

# Additions and corrections to the Gastropod fauna of the Pliocene of Estepona, southwestern Spain, 4<sup>1</sup>

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## INTRODUCTION

In this paper we update the systematic taxonomy of papers published by our team between 2000-2009 dealing with the Pliocene of Estepona. Four species are described as new, *Rimula lobilloensis* spec. nov., *Macromphalina aline-mulderae* spec. nov., *Euthriofusus postumus* spec. nov., and *Andonia wilhelminamariae* spec. nov., of which the last also occurs in the Pliocene of Italy. Several new subjective synonyms are identified: *Cymbium gracile lusitanica* Lozano-Francisco & Vera-Peláez, 2006 is junior subjective synonym of *Cymbium ibericum* Landau & Marquet, 2000. *Bolma malakensis* Lozano-Francisco & Vera-Peláez, 2006 is a junior subjective synonym of *Bolma castrocarensis* (Foresti, 1876). *Tribia plioeconomica* Lozano-Francisco & Vera-Peláez, 2006 is a junior subjective synonym of *Tribia hispanica* Brunetti, Forli & Vecchi, 2006. *Scaphella (Aurinia) josei* Lozano-Francisco & Vera-Peláez, 2006 is junior subjective synonym of *Euroscaphella carlae* (Landau & Silva, 2006). *Pisania plioalboranensis* Lozano-Francisco & Vera-Peláez, 2006 is junior subjective synonym of *Pisania plioangustata* (Sacco, 1904). *Columbella sphaerica* Lozano-Francisco & Vera-Peláez, 2006 is a secondary homonym of *C. sublachryma* var. *sphaerica* Hervier, 1900, and here considered a junior subjective synonym of *Columbella castoris* Lozano-Francisco & Vera-Peláez, 2006. *Pisania baetica* Lozano-Francisco & Vera-Peláez, 2006 is a junior subjective synonym of *Pisania magna* (Foresti, 1868). *Bullia eloisae* Lozano-Francisco & Vera-Peláez, 2006 is a junior subjective synonym of *Tritia oblonga* (Sassi, 1827). *Nassa andonae* Bellardi, 1882 is taken out of synonymy with *N. producta* Bellardi, 1882.

The Pliocene Estepona assemblages of south-western Spain are probably the most diverse molluscan Pliocene assemblage in Europe, with over 800 gastropod species present (BL personal observation). This gastropod fauna has been dealt with, in part, in a series of monographs and papers by the senior author and co-authors (Landau & Marquet, 2000, 2001, Fehse & Landau, 2002, 2003; La Perna et al., 2002; Landau & Lozouet, 2003; Landau et al., 2003, 2004a-b, 2006a-c, 2007, 2009; Landau & Fehse, 2004; Landau & Silva, 2006a-b; Landau & Jansen, 2015a-c), and a revision of the Pyramidellidae is in preparation. Other workers have also addressed various families within the assemblage; *i.e.* Muricidae (Muñiz Solís & Guerra-Merchán, 1994), Cancellariidae (Vera-Peláez & Muñiz-Solís, 1995; Vera-Peláez et al., 1995), Fasciolarinae (Muñiz Solís, 1998), Conidae (Muñiz Solís, 1999), Cysticidae (Muñiz Solís, 2002), Archaeogastropoda (Muñiz Solís, 1996; Lozano-Francisco & Vera-Peláez, 2002) and the turrids (Vera-Peláez et al., 1999; Vera-Peláez, & Lozano-Francisco, 2001a-b; Vera-Peláez, 2002).

The present paper is centred on the tireless collecting efforts of the junior author (HM) between the years 2008-2019, and describes and reports species not previously included in the monographic works by our team listed above. Secondly, the gastropod taxonomy relevant to these assemblages has changed immensely in the last 20 years,

1 No. 3 see: LANDAU, B.M. & JANSEN, A., 2015. Additions to the gastropod fauna of the Pliocene of Estepona, southwestern Spain, 3. The genus *Plesiothyreus* Cossmann, 1888 (Phenacolepadidae), with a note on its presence in the Middle Miocene of Winterwijk, Miste, The Netherlands. — *Cainozoic Research* 15 (1-2): 123-126.

partly as a result of huge amount of literature published by a number of highly active Italian Pliocene researchers, and at supraspecific level, by the application of molecular phylogeny. We take the opportunity to update the taxa recorded in the papers published by our group.

We also review a paper that has only recently come to our attention, written by Lozano-Francisco & Vera-Peláez (2006), in which they chose certain species from the Estepona assemblage for description. On further examination almost all of their new taxa are junior subjective synonyms. Correcting these synonymies is of palaeobiogeographic importance, as, in their content, the Estepona assemblages are typical for the Zanclean-lower Piacenzian [Mediterranean Pliocene Molluscan Unit 1 (MPMU1), sensu Monegatti & Raffi, 2001, 2007; Silva et al., 2010], but with a western influence at generic level (Landau & Marquet, 2000; Landau et al., 2006a; Landau & Silva, 2006a-b) with relatively few endemics (about 11% within the groups revised so far; BL unpublished data) considering the enormous number of species present. Thus inflating the number of Estepona endemics gives a false impression of the assemblage. Moreover, some of the species described as ‘endemic’ from Estepona have subsequently been found in the Italian Pliocene assemblages [i.e. *Hexaplex (Trunculariopsis) praeduplex* Landau, Houart & Silva, 2007 (Forli et al., 2013); *Belidaphne saldubensis* Vera-Peláez, 2002 (Della Bella et al., 2015)]. Even in this relatively small contribution to the assemblage, two of the four new species described also occur in the Italian Pliocene.

#### Age of the deposits

Prior to 2013 (Landau & Marquet, 2000, 2001; Landau & Lozouet, 2003; Landau et al., 2003, 2004a, b, 2006a, b, c, 2007, 2009; Landau & Fehse, 2004; Landau & Silva, 2006b) the age we gave for the deposits was upper Zanclean (upper lower Pliocene). In our later (Landau & Janssen, 2015a, b, c) works we have dated the assemblages as lowest Piacenzian, lower upper Pliocene (Guerra Merchán et al., 2002), an age corroborated by the assemblage of Euthecosomata (Janssen, 2004). Either way, they form part of the Mediterranean ecostratigraphic unit MPPMU1 of Monegatti & Raffi (2001), which includes the Zanclean and lowest Piacenzian (see Landau et al., 2011: text-fig. 9).

#### MATERIAL AND METHODS

The new material described herein was collected from several localities around Estepona by the junior author (HM; 2008-2019). For a map of localities see Landau et al. (2003: 4, text-fig. 1). These assemblages were dated as early Piacenzian by Guerra Merchán et al. (2002). The new material is housed in the Natural History Museum Vienna (NHMW)

and in the personal collection of Henk Mulder (Monster, The Netherlands). Henk Mulder’s private collection will eventually be donated to the Naturalis Biodiversity Center (Leiden, The Netherlands).

Abbreviations: CO = Velerín conglomerates; EL = El Lobillo; HM coll. = Henk Mulder collection, Monster, The Netherlands; NHMW coll. = Natural History Museum Vienna (Vienna, Austria); PQ = Parque Antena; VC = Velerín carretera.

This paper is arranged in chronological order of publication by our group.

**LANDAU, B.M. & MARQUET, R., 2000. The genus *Cymbium* (Gastropoda, Volutidae) in the Iberian Neogene. — Contributions to Tertiary and Quaternary Geology 37 (1-2): 23-34.**

*Cymbium gracile lusitanica* Lozano-Francisco & Vera-Peláez, 2006 was erected based on material from the Velerín conglomerates, and is a junior subjective synonym of *C. ibericum* Landau & Marquet, 2000. In the original description material from both the Guadalquivir Basin and the Estepona Basin (Velerín conglomerates) was included in the material studied (Landau & Marquet, 2000: 24).

**LANDAU, B.M., MARQUET, R. & GRIGIS, M., 2003. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 1: Vetigastropoda. — Palaeontos 3: 1-87.**

- p. 6 *Patella (Patellastra) ferruginea* Gmelin, 1791 (pl. 4 fig. 8) = *Patella ferruginea* Gmelin, 1791; see Koufopanou et al. (1999: 148). *Patella alessiae* Forli et al., 2004 from the lower Pliocene of Italy seems to have coarser sculpture, with less regular, more strongly nodular ribs, resulting in an irregular shell outline.
- p. 7 *Ansates pellucidum* (Linnaeus, 1758) (pl. 5 fig. 2) = *Patella pellucida* Linnaeus, 1758; see Koufopanou et al. (1999: 148).
- p. 8 *Acmaea (Tectura) virginea* (pl. 5 fig. 3) = *Tectura virginea* (O.F. Müller, 1776); see Nakano & Ozawa (2007: 91).
- p. 9 *Cocculina adunca* (Jeffreys, 1883) (pl. 5 fig. 8). This is a pseudococculinid and possibly another specimen of *Copulabyssia corrugata* (Jeffreys, 1883) recorded in Landau et al. (2003: fig. 6).
- p. 15 *Anatoma umbilicata* (Jeffreys, 1883) (pl. 1 fig. 4) is not that species, but *A. eximia* (Seguenza, 1877); see Geiger (2012: 872).
- p. 21 *Emarginula solidula* O.G. Costa, 1829 (pl. 3 fig. 5) is not that species, but *E. fissura* (Linnaeus, 1758). On examination of a large number of specimens from

- the locality of El Lobillo (HM coll.) we consider them all to be *E. fissura*. In typical specimens the primary and secondary ribs are well differentiated, but in some the difference is not as marked – leading to the misidentification.
- p. 24 *Rimula capuliformis* Pecchioli, 1864 (pl. 4 fig. 1) = *Puncturella capuliformis* (Pecchioli, 1864). On interior view there is a small but well developed septum surrounding the foramen apically, therefore placement in *Rimula* Defrance, 1827 is excluded (Simone & Cunha, 2014: 452). *Cranopsis* A. Adams, 1860 was synonymised with *Puncturella* Lowe, 1827 by Cunha et al. (2019: 261).
- p. 28 *Heteroninella bertarellii* (Andreoli & Marsigli, 1997) (pl. 6 figs 1-2). Forli et al. (2014: 69) reviewed a similar species, *Gibbula euomphala?* var. *anodosula* Sacco, 1896 with strong spiral sculpture that differs in having more numerous cords that are not as strong as in *H. bertarellii*. Those authors argued that *H. bertarellii* was better placed within the genus *Gibbula* based on apertural characters. We prefer to keep this species in the genus *Heteroninella* for the reasons discussed in Landau & Lozouet (2003: 3) and Landau et al. (2003). *Gibbula gigantea* Lozano-Francisco & Vera-Peláez, 2002 is a junior subjective synonym.
- p. 29 *Bolma (Bolma) castrocarensis* (Foresti, 1876) (pl. 7 fig. 1) = *Bolma castrocarensis* (Foresti, 1876). *Bolma malakensis* Lozano-Francisco & Vera-Peláez, 2006 is also a junior subjective synonym. It seems that those authors were not aware of the species in Foresti (1876), Sacco (1904), nor in Landau et al. (2003: 29) as there is no mention of the species in their discussion. It is only compared to *B. granosa* (Borson, 1821), which is clearly different.
- p. 33 *Bolma (Ormastralium) fimbriata* (Borson, 1821) (pl. 7 figs 5-6) = *Ormastralium fimbriatum* (Borson, 1821); see Landau et al. (2013: 32).
- p. 48 *Gibbula (Gibbula?) varia* (Linnaeus, 1758) (pl. 11 fig. 3). This species fits within the genus description of *Steromphala* Gray, 1848, as defined by Affenzeller et al. (2017: 803). The specimen from Estepona might represent *Steromphala verae* (Chirli, 2004) rather than *S. varia*, which has a wider, more funnel-shaped umbilicus. The Estepona shell is quite depressed, similar to one of the Italian specimens illustrated (Chirli, 2004, pl. 27 fig. 8), but none of the specimens of *S. verae* illustrated has the strengthened suprasutural cord seen in the Estepona shell. More specimens would be required to reach a firm conclusion.
- p. 49 *Gibbula (Forskalea) fanulum* (Gmelin, 1791) (pl. 11 fig. 1) = *Gibbula fanulum* (Gmelin, 1791); see Affenzeller et al. (2017: 20).
- p. 50 *Gibbula (Forskalea) pliosubcinctus* (Sacco, 1896) (pl. 10 figs 6-7) = *Gibbula pliosubcinctus* (Sacco, 1896); see Affenzeller et al. (2017: 20).
- p. 53 *Trochocochlea articulata* (Lamarck, 1822) (pl. 11 fig. 6) = *Phorcus articulatus* (Lamarck, 1822); see Donald et al. (2012: 43).
- p. 55 *Calliostoma (Calliostoma) miliaris* (Brocchi, 1814) (pl. 14 fig. 3) = *Clelandella miliaris* (Brocchi, 1814); see Gofas (2005: 134).
- p. 56 *Calliostoma (Calliostoma) cf. subexcavatum* (S.V. Wood, 1848) (pl. 12 fig. 4) = *Calliostoma cf. subexcavatum* (S.V. Wood, 1848).
- p. 57 *Calliostoma (Ampullotrochus) granulatum* (Von Born, 1778) (pl. 15 figs 1-2) = *Calliostoma granulatum* (Born, 1778); see MolluscaBase (2019c).
- p. 59 *Calliostoma (Ampullotrochus) opisthotenus* (Fontannes, 1879) (pl. 12 fig. 5, pl. 14 fig. 1) = *Calliostoma opisthotenus* (Fontannes, 1879); see MolluscaBase (2019c).
- p. 59 *Calliostoma (Ampullotrochus) scutiformis* (Sacco, 1896) (pl. 12 fig. 6, pl. 14 fig. 2) = *Calliostoma scutiformis* (Sacco, 1896); see MolluscaBase (2019c).
- p. 67 *Calliotropis (Solaricida?) peregrina* (Libassi, 1859) (pl. 18 fig. 1) = *Calliotropis peregrina* (Libassi, 1859).

