

The Mediterranean *Pusillina philippi* (Aradas et Maggiore, 1844) complex (Gastropoda Rissoidae) with the description of *Pusillina terlizziorum* n. sp.

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ABSTRACT

The complicated nomenclatural history of *Pusillina philippi* (Aradas et Maggiore, 1844) complex (Gastropoda Rissoidae) and its taxonomy are here traced after the study of large amount of shells and living specimens. A lectotype and two paralectotypes among a group of syntypes in Senckenberg Naturmuseum Frankfurt (Germany) are here designated to stabilize the taxon for further researches. The morphological variability of the shell of this species is reconstructed after comparisons with the typical materials, and a *morpho* restricted to the Ionian localities has been separated. Another close related form, taller and with a very different external soft parts colour pattern, is instead here described as a new species at all: *P. terlizziorum* n. sp.

KEY WORDS

Rissoidae; taxonomy; *Pusillina*; complex; new species; Mediterranean Sea.

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INTRODUCTION

Eleven species of the genus *Pusillina* Monterosato, 1884 (Gastropoda Rissoidae) are currently listed for the Mediterranean Sea (S.I.M. Sistematica Mediterranea, last access on August 09, 2024). This genus includes small marine gastropods, mainly living at low depth in algal or phanerogam meadows, sometimes abundant in rocky littoral, often lagoons or other repaired environments. The shell morphological characteristics are extremely variable, and this has always made difficult the specific separation, in spite of the low number of species. In fact every species has a wide range of shell variability which ends to overlap with that of other similar congeners or even of other genera of Rissoidae, *Rissoa* and *Alvania* in particular. Variability in morphological characters involves outline, dimensions, sculpture,

colour and thickness of the shell and also the protoconch. Concerning the environmental influence on morphological variability, discussing differences between *P. sarsii* (Lovén, 1846) and *P. inconspicua* (Alder, 1844), usually considered as “two well defined and distinct species”, Warén (1996) admitted that they become “virtually indistinguishable” in those Swedish localities where salinity is low (brackish waters). Thus he underlined two important problems: the morphology of the shell in that rissoids is affected by salinity; species morphological limits are overlapping in certain environmental conditions. He concluded that a possible explanation of this phenomenon is that the former could be a form of the latter adapted to low salinity.

Species of *Pusillina* were characterized by Monterosato (1884) as small *Rissoa* (*pusillus* in latin means “small”) with turreted whorls and

sharp external lip, being *Rissoa pusilla* Philippi, 1836 [= *P. philippi* (Aradas & Maggiore, 1844)] the type species. As could be argued by its diagnosis, Monterosato did not mention the protoconch as distinctive taxonomical character. With few exceptions only, Authors of the XIX century have not been taken in account protoconch parameters nor the living animal features as true taxonomical item. As a consequence, their concept of a single species did not imply differences in anatomy or shell morphology except for the teleoconch. This concept is particularly true for rissoids, which count numerous cases of «sister species» in which, sharing a morphologically almost identical teleoconch, cryptic species have been distinguished only in modern times by the different type of protoconch (paucispiral vs. multispiral). This latter practice is still debated as a true diagnostic character in several groups of gastropods (Oliverio, 1994, 1996; Bouchet, 1990; Pusateri et al., 2012). Verduin (1976), in the light to recognise a species from original descriptions and type materials, stressed the necessity to consider the essential idea of a species based on teleoconch characters (see Verduin, 1976, p. 44, note 15 concerning *R. pulchella/marginata*). This modality of operating is of some help in controversial interpretation of diagnosis of ancient sister taxa.

Verduin (1976), using protoconch dimension and numerical values for the number of ribbed whorls and axial ribs, is the first Author who tried to fix morphological distinguishing characters for each species of *Turboella* Gray, 1847, subsequently synonymized under *Pusillina* by Ponder (1985), who proposed the resurrection of the Monterosato's genus on account of anatomical differences, distinguishing it from members of *Rissoa* Desmarest, 1814. The protoconch morphology of different *Pusillina* species is almost stable in each species, thus resulting in the main character being able to distinguish species in a good satisfactory way inside their wide range of variability, as long as it is correctly interpreted.

Among all the so variable species of European *Pusillina*, only *P. philippi*, type species of the genus, represented a well distinguished species: it was considered quite easy to recognize for the small size, the conical outline, the hyaline appearance and the ribs abruptly terminating at the periphery. Moreover, the presence of only one type of

protoconch (multi-spiral) was above all reported by Verduin (1976) as unambiguous character to recognize this species, contrary to the others which instead show the long-standing problem of the interpretation of the multi vs. pauci-spiral types.

Fossil specimens of *P. philippi* were reported by Tabanelli et al. (2020) for the Plio-Pleistocene of Rio Albonello (Faenza, Italy) and by Landau et al. (2013) for the Middle Miocene (Serravallian) of Karaman Basin (Turkey). The figure of the former corresponds in shell and protoconch morphology to *P. philippi* while that of the latter better resembles *P. nana* (Lamarck, 1810), an Eocene similar species illustrated by Ponder (1984), due to the presence of a perfectly conic protoconch of 2.5 whorls and without any traces of spiral sculpture (as indicated in the description, p. 69).

However, due to repeated use of pre-occupied names, the taxonomic history of *P. philippi* is really quite complicate. Philippi (1836) described the *Rissoa pusilla*, recent from Palermo and Magnisi (Italy), but the name was primary homonym of *Rissoa pusilla* de Serres, 1829, as observed by Aradas & Maggiore (1844) who proposed for it the replacement name *Rissoa philippi*, one year before Nyst (1845), who instead proposed the name *Rissoa dolium* for the same reasons (for the correct interpretation of the date of publication of Aradas & Maggiore, see van Aartsen & Giannuzzi Savelli (1987), for that of Nyst, see Anderson et al. (1964). But confusion still continued when Philippi (1844), conscious of the homonymy, proposed the new name *Rissoa nana*, probably inviting Aradas to ignore his previous correct replacement name. This latter, in fact, in his following work (Aradas & Benoit, 1872-76), seem to have overlooked his name, *P. philippi*, in favour to the last proposed by the Prussian Author. Once again, however, Philippi had chosen a not valid name, since it was pre-occupied by two *R. nana*, the first of Lamarck (1810, as reported above), and the second of Grateloup (1838). Priolo (1954), reporting all these facts, decided anyway to use the Nyst's name because of the supposed synonymy of Aradas & Maggiore's name, position which, as discussed below, we do not agree with.

Our observation of living specimens referred to *P. philippi* revealed differences in colour pattern of external soft parts. Even if in the light of their wide range of variability, shell differences are also

present and constant and, together with those related to the protoconch and the external soft parts, according to us they are enough to justify the distinction of two different species, one of which is here described as new at all for science.

MATERIAL AND METHODS

We examined type materials of *P. pusilla* in the Bronn collection (SMF, 304942) as part of the Philippi's collection, on account of reasons expressed by Coan & Kabat (2017). As reported by same Authors (Coan & Kabat, 2017), this type material comprises syntypes from the type locality Magnisi (Siracusa, Sicily, Jonian Sea) accompanied by the relative labels.

The specimens here studied (1279 shells) were obtained by sorting out shells from sediments of many different localities. Sandy gravel was manually taken during many diving with or without SCUBA, using a hand-towed net of 1 mm mesh size. Molluscs were identified at species level under stereomicroscope. Apex dimensions were measured

using the method indicated by Verduin (1976), which characterize the apex with two dimensions: the diameter of the nucleus (ND) and the diameter of the first half whorl of protoconch (HWD). The concept of shell slenderness (H/w) follows the same indications as Verduin (1976).

The 1189 living specimens of the species here studied were obtained by manually "brushing" on algae covering hard substrata, from the surface to 42 m depth, with a hand-towed net of 1 mm mesh size. Further materials were obtained from residuals of by-catch nets and from samples for ecological studies taken by scraping out 20x20 cm squares. Not all the live collected materials were examined for the study of the external soft parts colour pattern, since a large number arrived still preserved at the laboratory for other purposes. Among this material 62 living specimens were maintained alive in seawater, illustrated with grey and coloured pencils and then preserved in 90° ethanol.

A complete list of the 2468 specimens utilized for the present contribution is here furnished among the studied materials of each species and a map of the finding localities is reported (Fig. 1).

