

Rediscovery of an enigmatic Euro-Mediterranean Pliocene nassariid species: *Nassarius crassiusculus* Bellardi, 1882 (Gastropoda: Nassariidae)

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ABSTRACT - *Nassarius crassiusculus* is an enigmatic Euro-Mediterranean Pliocene nassariid. Since its description, it had not been found until recently, when new material was collected in the Pliocene of Estepona, Spain and Siena, Italy. It is a peculiar species, easily distinguished from all other fossil and modern species of the Euro-Mediterranean area. A remarkable feature is an almost complete absence of sculpture. The only other Euro-Mediterranean Pliocene and Recent nassariids without sculpture are *Nassarius bonellii*, *Nassarius pyrenaicus* and the species of *Gussonea*, *Naytiopsis* and *Plicarcularia*. However *Nassarius crassiusculus* is unlikely to be related to these species. In fact absence of sculpture in nassariine nassariids seems a derived state that possibly appeared in different lineages, some of which were already defined in the Early-Middle Miocene.

RIASSUNTO - [Riscoperta di una specie enigmatica di nassariidi del Pliocene Euro-Mediterraneo: *Nassarius crassiusculus* Bellardi, 1882 (Gastropoda: Nassariidae)] - La riscoperta di *Nassarius crassiusculus* nel Pliocene della Spagna meridionale e dell'Italia centrale ne ha consentito la revisione. *Nassarius crassiusculus* è una specie molto peculiare, distinta da tutti gli altri nassariidi, viventi e fossili, dell'area euro-mediterranea. Una delle sue più importanti caratteristiche è la quasi completa assenza di scultura. I soli altri nassariidi privi (o quasi privi) di scultura noti per l'area euro-mediterranea sono *Nassarius bonellii*, *Nassarius pyrenaicus* e le specie dei generi/sottogeneri *Gussonea*, *Naytiopsis* e *Plicarcularia*. È improbabile, tuttavia, che *Nassarius crassiusculus* sia correlato con queste entità, visto che l'assenza di scultura nei nassariidi nassariini sembra un carattere derivato, apparso in differenti linee evolutive, alcune già definite dal Miocene Inferiore-Medio.

INTRODUCTION

Nassariid buccinoideans are a large and speciose group of very small to medium-sized Euro-Mediterranean Pliocene gastropods. They include many common species with wide geographical and stratigraphic range, but also rare species with restricted geographical and stratigraphic distribution, such as *Nassarius scalaris* (Borson, 1821) and *Nassarius strobelianus* (Cocconi, 1873).

An enigmatic Euro-Mediterranean Pliocene nassariid is *Nassarius crassiusculus*, a species described by Bellardi (1882) from the Late Miocene and Early Pliocene of Piedmont (northern Italy) and never found again until recently, when new material of this species was collected in the Pliocene of Estepona, Spain (Landau et al., 2009) and Siena, Italy. The material from Siena consists of two specimens, one intact and corresponding perfectly to that depicted by Bellardi (1882, Pl. 2, figs. 1a-1b) and more recently by Cavallo & Repetto (1992, Fig. 248) and Ferrero Mortara et al. (1984, Pl. 25, figs. 3a-3b) except for its larger size. These two specimens gave us the opportunity of re-describing this interesting rare nassariid species and discussing its taxonomic setting and the state of the art of nassariine nassariid systematics.

GEOLOGICAL SETTING

The Siena Basin is one of the best-preserved Neogene-Quaternary basins of the western flank of the Northern Apennines (Fig. 1b), a collisional belt formed during the

Tertiary in response to interaction between the Adria and Corso-Sardinian microplates (Carmignani et al., 2001 and references therein).

Deposition in Siena Basin started in the Late Miocene (Tortonian) with fluvio-lacustrine deposits, which are separated from the Upper Miocene sediments by a regional unconformity. These deposits testify sedimentation in a continental environment ranging from alluvial to lacustrine settings. Miocene deposits are only exposed in limited western marginal areas of the Siena Basin but their correlatives crop out diffusely in the nearby Casino Basin (Lazzarotto & Sandrelli, 1977; Bossio et al., 2000).