#### Family Haliotidae Rafinesque, 1815

#### Subfamily Haliotinae Rafinesque, 1815

#### Genus *Haliotis* Linnaeus, 1758

*Haliotis* Linnaeus, 1758: 779. Type species (by subsequent designation of Montfort, 1810: 119): *Haliotis asinina* Linnaeus, 1758. Present-day, Indo-Pacific.

#### *Haliotis quinquecentenaris*

#### Lozano-Francisco & Vera-Peláez, 2002

(Fig. 1)

*Haliotis (Sulculus) quinquecentenaris* Lozano-Francisco & Vera-Peláez, 2002: 159, pl. 1 figs A-E.

Material and dimensions. — Maximum height 28.9 mm, maximum diameter 88.9 mm (incomplete). NHMW 2019/0167/0057 CO (1).

Discussion. — *Haliotis quinquecentenaris* (Lozano-Francisco & Vera-Peláez, 2002) is characterised by its very large size, relatively rounded and high-arched shell and much reduced spiral sculpture, so that the surface is almost smooth. It is about the same size as *H. iberica* Landau, Marquet & Grigis, 2003, another endemic species from the Estepona assemblages, but that species is immediately separated by its strongly rugose spiral sculpture. *H. berti-*

*nii* Forli, Dell'Angelo, Ciappelli & Taviani, 2003 from the lower Pliocene of Italy has fewer even coarser rugose axials than *H. iberica*. It is extremely uncommon to find good specimens of both *H. quinquecentenaris* and *H. iberica* in the Estepona deposits, but this might be taphonomic bias due to their large size and fragility (Geiger & Groves, 1999). Fragments are more common.

We have argued that in this Pliocene tropical setting, upwelling of nutrient-rich cooler waters occurred in the Estepona area (Landau & Silva, 2006a; Silva et al., 2006). The presence of these two large shelled *Haliotis* further strengthen this argument, as Estes et al. (2005) found that large-bodied abalones occur exclusively in cold-water ecosystems dominated by kelps and other macroalgae.

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain (Lozano-Francisco & Vera-Peláez, 2002).

### Family Fissurellidae Fleming, 1822

#### Subfamily Zeidorinae Naef, 1913

#### Genus *Puncturella* Lowe, 1827

*Puncturella* Lowe, 1827: 77. Type species (by monotypy): *Patella noachina* Linnaeus, 1771. Present-day, Europe.

#### *Puncturella granulata* (Seguenza, 1863)

(Figs 2-3)

*Rimula granulata* Seguenza, 1863: 88, pl. 5 fig. 6.

*Puncturella* (*Cranopsis*) *granulata* (Seguenza) — Watson, 1886: 46, pl. 4 fig. 5.

*Puncturella watsoni* Dall, 1889: 403.

*Puncturella* (*Cranopsis*) *granulata* Seguenza — Dautzenberg & Fischer, 1896: 491; Dautzenberg & Fischer, 1897: 180; Pérez Farfante, 1947: 124, pl. 54 figs 4-7.

*Rimula granulata* G. Seguenza — Micali & Villari, 1989: 81, pl. 1 figs 1-4.

*Puncturella* (*Cranopsis*) *granulata* (Seguenza) — Corselli & Bernocchi, 1993: 110, pl. 1 fig. 1.

Material and dimensions. — Maximum height 2.3 mm, maximum diameter 4.4 mm. NHMW 2019/0167/0001-0002 CO (2).

Discussion. — The specimens illustrated here fit within the variability of *P. granulata* (Seguenza, 1863), as illustrated by Pérez Farfante (1947, pl. 54 figs 4-7). *Cranopsis* A. Adams, 1860 was synonymised with *Puncturella* Lowe, 1827 by Cunha et al. (2019: 261). The species is variable in height, and is characterised by its fine sculpture consisting of close-set concentric threads and riblets, short narrow slit widening and rounded apically, and shelf-like internal septum.

This species seems rare throughout its range and rarely recorded. For further discussion see Micali & Villari (1989) and Corselli & Bernocchi (1993).

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper); central Mediterranean, Italy (Seguenza, 1863; Corselli & Bernocchi, 1993).

Lower Pleistocene: central Mediterranean, Italy (Micali & Villari, 1989). Present-day: Eastern Atlantic, Azores (Dautzenberg & Fischer, 1896, 1897), Western Atlantic, Florida Keys to West Indies (Pérez Farfante, 1947).

### Subfamily Rimulinae Anton, 1838

#### Genus *Rimula* Defrance, 1827

*Rimula* Defrance, 1827: 472. Type species (by subsequent designation of Gray, 1847b: 147): *Emarginula blainvillii* Defrance, 1824. Eocene, France.

#### *Rimula lobilloensis* spec. nov.

(Figs 4-5)

Type material. — Holotype NHMW 2019/0167/0003 height 1.7 mm, maximum diameter 4.6 mm (Fig. 4); paratype 1 NHMW 2019/0167/0004; height 1.8 mm, maximum diameter 4.8 mm (Fig. 5).

Other material. — Known from type series only.

Type locality. — El Lobillo, Estepona, Andalusia, S. Spain.

Type stratum. — Lower Piacenzian, upper Pliocene.

Eymology. — Named after the type locality of El Lobillo in Estepona, southern Spain. *Rimula* gender feminine.

Diagnosis. — *Rimula* species of small size, elongate-ovate, low convex profile, finely sculptured by weak riblets and concentric lamellae, apex placed about one-fifth of shell length behind posterior margin.

Description. — Shell small, patelliform, ovate-elongate, thin, dorsum depressed convex with strongly recurved apex placed one-fifth of shell length behind posterior margin. Anterior slope 4/5 shell length convex, posterior slope straight to slightly concave. Apical whorl 1-1.25 laterally compressed whorls. Selenizone bearing raised comma-shaped lamellae, open mid third of its length, foramen rounded apically, pointed abapically. Sculpture of fine close-set axial riblets, crossed by even finer concentric lamellae. Internally smooth, glossy, no septum.

Discussion. — On interior view there is no septum, placing this species in the genus *Rimula* Defrance, 1827 (Simone & Cunha, 2014: 452). The most similar species is *R. frenulata* (Dall, 1899) from the present-day Florida Keys and Caribbean, which is also small, with fine sculpture, but that species differs in being even more elongate and the apex is

placed closer to, and in some specimens overhangs, the posterior edge.

The specimen described as *R. fusifissura* Lozano-Francisco & Vera-Peláez, 2002 does not seem to have a selection zone and the apex is subcentrally positioned, and might represent a juvenile *Diodora* in its 'Rimula' stage.

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain.

**Family Calliostomatidae Thiele, 1924 (1847)**  
**Subfamily Calliostomatinae Thiele, 1924 (1847)**  
**Genus *Calliostoma* Swainson, 1840**

*Calliostoma* Swainson, 1840: 218, 351. Type species (by subsequent designation of Herrmannsen, 1846: 154): *Trochus conulus* Linnaeus, 1758. Present-day, Europe.

***Calliostoma spongiarum***  
**(Bucquoy, Dautzenberg & Dollfus, 1885)**  
 (Figs 6-7)

*Trochus dubius* var. *spongiarum* Bucquoy, Dautzenberg & Dollfus, 1885: 353, pl. 42 figs 8-9.

*Calliostoma* (*Calliostoma*) *laugieri spongiarum* (B.D.D.) — Giannuzzi-Savelli et al., 1994: 62, figs 140-142.

*Calliostoma* (*Calliostoma*) *subexcavatum* (S. Wood) — Muñiz Solís, 1996: 6, figs 2G-I [non *Calliostoma subexcavatum* (S.V. Wood, 1848)].

Material and dimensions. — Maximum height 14.5 mm, width 12.9 mm. NHMW 2019/0167/0053-0054 CO (9).

Discussion. — With better preserved material from the Estepona assemblages now available, we consider the species identified by Muñiz Solís (1996) as *C. subexcavatum* (S.V. Wood, 1848) not to be that species, but to represent *C. spongiarum* (Bucquoy, Dautzenberg & Dollfus, 1885). *Calliostoma spongiarum* was considered by Giannuzzi-Savelli et al. (1994: 62, 63) a subspecies of *C. laugieri* (Payraudeau, 1826). At that time *C. spongiarum* seemed to be endemic

to the Gulf of Gabes (Tunisia). Since then specimens have been collected from the Stagnone di Marsala (Trapani, Sicily) and from other places in the Tyrrhenian Sea, so that today those authors consider them distinct species (Giannuzzi-Savelli, personal communication BL, 2019). However, this position is not accepted by all, and *C. spongiarum* is considered a dubious synonym of *C. laugieri* by WoRMS (MolluscaBase, 2019d). In the original description the early whorls of *C. spongiarum* are described as smooth, but we figure for comparison an extant specimen from Civitavecchia (Italy) (Fig. 7), which also has slightly granular early teleoconch whorls. Colour pattern is preserved in the Estepona specimen, similar to that seen in the present-day shell illustrated. We are not aware of any recent revision of the Mediterranean calliostomids, and provisionally consider *C. spongiarum* as a valid taxon. This is the first fossil record for the species. *Calliostoma* (*Calliostoma*) cf. *subexcavatum* (S.V. Wood, 184) illustrated in Landau et al. (2003: 56, pl. 12 fig. 4), also from the Estepona deposits, has more granular sculpture than *C. spongiarum*.

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain (Muñiz Solís, 1996; Landau et al., 2003). Present-day: central Mediterranean (Giannuzzi-Savelli et al., 1994).

**LANDAU, B.M., MARQUET, R. & GRIGIS, M., 2004a. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 2: Orthogastropoda, Neotaenioglossa. — *Palaeontos* 4: 1-108, pls 1-20.**

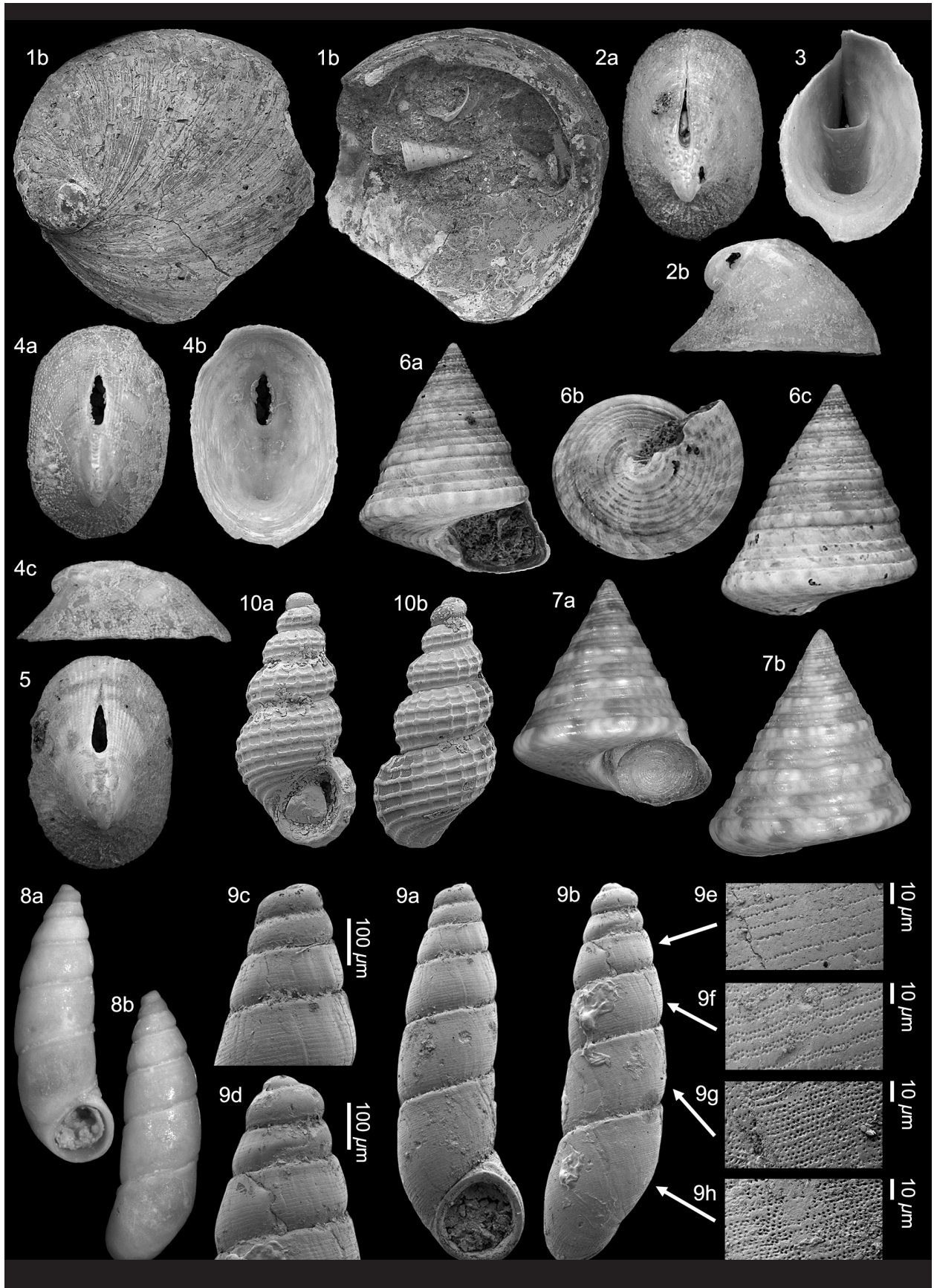
p. 5-10 In our opinion, all species placed in *Cerithium* (*Thericium*) should be placed in *Thericium*; see Landau et al. (2013: 40). We are not aware of any molecular data yet available to support this position.

