Fig. 265: L = 2.7 mm. Fig. 266: L = 2.35 mm. Fig. 267: L = 2.25 mm. Fig. 268: L = 2.70 mm. Fig. 269: L = 2.8 mm. Fig. 270: L = 2.35 mm. Fig. 271: *G. cf. epigrus*, Kerkennah Islands (Tunisia), L = 2.35 mm.





Figures 272–287. *Gibberula philippii*, Karpathos Island (Greece), 40 m. Fig. 272, 273: L = 2.9 mm. Figs. 274, 275: L = 2.5 mm. Figs. 276, 277: L = 2.3 mm. Figs. 278, 279: L = 3.0 mm. Figs. 280, 281: L = 2.9 mm. Figs. 282, 283: L = 3.0 mm. Figs. 284, 285: L = 2.8 mm. Figs. 286, 287: L = 2.8 mm.



Figures 288–303. *Gibberula philippii*, Karpathos Island (Greece), 40 m. Fig. 288: L = 2.8 mm. Figs. 290, 291: L = 2.7 mm. Figs. 292, 293: L = 2.7 mm. Figs. 294, 295: L = 2.6 mm. Figs. 296, 297: L = 2.4 mm. Figs. 298, 299: L = 2.5 mm. Figs. 300, 301: L = 2.7 mm. Figs. 302, 303: L = 2.4 mm.