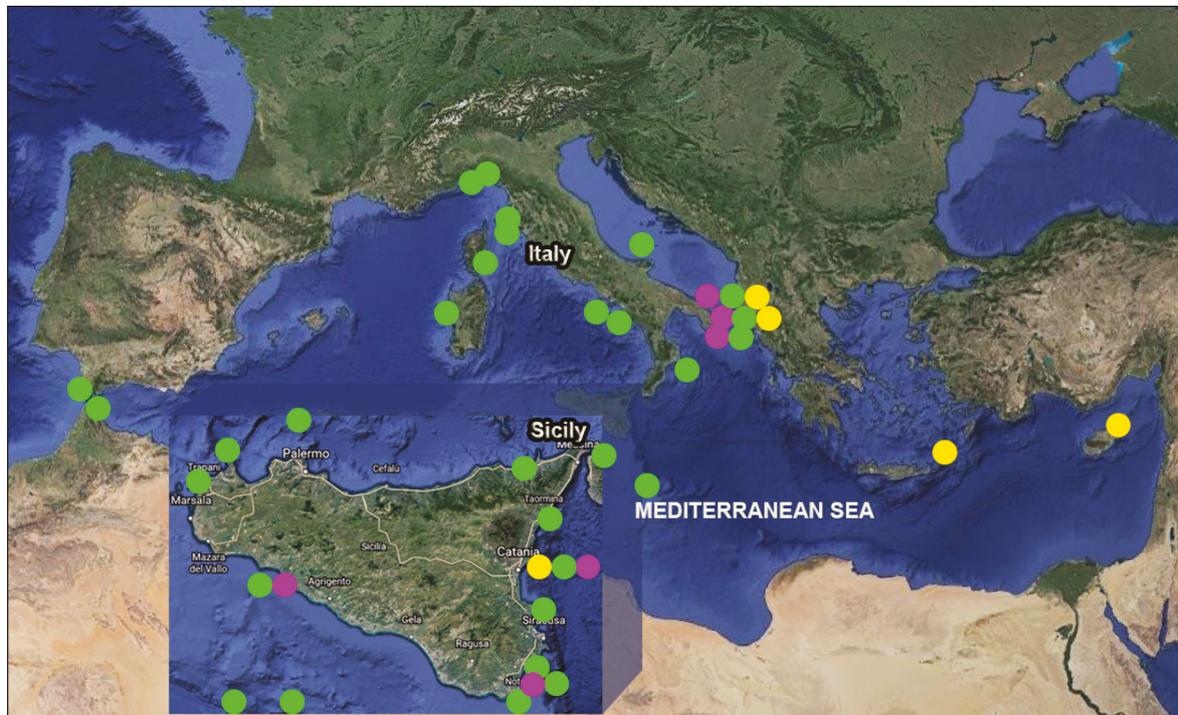


Figure 1. Map of the sampling Mediterranean Sea localities: green circle: *Pusillina philippi*; pink circle = *P. philippi* morpho A; yellow circle = *P. terlizziorum* n. sp.

Some species of rissoids, similar to *P. philippi*, were also observed for comparisons. Though not congeneric, some morphs morphologically fall into the intraspecific variability of the species here studied. Some hundred specimens of each of the following most similar species were studied: *Pusillina inconspicua* (Alder, 1844), *P. radiata* (Philippi, 1836), *Rissoa similis* Scacchi, 1836, *Alvania rudis* (Philippi, 1844).

ABBREVIATIONS AND ACRONYMS. apg: anterior podalic mucous gland; bc: basal callus; coll. = collection; ct: cephalic tentacles; e: eyes; f: foot; H: maximum height (in mm); h: height of last whorl (in mm); HWD = diameter of the first half whorl of protoconch; mt: metapodial tentacle; N: nucleus; ND: nucleus diameter; NO: orientation of nucleus (= position of the very first part of nucleus) compared to PTt; op: operculum; oppg: opening of pedal gland; PI: protoconch I; PIs: protoconch I scar; PII: protoconch II; pr: protoconch; PTt: protoconch/teleoconch transition; s: snout; SEM = scanning electron microscope; sg: salivary glands; sh./s = shell/s without soft parts inside; sp./s = living collected specimen/s; sr: spire; ST: smooth portion of first teleoconch whorl; T: teleoconch; W: maximum width (in mm).

Malacological collections: AGC = Alfio Germanà (Catania, Italy); AVC = Alberto Villari (Messina, Italy); DSC = Danilo Scuderi (Catania, Italy); MNHN = Museum National d'Histoire Naturelle, Paris, France; PMC = Pasquale Micali (Fano, Italy); SMF = Senckenberg Naturmuseum Frankfurt, Germany.

RESULTS

In the past, some Authors preferred to use the name *P. dolium*, like Priolo (1951) who considered *Rissoa philippi* of Aradas & Benoit a not available name because he supposed it was synonym of "... another form equally named by Jeffreys" (Priolo, 1951, 188). Our literature survey on the paper of Jeffreys (1856) have not been ascertained the presence of any synonym, being present only *Rissoa philippiana* Jeffreys, 1856, currently synonym of *Alvania pagodula* (Bucquoy et al., 1884), which is a different name and a different species. Monterosato reported the varieties *major*, *minor*, *elongata* and *rufa* without any other notice.

Considering all the unlucky and invalid choices of names by Philippi and the chronology of subsequent replacements, the name to be utilized for the species under consideration is *Pusillina philippi* (Aradas & Maggiore, 1844), as currently done in the main Mediterranean checklists.

Verduin (1976) re-described *Pusillina philippi*, named it *Rissoa dolium* Nyst, 1843, as follows: "This species is usually easily recognized by a characteristic combination of features, such as the small dimensions (1.35 to 3.35 mm), the slenderness (1.85 to 2.40), the distinct convexity of the whorls, the number of ribs per whorl (12 to 20), the often purple apex and, last but not least, the high number of ribbed whorls (exceptionally less than two, often three or more). The labial rib is usually, but not always, absent or faint. Sometimes there are a few fine spiral striae between the lower ends of the ribs".

Species considered by us belonging to *P. philippi* complex are characterised by a combination of characters: a small elongated shell (slenderness 1.85–2.40 as indicated by Verduin, 1976), minute in size (max. height 1.35–3.35 mm as indicated by Verduin, 1976), convex whorls of which three or more are ribbed by axial ribs abruptly terminating at periphery, faint spiral sculpture at periphery, not always visible, rounded mouth; protoconch of 2.5–3.2 whorls with a small nucleus (ND = 50 to 68 μm ; HWD = 150 to 185 μm), almost smooth except for faint undulate growth lines and a thin spiral cordlet at the base of the last whorl (see Figs. 31–33). On account of these characters, we recognise two different species in this complex: the nominal species, *P. philippi*, and a second which we here propose as a new species. We also separated a third one, which we were not able to fully distinct morphologically from *P. philippi* in a satisfactory way. It is here proposed as a simply morpho of *P. philippi*, but it is possible that a further separate species could be involved.

Due to their very large variability, which is expression of their plastic tendency to adapt to different environmental conditions, the real morphological limits of the teleoconch of each *Pusillina* species here studied, tend to overlap with those of the other two, except for the diagnostic characters mentioned below. The protoconch morphology of different *Pusillina* species appears therefore to be almost stable, thus resulting in the

main morphological character being able to distinguish in a satisfactory way the species inside their wide variability range.