p. 15 *Turritella erronea* Cossmann in Friedberg, 1914 (pl. 2 figs 9-10; pl. 3 fig. 5) = *Archimediella abundans* (Handmann 1882); see Harzhauser & Landau (2019: 26). The Estepona specimens have fine secondary spiral sculpture similar to that illustrated by Harzhauser & Landau (2019: 23, fig. 10F). This species

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> **Figs 1-10.** Recent and fossil gastropods (Figs 1-6, 8 and 10 are from Estepona, Spain, lower Piacenzian, upper Pliocene). **Fig. 1.** *Haliothis quinquecentenaris* (Lozano-Francisco & Vera-Peláez, 2002), NHMW 2019/0167/0057, height 28.9 mm, maximum diameter 88.9 mm, Velerín conglomerates. **Figs 2-3.** *Puncturella granulata* (Seguenza, 1863). **2.** NHMW 2019/0167/0001, height 2.3 mm, maximum diameter 4.4 mm, Velerín conglomerates. **3.** NHMW 2019/0167/0002, height 2.1 mm, maximum diameter 4.2 mm, Velerín conglomerates. **Fig. 4-5.** *Rimula lobilloensis* spec. nov. **4.** Holotype NHMW 2019/0167/0003, height 1.7 mm, maximum diameter 4.6 mm, El Lobillo. **5.** Paratype 1 NHMW 2019/0167/0004, height 1.8 mm, maximum diameter 4.8 mm, El Lobillo. **Figs 6-7.** *Calliostoma spongiarum* (Bucquoy, Dautzenberg & Dollfus, 1885). **6.** NHMW 2019/0167/0053, height 11.7 mm, width 9.7 mm, Velerín conglomerates. **7.** Height 10.4 mm, width 8.7 mm, Civitavecchia, Rome, Italy, present-day (coll. Attilio Pagli, photographs Andrea Nappo). **Figs 8-9.** *Pelycidion posticum* (Gougerot, Fekih & Le Renard, 1977). **8.** NHMW 2019/0167/0005, height 1.5 mm, width 440 µm, Velerín conglomerates. **9.** NHMW 2018/0331/0100, height 1.3 mm, width 410 µm, Vale de Freixo, Pombal, central-west Portugal, lower Piacenzian, upper Pliocene (SEM image). **Fig. 10.** *Alvania* sp., NHMW 2019/0167/0007, height 2.2 mm, width 1.0 mm, Velerín conglomerates (SEM image).

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forms part of the relict fauna found in the Estepona assemblages.

- p. 17 *Turritella spirata* (Brocchi, 1814) (pl. 2 fig. 11; pl. 3 fig. 7) = *Oligodia spirata* (Brocchi, 1814); see Harzhauser & Landau (2019: 54).
- p. 19 *Turritella tornata* (Brocchi, 1814) (pl. 2 fig. 12; pl. 3 fig. 8) = *Helminthia tornata* (Brocchi, 1814).
- p. 19 *Turritella tricarinata* (Brocchi, 1814) (pl. 2 fig. 13; pl. 3 fig. 9) = *Turritellinella tricarinata* (Brocchi, 1814); see Harzhauser & Landau (2019: 74).
- p. 21 *Turritella unicarinata* (Cerulli-Irelli, 1912) (pl. 3 figs 1, 6) = *Oligodia unicarinata* (Cerulli-Irelli, 1912).
- p. 21 *Turritella varicosa* (Brocchi, 1814) (pl. 3 figs 1, 10) = *Oligodia varicosa* (Brocchi, 1814).
- p. 22 *Turritella vermicularis* (Brocchi, 1814) (pl. 3 figs 3, 11) = *Helminthia vermicularis* (Brocchi, 1814); see Landau et al. (2013: 62).
- p. 28 *Serpulorbis arenaria* (Linnaeus, 1758) (pl. 3 fig. 17) = *Tylacodes aenarius* (Linnaeus, 1758); see Bieler & Petit (2010: 185).
- p. 41 *Alvania fariai* Rolán & Fernandes, 1990 (pl. 7 figs 3-4). This species was placed in the genus *Galeodinopsis* Sacco, 1895 by Garilli (2008), and considered a junior subjective synonym of *Galeodinopsis tiberiana* (Coppi, 1876); see Garilli (2008: 43). However, this synonymy has not been adopted by WoRMS (MolluscaBase, 2019e).
- p. 46 *Alvania* sp. 1 (pl. 10 fig. 3) = ?*Alvania magistra* Chirli, 2006; although there is some difference in the protoconch microsculpture between the Spanish and Italian shells; see Chirli (2006: 25, pl. 11 figs 13-16; pl. 12 figs 1-8).
- p. 63 *Strombus* (*Strombus*) *coronatus* Defrance, 1827 (pl. 14 fig. 6) = *Persististrombus coronatus* (Defrance, 1827); see Harzhauser & Kronenberg (2013).
- p. 75 *Macromphalus* cf. *brandenburgi* (O. Boettger, 1907) (pl. 16 figs 2, 3e) = *Cymenorytis landaui* Sosso, Dell'Angelo & Bonfitto, 2013; see Sosso et al. (2013: 160) and Tabanelli (2018).

#### Superfamily Cerithioidea Fleming, 1822

##### Family Pickworthiidae Iredale, 1917

##### Subfamily Pelycidiinae Ponder & Hall, 1983

##### Genus *Pelycidion* P. Fischer, 1873

*Pelycidion* P. Fischer, 1873: 182. Type species (by monotypy): *Pelycidion venustulum* P. Fischer, 1873. Present-day, West Africa.

##### *Pelycidion posticum* (Gougerot, Fekih & Le Renard, 1977)

(Figs 8-9)

*Allixia acicularis postica* Gougerot, Fekih & Le Renard, 1997: 43, figs 4a-b.

*Pelycidion posticum* (Gougerot, Fekih & Le Renard) — Ceregato et al., 2004: 110, figs 1a-c, 2a-c.

Material and dimensions. — Height 1.5 mm, width 440 µm. NHMW 2019/0167/0005 CO (1).

Discussion. — We record this species from the lower Piacenzian Mediterranean Estepona Basin (Fig. 8) and the Atlantic Mondego Basin. It is likely that this species is quite widespread in the Mediterranean and adjacent Atlantic, but has escaped detection due to its minute size. *Pelycidion posticum* (Gougerot, Fekih & Le Renard, 1977) was fully discussed by Ceregato et al. (2004). The protoconch sculpture and teleoconch sculpture of spiral threads is somewhat worn in the Estepona specimen, but well preserved in the Portuguese fossil shell (Fig. 9).

Distribution. — Upper Pliocene: Atlantic, Mondego Basin, Portugal (this paper); western Mediterranean, Estepona Basin, Spain (this paper); central Mediterranean, Italy (Ceregato et al., 2004), Tunisia (Gougerot et al., 1977).

#### Superfamily Rissoidae Gray, 1847

##### Family Rissoidae Gray, 1847

##### Genus *Alvania* Risso, 1826

*Alvania* Risso, 1826: 140. Type species (by subsequent designation of Nevill, 1885: 105): *Alvania europea* Risso, 1826 (= *Turbo cimex* Linnaeus, 1758). Present-day, Mediterranean.

##### *Alvania* sp.

(Fig. 10)

Material and dimensions. — Maximum height 2.7 mm, width 1.3 mm. NHMW 2019/0167/0007-0008 CO (2).

Discussion. — Unfortunately, the two specimens available are somewhat worn, and the protoconch surface microsculpture is abraded, making them unsuitable for formal description. They represent a small, slender *Alvania* species composed of four convex whorls, with cancellate sculpture, the spiral element predominant, about 18 ribs and six cords on the penultimate whorl, with small tubercles developed at the intersections. Fine spiral microsculpture of threads present in the intersections. The protoconch is paucispiral, composed of about 1.5 whorls and sharply delimited from the teleoconch. Although the surface is mostly abraded, an irregular row of micropustules is preserved a short distance above the suture.

They are most similar in size and sculpture to *Alvania testae* (Aradas & Maggiore, 1844) that was recorded from the Estepona assemblage (Landau et al., 2004: 43, pl. 9 fig. 1), but they are more slender and the axial ribs are prosocline instead of strongly opisthocline, as seen in *A. testae*. We await better preserved material to more accurately characterise this species.

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper).

### Genus *Peringiella* Monterosato, 1878

*Peringiella* Monterosato, 1878: 87, 114. Type species (by subsequent designation of Bucquoy, Dautzenberg & Dollfus, 1884: 312): *Rissoa laevis* Monterosato, 1878 (non J. de C. Sowerby, 1829) = *Peringiella denticulata* Ponder, 1985. Present-day, Mediterranean.

#### *Peringiella* cf. *denticulata* Ponder, 1985

(Fig. 11)

*Peringiella denticulata* Ponder, 1985: 62 (nom. nov. pro *Rissoa laevis* Monterosato, 1878, non Sowerby, 1829).

*Peringiella denticulata* Ponder — Giannuzzi-Savelli et al., 1997: 80, figs 148, 149.

*Peringiella denticulata* Ponder — Chirli, 2006: 44, pl. 20 figs 14-16.

**Material and dimensions** – Maximum length 2.6 mm, width 1.2 mm. NHMW 2019/0167/0055-0056 EL (4).

**Discussion.** — The specimen illustrated here is closely similar to *P. denticulata* Ponder, 1985 from the present-day Mediterranean. However, we hesitate to synonymise it as none of the four specimens from Estepona have denticles within the outer lip, typical for this species. We note that Chirli (2006: 44, pl. 20 figs 14-16) recorded this species from the lower Pliocene of Italy and described the inside of the outer lip as smooth. Indeed, like the Estepona specimen, no denticles are seen in the figured specimen from Italy. It is possible that these shells represent a closely related edentate Pliocene species, but we have insufficient material to come to a firm conclusion.

**Distribution.** — Lower Pliocene: central Mediterranean, Italy (Chirli, 2006). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper).

### Superfamily Truncatelloidea Gray, 1840

#### Family Caecidae Gray, 1850

#### Subfamily Caecinae Gray, 1850

#### Genus *Caecum* Fleming, 1813

*Caecum* Fleming, 1813: 67. Type species (by subsequent designation of Gray, 1847b: 203): *Dentalium trachea* Montagu, 1803 = *Dentalium imperforatum* Kanmacher, 1798. Present-day, temperate Europe.

#### *Caecum auriculatum* de Folin, 1868

(Fig. 12)

*Caecum auriculatum* de Folin, 1868: 94, pl. 11 figs 2-3.

*Brochina Chiereghiniana* Brusina, 1869: 248.

*Caecum syriacum* de Folin, 1869: 114; pl. 11 figs 7-8.

*Brochina decurtata* Monterosato, 1884: 23.

*Caecum auriculatum* de Folin — Fekih, 1975: 97, pl. 30 fig. 18; van Aartsen, 1977: 8, figs 1-3, 10-12; Panetta, 1980: 285, pl. 2 fig. 2; van der Linden, 1986: 405, text-fig. 6; Porta et al., 1993: pl. 3 fig. 8; Ruggieri, 1994: 1, figs 1-4; Pizzini et al., 1995: 79, figs 1-17.

*Caecum crispum* Cerulli-Irelli, 1912 — Chirli, 1995: 22, pl. 1 fig. 2 [non Cerulli-Irelli, 1912; junior homonym of *C. crispum* Verrill & Bush, 1900].

*Caecum auriculatum* de Folin — Giannuzzi-Savelli et al., 1997: 122, fig. 533; Chirli, 2006: 60 pl. 26 figs 9-14; Brunetti & Cresti, 2018: 48, fig. 117.

**Material and dimensions.** — Length 3.0 mm, width 710 µm. NHMW 2019/0167/0006 CO (1).

**Discussion.** — This species is characterised by its regularly cylindrical, regularly arched tube-like shell, which is smooth, lacking any sculpture. The septum is hemispherical, more or less protruding, with an ear-like projection on the dextral side. In fully grown specimens a poorly delimited annulus encircles the aperture. *Caecum glabrum* (Montagu, 1803) differs in having a completely round septum, without the ear-like projection seen in *C. auriculatum* de Folin, 1868. *Caecum subannulatum* de Folin, 1870 differs in being more slender, in having faint annular sculpture and a stronger annulus around the aperture. *Caecum auriculatum* is extremely uncommon in the Estepona assemblages.

**Distribution.** — Lower Pliocene: central Mediterranean, Italy (Chirli, 1995, 2006); central Mediterranean, Tunisia (Fekih, 1975). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper); central Mediterranean, Italy (Brunetti & Cresti, 2018). Pliocene (indeterminate): central Mediterranean, Italy (Ruggieri, 1994). Lower Pleistocene: central Mediterranean, Italy (Ruggieri, 1994). Upper Pleistocene: western Mediterranean, Spain (Porta et al., 1993). Present-day: Atlantic, NW France to southern Portugal (van der Linden, 1986), Mediterranean (Pizzini et al., 1995).