Conversely to the Miocene succession, Pliocene deposits crop out extensively in the Siena Basin and overlay Upper Messinian sediments and pre-Neogene bedrock. Pliocene sedimentation started in the lowermost part of Early Pliocene (*Sphaeroidinellopsis seminulina* l.s. Zone) and persisted until the Middle Pliocene (*Globorotalia crassaformis/aemiliana* Zone) (Bossio et al., 1993) when overall uplift of southern Tuscany caused major marine regression and emergence of the basin (Costantini et al., 1982). Pliocene deposits are prevalently indicative of marine environments and are represented by nearshore sands and conglomerates which pass basinward to offshore muds. Continental deposits are also recognized, especially in the lowermost part of the succession, and they consist of fluvial sandy conglomerates and floodplain silty-clays (Aldinucci et al., 2007).

Traditionally the overall stratigraphy of the Neogene succession has been studied using lithostratigraphic criteria while detailed sedimentological studies have been

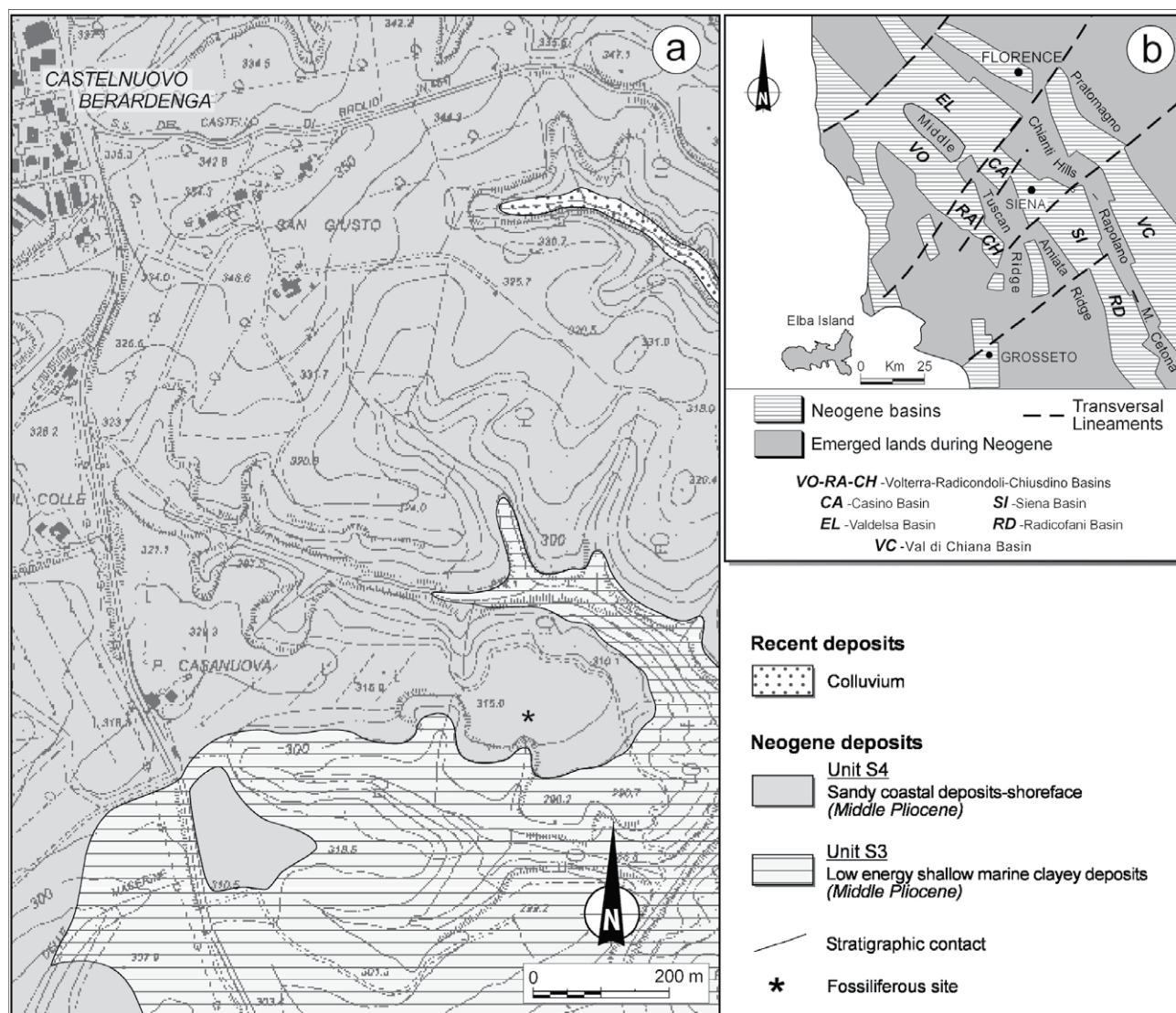


Fig. 1 - a) Simplified geological map of the Castelnovo Berardenga area. b) Structural setting of southern Tuscany.

few. Only recently have some key areas been investigated using modern facies analysis and stratigraphic concepts (Aldinucci et al., 2008, 2009), that allow a new subdivision of the whole sedimentary succession into four depositional units, S1 to S4 from the oldest to the youngest. Each unit is bounded by unconformity surfaces and their correlative conformity.