Systematics

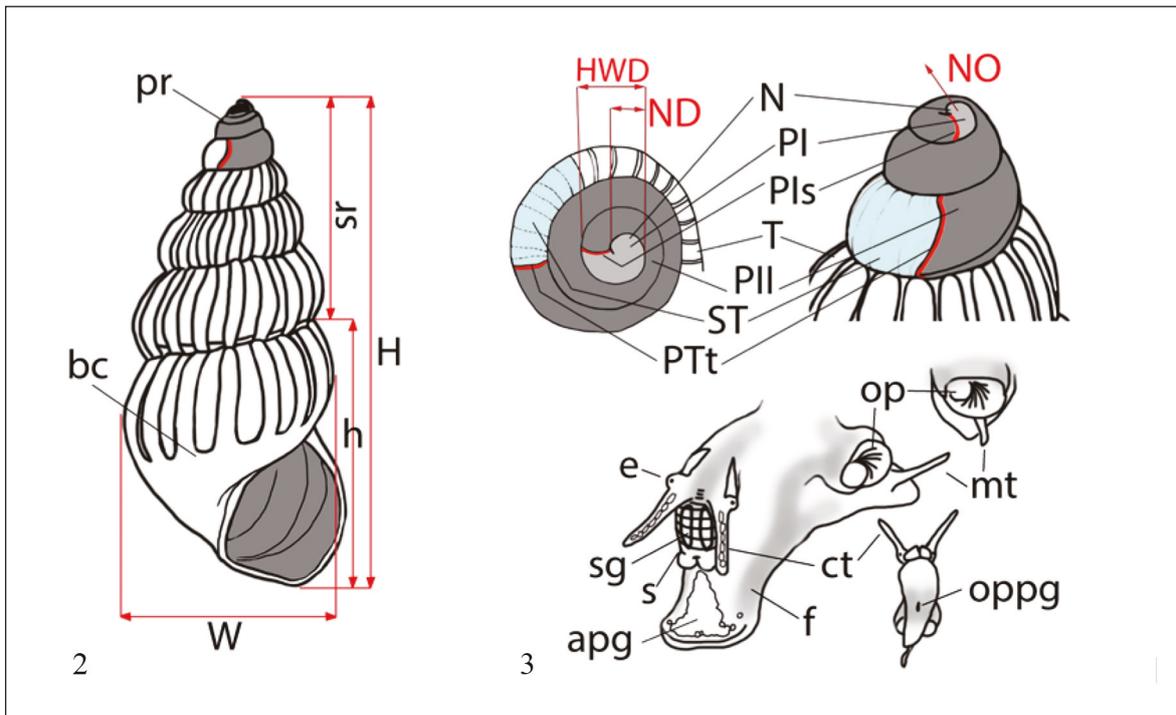
Classis GASTROPODA Cuvier, 1795
 Subclassis CAENOGASTROPODA Cox, 1960
 Superfamilia RISSOOIDEA Gray, 1847
 Familia RISSOIDAE Gray, 1847
 Genus *Pusillina* Monterosato, 1884
 TYPE-SPECIES. *Rissoa pusilla* R.A. Philippi, 1836

DESCRIPTION. Shell (Figs. 2, 3) small, thin, elongate-conical, usually transparent, with brownish spots or brownish axial bands; umbilical chink very narrow to completely absent; axial sculpture constituted by narrow ribs usually not extending below the periphery, where a thin basal callus covers the base, sometimes visible as a thin cordlet placed very close to abapical suture; spiral sculpture composed by very faint cordlets could sometimes be present in the interspaces between axial ribs. Peristome simple, with almost straight

inner lip attached to parietal wall and sharp outer lip with a slight varix in some species. Protoconch usually constituted by protoconch I and II, almost unsculptured, except for a single thin spiral adsutural cordlet, and a more or less protruding rounded nucleus. Both transitions are delimited by scarcely to faint transitional band. The initial portion of the first teleoconch whorl may be more or less smooth, therefore for a correct count of the protoconch whorls number, the transition scar with teleoconch and its real position in relation to the nucleus orientation is a good reference point.

Foot almost elongated and tapered in the middle, rounded anteriorly and acute posteriorly, with a wide sole where is present the opening of a posterior mucous gland; usually different chromatic patterns distinguish the species. Cephalic tentacles long; two pallial and only one metapodial tentacles are present. Operculum thin with eccentric nucleus.

REMARKS. Shells of *Pusillina* are similar to those of *Rissoa*, but they are smaller. In some specimens a more or less wide smooth portion of the first teleoconch whorl (ST) could follow the not well marked protoconch/teleoconch scar (PTt), altering



Figures 2, 3. Schematic drawing of the shell (Fig. 2, left), protoconch (Fig. 3, right up) and living animal (Fig. 3, right down) of a generic *Pusillina*. Nomenclature as in "Abbreviations and acronyms".

the correct perception of the real dimensions of the protoconch under stereoscope observations. Important anatomical differences were mentioned by Ponder (1984).

Pusillina philippi (Aradas et Maggiore, 1844)
(Figs. 4–26; 31–33; 37–41)

Rissoa pusilla - R.A. Philippi, 1836

Rissoa dolium - Nyst, 1845

Rissoa nana - R.A. Philippi, 1844

Rissoa philippi - Aradas & Maggiore, 1844

Pusillina sp.1 - Scuderi, 2023 (p. 58; p. 145, Fig. 6 (partly) and 7; p. 241, Fig. 16).

ORIGINAL DESCRIPTION. Philippi, 1836: “*Rissoa pusilla mihi. v. t. X. f. 13* [here in Fig. 11]. *R. testa oblongo-conica, ventricosa, alba, anfractibus valde convexis, costatis, apertura ovata, spira multo brevior, labro simplici. Cum priore reperta. Testa minuta, 1''' longa (2.2 mm), ovato-oblonga, conica, ventricosa, acuta, anfractibus quinque valde convexis, costis circiter 12 in quovis aufractu, striis transversis nullis; apertura ovata, superne vix angulata, 1/3 aut vix 2/5 totius longitudinis occupans. Labrum simplex*”.

TYPE LOCALITY. “*Peninsulae Thapsi*”, today named Magnisi (North of Siracusa, Eastern Sicily, Italy).

TYPE MATERIAL. Three syntypes in SMF (Figs. 4–10), registration number 304942, glued on a small green cardboard from the type locality Magnisi (as indicated on the label, Fig. 12). Here we select the second specimen of the series as lectotype (Figs. 5 and 8), and the other two as paralectotypes.

OTHER EXAMINED MATERIAL. ITALY • 4 sps; Catania, San Giovanni Li Cuti; 3–38 m depth; brushing on algae covering hard substrata; DSC • 99 shs; Catania, San Giovanni Li Cuti; 3–38 m depth; shell grit collected with SCUBA; DSC • 21 sps; Catania, Caito; 30 m depth; residuals of by-catching nets; DSC • 38 shs; Catania, Cannizzaro; 42 m depth; shell grit collected with SCUBA; DSC • 4 sps; Catania, Armisi; 20 m depth; brushing on algae covering hard substrata; DSC • 2 shs; Catania, Armisi; 20 m depth; from shell grit collected with SCUBA; DSC • 46 shs; Catania, Acitrezza; 50 m depth; fishing nets residuals; DSC

• 3 sps; Catania, Riposto, Fondachello; 3 m depth; brushing on algae covering hard substrata; DSC • 20 shs; Sicily, Lampedusa island; 3–10 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 8 shs; Sicily, Linosa island, Faro; 35 m depth; shell grit collected with SCUBA; DSC • 24 shs; Agrigento, Portopalo di Menfi; beached shell grit; DSC • 2 sps; Messina, Ganzirri; 3 m depth; brushing on algae covering hard substrata; AVC • 4 shs; Messina, Ganzirri; 3 m depth; brushing on algae covering hard substrata; AVC • 8 shs; Messina, Oliveri; 3–5 m depth; shell grit manually collected; DSC • 2 shs; Messina, Ganzirri; 3 m depth; brushing on algae covering hard substrata; AVC • 2 shs; Messina, Taormina, Isola Bella; 20 m depth; shell grit collected with SCUBA; AVC • 24 shs; Siracusa, Magnisi; beached bioclastic coarse sediment; topotypes, DSC • 1 sh; Siracusa, Eloro beach; 3–5 m depth; shell grit manually collected; DSC • 4 shs; Siracusa, Portopalo di Capo Passero; beached shell grit; DSC • 1 sh; Sicily, Ustica island, Punta San Paolo; 35 m depth; shell grit collected with SCUBA; DSC • 2 shs; Trapani, San Vito lo Capo; beached shell grit; DSC • 41 shs; Trapani, Tramontana beach; beached shell grit; DSC • 2 shs; Crotone, ENI oil rigs; 100 m depth; shell grit collected with van Veen grab; DSC • 1040 sps; Porto Cesareo, La Strea; 0–1 m depth; from hard substrata; DSC • 68 shs; Porto Cesareo, La Strea, Le Dune; beached shell grit; DSC • 20 shs; Otranto; 6 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 24 sps; Otranto; 6 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 10 shs; Tremiti islands, San Domino; 6 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 20 sps; Otranto; 6 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 20 sps; Brindisi, from Cerano to Punta Torre Cavallo; 1–3 m depth; from hard substrata; DSC • 102 shs; Brindisi, from Cerano to Punta Torre Cavallo; 1–3 m depth; from hard substrata; DSC • 3 shs; Procida island; 5–8 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 5 shs; Ischia island; 5–8 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 2 shs; Salerno, Santa Maria di Castellabate; 30 m depth; shell grit collected with van Veen grab; DSC • 4 shs; Salerno, Marina di Camerota, Punta degli Infreschi; 30 m depth; shell grit collected with van Veen grab; DSC • 3 shs; Oristano, S'Archittu; beached shell grit; DSC • 336