**Family Vitrinellidae Bush, 1897****Genus *Circulus* Jeffreys, 1865**

*Circulus* Jeffreys, 1865: 315. Type species (by monotypy): *Delphinula duminyi* Requier, 1848 (= *Valvata striata* Philippi, 1836). Present-day, Mediterranean.

***Circulus striatus* (Philippi, 1836)**

(Figs 13-15)

*Valvata striata* Philippi, 1836: 137, pl. 9 fig. 3.

*Circulus striatus* (Philippi) — Landau et al., 2018: 307, pl. 135 figs 1-3 (cum syn.).

Material and dimensions. — Maximum diameter 3.8 mm, height 1.5 mm. NHMW 2019/0167/0048-50 EL (3), NHMW 2019/0167/0051 EL (8).

Discussion. — Landau et al. (2003: 58) stated that *C. striatus* (Philippi, 1836) did not occur in the Estepona deposits. This was a *lapsus*, as specimens were at hand, but only from El Lobillo. Oliver & Rolán (2011: 13) discussed the spirally striate form *Valvata striata* Philippi, 1836 and the strongly tricarinate form *Adeorbis tricarinatus* S.V. Wood, 1848 and noted that both extremes plus intermediate forms were found together in a small geographical area, and considered them extreme forms of a single species, *Circulus striatus*. As can be seen from the specimens illustrated (Figs 13-15), the same is true in the Estepona assemblage.

Landau et al. (2003: 58) recorded a second species from the Estepona assemblages under the name *C. miotaurinensis* (Sacco, 1896) (Fig. 16). Despite the enormous variability in both shape and sculpture in *C. striatus*, *C. miotaurinensis* in the Estepona assemblage attains a much greater maximum diameter (maximum diameter *C. miotaurinensis* in Estepona 13.2 mm; extant *C. striatus* 2.75 mm; *vide* Fretter & Graham, 1978: 227). The keels are much stronger and, importantly, specimens of *C. striatus* we have seen with a strong basal keel have three keels developed, whereas in *C. miotaurinensis* only the peripheral and basal keels are present, the dorsal shoulder keel is absent. Lastly, the umbilicus is broader and delimited by a slightly thickened periumbilical cord.

Distribution. — Upper Miocene: Atlantic (Tortonian), NW France (Landau et al., 2018). Lower Pliocene: North Sea Basin, Coralline Crag, England (Wood, 1848; Harmer, 1923), Kattendijk Formation, Belgium (Glibert, 1957; Marquet, 1997, 1998); Atlantic, Guadalquivir Basin, Spain (González-Delgado, 1985; Landau et al., 2011); western Mediterranean: eastern Spain (Almera & Bofill, 1898; Martinell, 1980); central Mediterranean, Italy (Pavia, 1976; Chirli, 2006). Upper Pliocene: Mondego Basin, Portugal (Silva, 2001); western Mediterranean, Estepona Basin, Spain (this

paper); central Mediterranean, Italy (Cavallo & Repetto, 1992; Ferrero et al., 1998). Lower Pleistocene: North Sea Basin, The Netherlands (van Regteren Altena et al., 1954); central Mediterranean, Italy (Cerulli-Irelli, 1916). Present-day: eastern Atlantic frontage coasts of Ireland, into Mediterranean (Fretter & Graham, 1978).

***Circulus supranitidus* (S.V. Wood, 1842)**

(Fig. 17)

*Adeorbis supra-nitidus* S.V. Wood, 1842: 530.

*Circulus supranitidus* (Wood) — Landau et al., 2013: 87, pl. 7 fig. 8, pl. 60 fig. 6 (cum syn.).

Material and dimensions. — Maximum height 1.3 mm, maximum diameter 3.3 mm. NHMW 2019/0167/0009-0010 EL (2).

Discussion. — *Circulus supranitidus* (S.V. Wood, 1842) is characterised by its total lack of spiral sculpture, apart from the peripheral and basal keels and umbilical cords. Other eastern Atlantic species with reduced spiral sculpture are *C. pseudopraecedens* Adam & Knudsen, 1969, from West Africa (Senegal to Angola), which differs in having an upper keel delimiting the shoulder and *C. senegalensis* Adam & Knudsen, 1969, also from West Africa (Western Sahara to Angola), which has an evenly rounded last whorl, with the keels hardly or not developed (see Oliver & Rolán, 2011).

In the European fossil record the most similar species is *C. gliberti* (Janssen, 1967) from the lower-middle Miocene North Sea Basin. It was originally described as a subspecies of *C. praecedens* (von Koenen, 1882), from which differs, like the Estepona species, in not having a strong upper keel delimiting the shoulder. Subspecific status is not possible as both occur in the Dingden assemblage. Specimens of *C. gliberti* at hand from the Miocene of Miste (The Netherlands) differ in being much smaller than the Estepona species (maximum width about 3.0 mm), the protoconch whorls are more elevated, the teleoconch whorls are more depressed immediately below to the suture, the peripheral and basal keels on the last whorl are much weaker, and the umbilicus wider and not sharply delimited by a strong periumbilical cord as in *C. supranitidus*. *Circulus gynospira* (Cossmann & Peyrot, 1916) from the Atlantic middle Miocene Serravallian Aquitaine Basin of France also lacks spiral sculpture, but differs from *C. supranitidus* in not having a peripheral keel, the basal keel is much weaker, and there are more numerous but weaker umbilical cords. *Circulus planorbillus* (Dujardin, 1837) from the Atlantic middle Miocene Aquitaine and Loire basins of France also lacks spiral sculpture, but differs in having well developed upper, peripheral and basal keels and the umbilical cords are

weaker. Landau et al. (2013: 85) recorded this species from the middle Miocene eastern Proto-Mediterranean of Turkey. It is likely that this species has a wider distribution, but has seldom been recognised.

Distribution. — Middle Miocene: Proto-Mediterranean (Serravallian), Karaman Basin, Turkey (Landau et al., 2013). Lower Pliocene: Atlantic, North Sea Basin, England (Wood, 1842, 1848; Harmer, 1923). Upper Pliocene: Atlantic, North Sea Basin, England (Harmer, 1923), Belgium (Glibert, 1957; Marquet, 1997, 1998); western Mediterranean, Estepona Basin, Spain (this paper).

### Superfamily Vanikoroidea Gray, 1840

#### Family Vanikoridae Gray, 1840

#### Genus *Macromphalina* Cossmann, 1888

*Macromphalina* Cossmann, 1888: 184. Type species (by original designation): *Sigaretus problematicus* Deshayes, 1864. Middle Eocene, France.

#### *Macromphalina alinemulderae* spec. nov.

(Fig. 18)

Type material. — Holotype NHMW 2019/0167/0011, maximum diameter 5.0 mm, height 1.6 mm.

Type locality. — Velerín Carretera, Estepona, Andalusia, S. Spain.

Type stratum. — Lower Piacenzian, upper Pliocene.

Etymology. — Named after Aline Mulder, sister of the second author *Macromphalina* gender feminine.

Diagnosis. — *Macromphalina* species with multispiral protoconch strongly deviated from main shell axis, flattened teleoconch whorls with fine crowded spiral threads, axial sculpture reduced to growth lines, umbilicus wide, poorly delimited.

Description. — Shell small, depressed auriculiform. Protoconch mammillate, multispiral, tall, strongly deviated from main axis of shell, surface abraded: no sculpture preserved. Transition with teleoconch abrupt. Teleoconch consisting of 1.5 rapidly expanding strongly depressed whorls, with periphery at abapical suture. Suture linear, deeply impressed. Sculpture of close-set axial growth lines and extremely fine crowded subequal spiral threads. Last whorl strongly depressed, with roundly angled periphery, base evenly rounded, bearing wide, poorly delimited umbilicus, sculpture similar to dorsum. Aperture wide. Outer lip thin, greatly expanded, strongly rounded in profile. Columella straight, hardly thickened.

Discussion. — A single beautifully preserved specimen from the Velerín carretera deposit is here described as *M. alinemulderae* spec. nov. It has some affinity with

the extant West African species *M. dautzenbergi* Adam & Knudsen, 1969, which also has a deviated mammillate protoconch, but differs in being more depressed and in having even finer spiral sculpture. Moreover, the axials in that species are stronger, making the dorsum somewhat rugose. *Macromphalina bouryi* (Dautzenberg, 1912), also from West Africa, is similar in teleoconch sculpture, but has a less depressed shell and the protoconch, which is more strongly sculptured, is only slightly tilted in relation to the teleoconch axis. *Micromphalina gofasi* Rubio & Rolán, 1994 from Angola differs from both of the above in having strong spiral sculpture. Two congeners occur in the Estepona assemblages; *M. depressa* (Boettger, 1907) has coarse predominantly spiral sculpture and *M. plioastensis* (Sacco, 1898) has strongly predominant axial sculpture. In neither of these species is the protoconch as strongly tilted as it is in *M. dautzenbergi*.

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper).

**LANDAU, B.M., BEU, A. & MARQUET, R., 2004b. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 5: Tonnoidea, Ficoidea. — *Palaeontos* 5: 35-102, pls 1-10.**

p. 55-62 All species placed in *Cymatium* (*Monoplex*) placed in *Monoplex* Perry, 1811. Raised to full genus level by Beu (2010: 142).

p. 69 *Bufonaria* (*Aspa*) *marginata* (Gmelin, 1791) (pl. 5 figs 6-7; pl. 10 fig. 2) = *Aspa marginata*; see Beu (2010: 65).

**LANDAU, B.M., PETIT, R.E. & MARQUET, R., 2006b. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 12. Cancellariidae. — *Palaeontos* 9: 61-101, pls 1-9.**

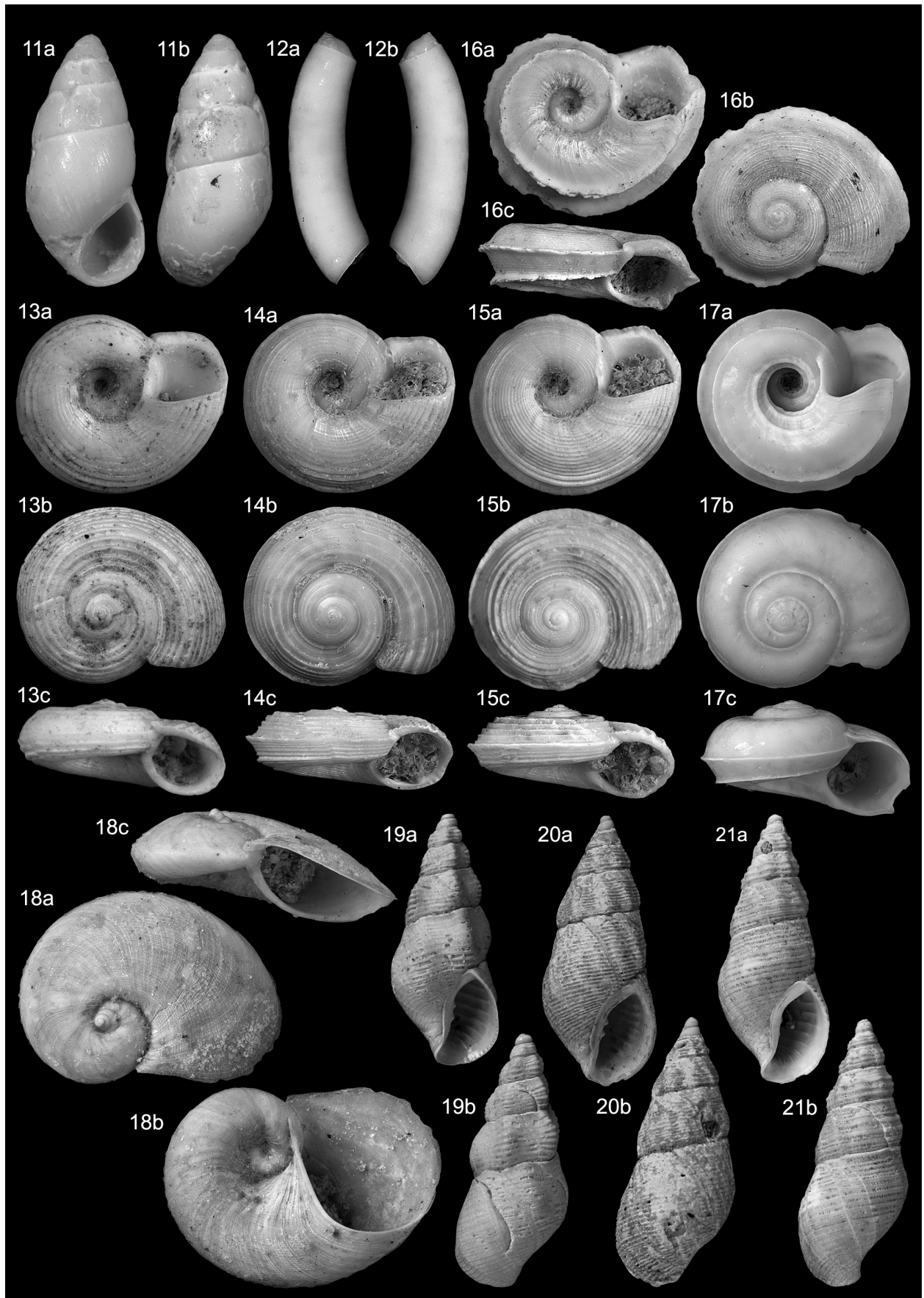
p. 63 *Cancellaria* (*Bivetiella*) *cancellata* (Linnaeus, 1767) (pl. 1 figs 1-2) = *Bivetiella cancellata* (Linnaeus, 1767); see Verhecken (2007: 295), Brunetti et al. (2011: 88).

p. 65 We note that Brunetti et al. (2008) recognised two sympatric species within *Contortia* in both the Italian and Spanish Pliocene; *Contortia italica* (D'Ancona, 1872) (Landau et al., 2006b, pl. 1 fig. 7; pl. 2 fig. 2) and *Contortia strictoturrita* (Sacco, 1894) (Landau et al., 2006b, pl. 1 figs 4-6, 8-9; pl. 2 fig. 3).

p. 68 *Trigonostoma* (*Ventrilia*) *imbricatum* (Hörnnes, 1854) (pl. 4 figs 7-8) = *Scalptia etrusca* Brunetti, Della Bella, Forli & Vecchi, 2008; see Brunetti et al. (2008: 52).

p. 77 *Sveltia varicosa* (Brocchi, 1814) (pl. 6 figs 3-4) = *Sveltia confusa* Brunetti, 2016; see below.

p. 79 *Sveltia tribulus* (Brocchi, 1814) (pl. 6 figs 5-8).