The species studied in this paper was collected in the Castelnovo Berardenga area (Fig. 1a), where Pliocene deposits crop out diffusely. Biostratigraphic constraints and stratigraphic position suggest a Middle Pliocene (Piacenzian) age for the sediments, according to Gandin (1982) and Aldinucci et al. (2007).

Detailed facies analysis of the outcrop where shell samples were collected is now impossible because the old exposures are currently covered. In limited outcrops it is possible to observe a succession made of fine-medium silt-rich, non graded sands, with a crudely plane parallel stratification. Rare scattered granules and pebbles are also present. Very silty and clayey strata, often bioturbated, are relatively common.

Sedimentary features suggest deposition in a shoreface environment (Walker & Flint, 1992). In particular, the abundance of silt and mud testifies sedimentation in a lower shoreface, near offshore environment, where the sea-floor was little affected by wave action during fair-weather conditions. On the basis of age and sedimentological characteristics, these deposits can be attributed to the youngest depositional unit (S4) of Aldinucci et al. (2009).

NASSARIID MORPHOLOGICAL NOMENCLATURE

The morphological nomenclature adopted is that proposed by Cox (1960) in the *Treatise of Paleontology*, but some specific terms are derived from Nuttal & Cooper (1973), Allmon (1990) and Haasl (2000). Nassariid species usually have a shell with a neck distinct from the adapical portion of last whorl (no term being in use, we will call it "bulk of the last whorl"). Usually the bulk of the last whorl and the neck are separated by a deep groove (neck

groove); occasionally the distinction is barely evident or not at all. The neck continues with a very short siphonal canal, often so reduced as to consist only of the siphonal apertural lips. The siphonal canal communicates with the shell aperture by narrow to variably wide siphonal notch and opens dorsally with a deep, v-shaped aperture. The siphonal aperture is usually bordered by a slightly reflexed rim, divided into an inner (or adaxial) siphonal apertural lip and an outer (or abaxial) siphonal apertural lip by an indentation located at innermost point of siphonal aperture. Sometimes the neck groove is evident and continues to the outer margin of the peristome and may also be abapically marked by a more or less evident keel, continuous with the outer siphonal apertural lip. In other cases, the neck groove is not different from the other spiral grooves of the last whorl and may stop at the siphonal indentation. The aperture is bordered on its inner (adaxial) margin by an apertural callus between the adapical vertex and adaxial margin of the siphonal notch; the apertural callus may only cover the inner margin of the aperture and neck (peri-apertural parietal callus) or a large portion of the bulk of the last whorl and neck. On the internal surface of the outer margin of the peristome, there are many denticles or slender variably long folds named “lirae”; on the internal surface of the inner margin of the peristome, there may be a denticle near the adapical vertex of the aperture, some blunt denticles on the columella and a terminal columellar fold. When the apertural callus is very developed, it may constitute a sort of apron covering a large portion of the bulk of the last whorl or a sort of very large shield covering the apertural surface of most or all shell whorls. The neck may be marginally, partially or completely covered by the apertural callus. When the neck is extensively covered by the callus, the terminal columellar fold constitutes the adaxial margin of the siphonal notch. The portion of the neck which remains free may be sculptured with spiral grooves, similar to those of the last whorl, or with growth lines comarginal to the inner siphonal apertural lip or with a mixture of the two. In the case of evident comarginal sculpture, the marks of subsequent positions of the indentation form a structure sometimes encircling a sort of more or less evident pseudumbilicus, called the siphonal fasciole.

RE-DESCRIPTION OF *NASSARIUS CRASSIUSCULUS* (Bellardi, 1882)

Primary reference - *Nassa crassiuscula* Bellardi, 1882: p. 246, Pl. 2, figs. 1a-1b.