shs; La Spezia, Vernazza; beached shell grit; DSC • 43 shs; Genova, Rapallo, San Michele di Pagana; 3–5 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 5 shs; Elba island; 3–5 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 3 shs Pisa, Calafuria; 3–5 m depth; shell grit from intermattes of *Posidonia* beds; DSC. FRANCE • 19 shs; Corsica, Paragan-Piscuani; beached shell grit; DSC. SPAIN • 1 sh; Tarifa; 22 m depth; shell grit collected with SCUBA; DSC. MOROCCO • 4 shs; Ceuta; 35 m depth; shell grit collected with SCUBA; DSC. MALTA • 35 shs; Bahar ic Caghaq; beached shell grit; DSC.

The following material has been separately considered as belonging to *P. philippi* morph A, which we discuss on Remarks:

ITALY • 4 sps; Catania, Santa Tecla; 3 m depth; brushing on algae covering hard substrata; DSC • 4 shs; Catania, Cannizzaro; 42 m depth; shell grit collected with SCUBA; DSC • 41 shs; Catania, Caito; 30 m depth; residuals of by-catching nets; DSC • 6 shs; Catania, San Giovanni Li Cuti; 38 m depth; shell grit collected with SCUBA; DSC • 65 shs; Agrigento, Portopalo di Menfi; beached shell grit; DSC • 1 sh; Siracusa, Calabernardo; beached shell grit; DSC • 112 shs; Porto Cesareo, La Strea, Le Dune; beached shell grit; DSC • 5 sps; Otranto; 3–5 m depth; shell grit from intermattes of *Posidonia* beds; DSC • 7 sps; Brindisi, from Cerano to Punta Torre Cavallo; 1–3 m depth; from hard substrata; DSC.

DESCRIPTION (based on type and collected material). Shell small, oblong, somewhat conical, with elongate spire, relatively solid. Average length: 2.26 mm. Slenderness: 2.05–2.16. Teleoconch constituted by 4.5 convex whorls with deep sutures, with their maximum width at 1/3 of the height. Rounded aperture which occupies about 47% of the shell height. Peristome continuous. Outer lip sharp forming a slight protrusion in the lower part. Umbilical chink very faint or absent. Axial sculpture consisting of orthocone to slightly opisthocline strong and almost flat axial ribs, larger than the interspaces, in number of 18 on the last two whorls, where they are interrupted at the periphery by a well-marked basal callus, perceptible as a marked step. The number of ribbed whorls is about 3–4. A well visible spiral sculpture, constituted by 5–6 faint

cordlets, is present in the interspaces, especially in the peripheral zone of the last whorl, but is also visible on the lower part of the penultimate whorl. The background colour is matte-white even in live collected specimens, tending to yellowish on the earlier teleoconch whorls, with red-brown straight longitudinal lines on the ribs and in the interspaces, forming narrow bands running from the brownish-violet base to the suture. They are interrupted by two distinct white bands, one at the base contiguous to the violet internal lip, the second at periphery.

Protoconch multispiral (Figs. 31–33) constituted by a short protoconch I and a wider protoconch II; conical, acute, violet, of 3–3.2 rounded whorls, with prominent nucleus. Almost smooth surface, except for faint and undulated growth lines and one thin spiral abapical carina. Maximum protoconch diameter 337.8 µm, ND 61.8 µm, diameter of the first protoconch whorl 125.2 µm. Protoconch-teleoconch transition not well marked, sinuous, opisthocline.

External soft parts: background colour whitish on the head and posterior tip, becoming pale brown on the snout, anterior foot and between operculum lobes; dark brown on the middle side of the foot and tips of operculum lobes. White speckles over cephalic tentacles, foot, sole, operculum and snout, where two long white salivary glands are present. On the central part of the operculum white speckles are coalescent, forming a central bunch, and an orange strip is on the internal side. White strips behind eyes. A dark brown stain between lobes of snout and on the sole, where indicates oppg, are always present, while long and narrow strips are on sides of the snout. Two (anterior and posterior) pallial tentacles and a single metapodial tentacle are present (Figs. 37–39).

VARIABILITY. As all the other *Pusillina* species, also *P. philippi* shows a remarkable variability as concern dimensions and sculpture, due to environmental conditions, especially salinity. Less variable are the slenderness, profile (more turreted as in Fig. 22) and colour pattern. Some populations (Punta degli Infreschi, for example) show more thickened outer lip. Adult specimen height ranges from 1.8 to 3.4 mm. Entirely brown shells are not uncommon. Maximum height is 3.4 mm. A different morph of this species is discussed on remarks.

DISTRIBUTION AND BIOLOGY. This species is present in all the Mediterranean and Black Sea (Micu, 2004), but does not enter the Atlantic Ocean (fide Gofas & Oliver, 2011). It lives grazing on algae in shallow (usually up to 30 m depth) rocky photophilic biocoenosis and on *Posidonia oceanica*. Data on the presence and stratigraphic distribution of this species from Plio-Pleistocene (see Tabanelli et al., 2020) is here confirmed, while Eocene or Miocene materials are probably referable to the similar *P. nana* (Lamarck, 1804).