- According to Brunetti et al. (2006) the Estepona specimens do not represent that species. Those authors recognised two species within the Spanish Pliocene; *Tribia latefasciata* (Sacco, 1894) (Landau et al., 2006b, pl. 6 fig. 7) and *T. hispanica* Brunetti, Forli & Vecchi, 2006 (Landau et al., 2006b, pl. 6 figs 5-6). The same species was described as *T. pliogeometrica* Lozano-Francisco & Vera-Peláez, 2006 in the same year. Bollettino Malacologico 2006 volume 42(5-8), the middle numbers, usually published mid-year, was delayed. On the back cover of the issue last line of text reads “Finito di stampare il 30 settembre 2006”. On the front cover last line of text reads “Dicembre 2006 spedizione n. 1/2007”. According to the editor of the Bollettino Malacologico the date of September on the back cover may be incorrect, the December date on the front cover is correct (Paolo Crovato, personal communication BL, 01/02/2020). Pliocenica 2006 volume 5 was also published in December (front cover under journal name). Neither journal gives a day of publication. According to the ICZN Code (21.3.1; 1999) if the day is not specified, the last day of the month should be taken as the publication date. The paper by Lozano-Francisco & Vera-Peláez was not submitted to the journal until the 19<sup>th</sup> October, 2006 and accepted 30<sup>th</sup> November 2006 (2006: 105). The paper by Brunetti et al. (2006: 57, bottom right hand corner page) was received on March 23, 2006 and was accepted on October 25, 2006. Therefore, accepted before Lozano-Francisco & Vera-Peláez was submitted. Acting as first revisor (ICZN, 1999 Article 24.2.2) we therefore consider *T. hispanica* Brunetti, Forli & Vecchi, 2006 the valid name and *T. pliogeometrica* Lozano-Francisco & Vera-Peláez, 2006 a junior subjective synonym.
- p. 81 *Brocchinia tauroparva* Sacco, 1894 (pl. 7 figs 5-6) = *Brocchinia subanodosa* Sacco, 1894. Brunetti et al. (2011) recognised three species within the Italian Pliocene. Two have closely similar teleoconch characters; *B. depressiplicata* Sacco, 1894 with a protoconch of two whorls, *B. subanodosa* with a protoconch of 2.75 whorls, and the third *B. crassinodosa* Sacco, 1894, with a protoconch of 2.5 whorls, smaller, with strong axial ribs. With the additional material in the HM coll., all three forms can be recognised in the Pliocene of Estepona. In order to clarify the synonymy, below we give a revised chresonymy for all three species.
- p. 86 *Babylonella fusiformis* (Cantraine, 1835) (pl. 9 figs 1-4) = *Pseudobabylonella fusiformis* (Cantraine, 1835); see Brunetti et al. (2009: 65). We note that Brunetti et al. (2009) recognised three species in the Italian Pliocene and attributed the Estepona specimens to *P. subangulosa* (S.V. Wood, 1848) (pl. 9 fig. 1) and *P. applicata* Brunetti, Della Bella, Forli & Vecchi, 2009 (pl. 9 figs 2-3). We prefer to consider these forms a single variable species; see Van Dingenen et al., 2017: 42-43).
- p. 88 *Admete* (s.l.) *dregeri* (Hoernes & Auinger, 1890) (pl. 9 figs 5-7) = *Cancellicula dregeri* (Hoernes & Auinger, 1890); see Brunetti et al. (2009: 75).

**Family Cancellariidae Forbes & Hanley, 1851**  
**Subfamily Cancellariinae Forbes & Hanley, 1851**  
**Genus *Brocchinia* Jousseau, 1887**

*Brocchinia* Jousseau, 1887: 221. Type species (by monotypy): *Voluta mitraeformis* Brocchi, 1814. Pliocene, Italy.

***Brocchinia crassinodosa* Sacco, 1894**  
 (Fig. 19)

*Brocchinia crassinodosa* Sacco, 1894: 70, pl. 3 fig. 90.  
*Narona* (*Brocchinia*) *crassinodosa* Sacco — Inzani, 1993: 83, pl. 3 fig. 13.  
*Brocchinia crassinodosa* Sacco — Ferrero-Mortara et al., 1984: 178, pl. 33 fig. 7; Brunetti & Vecchi, 2005: 21, pl. 8 fig. 1; Brunetti et al., 2011: 123, figs 21A-E, 22E-F.

< **Figs 11-21.** Gastropods of Estepona, Spain, lower Piacenzian, upper Pliocene. **Fig. 11.** *Peringiella* cf. *denticulata* Ponder, 1985, NHMW 2019/0167/0055, length 2.6 mm, width 1.2 mm, El Lobillo. **Fig. 12.** *Caecum auriculatum* de Folin, 1868, NHMW 2019/0167/0006, length 3.0 mm, width 710 µm, Velerín conglomerates. **Figs 13-15.** *Circulus striatus* (Philippi, 1836). **13.** NHMW 2019/0167/0048, height 1.5 mm, maximum diameter 3.7 mm, El Lobillo. **14.** NHMW 2019/0167/0049, height 1.5 mm, maximum diameter 3.8 mm, El Lobillo. **15.** NHMW 2019/0167/0050, height 1.7 mm, maximum diameter 3.7 mm, El Lobillo. **Fig. 16.** *Circulus miotaurinensis* (Philippi, 1836), NHMW 2019/0167/0052, height 3.0 mm, maximum diameter 8.4 mm, El Lobillo. **Fig. 17.** *Circulus supranitidus* (S.V. Wood, 1842), NHMW 2019/0167/0009, height 1.3 mm, maximum diameter 3.3 mm, El Lobillo, Estepona. **Fig. 18.** *Macromphalina alinemulderae* spec. nov., holotype NHMW 2019/0167/0011, maximum diameter 5.0 mm, height 1.6 mm, Velerín carretera. **Fig. 19.** *Brocchinia crassinodosa* Sacco, 1894, NHMW 2019/0167/0014, height 9.6 mm, width 4.0 mm, Velerín carretera. **Fig. 20.** *Brocchinia depressiplicata* Sacco, 1894, NHMW 2019/0167/0018, height 15.5 mm, width 6.3 mm, El Lobillo. **Fig. 21.** *Brocchinia subanodosa* Sacco, 1894, NHMW 2019/0167/0022, height 11.8 mm, width 4.9 mm, Velerín carretera.

Material and dimensions. — Maximum height 9.6 mm. NHMW 2019/0167/0014-0015 VC (2), NHMW 2019/0167/0016 CO (2), NHMW 2019/0167/0017 EL (2).

Discussion. — *Brocchinia crassinodosa* Sacco, 1894 is characterised by its small size, protoconch of about 2.5 whorls, and teleoconch with seven very strong a broad axial ribs overrun by weak, narrow, regular cords. *Brocchinia subanodosa* Sacco, 1894, with which it co-occurs in the Estepona deposits, is larger, with weaker axial sculpture and stronger spirals. *Brocchinia depressiplicata* Sacco, 1894 from the Italian Pliocene is also larger, has a protoconch of only two whorls, the teleoconch whorls are less convex, with more numerous, but weaker axial ribs.

Distribution. — Upper Miocene: central Proto-Mediterranean, Italy (Sacco, 1894), Lower Pliocene: central Mediterranean, Italy (Brunetti et al., 2011). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper), central Mediterranean, Italy (Inzani, 1993; Brunetti & Vecchi, 2005; Brunetti et al., 2011).

***Brocchinia depressiplicata* Sacco, 1894**

(Fig. 20)

*Voluta mitraeformis* Brocchi, 1814: 645, pl. 15 fig. 13. Junior primary homonym of *Voluta mitraeformis* Lamarck, 1811. *Brocchinia mitraeformis* var. *depressiplicata* Sacco, 1894: 69; pl. 3 fig. 85.

*Brocchinia mitraeformis* var. *laevifasciata* Sacco, 1894: 69; pl. 3 fig. 88.

*Brocchinia mitraeformis* var. *pyramidalis* Sacco, 1894: 70; pl. 3 fig. 89.

*Cancellaria cerithiopsis* Almera & Bofill, 1898: 18, pl. 11 figs 22, 22a.

*Cancellaria* (*Narona*) (*Brocchinia*) *mitraeformis* (Brocchi) — Rossi-Ronchetti, 1955: 266, fig. 142.

*Narona* (*Brocchinia*) *mitraeformis* (Brocchi) — Venzo & Pelosio, 1963: 113, pl. 37 figs 20, 20a, 22, 22a.

*Voluta mitraeformis* Brocchi — Pinna & Spezia, 1978: 169, pl. 68 fig. 1 [non Lamarck, 1811].

*Narona* (*Brocchinia*) *mitraeformis* (Brocchi) — Davoli, 1982: 61 pl. 7, figs 3-6.

*Brocchinia mitraeformis* (Brocchi) — Davoli, 1995: 247, pl. 4 figs 1-2; pl. 6 fig. 3.

*Brocchinia depressiplicata* Sacco — Brunetti et al., 2011: 118, figs 19A-H, 22A-B.

Material and dimensions. — Maximum height 15.5 mm. NHMW 2019/0167/0018-0019 EL (2).

Discussion. — *Brocchinia depressiplicata* Sacco, 1894 is characterised by its protoconch consisting of two whorls, its rather flat-sided spire whorls, low ribs that persist onto the last whorl and fine spiral sculpture. Unfortunately, none

of the specimens from Estepona we attribute to this species have their protoconch intact.

Distribution. — Upper Miocene: central Proto-Mediterranean, Italy (Davoli, 1982, 1995; Brunetti et al., 2011), Lower Pliocene: central Mediterranean, Italy (Sacco, 1894; Venzo & Pelosio, 1963; Brunetti et al., 2011); western Mediterranean, eastern Spain (Almera & Bofill, 1898). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper); central Mediterranean, Italy (Sacco, 1894; Brunetti et al., 2011).

***Brocchinia subanodosa* Sacco, 1894**

(Fig. 21)

*Cancellaria mitraeformis* Broc. — Bellardi, 1841: 16, pl. 1 figs 5-6 (junior primary homonym of *Voluta mitraeformis* Lamarck, 1811).

*Cancellaria mitraeformis* Brocchi — D'Ancona, 1872: 118 [236], pl. 13 fig. 7a-b.

*Brocchinia mitraeformis* Sacco, 1894: 68; pl. 3 fig. 81.

*Brocchinia mitraeformis* var. *subanodosa* Sacco, 1894: 69; pl. 3 fig. 83.

*Brocchinia mitraeformis* var. *anodosomagna* Sacco, 1894: 69; pl. 3 fig. 84.

*Brocchinia mitraeformis* var. *paucicostellata* Sacco, 1894: 69; pl. 3 fig. 86.

*Brocchinia mitraeformis* var. *subasaturata* Sacco, 1894: 69; pl. 3 fig. 87.

*Brocchinia mitraeformis* (Brocchi) — Cossmann, 1899: 19, pl. 1 fig. 22.

*Narona* (*Brocchinia*) *mitraeformis* (Brocchi) — Pelosio, 1967: 152, pl. 44 figs 7-11.

*Narona* (*Brocchinia*) *pusilla* (Adams, H.) — Malatesta, 1974: 376, pl. 29 fig. 23 [non *Cancellaria pusilla* H. Adams, 1869 (= *Brocchinia canariensis* Rolán & Hernández, 2009); junior primary homonym of *Cancellaria pusilla* G.B. Sowerby I, 1832].

*Brocchinia tauroparva* Sacco — Cavallo & Repetto, 1992: 124, fig. 325 (non Sacco, 1894).

*Narona* (*Brocchinia*) *mitraeformis* (Brocchi) — Inzani, 1993: 83, pl. 3 figs 9, 12-13.

*Brocchinia mitraeformis* (Brocchi) — Vera-Peláez et al., 1995: 159, pl. 4 figs E & H, pl. 6 figs G & H; Silva, 2001: 511, text-fig. 3.176, pl. 22 figs 20-21; Chirli, 2002: 61, pl. 30 figs 7-16; Chirli & Richard, 2008: 54, pl. 10 figs 8-9; Sosso & Dell'Angelo, 2010: 44, 60 unnumbered fig. middle low right.

*Brocchinia tauroparva* Sacco — Landau et al., 2006: 81, pl. 7 figs 5-6 (non Sacco, 1894).