Type material - Five syntypes are in the Bellardi - Sacco collection at the “Museo Regionale di Scienze Naturali” of Turin: one from the Pliocene of Vezza d’Alba (BS.012.04.035/P1) and four from the Miocene of Stazzano (BS.012.04.035/T4) (Ferrero Mortara et al., 1984). Due to uncertainty about their conspecificity (e.g. Landau et al., 2009), we restrict the original concept of this taxon to the specimen from Vezza d’Alba designating it as the lectotype.

Type locality - “Pliocene inferiore: Vezza presso Alba”.

Material examined - Abandoned quarry west of Podere Casanuova (1 complete shell, G. Manganelli collection; 1 incomplete shell, V. Spadini collection).

Diagnosis - A medium-sized species of *Nassarius* s.l. characterized by elongate conical shell with distinct neck having slightly evident comarginal sculpture; elongate aperture with long acute anal canal, peri-apertural callus, very short siphonal canal and outer lip with broad thick external varix and many internal denticles; sculpture reduced to a few blunt spiral grooves in basal portion of bulk of last whorl (axial ribs or riblets completely absent).

Description of Siena specimens - Shell (Fig. 2) medium in size for nassariid species, elongate conical, slightly flattened dorsoventrally, with at least six flat smooth whorls (protoconch and early teleoconch whorls worn), separated by irregular adpressed sutures; last whorl large, slightly inflated, about two thirds of total shell height with straight neck separated from bulk of last whorl by shallow groove; aperture elongate with long acute anal canal (posterior canal), bordered by peri-apertural callus on inner margin and robust outer lip on outer margin, and interrupted by wide siphonal notch; apertural callus narrow with small tubercle near adapical vertex, well developed on columella, and reflected to partially cover neck; columella truncated, smooth with blunt “terminal fold” (and only deep median denticle in complete specimen); outer lip with broad thick external varix and many internal denticles (14 in complete specimen, first and last of which largest); siphonal canal very short, open dorsally via v-shaped siphonal aperture and with outer siphonal apertural lip almost absent; spiral sculpture consisting of few irregular imperceptible obsolete grooves in basal portion of bulk of last whorl; axial sculpture absent; neck with blunt comarginal sculpture.

Dimensions - Bellardi (1882) reported the size of only one specimen as 22 mm in height and 13 mm in width. Specimens from Estepona and Siena are larger: those from Estepona reach 31.1 mm in height (Landau et al., 2009) and the complete shell of the two from Siena is 30 mm in height and 15 mm in width.

Geographic and stratigraphic distribution - Bellardi (1882) recorded *Nassarius crassiusculus* from the Late Miocene of Stazzano and the Early Pliocene of Vezza d’Alba (both localities are in Piedmont, northern Italy). However, the identity of the material from Stazzano is uncertain (Landau et al., 2009). Pliocene specimens are only known from three sites of the central - western Mediterranean: Vezza d’Alba (Bellardi, 1882), Estepona (Landau et al., 2009) and Siena (this paper). Little is known about its stratigraphic range: Estepona specimens are from the lower Piacenzian (Early-Middle Pliocene) (Landau et al., 2009) and those from Siena from the Piacenzian (Middle Pliocene).

DISCUSSION

The supraspecific systematics of nassariid gastropods is still a very inadequate and controversial subject and this

affects the supraspecific setting of *Nassa crassiuscula*. In the most recent survey of the family, Cernohorsky (1984) recognized three subfamilial groups (Dorsaninae Cossmann, 1901, Nassariinae Iredale, 1916, and Cylleninae Bellardi, 1882; for the relative precedence of these names, see Bouchet & Rocroi, 2005) and four genera in the Nassariinae: *Cyclope* Risso, 1826, *Demoulia* Gray, 1838, *Hebra* Adams & Adams 1853, and *Nassarius* Duméril, 1826, the latter with 26 (!) subgenera.

Nassariid systematics and phylogeny were subsequently addressed by Gili & Martinell (2000) and Haasl (2000). Gili & Martinell (2000) analysed the relationships between two *Cyclope* species - the fossil *C. migliorinii* (Bevilacqua, 1928) and the recent *C. neritea* (Linnaeus, 1758) - and two recent species of *Plicarcularia* Thiele, 1929, using *Nassarius* s.l. as outgroup. They found monophyly of *Cyclope* and paraphyly of *Plicarcularia*, but their results are invalidated by analysis of too small a selection of taxa. Haasl (2000) investigated the phylogeny of a selection of recent and fossil nassariids, with special attention to their basal relationships. He assumed monophyly of the genus-group taxa *a priori* and consequently did make any contribution to better understanding of *Nassarius* systematics.