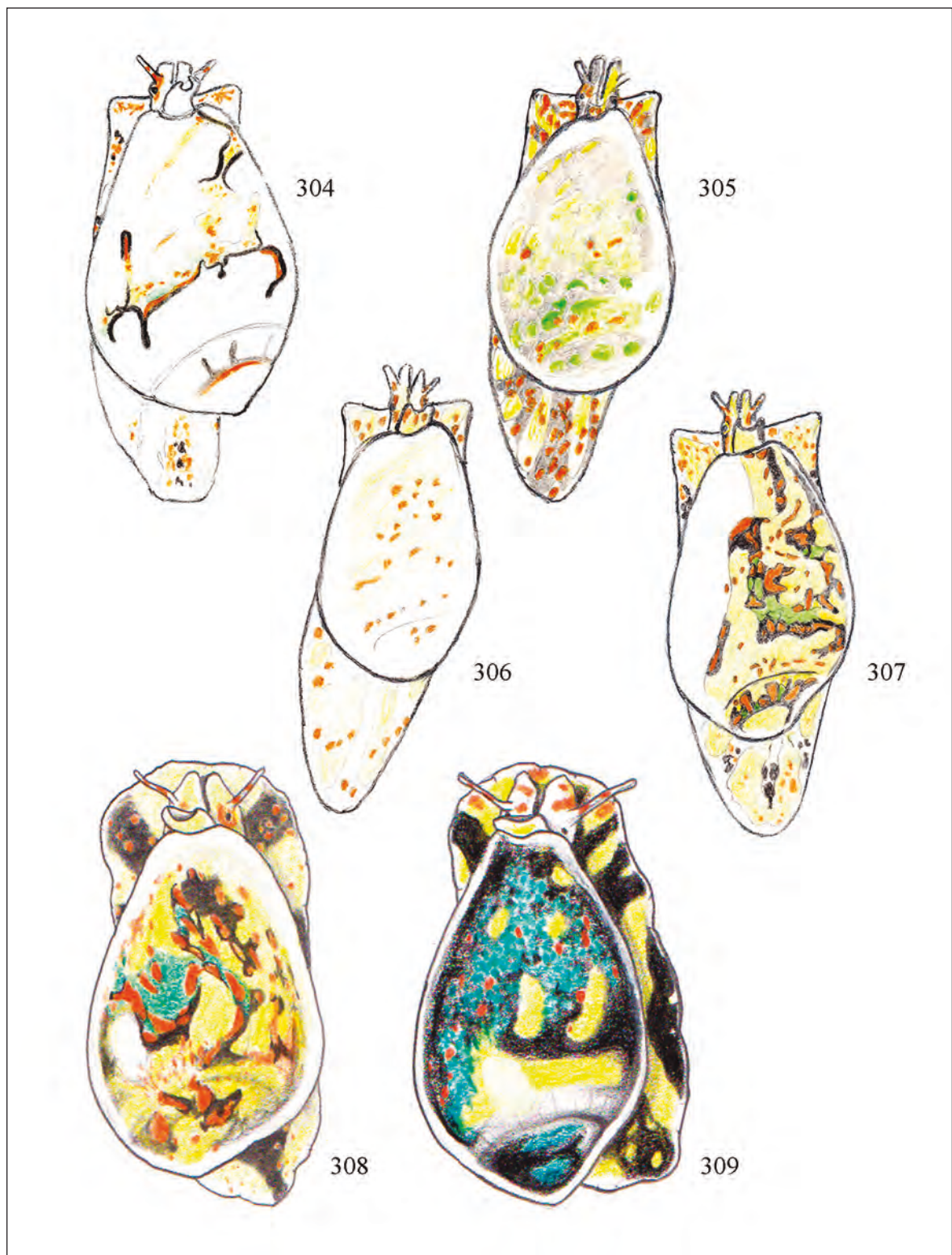


Figure 304. *Gibberula philippii*, West Ibiza (Spain), shallow water. Figures 305, 306. *Gibberula philippii*, Giens-L'Almanarre (France), shallow water. Figure 307. *Gibberula philippii*, Giens-La Baume (France), shallow water. Figures 308, 309. *Gibberula philippii*, Catania (Italy).



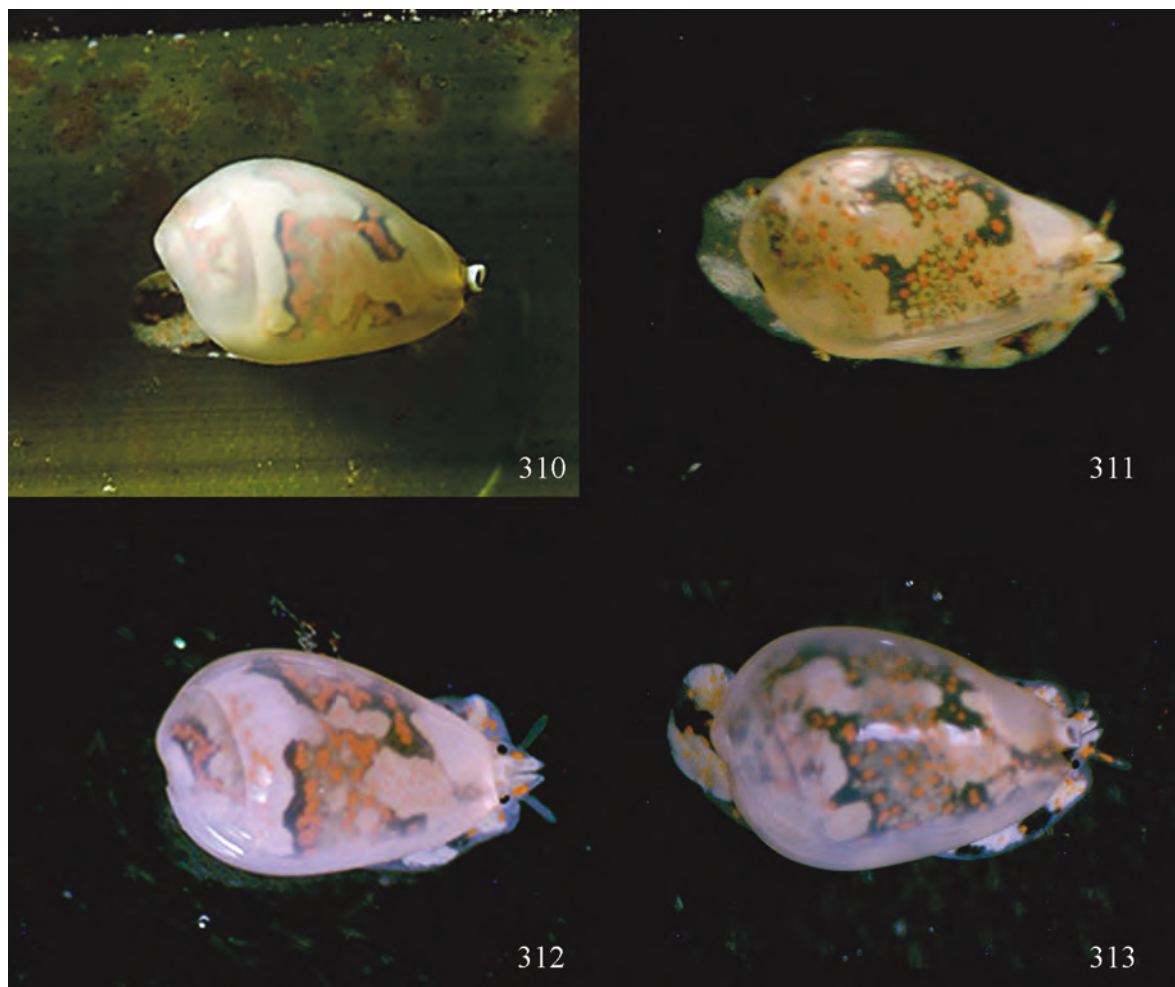


Figure 310. *Gibberula philippii*, Cataluna, shallow water. Figure 311. *G. philippii*, Lago Faro, shallow water. Figures 312, 313. *G. philippii*, Scilla, shallow water.

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