*Brocchinia subanodosa* Sacco — Brunetti et al., 2011: 121, figs 20A-H, 22C-D.

Material and dimensions. — Maximum height 13.9 mm,

NHMW 2019/0167/0020 PQ (4), NHMW 2019/0167/0021 CO (13), NHMW 2019/0167/0022-0023 VC (8).

Discussion. — *Brocchinia subanodosa* Sacco, 1894 is characterised by its protoconch consisting of 2.75 whorls, its convex spire whorls, weak axial sculpture that tends to become obsolete on the last two whorls and slightly stronger spiral cords with somewhat lamellar interspaces between the cords. We confirm that the protoconch in the Estepona specimens consists of 2.75 whorls with a small nucleus, as described by Brunetti et al. (2011).

Distribution. — Lower Pliocene: central Mediterranean, Italy (Sacco, 1894; Pelosio, 1967; Chirli, 2002; Brunetti et al., 2011). Upper Pliocene: Atlantic, Mondego Basin, Portugal (Silva, 2001); western Mediterranean, Estepona Basin, Spain (Vera-Peláez et al., 1995; Landau et al., 2006), France (Chirli & Richard, 2008); central Mediterranean, Italy (Sacco, 1894; Malatesta, 1974; Cavallo & Repetto, 1992; Inzani, 1993; Brunetti et al., 2011; Sosso & Dell'Angelo, 2011).

#### Genus *Sveltia* Jousseume, 1887

*Sveltia* Jousseuma, 1887: 214. Type species (by original designation): *Voluta varicosa* Brocchi, 1814. Pliocene, Italy.

#### *Sveltia confusa* Brunetti, 2016 (Fig. 22)

*Narona* (*Sveltia*) *varicosa* (Brocchi) — Gonzalez-Delgado, 1993: 21, pl. 1 figs 13-14 [non *Sveltia varicosa* (Brocchi, 1814)].

*Narona* (*Sveltia*) *varricosa* [sic] (Brocchi) — Vera-Peláez et al., 1995: 148, fig. 3 A-B, fig. 5 C-D [non *Sveltia varicosa* (Brocchi, 1814)].

*Sveltia varicosa* (Brocchi) — Landau et al., 2011: 32, pl. 16, fig. 6 [non *Sveltia varicosa* (Brocchi, 1814)].

*Sveltia confusa* Brunetti, 2016: 320, figs 1-4, 7, 9.

Material and dimensions. — Height 18.7 mm, width 9.3 mm. NHMW 2019/0167/0058 CO (1).

Discussion. — Landau et al. (2006) discussed this species as *S. varicosa* (Brocchi, 1814) from Estepona, but did not figure specimens from the Estepona Basin. Unlike the Guadalquivir Basin where it is very abundant, it is exceptionally rare in the Estepona deposits. Thanks to the tireless collecting efforts of the second author, we now illustrated a specimen from the Velerín conglomerates of Estepona (Fig. 22). Vera-Peláez et al. (1995: 148, fig. 3 A-B; fig. 5 C-D) figured a specimen from Velerín, which Brunetti (2016) considered a distinct species; *S. confusa*. The specimens from the Guadalquivir and Estepona basins of southern Spain were said to differ from *S. varicosa* (Brocchi, 1814) in having the spiral sculpture more uniform in strength, with less difference

between primary and tertiary cords, finer axial ribs forming spines at the shoulder and a flatter, better defines subsutural ramp. On further examination of the material at hand, these differences are small, but consistent, and true *S. varicosa* does not seem to occur in these southern Spanish deposits. Adopting this stricter species concept the specimens illustrated by Silva (2001, pl. 22 figs 17-18) from the upper Pliocene Mondego Basin of central-west Portugal as *S. varicosa* are neither of the above species and will be described in a separate paper. All these forms have a similar multispiral protoconch composed of about three smooth whorls.

Distribution. — Lower Pliocene: Atlantic, Guadalquivir Basin, Spain (Gonzalez-Delgado, 1993; Landau et al., 2011; Brunetti, 2016); central Mediterranean, Italy (Brunetti, 2016). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (Vera-Peláez et al., 1995).

#### LANDAU B.M. & SILVA, C.M. DA, 2006b. The genus *Scaphella* (Gastropoda: Volutidae) in the Neogene of Europe and its paleobiogeographical implications. — *The Nautilus* 120 (3): 81-94.

*Scaphella* (*Aurinia*) *josei* Lozano-Francisco & Vera-Peláez, 2006 (published December, 2006) is a junior subjective synonym of *Scaphella carlae* Landau & Silva, 2006 (published 22<sup>nd</sup> September 2006), later placed in the genus *Euroscaphella* Van Dingenen, Ceulemans & Landau, 2014 (Van Dingenen et al., 2014: 104).

#### LANDAU, B.M., LA PERNA R. & MARQUET, R., 2006c. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 6. Triphoroidea, Epitonioidea, Eulimoidea. — *Palaeontos* 10: 1-96, pls 1-22.

p. 12 *Cerithiopsis* (*s.l.*) *barleei* Jeffreys, 1867 (pl. 3 fig. 2). Cecalupo & Robba (2010: 61) suggested placement in the genus *Prolixidens* Marshall, 1978, but this position has not been adopted by WoRMS (MolluscaBase, 2019b).

p. 14 *Cerithiopsis* (*s.l.*) *subulata* (S.V. Wood, 1848) (pl. 4 fig. 1). This is an undescribed *Cerithiopsidella* sp. This group is speciose in the European Tertiary and in need of revision; see Landau et al. (2018: 235).

p. 24 *Epitonium dendrophylliae* Bouchet & Warén, 1986 (pl. 7 figs 3-6) = *Epidendrium dendrophylliae* (Bouchet & Warén, 1986); see Gittenberger & Gittenberger (2005: 153).

p. 50 *Nodiscala hellenica* (Forbes, 1844) (pl. 15 figs 2-3) = *Nodiscala coronata* (Philippi & Scacchi, 1840); see MolluscaBase (2020a). WoRMS does not accept the genus *Nodiscala*, which is synonymised with *Opa-*

*lia* H. Adams & A. Adams, 1853 (MolluscaBase, 2020b). However, until molecular evidence to the contrary, we prefer to use the genus *Nodiscala* for the reasons discussed in Landau et al. (2006: 49).

**Superfamily Epitonioidae Berry, 1910 (1812)**

**Family Epitoniidae Berry, 1910 (1812)**

**Genus *Acirsa* Mörch, 1857**

*Acirsa* Mörch, 1857: 77. Type species (by monotypy): *Scaloria borealis* Lyell, 1841. Present-day, Greenland. For generic synonymy see Van Dingenen et al. (2016: 167).

***Acirsa semicorrugata* Chirli, 2009**

(Fig. 23)

*Acirsa (Hemiacirsa) couffoni* Brébion, 1964: 255, pl. 6 fig. 28 (*nomen nudum*).

*Acirsa semicorrugata* “d’Ancona ms.” Chirli, 2009: 43, pl. 17 figs 1-8.

*Acirsa semicorrugata* — Van Dingenen et al., 2016: 167, pl. 15 fig. 11.

Material and dimensions. — Height 19.7 mm. NHMW 2019/0167/0060 CO (1).

Discussion. — *Acirsa semicorrugata* Chirli, 2009 was said to differ from *A. corrugata* (Brocchi, 1814) in having less convex whorls and the ribs obsolete on the last whorl.

Notwithstanding the hesitation we expressed in Van Dingenen et al. (2016: 167) on the validity of this species, this shell from Estepona is undoubtedly conspecific with those illustrated as *A. semicorrugata* Chirli, 2009 from Italy (Chirli, 2009: pl. 17 figs 1-8). For full discussion, see Van Dingenen et al. (2016: 167).

Distribution. — Lower Pliocene: Atlantic, NW France (Van Dingenen et al., 2016); central Mediterranean, Italy (Chirli, 2009). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper).

**Family Nystiellidae Clench & Turner, 1952**

**Genus *Opaliopsis* Thiele, 1928**

*Opaliopsis* Thiele, 1928: 92. Type species (by original designation): *Scala elata* Thiele, 1925 (by original designation). Present-day, East Africa.

***Opaliopsis atlantis* (Clench & Turner, 1952)**

(Fig. 24)

*Nystiella atlantis* Clench & Turner, 1952: 343, pl. 168

*Nystiella atlantis* Clench & Turner — Crovato & Taviani, 1985: 290, figs 1-4; Rios, 2009: 186, fig. 454.

*Opaliopsis atlantis* (Clench & Turner) — Bouchet & Warén, 1986: 489, figs 1133, 1151-1152; Mifsud, 1993: 61, unnumbered fig.; Mifsud, 1994: 61, unnumbered fig.; Weil et al., 1999: 26, fig. 67; Ardovini & Cossignani, 1999: 139, unnumbered fig.; Smriglio & Mariottini, 1999: 138, figs 3-4; Segers et al., 2009: 107; Mifsud, 2009: 1, fig. 1A; Andrade et al., 2011: 1562, figs 1-3.

Material and dimensions. — Height 11.9 mm, NHMW 2019/0167/0047 CO (1).

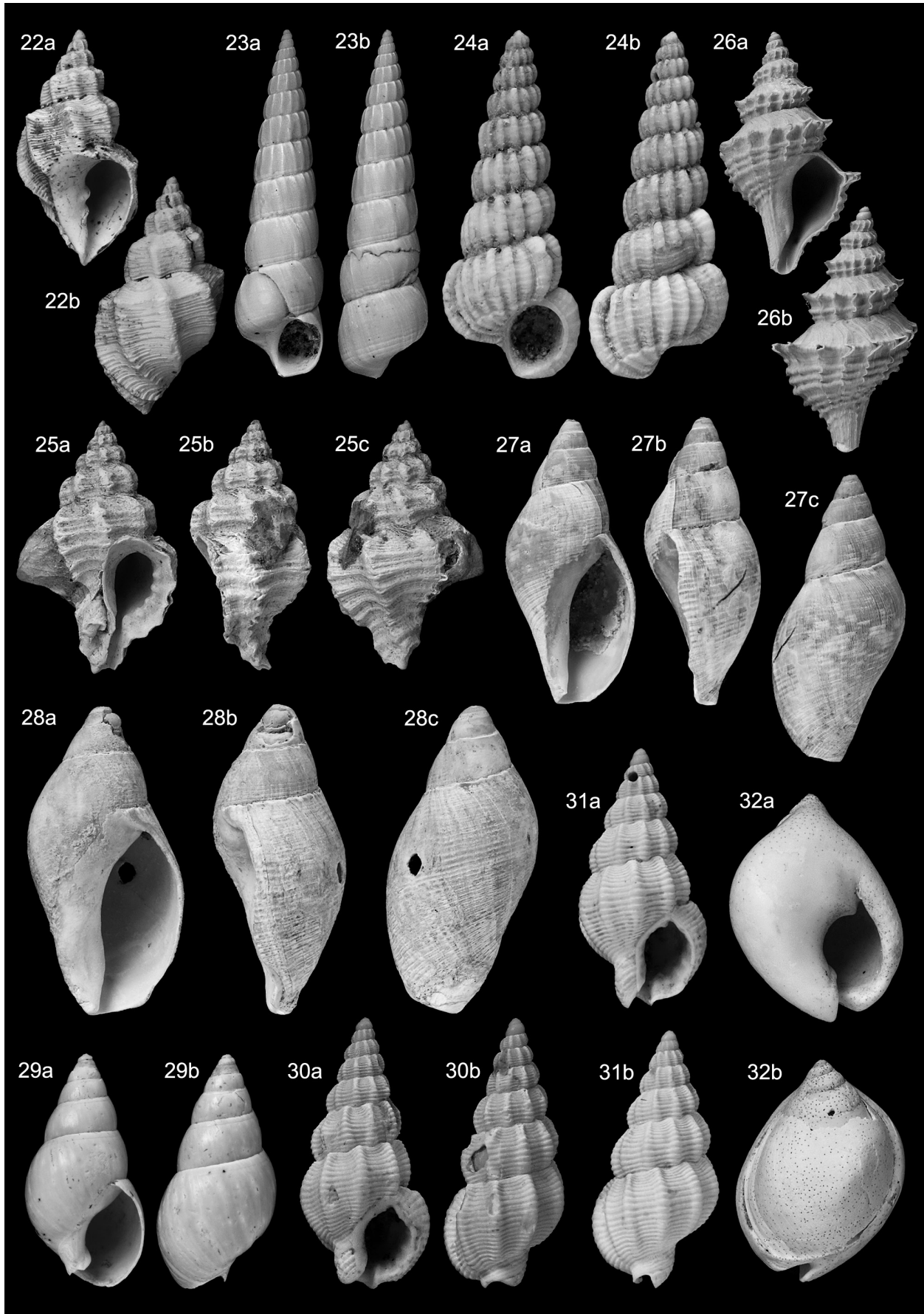
Discussion. — *Opaliopsis atlantis* (Clench & Turner, 1952) has a very characteristic shell. Both in the lower Pleistocene of Italy (Di Geronimo & La Perna, 1997; Di Geronimo et al., 2005) and present-day (Mifsud, 2009), *O. atlantis* is associated with deep-water coral ecosystems and today it is an Amphi-Atlantic species. Species from the family are known to be parasites of Cnidaria, particularly of the orders Zoantharia and Actinaria (corals and sea anemones) (Bouchet & Warén, 1986; Kokshoorn et al., 2007). This the stratigraphically oldest record for the species.