As reasonably stated by Harzhauser & Kowalke (2004) there is no clear separation or differentiation between the various subgenera of *Nassarius*. They therefore ranked two of the most distinct (*Naytiopsis* Thiele, 1929 and *Profundinassa* Thiele, 1929) as separate genera, but avoided using the others, even if they recognized the existence of distinct lineages, including Miocene Paratethyan and Recent Mediterranean species. Although this approach is the simplest one, it may be a realistic solution at the present state of knowledge: it was also adopted by Bouchet et al. (1998) in the checklist of European marine molluscs and by Landau et al. (2009) in their survey of Estepona nassariids. In fact, even if some putative natural groups certainly exist, some of which were already definite in the Early-Middle Miocene (for example, *Profundinassa*, *Sphaeronassa* Locard, 1886, and so on), there is no evidence that most of the other species-rich genus-group taxa, as currently conceived, are monophyletic. Moreover, their diagnosis often lacks clear differential features, making the current subgeneric classification largely subjective (for example, see inclusion of *Buccinum macrodon* Bronn, 1831 in *Nassarius* s.s., *Buccinum clathratus* Brocchi, 1814 in *Niotha* Adams & Adams, 1853, *Nassa turrita* Borson, 1821 in *Alectrion* Mountfort, 1810, and so on). We therefore use the subgenera accepted by Cernohorsky (1984) as basis for discussion, considering them informal

taxa pending revision. We realize that some might be valid genera, others valid subgenera of *Nassarius* or other taxa formerly treated as subgenera of *Nassarius*, and others invalid taxa.

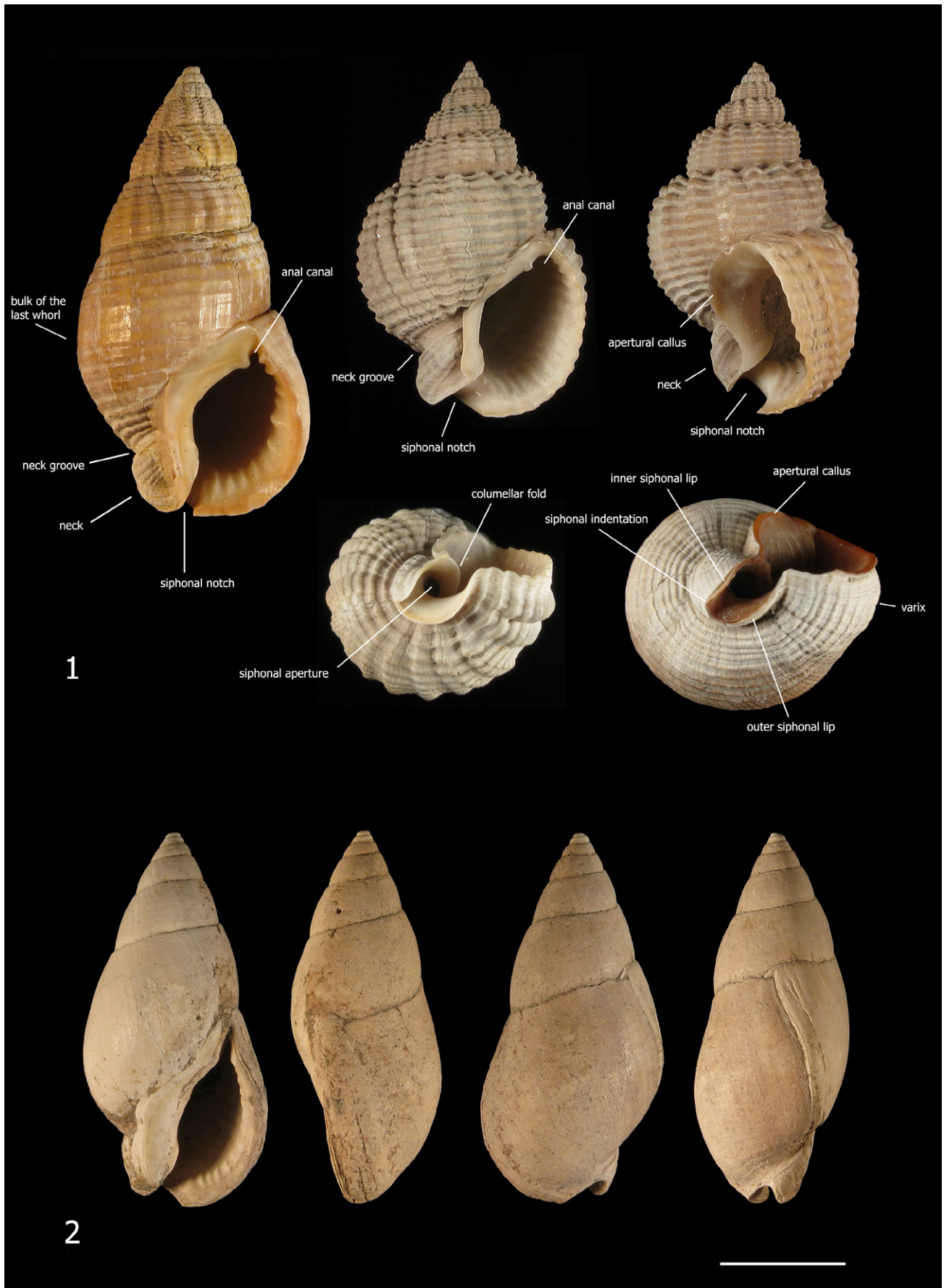
Nassarius crassiusculus is a very peculiar species easily distinguished from all other fossil and modern species of the Euro-Mediterranean area. It has a medium-sized, elongate shell with very reduced sculpture (only some blunt spiral grooves in the basal portion of the bulk of the last whorl), a distinct neck with slightly evident comarginal sculpture, an elongate aperture with a long acute anal canal, a very short siphonal canal and a broad external peristomal varix.