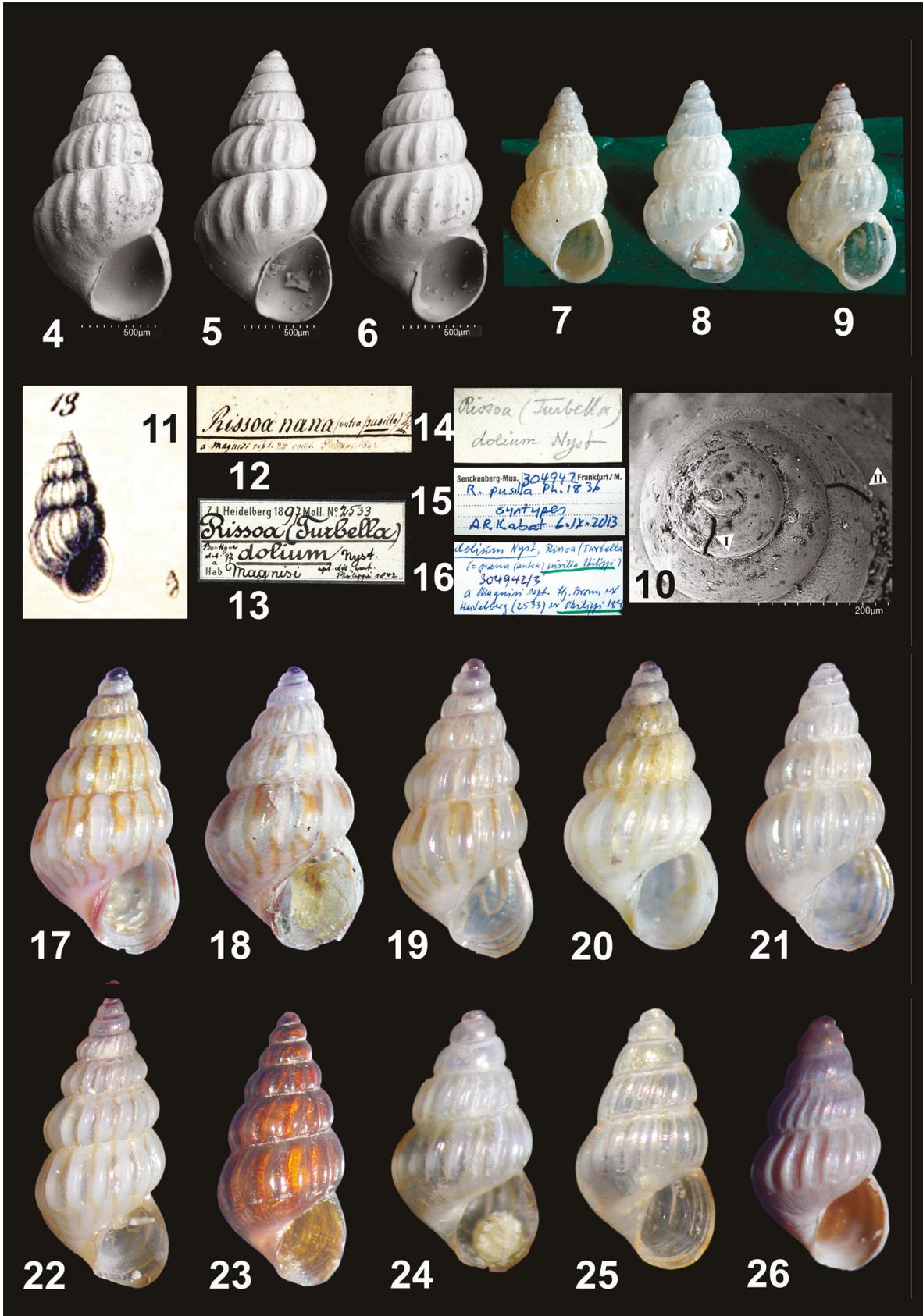
REMARKS. This species is clearly characterised, as indicated by Verduin (1976) “*This species is usually easily recognized by a characteristic combination of features, such as the small dimensions (1.35 to 3.35 mm), the slenderness (1.85 to 2.40), the distinct convexity of the whorls, the number of ribs per whorl (12 to 20), the often purple apex and, last but not least, the high number of ribbed whorls (exceptionally less than two, often three or more). The labial rib is usually, but not always, absent or faint. Sometimes there are a few fine spiral striae between the lower ends of the ribs. Completely brown specimens are not very rare*”. Verduin (1976) did not mention that the axial ribs abruptly end at the periphery and the base is smooth. This character is mentioned by Scaperrotta et al. (2013), while Gofas & Oliver (2011) indicated that the ribs “*se terminan progresivamente en la periferia*”. Their photo shows a specimen with the interspaces closed just above the periphery. In the original drawing the axial ribs are extending well below periphery, but this seem an exaggeration of the illustrator, since in syntypes they are interrupted, though the first two (Figs. 4 and 5) show feeble extension over the base at SEM photos. Some populations in the Ionian Sea (Fig. 1, yellow circles) show little but constant morphological differences in both the shell and

the soft parts. Only, according to us, these differences are not sufficient to distinguish these specimens as a separate species with reasonable certainty. We therefore have treated separately these specimens as *P. philippi morpho A* (Figs. 24–26; 40–42). Specimens of this *morpho* are distinguishable on the basis of the following characters:

- smaller dimensions (average height: 1.83 mm);
- maximum width of whorls in the middle rather than at 1/3 of the height;
- more delicate shell and less marked axial ribs;
- basal callus thinner or absent;
- protoconch multispiral (Fig. 49) but with a smaller and uncoloured nucleus (max. protoconch diameter = 337.3 μ m; ND = 52.4 μ m; HWD = 110.3 μ m);
- shell colour pattern different: upper brownish straight longitudinal lines are paler and confined only to the thin axial ribs, being never present in interspaces, while the abapicals are substituted by a single continuous spiral band;
- animal colour pattern different, constituted only by pale whitish background colour, tending to yellowish, with pale brown medial band on the lateral side of the foot and tips of operculum lobes. Sparse white speckles all over the head-foot and a wide white gland on the anterior part of the foot (Figs. 40–42).

This *morpho* is always smaller, weak and with delicate sculpture than in the other two congeners here considered. Height reaches up to 1.5–2.2 mm. The maximum width of each teleoconch whorl is almost at the half and not at 1/3 of the height. In some localities almost entirely and fully dark specimens (Fig. 23) are not infrequent. In some specimens the thin basal callus could be almost absent: in these cases the narrow axial ribs run until the umbilical area or so.

Figures 4–26. *Pusillina philippi*. Figs. 4–10: SEM (4–6, 10) and digital (7–9) photographs of the syntypes in SMF, H = 2.1 mm, 2.2 mm and 2.3 mm, respectively; Fig. 11: original drawing of *Rissoa pusilla* after Philippi (1836); Figs. 12–16: original and modern labels accompanying type materials in SMF; Fig. 17: living specimen from Acitrezza (Catania), H: 2.4 mm; Figs. 18: living specimen from S. Giovanni Li Cuti (Catania), H: 1.8 mm; Fig. 19: specimen from Brindisi, H: 2.3 mm; Fig. 20: living specimen from Fondachello (Riposto, Catania), H: 2.2 mm; Fig. 21: specimen from Magnisi (Siracusa), H: 2.0 mm; Fig. 22: specimen from Lampedusa Is., H: 2.9 mm; Fig. 23: entirely dark specimen from Brindisi, H: 2.4 mm; Fig. 24: a living specimen of the *morpho A* from Santa Tecla (Catania), H: 1.6 mm; Fig. 25: specimen of the *morpho A* from Portopalo di Menfi (Agrigento), H: 1.3 mm; Fig. 26: entirely dark specimen of the *morpho A*, Brindisi, from Cerano to Punta Torre Cavallo; H: 1.6 mm.



The small and delicate structure of the teleoconch could morphologically fall into the variability range of the former species.

Pusillina terlizziorum n. sp. (Figs. 27–30; 34–36; 43–45)

<https://www.zoobank.org/5EB4FB83-12D5-4978-AC33-4A22A7200D10>

Pusillina sp. 2 - Scuderi, 2023 (p. 58; p. 145, Fig. 8; p. 241, Fig. 17).

TYPE MATERIAL. Holotype: ITALY • 1 sp; Catania, Ognina; 2 m depth; living specimen, brushing on little stones laying on a volcanic sandy and muddy bottom, D. Scuderi legit, H = 2.6 mm, W = 1.3 mm, (Figs. 27, 34–36, 43–45); Holotype, MNHN-IM-2000-28855. Paratypes: ITALY • 1 sp; Catania, Caito; 30 m depth; residuals of by-catching nets, D. Scuderi legit, H = 2.8 mm, W = 1.4 mm, (Fig. 28); paratype 1, MNHN-IM-2000-28856 • 1 sp; same data as paratype 1; D. Scuderi legit.; H = 2.7 mm, W = 1.4 mm, (Fig. 30); paratype 2, DSC • 1 sp; same data as paratype 1; D. Scuderi legit, H = 2.6 mm, W = 1.2 mm, (Fig. 29); paratype 3, PMC • 1 sp; same data as paratype 1; D. Scuderi legit, H = 3.1 mm, W = 1.5 mm; paratype 4, DSC • 1 sp; same data as for paratype 1; D. Scuderi legit, H = 2.9 mm, W = 1.3 mm; paratype 5, PMC.