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper). Lower Pleistocene: central Mediterranean, Italy (Crovato & Taviani, 1985; Di Geronimo & La Perna, 1997; Di Geronimo et al., 2005). Present-day: Eastern Atlantic: Azores, Strait of Gibraltar (Bouchet & Warén, 1986), Canary Islands, Madeira

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> **Figs 22-32.** Gastropods of Estepona, Spain, lower Piacenzian, upper Pliocene. **Fig. 22.** *Sveltia confusa* Brunetti, 2016, NHMW 2019/0167/0057, height 18.7 mm, width 9.3 mm, Velerín conglomerates. **Fig. 23.** *Acirsa semicorrugata* Chirli, 2009, NHMW 2019/0167/0060, height 19.7 mm, width 5.1 mm, Velerín conglomerates. **Fig. 24.** *Opaliopsis atlantis* (Clench & Turner, 1952), NHMW 2019/0167/0047, height 11.9 mm, width 4.4 mm, Velerín conglomerates. **Fig. 25.** *Murexsul zezae* Brunetti & Forli, 2010, NHMW 2019/0167/0061, height 13.1 mm, width 8.0 mm, Velerín conglomerates. **Fig. 26.** *Trophonopsis squamulata* (Brocchi, 1814), NHMW 2019/0167/0012, height 9.1 mm, width 5.3 mm, Velerín carretera. **Figs 27-28.** *Nucella bermejensis* (Lozano-Francisco & Vera-Peláez, 2006). **27.** NHMW 2019/0167/0024, height 26.6 mm, width 11.0 mm, Velerín conglomerates. **28.** NHMW 2019/0167/0025, height 26.4 mm, width 12.4 mm, Velerín conglomerates. **Fig. 29.** *Tritia oblonga* (Sasso, 1827), NHMW 2019/0167/0027, height 13.8 mm, width 6.8 mm, El Lobillo. **Figs 30-31.** *Tritia andonae* Bellardi, 1882. **30.** NHMW 2019/0167/0028, height 10.4 mm, width 4.8 mm, Velerín conglomerates. **31.** NHMW 2019/0167/0029, height 10.9 mm, width 5.3 mm, Velerín conglomerates. **Fig. 32.** *Tritia gibbosula pliopergibbosa* (Sacco, 1904), NHMW 2019/0167/0059, height 18.4 mm, width 10.0 mm, Velerín conglomerates.

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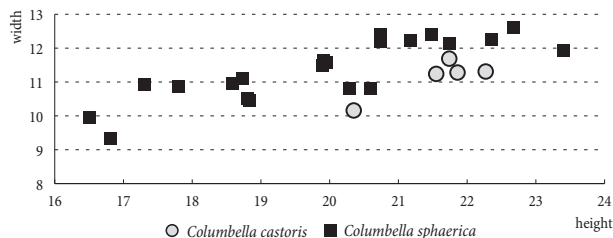




(Segers et al., 2009), Mediterranean (Smriglio & Mariottini, 1999; Mifsud, 2009), western Atlantic: USA, Florida, Cuba (Clench & Turner, 1952), Brazil (Rios, 2009; Andrade et al., 2011).

**LOZANO-FRANCISCO, M.C. & VERA-PELÁEZ, J.L., 2006. Catálogo del material tipo del Museo Municipal Paleontológico de Estepona, parte I. Mollusca, Gastropoda, Descripción de nuevas especies del Plioceno de las cuencas de Estepona (Málaga) y del Guadalquivir (Huelva) (España). — Pliocénica 5: 105-124.**

- p. 106 *Bolma malakensis* Lozano-Francisco & Vera-Peláez, 2006 (pl. 1 figs 1-5) = *Bolma castrocarensis* (Foresti, 1876); see p. 28 (this paper).
- p. 108 *Pisania plioalboranensis* Lozano-Francisco & Vera-Peláez, 2006 (pl. 2 figs 15, 16) = *Pisania plioangustata* (Sacco, 1904); see Brunetti & Della Bella (2016: 18).
- p. 109 *Pisania baetica* Lozano-Francisco & Vera-Peláez, 2006 (pl. 2 figs 3-8) = *Pisania magna* (Foresti, 1868); see Brunetti & Della Bella (2016: 19). Lozano-Francisco & Vera-Peláez (2006: 110) clearly described the fine crowded spiral cords typical for the species.
- p. 110 *Columbella sphaerica* Lozano-Francisco & Vera-Peláez, 2006, (pl. 2 figs 11-14) and *Columbella castoris* Lozano-Francisco & Vera-Peláez, 2006 (pl. 2 figs 17-22). The only difference given between these species in the original discussion is that *C. sphaerica* was more globose with a narrower aperture. This group is well represented in the material at hand and we are unable to separate the two. In the scatter diagram below (Text fig. 1), using morphometric data from the original descriptions, it seems that the slightly narrower shells were separated as *C. castoris*. *Columbella sphaerica* is a secondary homonym of *C. sublachryma* var. *sphaerica* Hervier, 1900, and therefore unavailable, leaving *C. castoris* as the valid name for this species.



**Text fig. 1.** *Columbella sphaerica/castoris*; width/height in mm. Data taken from type series in Lozano-Francisco & Vera-Peláez (2006: Tables 5, 6).

- p. 112 *Bullia eloisae* Lozano-Francisco & Vera-Peláez, 2006 (pl. 1 figs 10-15) = *Tritia oblonga* (Sasso, 1827); see p. 44 (this paper).
- p. 115 *Scaphella (Aurinia) josei* Lozano-Francisco & Vera-Peláez, 2006 (pl. 3 figs 2, 4-19) = *Euroscaphella carlae* (Landau & Silva, 2006); see p. 39 (this paper).
- p. 116 *Cymbium gracile lusitanica* Lozano-Francisco & Vera-Peláez, 2006 (pl. 4 figs 1-6) = *Cymbium ibericum* Landau & Marquet, 2000; see p. 27 (this paper).
- p. 118 *Tribia plioeometrica* Lozano-Francisco & Vera-Peláez, 2006 (pl. 2 figs 13-24) = *Tribia hispanica* Brunetti, Forli & Vecchi, 2006; see p. 37 (this paper).

Therefore, of the ten non-turrid species/subspecies erected by Lozano-Francisco & Vera-Peláez (2006), only two; *Nucella bermejensis* and *Columbella castoris* are considered valid taxa. The turrid taxa will be reviewed in a subsequent paper.

**LANDAU B.M., HOUART, R. & SILVA, C.M. DA, 2007. The Early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 7 Muricidae. — Palaeontos 11: 1-87, pls 1-15.**

- p. 10 *Hexaplex (Trunculariopsis) campanii* (De Stefani & Pantanelli, 1878) (pl. 2 figs 2-4) = *Hexaplex (Trunculariopsis) dumosus* (De Stefani, 1875); see Forli et al. (2013).
- p. 16 *Pterynotus swainsoni* [sic] (Michelotti, 1841) (pl. 4 figs 1-2) = *Timbellus swainsonii* (Michelotti, 1841); see Merle et al. (2011: 135).
- p. 18 *Purpurellus veranyi* (Paulucci, 1866) (text-fig. 4, pl. 4 figs 3-5, pl. 5 figs 1-5) = *Purpurellus cyclopterus* (Millet, 1865); see Landau et al. (2016: 224).
- p. 35 *Hadriana craticuloides* (Vokes, 1964) = *Hadriana craticulata* Bucquoy & Dautzenberg, 1882; see MolluscaBase (2019a).
- p. 49 *Thais (Mancinella) striolata* (Bronn, 1831) = *Mancinella striolata* (Bronn, 1831); see Claremont et al. (2013).

**Family Muricidae Rafinesque, 1815**  
**Subfamily Muricopsinae Radwin & D'Atillio, 1971**  
**Genus *Murexsul* Iredale, 1915**

*Murexsul* Iredale, 1915: 471. Type species (by original designation): *Murex octogonus* Quoy & Gaimard, 1833. Present-day, New Zealand.

***Murexsul zezae* Brunetti & Forli, 2010**

(Fig. 25)

*Murexsul zezae* Brunetti & Forli, 2010: 4, figs 1, 2A-H, 3a.

*Murexsul zezae* — Sosso & Dell'Angelo, 2010: 38 unnumbered fig. 2<sup>nd</sup> row right.

Material and dimensions. — Height 13.1 mm, width 8.0 mm. NHMW 2019/0167/0061 CO (1).

Discussion. — We attribute a slightly abraded specimen to the recently described *M. zezae* Brunetti & Forli, 2010. It is most similar to, and co-occurs with, *Muricopsis alternaticosta* (Michelotti, 1841), but differs in having more numerous axial ribs (6 vs. 5) and more numerous labial denticles (5 vs. 4), in having a longer siphonal canal, and in lacking the tow strong abapical columellar tubercles typical for the genus *Muricopsis* Bucquoy & Dautzenberg, 1882. For further discussion see Brunetti & Forli (2010).

Distribution. — Lower Pliocene: central Mediterranean, Italy (Brunetti & Forli, 2010; Sosso & Dell'Angelo, 2010). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper).

**Subfamily Pagodulinae Barco, Schiaparelli, Houart & Oliverio, 2012**

**Genus *Trophonopsis* Bucquoy & Dautzenberg, 1882**

*Trophonopsis* Bucquoy & Dautzenberg, 1882: 40. Type species (by original designation): *Murex muricatus* Montagu, 1803. Present-day, British Isles.

***Trophonopsis squamulata* (Brocchi, 1814)**

(Fig. 26)

*Murex squamulatus* Brocchi, 1814: 422, pl. 8 fig. 13.

*Murex squamulatus* — d'Ancona, 1871: 45, pl. 3 fig. 3.

*Fusus* (*Pagodula*) *squamulatus* (Br.) — Cossmann, 1903: 192, pl. 2 fig. 21; Sacco, 1904: 25.

*Fusus* (*Pagodula*) *squamulatus* var. *subacarinata* Sacco, 1904: 25.

*Murex* (*Pagodula*) *squamulatus* Br. — Cerulli-Irelli, 1911: 263, pl. 25 fig. 18.

*Streptochetus* (*Pagodula*) *squamulatus* Br. — Montanaro, 1935: 58, pl. 4 fig. 7.

*Trophon* (*Trophonopsis*) *squamulatus* (Brocchi) — Rossi-Ronchetti, 1955: 177, fig. 92.

*Trophonopsis* (*Trophonopsis*) *squamulata* (Brocchi) — Pinna, 1971: 433, pl. 77, fig. 12; Malatesta, 1974: 297, pl. 25 fig. 11.

*Murex squamulatus* Brocchi — Pinna & Spezia, 1978: 153, pl. 51 fig. 1.

*Trophonopsis squamulatus* (Brocchi) — Inzani & Bertarelli, 1985: 34, pl. 3 fig. 7.

*Trophonopsis* (*Trophonopsis*) *squamulata* (Brocchi) — Andreoli & Marsigli, 1992: 11, pl. 4 fig. 6.

*Trophon squamulatus* (Brocchi) — Chirli, 2000: 45, pl. 17 figs 1-4.

Material and dimensions. — Maximum height 9.1 mm. NHMW 2019/0167/0012-0013 VC (2).

Discussion. — *Trophonopsis squamulata* (Brocchi, 1814) is characterised by the presence of squamous spiral cords below the shoulder that separates it from the Mediterranean Pliocene *Paodula vaginata* (De Cristofori & Jan, 1832) and the Pleistocene to present-day *P. echinata* (Kiener, 1840), both of which do not have cords below the spinous shoulder cord. The specimens from Estepona are small compared to those from Italy, and probably represent juvenile specimens.

Distribution. — Upper Miocene: central Proto-Mediterranean, Italy (Montanaro, 1935). Lower Pliocene: central Mediterranean, Italy (Sacco, 1904; Chirli, 2000). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper), central Mediterranean, Italy (Pinna, 1971; Malatesta, 1974). Pliocene (unspecified): central Mediterranean, Italy (Inzani & Bertarelli, 1985; Andreoli & Marsigli, 1992). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1911).

**Subfamily Ocenebrinae Cossmann, 1903**

**Genus *Nucella* Röding, 1798**

*Nucella* Röding, 1798: 130. Type species (by subsequent designation of Stewart, 1927: 386): *Buccinum filosum* Gmelin, 1791. Present-day, Europe.

***Nucella bermejensis* Lozano-Francisco & Vera-Peláez, 2006**  
(Figs 27-28)

*Nucella bermejensis* Lozano-Francisco & Vera-Peláez, 2006: 108, pl. 1 figs 6-9.

Material and dimensions. — Maximum height 26.6 mm. NHMW 2019/0167/0024-0026 CO (3).

Discussion. — *Nucella bermejensis* Lozano-Francisco & Vera-Peláez, 2006 is characterised by its slender fusiform shell, much thinner than usual for the genus, sculpture reduced to weak, narrow, flattened, crowded spiral cords covering the entire surface, an elongated aperture, a thin outer lip without labial callus or denticles developed within, anal sinus not developed, a broadly and shallowly excavated columella devoid of any folds, and a moderately

long, wide, open siphonal canal. The last whorl is regularly fusiform with neither the shoulder nor the base or siphonal fasciole delimited. There is a suggestion of colour pattern of narrow reddish rectangles or stripes. The protoconch is not preserved in any of the material at hand, but was described as paucispiral, less than two whorls by Lozano-Francisco & Vera-Peláez (2006). There seems to be little intraspecific variation, mainly concerning degree of inflation, as the material at hand is similar to that of the type series.