Bellardi (1882) included it in his sixth series of the genus *Nassa* together with *Nassa defossa* Bellardi, 1882, from the Late Miocene of Colli Torinesi and Stazzano and stated that it was close to *Nassa acuminata* Millet de la Turtaudière, 1866, from the Miocene of Sceaux and Thourenne (Département de Maine-et-Loire, France). Sacco (1904), in the additions and corrections to his and Bellardi's survey on Tertiary molluscs from Piedmont and Liguria, stated only that *Nassa crassiuscula* was close to *Nassa defossa*, a species assigned by Cossmann (1901) to *Arcularia* Link, 1907, together with *Nassa coarctata* Eichwald, 1830, and the species included in Bellardi's seventh (*Nassa lacrima* Bellardi, 1882) and eighth series (*Nassa magnicallosa* Bellardi, 1882, *Nassa gibbosula* Linnaeus, 1758, *Nassa ringicula* Bellardi, 1882, and *Nassa soldanii* Bellardi, 1882). The only subsequent authors to mention Bellardi's species before the recent findings from the Pliocene of Estepona and Siena seem to be Cavallo & Repetto (1992) who assigned it to *Gussonea* Monterosato, 1912. Landau et al. (2009) included *N. crassiusculus* in an assemblage of robust, weakly sculptured, medium sized shelled *Nassarius* species also comprising *Nassarius bonellii* (Sismonda, 1847), *Nassarius pfeifferi* (Philippi, 1844) and *Nassarius corniculum* (Olivieri, 1792) and informally named after Sismonda's species "*N. bonellii* group".

Unfortunately, possible relationships with *Nassa acuminata* and *Nassa defossa* could not be re-examined. These obscure nominal taxa have never been illustrated or revised. Brébion (1964) who re-examined Millet's species depicting much type material, did not mention *Nassa acuminata* (R. Marquet, pers. comm. 24 March 2005). Bellardi studied typical specimens received from the abbot Louis Bardin (Angers, France), but this material was returned or lost because it is not present in his collection at the Museo Regionale di Scienze Naturali (D. Ormezzano, pers. comm.), nor is that of *Nassa defossa* (see Ferrero Mortara et al., 1984).

EXPLANATION OF PLATE 1

- Fig. 1 - Morphological features of the shell of some Euro-Mediterranean Pliocene nassariid species (from the left): *Nassarius turritus* (Borson, 1822), apertural view; *Nassarius clathratus* (Born, 1778), apertural, lateral and basal views; *Demoulia conglobata* (Brocchi, 1814), basal views; scale bar: 10 mm.
- Fig. 2 - A complete shell of *Nassarius crassiusculus* (Bellardi, 1882) from the abandoned quarrywest of Podere Casanuova from the left: frontal, right lateral, posterior and left lateral views; scale bar: 10 mm.