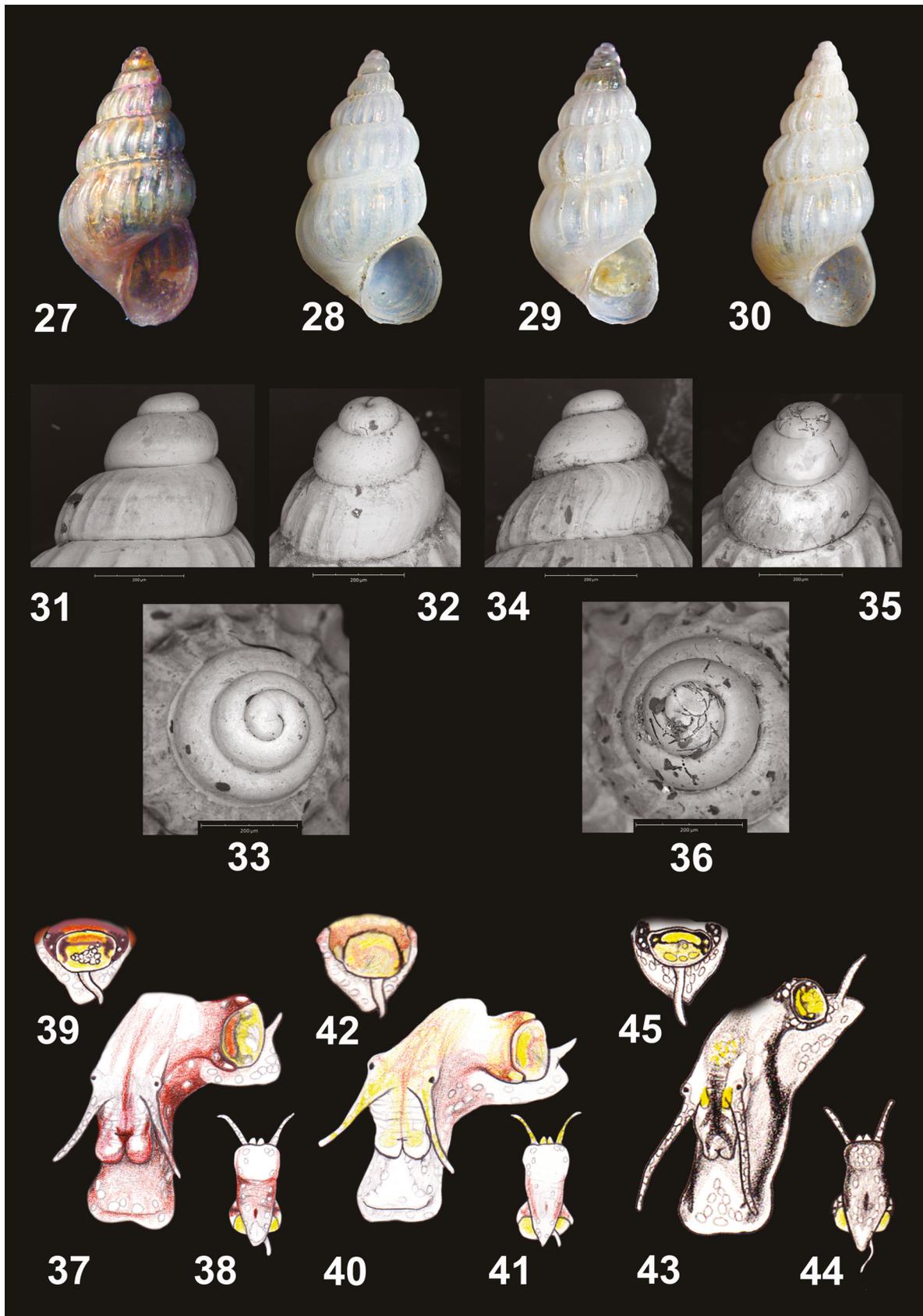
OTHER EXAMINED MATERIAL. The following specimens of *P. terlizziorum* were also examined: ITALY • 34 shs; Catania, Caito; 30 m depth; residuals of by-catching nets; DSC • 2 shs; Catania, Caito; 30 m depth; residuals of by-catching nets; PMC • 7 shs; Catania, San Giovanni Li Cuti; 9–35 m depth; from shell grit collected with SCUBA; DSC • 2 sh; Catania, San Giovanni Li Cuti; 9–35 m depth; from shell grit collected with SCUBA; PMC • 9 shs; Catania, Cannizzaro; 42 m depth; from shell grit collected with SCUBA; DSC • 5 shs; Catania, Cannizzaro; 42 m depth; from shell grit collected with SCUBA;

PMC • 2 shs; Catania, Armisi; 20 m depth; from shell grit collected with SCUBA; DSC • 3 shs; Catania, Armisi; 20 m depth; from shell grit collected with SCUBA; AVC • 2 shs; Catania, Acitrezza; 50 m depth; residuals of by-catching nets; DSC • 7 shs; Catania, Capomulini; 25 m depth; from shell grit collected with SCUBA; DSC • 3 shs; Catania, Santa Tecla; 25 m depth; from shell grit collected with SCUBA; DSC • 4 shs; Messina, Taormina, Isola Bella; 25 m depth; from shell grit collected with SCUBA; AVC • 4 shs; Lecce, Porto Cesareo, Le Dune; beached shell grit; DSC • 11 sps; Brindisi, from Cerano to Punta Torre Cavallo; from hard substrata; DSC.

GREECE • 4 shs; Karpathos island, Achata; 20 m depth; from shell grit collected with SCUBA; DSC • 2 shs; Karpathos island; 20 m depth; from shell grit collected with SCUBA; PMC • 19 shs; Cyprus island, Karpaz; 33 m depth; from shell grit collected with SCUBA; DSC (ex AGC)

DESCRIPTION. Shell small, oblong, distinctly conical, with elongate spire, relatively solid. Average length: 2.66 mm. Slenderness: 2.16–2.42. Teleoconch constituted by 4.5–5 distinctly convex whorls, with deep sutures and maximum width placed abapically, at 1/3 of the height. Rounded aperture which occupies about 30–35% of the shell height. Peristome continuous. Outer lip sharp forming a slight protrusion in the lower part. Umbilical chink very faint or absent. Axial sculpture consisting of slightly opisthocline, thin and sinuous axial ribs, large as the interspaces, in number of 18 on the penultimate whorl and around 24 on last whorl, where they become obsolete at the periphery; basal callus very thin. The number of ribbed whorls is about 4–5. No spiral sculpture visible between the rib interspaces. The background colour is matte-white even in live collected specimens, tending to hazel on the initial teleoconch whorls and protoconch, with stains of the same colour on axial ribs, alternated to not coloured ones, in the subsutural zone and at periphery. Base,

Figures 27–30. *Pusillina terlizziorum* n. sp. Figs. 27: holotype, Ognina (Catania), H: 2.6 mm; Fig. 28: paratype 1 from Caito (Catania), H: 2.8 mm; Fig. 29: paratype 2 from Caito (Catania), H: 2.7 mm; Fig. 30: paratype 3 from Caito (Catania), H: 2.6 mm; Figures 31–33. *Pusillina philippi*, SEM photographs of the protoconch of the specimen in Fig. 18. Figures 34–36. *Pusillina terlizziorum*, SEM photographs of the protoconch of paratype 1 (Fig. 28). Figures 37–39. *Pusillina philippi*, drawings of the external soft parts of the specimen in Fig. 18. Figures 40–42. *Pusillina philippi* morpho A, drawings of the external soft parts of the specimen in Fig. 24. Figures 43–45. *Pusillina terlizziorum*, drawings of the external soft parts of the holotype (Fig. 27).



subsutural zone and internal lip of the same hazel colour. One large white band in background is present between periphery and subsutural zone (Fig. 27 and Table 1).

Protoconch multispiral (Figs. 34–36) constituted by a short protoconch I and a wider protoconch II; conical, acute, hazel in colour, of 3 rounded whorls, with prominent violet nucleus. Almost smooth, except for faint and undulated growth lines and one thin spiral abapical carina. Maximum protoconch diameter 293.5 μm , ND = 36.1 μm , HWD = 97.7 μm . Protoconch-teleoconch transition well marked, sinuous, opisthocone.

External soft parts: background colour whitish on snout and foot, becoming pale grey on the head and side of the foot. Black strips are on central snout, where they form a fish-bone drawing, sides of operculum lobes and middle of the foot, stretching out towards the anterior part of the foot. Yellowish hue on posterior head and at the base of cephalic tentacles, on the upper part of the long white salivary glands. White scattered speckles on entire head-foot, opercular lobes and sole: those over cephalic tentacles, opercular lobes and anterior and posterior foot are smaller than those between head and operculum. On the central part of the operculum yellowish speckles are coalescent, forming some bunches, and a yellow strip is on the internal side. White strips behind eyes, stretching out towards the base of the cephalic tentacles, before eyes. A black stain on the sole indicates oppg. Two (anterior and posterior) pallial tentacles and a single metapodial tentacle are present. Cephalic and metapodial tentacles seem longer than in *P. philippi* (Figs. 43–45).

VARIABILITY. The largest species of the complex in average shell length. The number of the axial ribs could be higher or lower, thus resulting narrower or slightly less robust. No entirely smooth or dark specimens have been recorded. Some specimens (Fig. 27) are more intensely coloured, while others completely white, except for the protoconch and the first teleoconch whorl. Adult specimens height ranges up to 2.4–3.4 mm.

DISTRIBUTION AND BIOLOGY. This new species is currently known to be present only along the Eastern part of the Mediterranean (extreme Southern Adriatic, Ionian and Aegean seas). The

only living specimen studied (living specimens from “Cerano” were unable to be observed being preserved in ethanol) has been found on a stone covered by rich bio-concretions over a muddy-sand shallow bottom, inside a small harbour, but probably it was carried inside the harbour from deeper biocoenosis after cleaning the bycatch nets. There are no data on the presence and the stratigraphic distribution of this species in fossil materials.

ETYMOLOGY. This species is dedicated to Antonio Terlizzi (Stazione Zoologica Anton Dohrn, Naples, Italy) and his family, expert of ecology and malacology and friend of the first Author of the present paper.

REMARKS. This species is well defined on account of both shell and soft parts characters, allowing a good morphological separation from *P. philippi* and its *morpho A*. Worn shells could be confused with higher specimens of *P. philippi*.

DISCUSSION

Based on the observation of the external soft parts and shell characters, the presence of different cryptic species referred to *P. philippi* complex is here demonstrated. However, drawings presented in Scuderi (2023) were provisional since the three different patterns involved were still under study and types of the nominal species were not known. Drawings of the external soft parts of *P. philippi* (Scuderi, 2023: p. 145, Tav. XVI, Fig. 6) derived from puzzling pictures of the typical *P. philippi* (here in Figs. 37–39) and that here indicated as *morph A* (here in Figs. 40–42). Moreover, at that time, pictures of the typical *P. philippi* (in the same plate indicated as *Pusillina* sp. 1 from “Fondachello” (Riposto, Italy), the shell here shown in Fig. 20) were from a peculiar, almost unique, uncoloured population. After resolving the taxonomical questions and comparing patterns of some live collected specimens, pictures in Figs. 37–44 represent the real patterns of *P. philippi*, its *morph A* and *P. terlizziorum* n. sp.

Compared to other *Pusillina* members (Table 1, Figs. 45–50), the common concept of *P. philippi* which survived till the present days (Verduin,

1976) is based on the idea of a thin and slender species, with convex whorls, rather constant in shell shape and dimensions and with a multispiral protoconch (Fig. 48). Samples from all the Mediterranean Sea have demonstrated the presence of three morphological patterns with different shell characters, different protoconch and soft parts, whose geographical distribution and habitat seems to be different, even if locally overlapped. While *P. philippi* is widespread in all the Mediterranean, mainly on phanerogam beds at relatively low depth (10–40 m), concerning the habitat, distributions of *P. philippi morpho A* and *P. terlizziorum* n. sp. appear restricted to the Ionian Sea (with the exception of the extreme Southern Adriatic and Aegean seas), in photophilic rocky environments.

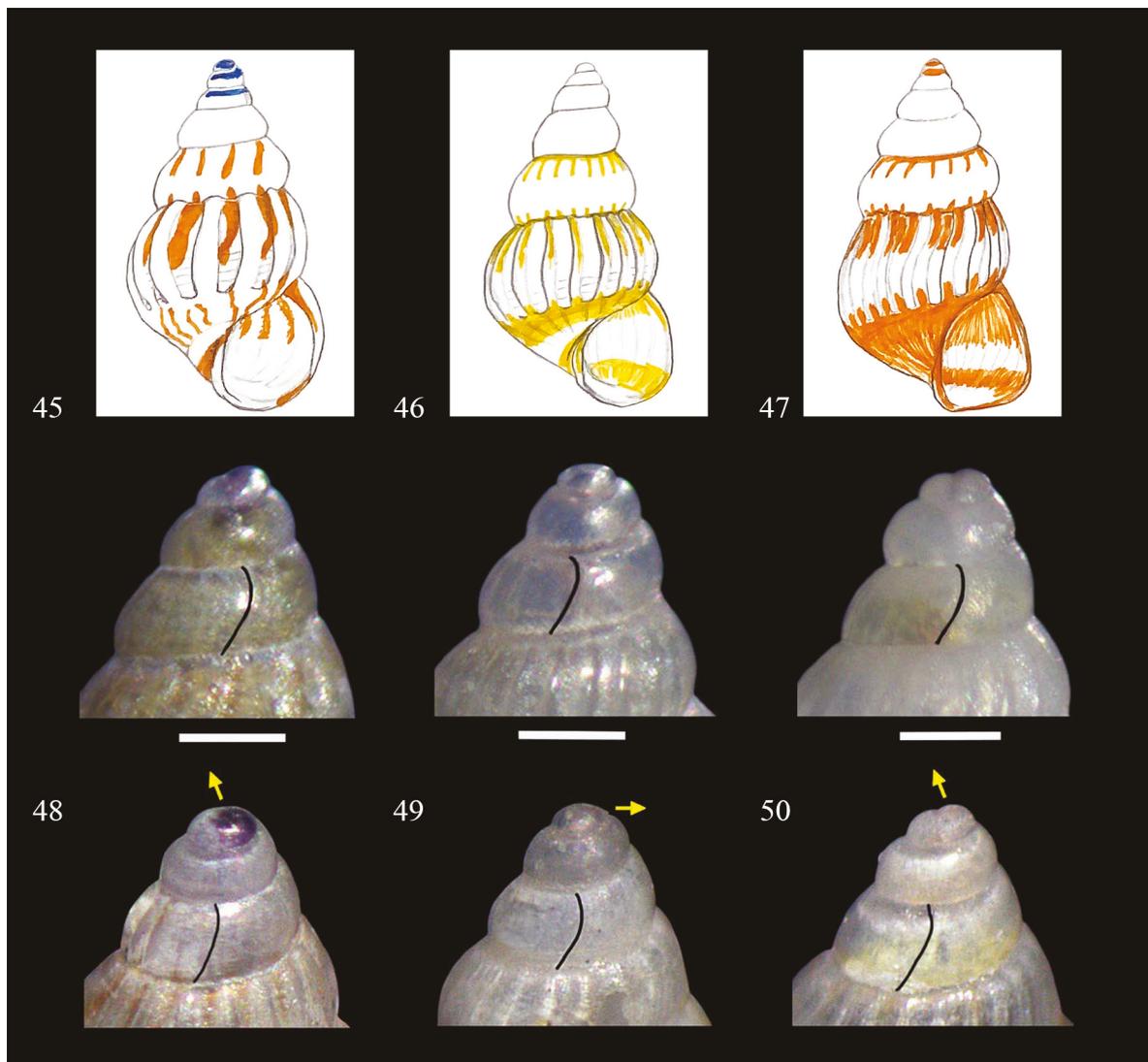
Regarding the difference between *P. philippi* and *P. radiata* (Philippi, 1844), Verduin (1976) stated: “Occasionally it may be difficult to

distinguish the species from *R. radiata*. In those cases the form of the apex is decisive, the nucleus protruding more from the first half whorl in *R. dolium* than in *R. radiata*”. Apex sizes were not indicated by Verduin (1976) for *P. philippi*, while for a lot identified as *P. radiata* from Sicily, in Schwartz’s collection, he indicated ND = 0.08 mm and HWD = 0.15 mm. Based on our observations, the protoconch of *P. radiata* is large but has a flatter first protoconch whorl than in species of *P. philippi* complex: maximum protoconch diameter 284 µm, ND = 58 µm, HWD = 120 µm.

Ponder (1985) figured *P. nana* (Lamarck, 1804), an Eocene species which become a senior secondary homonym of the second name instituted by Philippi (1844) in replacing *R. pusilla*. Though variable, this abundant fossil species has a more stumpy shell and is smaller than the previous discussed species, being

Species	General shell characters	Axial ribs	Protoconch	External soft parts pattern
<i>Pusillina philippi</i> (Aradas et Maggiore, 1844)	oblong, almost conical, with elongate spire, solid and well coloured with flat whorls (Fig. 45)	robust and opisthocline. A well marked basal callus make axial ribs interrupted at the periphery	conical, with usually more than 3 whorls, blue-violet in colour, with darker and protruded nucleus (Fig. 48)	brown tinges on head-foot, more intense on the sides, operculum suspenders and central snout. Anterior foot without white glands
<i>Pusillina philippi morpho A</i>	small and thin, only very weakly coloured, never solid, well rounded whorls (max. wide at ½ whorl) and a basal callus very thin, sometimes absent (Fig. 46)	thin and almost orthocline, often trespassing the periphery of the last whorl	slightly shorter, colour less, inflated, with rounded whorls slightly shouldered at sutures and a with small less protruding nucleus, inflated (Fig. 49)	the animal colour is paler than the nominal species and bears a wide white gland in the anterior part of the foot
<i>Pusillina terlizziorum</i> n. sp.	oblong, distinctly conical, with elongate spire, solid and weakly coloured, with well rounded whorls at the lower half of the whorl, tapered at the upper half (Fig. 47)	the basal callus is absent and the numerous, thin axial ribs still continue to extend to the base.	more ample than <i>P. philippi</i> , with rounded whorls and not protruded nucleus (Fig. 50)	black tinges on head-foot, more intense on sides, operculum suspenders and central snout. The lateral line reaches the anterior part of the foot, where there is a white gland

Table 1. Main characters comparisons between species (colours of the shells are only illustrative).