A remarkable feature of *N. crassiusculus* is an almost complete absence of sculpture. The only other Euro-Mediterranean Pliocene and Recent nassariids without sculpture are *N. bonellii*, *Nassarius pyrenaicus* (Fontannes, 1879) and the species of *Gussonea*, *Naytiopsis* and *Plicarcularia*, although *N. pyrenaicus* and species of *Gussonea* may sometimes have blunt ribs on the first teleoconch whorls and species of *Gussonea* also on the last ones. However, it is unlikely that *N. crassiusculus* has relationships with these species.

Nassarius bonellii is another nassariid species of uncertain systematic setting: it has recently been assigned to *Amyclina* Iredale, 1918 (as distinct genus: Pavia, 1976; as subgenus of *Nassarius*: Ferrero & Merlino, 1992), *Gussonea* Monterosato, 1912 (as subgenus of *Nassarius*: Cavallo & Repetto, 1992) and *Nassarius* (e.g. Basilici et al., 1997). It is distinct from *N. crassiusculus* by virtue of its more ovoid shell, usually shorter spire, wider and slightly oblique aperture, more developed and bilobate apertural callus completely covering neck, wider siphonal notch and numerous, slender and fragmented lirae (for shells of *N. bonellii*, see: Pavia, 1976, Pl. 7, figs. 3a-3b; Cavallo & Repetto, 1992, Fig. 247; Ferrero Mortara et al., 1984, Pl. 20, figs. 11a-11b; Chirli, 2000, Pl. 26, figs. 4-7; Landau et al., 2009, Pl. 4, figs. 5-6). Landau et al. (2009) tentatively assigned some specimens from the Early-Middle Pliocene of Mondego Basin (Portugal) to this species, stating that they are reminiscent of *Nassa bonellii* var. *persulcata* Sacco, 1904. They differ from typical *N. bonellii* due to their smaller size, more elongated and fragile shell and less developed apertural callus, seeming somewhat intermediate between *N. bonellii* and *N. pyrenaicus*, so it is not surprising that they were formerly assigned to the latter by Gili et al. (1995).

Nassarius pyrenaicus is a little known medium-sized nassariid species, also reported under the name of its junior synonym *Nassarius tersus* (Bellardi, 1882) and perhaps conspecific with the Recent West Atlantic and Mediterranean *Nassarius heyneimanni* (von Maltzan, 1884) (Landau et al., 2009). It is distinct from *N. crassiusculus* by virtue of its smaller shell, the delicate apertural callus imperceptibly covering the neck and most of the apertural surface of the last whorl, and numerous, slender lirae.

Recent Mediterranean *Plicarcularia* are represented by two small nassariids (Giannuzzi Savelli et al., 2003) characterized by very large last whorl, apertural callus constituting a large shield covering neck and almost all the apertural surface of the whorls and overflowing dorsally on the left side, almost paraxial terminal columellar fold constituting adaxial margin of siphonal notch and outer lip with wide thick external varix joining the overflowing shield to constitute a wide medial belt around the shell. Outside the Mediterranean, *Plicarcularia* is widespread in the Indo-Pacific where it includes many species (Cernohorsky, 1984), most of which may have a variety of axial and spiral sculpture and, apart from their lesser size, are so similar to species of *Nassarius* (s.s.) that it is not easy to understand why they have not been assigned to this subgenus.

Naytiopsis only includes the type species (Giannuzzi Savelli et al., 2003), *Nassarius granum* (Lamarck, 1822), which has a small, ovoid shell with delicate apertural

callus imperceptibly covering neck and most of apertural surface of whorls. *Nassarius granum* is clearly similar to some slender Mediterranean Pliocene *Plicarcularia* species and may be a member of this group (the main differences consist in the weakness of the callus and the absence of the parietal tooth). Chirli (2000, Pl. 36, figs. 10-12) reported one of these from the Pliocene of Tuscany as *Nassarius soldanii* (Bellardi, 1882). Harzhauser & Kowalke (2004) assigned a species from the Badenian of the Vienna Basin and from Romania to *Naytiopsis*: *Naytiopsis karrer* (Hoernes & Auinger, 1882). However this species is closer to those included by Bellardi in his 52nd series of the genus *Nassa* (corresponding to the *Nassarius heyneimanni* group) than to modern *N. granum*. Like *N. granum*, they are characterized by similar apertural callus structure but have neither ovoid shell shape nor a wide thick external varix.