Figures 45-47. Shell of *Pusillina philippi* (Fig. 45), *P. philippi* morpho A (Fig. 46) and *P. terlizziorum* n. sp (Fig. 47). Figures 48-50. Photographs of the protoconch of *Pusillina philippi* (Fig. 48), *P. philippi* morpho A (Fig. 49) and *P. terlizziorum* n. sp. (Fig. 50). The PTt is marked in black; yellow arrows indicate NO (scale bar: 200 μ m).

comparable only with the smaller specimens of *P. philippi*. The axial ribs are orthocline as in this latter species and the protoconch is perfectly conical and smooth (the spiral cord at the base of the last protoconch whorl is not visible), with only feebly rounded whorls and a not protruded nucleus.

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REFERENCES

- Aartsen J.J. Van & Giannuzzi Savelli R., 1987. On the dates of publication of Aradas & Maggiore's "Catalogo ragionato..." and its malacological implication. *Bollettino Malacologico*, 23: 269–273.
- Anderson H.J., Chevalier J.P., Hesemann J., 1964. Faunen aus dem Miocän Nordwestdeutschlands. Nordrhein-Westfalen, Geologisches Landesamt, Geolog. Landesamt Nordrhein-Westfalen, 390 pp.
- Aradas A. & Benoit L. (1872–1876 ["1870"]). Conchigliologia vivente marina della Sicilia e delle isole che la circondano. *Atti dell'Accademia Gioenia di Scienze Naturali*. ser. 3, 6: 1–113, pls 1–2 [1872]; 113–226, pls 3–4 [1874]; 227–324.
- Aradas A. & Maggiore G. (1840–1844). *Catalogo ragionato delle conchiglie viventi e fossili di Sicilia*. *Atti dell'Accademia Gioenia di Scienze Naturali* 15(2): 187–217, 349–366 [1840]; 16(1): 49–87 [?1841]; 17(1): 53–106 [?1841]; 17(2): 163–205 [?1842]; 20: 101–142, 343–360 [1844].
- Bouchet P., 1990. Turrid genera and mode of development: the use and abuse of protoconch morphology. *Malacologia*, 32: 69–77.
- Cecalupo A., Buzzurro G. & Mariani M., 2008. Contributo alla conoscenza della malacofauna del Golfo di Gabès (Tunisia). *Quaderni della Civica Stazione Idrobiologica di Milano*, 31: 1–173, pl. 1–92.
- Cossignani T. & Ardovini R., 2011. *Malacologia Mediterranea: Atlante delle conchiglie del Mediterraneo*. 7500 foto a colori. Ancona, L'Informatore Piceno, 536 pp.
- Giannuzzi-Savelli R., Pusateri F., Palmeri A. & Ebreo C., 1999. Atlante delle conchiglie marine del Mediterraneo, vol.3 (Caenogastropoda parte 2: Ptenoglossa). Edizioni Evolver, Roma, 127 pp.
- Gofas S. & Oliver J. D., 2011. Familia Rissoidae. In: Gofas S., Moreno D. & Salas C. (coords), *Moluscos marinos de Andalucía*. Málaga. Servicio de Publicaciones e Intercambio Científico. Universidad de Málaga, pp. 167–194.
- Grateloup J.P.S. de, 1838. Conchyliologie fossile du Bassin de l'Adour, 5. Famille des Plicacés (Trachélipodes LAM.). *Actes de la Société Linnéenne de Bordeaux*, 10: 251–290.
- Jeffreys, J.G., 1856. On the marine Testacea of the Piedmontese coast. *Annals and Magazine of Natural History*. ser. 2, 17: 155–188.
- Landau B.M., Harzhauser M., Büyükmeriçet Y. & Marques da Silva C., 2013. Systematics and palaeobiogeography of the gastropods of the middle Miocene (Serravallian) Karaman Basin, Turkey. *Cainozoic Research*, Volume 11–13 - Issue 1 pp. 3–584.
- Micu D., 2004. Annotated Checklist of the Marine Mollusca from the Romanian Black Sea. Conference: International Workshop on Black Sea Benthos, Istanbul-Turkey, pp. 89–152.
- Nyst P.H.J., 1845. Description des coquilles et des polypiers fossiles des terrains tertiaires de la Belgique. M. Hayes, Bruxelles 697 pp.
- Oliverio M., 1994. Developmental vs genetic variation in two Mediterranean rissoid gastropod complexes. *Journal of Molluscan Studies*, 60: 461–465. <https://doi.org/10.1093/mollus/60.4.461>
- Oliverio M., 1996. Life-histories, speciation and biodiversity in Mediterranean prosobranchs gastropods. *Vie et Milieu*, 46: 163–169.
- Philippi R.A., 1836. *Enumeratio molluscorum Siciliae cum viventium tum in tellure tertiaria fossilium quae in itinere suo observavit*. Vol. 1. xiv + 267 p., pls. 1–12. Sumptibus Simonis Schroppii et Sociorum. Berolini [Berlin].
- Philippi R.A., 1844. *Enumeratio molluscorum Siciliae cum viventium tum in tellure tertiaria fossilium, quae in itinere suo observavit*. Vol. 2. Halle [Halis Saxorum]: Eduard Anton., iv + 303 pp., pls 13–28.
- Ponder W.F., 1985. A review of the genera of the Rissoidae (Mollusca: Mesogastropoda: Rissoacea). *Records of the Australian Museum Supplement*, 4: 1–221.
- Priolo O., 1954. Nuova revisione delle conchiglie marine di Sicilia. Memoria VII. *Atti dell'Accademia Gioenia di Scienze Naturali*, (6) 9: 177–213.
- Pusateri F., Giannuzzi-Savelli R., Oliverio M., 2012. A revision of the Mediterranean Raphitominiae 1: On the sibling species *Raphitoma contigua* (Monterosato, 1884) and *Raphitoma spadiana* n. sp. (Gastropoda, Conoidea). *Iberus*, 30: 41–52.
- Scaperrotta M., Bartolini S. & Bogi C., 2013. Accrescimenti: stadi di accrescimento dei molluschi marini del Mediterraneo. Vol. V. Ancona: L'Informatore Piceno.
- Scuderi D., 2023. *Gasteropodi vivi. 600 specie del Mar Mediterraneo*. Edizioni Danaus, Palermo, 304 pp.
- SIM Sistematica Mediterranea: https://www.societaitalianadimalacologia.it/index.php?option=com_content&view=article&id=761:eulimidae&catid=108:mediterranea&Itemid=191, last access on August, 09, 2024.
- Tabanelli C., Bertaccini E., Bertamini R., Bongiardino C., Gardella F. & Petracci P., 2020. La malacofauna dello "spungone". Le famiglie Rissoidae e Rissoidae: addenda et corrigenda (Mollusca: Caenogastropoda: Littorinimorpha: Rissoidae,

- Rissoinidae). *Quaderno di Studi e Notizie di Storia Naturale della Romagna*, 51: 19–40.
- Verduin A., 1976. On the systematics of recent *Rissoa* of the subgenus *Turboella* Gray, 1847, from the Mediterranean and European Atlantic coasts. *Basteria*. 40: 21–73.
- Warén A., 1996. Ecology and Systematics of the North European species of *Rissoa* and *Pusillina* (Prosobranchia: Rissoidae). *Journal of the Marine biological Association of the UK*, 76 (4): 1013–1059.
<https://doi.org/10.1017/S0025315400040947>