Besides the type species, *Nassarius tinei* (Maravigna, 1840), *Gussonea* includes two other recent species (Giannuzzi Savelli et al., 2003): *N. corniculum* (note that “*corniculum*” is a noun in apposition, not an adjective) and *N. pfeifferi*. Unlike the two other species, which lack spiral sculpture and have a periapertural callus, the type species has evident spiral sculpture and a thin apron-like apertural callus (Parenzan, 1979; Giannuzzi Savelli et al., 2003). The two other species are characterized by small size, ovate-elongate or inflated shell with thickened periapertural callus (i.e. covering only the inner margin of the aperture and the neck), neck slightly arched towards aperture and barely distinct from the bulk of the last whorl. *Nassarius corniculum* is the type species of *Amycla* Adams & Adams, 1853 which, being a junior homonym of *Amycla* Rafinesque, 1815 (Insecta, Neuroptera) and *Amycla* Doubleday, 1849 (Insecta, Lepidoptera), has been validly replaced by *Amyclina* Iredale, 1918. Subsequently *Amyclina* was synonymized with *Gussonea* by Piani (1980) and although this is usually accepted, the matter deserves further investigation. *Nassarius corniculum* inhabits coastal lagoons and marshes and often has specimens with bulging axial ribs in the last whorl. These specimens recall those of Pliocene species such as *Nassarius bollenensis* (Tournouer, 1874), *Nassarius mayeri* (Bellardi, 1882) and so on, usually reported from coastal salt marsh outcrops and often assigned to the American Pacific *Phrontis* Adams & Adams, 1853. Although fossil and recent specimens may belong to more distinct species, it is astonishing that no one observed their relationships before. Putative taxa of this group from the Early and Middle Miocene of Loire and Paratethys (*Buccinum dujardinii* Deshayes, 1844, *Hinia edlaueri* Beer-Bistrick, 1958, *Buccinum schönii* Hoernes & Auinger, 1882) were even recently assigned to *Sphaeronassa* by Baluk (1997) and Harzhauser (2002). Landau et al. (2009) reported both *N. pfeifferi* and *N. corniculum* from the Pliocene of Estepona, but we are puzzled about their identification. The only figured shell of *N. pfeifferi* (Landau et al., 2009, Pl. 4, figs. 7a-7b) seems to have a long acute anal canal not so evident in recent specimens (cf. Giannuzzi Savelli et al., 2003, Figs. 418-421) and the same is also true of the two figured shells of *N. corniculum* (cf. Landau et al., 2009, Pl. 4, figs. 10-11 and Giannuzzi Savelli et al., 2003, Figs. 422-429). Recent slender specimens of *N. pfeifferi* are somewhat reminiscent of *N. crassiusculus*,

although distinct in many features (smaller size, neck slightly arched towards aperture and indistinct from bulk of last whorl, posterior canal less acute and wider, almost paraxial terminal columellar fold constituting adaxial margin of siphonal notch).

Landau et al. (2009) concluded that *N. crassiusculus* and *N. corniculum* are closely related because “the varix so typical of the *N. crassiusculus* shell, and unusual amongst nassariids, is also present to a lesser extent in some of our specimens of *N. corniculum* and in some Recent specimens”. Apart from some uncertainty about the status of *N. corniculum* from Estepona, we note that external peristome varix is not unusual in nassariids, being present also in species of *Naytiopsis*, *Plicarularia* and *Sphaeronassa*.

Nassarius crassiusculus evidently shares the absence of sculpture with some groups of nassariids, but at the present state of knowledge there is no other evidence which might indicate a preferential hypothesis of relationships with either of these. Absence of sculpture in nassariine nassariids seems a derived state that possibly appeared in different lineages, some of which (Mediterranean *Plicarularia*, *Sphaeronassa* and so on) were already defined in the Early-Middle Miocene, and it cannot be excluded that *N. crassiusculus* belongs to a lineage of its own.

There is much work to do on the extant nassariids and modern approaches such as DNA sequencing may contribute to a better understanding of their phylogeny and systematics. However, although a reliable classification of extant taxa (at present not available) is essential for analysis of the fossils, it will not necessarily help obtain more certain systematic allocation. Indeed, the only characters available for fossil molluscs (shell characters) may be insufficient (because extant taxa may be defined on the basis of anatomical characters or molecular sequences) or inadequate (due to homoplasy) for systematic assignment or establishing the rank of taxa, a prospect we will increasingly have to accept.

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