The original description compared this species to the Pliocene to present-day northern European *Nucella lapillus* (Linnaeus, 1758), but it has little in common with typical forms of that species, which is much thicker shelled and has stout teeth within the outer lip. *Nucella lapillus* is an extraordinarily variable species and thin-lipped forms with hardly any denticles do occur, but these are always broader and thicker shelled than *N. bermejensis*. Indeed this species may not even be a muricid, as it shows a resemblance to certain buccinid groups. We are uncertain of its taxonomic position and provisionally keep it in its original placement.

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain (Lozano-Francisco & Vera-Peláez, 2006).

**LANDAU, B.M., SILVA, C.M. DA & GILL, C., 2009. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 8. Nassariidae. — Palaeontos 17: 1-101, pls 1-22.**

Based on molecular phylogenetics, all European Neogene nassariids belong in the genus *Tritia* Risso, 1826 (Galindo et al., 2016). Therefore, all species placed in *Nassarius* Duméril, 1806 by Landau et al. (2009) are transferred to *Tritia*. In subsequent studies we have endeavoured to continue with the concept of species-groups as used in Landau et al. (2009).

p. 21 *Nassarius oblongus* (Sasso, 1827) (pl. 4 fig. 1; pl. 16 fig. 3) = *Tritia oblonga* (Sassi, 1827). Landau et al. (2009: 21) stated that the very faint cord below the suture described by Bellardi (1882: 155) was not present in the Estepona specimens. In the original description the shell is also described as smooth above the base: “*B. oblongum. Nassa semistriata*. Brogn. pl. IV. fig. 8. a. Il nostro individuo ha una forma più allungata di quello rappresentato nella fig. A, ed alcune strie si ravvisano soltanto alla estremità della base, essendo in tutto il rimanente liscio, e nitido lo smalto”. (Sasso, 1827: 481). This is also true for specimens from the Velerín conglomerates. However, it is clearly developed in the shell figured here (Fig. 29) from El Lobillo. We consider them to be variations within a single species. *Bullia eloisae* Lozano-

-Francisco & Vera-Peláez, 2006 is a junior subjective synonym.

p. 43 *Nassarius productus* (Bellardi, 1882) (pl. 9 figs 3-7; pl. 19 fig. 4) = *Tritia producta* (Bellardi, 1882). *Nassa andonae* Bellardi, 1882 is taken out of synonymy (see below).

#### Superfamily Buccinoidea Rafinesque, 1815

#### Family Nassariidae Iredale 1916 (1835)

#### Subfamily Nassariinae Iredale 1916 (1835)

#### Genus *Tritia* Risso, 1826

*Tritia* Risso, 1826: 172. Type species (by subsequent designation of Gray, 1847: 139): *Buccinum reticulatum* Linnaeus, 1758. Present-day, Europe. A synonym is *Hinia* Leach, 1847.

#### *Tritia andonae* (Bellardi, 1882)

(Figs 30-31)

*Nassa Andonae* Bellardi, 1882: 108, pl. 7 fig. 4

*Nassa Andonae* — Ferrero Mortara et al., 1984: 113, pl. 27 fig. 3.

*Nassarius (Hima) andonae* (Bellardi) — Cavallo & Repetto, 1992: 108, fig. 253; Chirli, 2000: 70, pl. 28 figs 5-8.

Material and dimensions. — Maximum height 12.6 mm. NHMW 2019/0167/0028-30 CO (3).

Discussion. — Landau et al. (2009: 43) synonymised *Nassa andonae* Bellardi, 1882 with *Nassa producta* Bellardi, 1882. This is incorrect. The two are very similar, but the differences highlighted by Bellardi (1882: 108) are valid. *Tritia andonae* differs from *T. producta* in having a larger shell, which is less slender. The spire whorls are regularly convex and not swollen just above the abapical suture and straight sided above to the adapical suture, as in *T. producta*. The axial ribs are more numerous and the spiral cords are not weaker between the ribs, as they are in *T. producta*, in which the cords are subobsolete mid-interspace between the ribs. A further difference is that the outer lip is thicker and slightly more alate adapically in *T. andonae*. *Tritia serraticosta* (Bronn, 1831) is also closely similar. It is usually smaller than *T. andonae* and more slender, the ribs are not as elevated and the spiral cords are wider and separated by much narrower interspaces than in *T. andonae*. Furthermore, the outer lip is thinner and hardly alate adapically. All three species belong within the *T. serraticosta* species-group of Landau et al. (2009: 40) and have the typical multispiral protoconch seen in the group. *Tritia andonae* is far less common in the Estepona assemblages than either of the two congeners discussed above and so far found only in the conglomerates.

Distribution. — Lower Pliocene: central Mediterranean, Italy (Bellardi, 1882; Chirli, 2002). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper); central Mediterranean, Italy (Bellardi, 1882; Cavallo & Repetto, 1992).

***Tritia gibbosula pliopergibbosa* (Sacco, 1904)**

(Fig. 32)

*Nassa* (*Arcularia*) *gibbosula pliopergibbosa* Sacco, 1904: 63, pl. 15 figs 34-35.

*Nassarius gibbosulus pliopergibbosus* (Sacco) — Landau et al., 2009: 60, pl. 12, figs 11-12, pl. 22 fig. 2 (cum syn.).

*Tritia gibbosula pliopergibbosa* (Sacco) — Van Dingenen et al., 2017: 34, pl. 2 fig. 8 (cum syn.).

Material and dimensions. — Height 18.4 mm, width 10.0 mm. NHMW 2019/0167/0059 CO (1).

Discussion. — *Tritia gibbosula pliopergibbosa* (Sacco, 1904) differs from the present-day Mediterranean and adjacent Atlantic *T. gibbosula* (Linnaeus, 1758) in the proportions of their shells. The fossil shells are less tall than the present-day shells, but of similar diameter. This gives the shell a squatter, more quadrate appearance, especially the last whorl. In the fossil shells the mean ratio of the diameter against height of the shell is 75%, whereas in the Recent shells it is only 69%. For further discussion see Landau et al. (2009) and Van Dingenen et al. (2017). This large adult shell is the only specimen we have seen from the Estepona assemblages.

Distribution. — Middle Miocene: Atlantic, Aquitaine Basin, France (Peyrot, 1925). Upper Miocene: Atlantic, Caceia, southern Portugal (NHMW coll.); Proto-Mediterranean, Italy (Bellardi, 1882; Montanaro, 1939; Venzo & Pelosio, 1963). Lower Pliocene: Atlantic, NW France (Van Dingenen et al., 2017), Guadalquivir Basin, Spain (González-Delgado, 1989; Landau et al., 2011); western Mediterranean, north-east Spain (Martinell, 1982; Gili, 1991), southern France (Martinell & Domènech, 1986; Gili, 1991); central Mediterranean, Italy (Bellardi, 1882; Chirli, 1988, 2000), Tunisia (Fekih, 1975). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper), Alpes Maritimes (Chirli & Richard, 2008); central Mediterranean, Italy (Bellardi, 1882; Malatesta, 1974; Cavallo & Repetto, 1992). Pliocene indet.: central Mediterranean, Italy (Sacco, 1904).

In this work we do not review the papers by Muñoz-Solís (1998, 1999) Vera-Peláez and co-authors (1999, 2001a, b, 2002) on parts of the gastropod assemblage not covered by the senior author and co-authors. However, we take the opportunity of describing some striking new species.

**Family Fascioliidae Gray, 1853**

**Genus *Euthriofusus* Cossmann, 1901**

*Euthriofusus* Cossmann, 1901: 6, 27. Type species (by original designation): *Fasciolaria burdigalensis* de Basterot, 1825. Miocene, France.

***Euthriofusus postumus* spec. nov.**

(Figs 33-34)

Type material — Holotype NHMW 2019/0167/0035, height 41.3 mm, width 7.4 mm (Fig. 33); paratype 1 NHMW 2019/0167/0036, height 37.1 mm, width 16.9 mm (Fig. 34); paratype 2 NHMW 2019/0167/0037, height 39.2 mm, width 17.6 mm; paratype 3 NHMW 2019/0167/0038, height 36.0 mm, width 17.0 mm; paratype 3 NHMW 2019/0167/0039, height 34.4 mm, width 17.0 mm.

Other material. — NHMW 2019/0167/0040 CO (17).

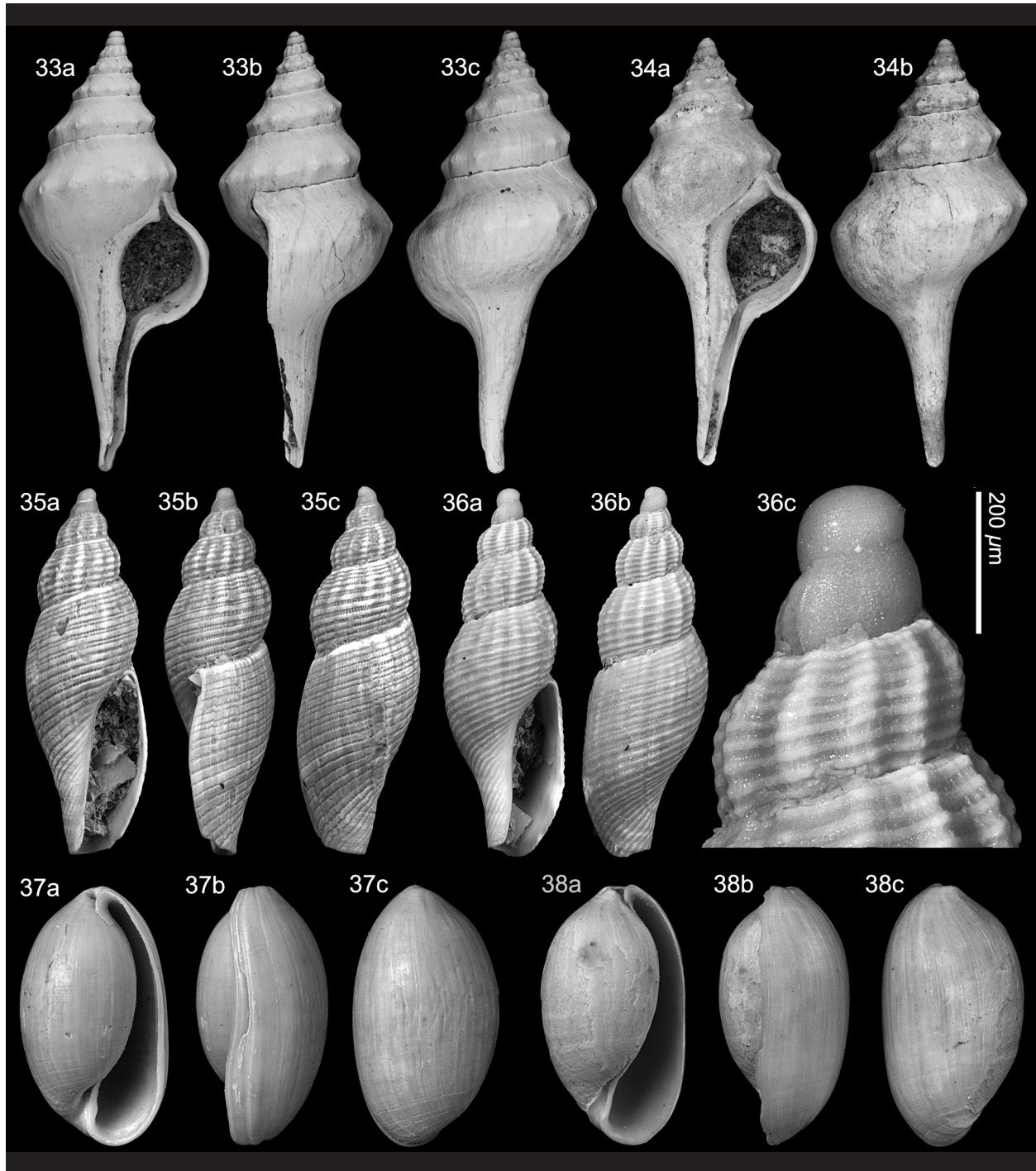
Type locality. — Velerín conglomerates, Estepona, Andalusia, S. Spain.

Type stratum. — Lower Piacenzian, upper Pliocene.

Etymology. — Latin ‘*postumus*, -a, -um’ adjective, meaning last, final. *Euthriofusus* gender masculine.

Diagnosis. — *Euthriofusus* species of small size for genus, multispiral dome-shaped protoconch, teleoconch with sculpture reduced to tubercles at the shoulder and very weak spiral threads, last whorl short, small aperture, very long, straight siphonal canal.

Description. — Shell medium sized, solid. Protoconch tall dome shaped, composed of 2.75 smooth whorls, with small nucleus. Junction marked by beginning of adult sculpture. Teleoconch of 5-5.5 angular whorls, with broad, weakly concave subsutural ramp, roundly angled at shoulder placed at about one-quarter whorl height, straight sided below to impressed, linear suture. First whorl with nine low, broad, opisthocline axial ribs that rapidly weaken on second whorl, reduced to rounded tubercles at shoulder, 12 on penultimate whorl. Spiral sculpture very weak, faint threads most evident on early teleoconch whorls, irregularly obsolete on last whorl. Last whorl short, broad concave subsutural ramp, broadly rounded at shoulder, placed mid-whorl, bearing row of tubercles, strongly constricted at base, siphonal fasciole poorly delimited, long, straight, narrow. Aperture small, ovate; anal canal marked by deep, narrow notch; siphonal canal very long and narrow, straight, open. Outer lip sinuous in profile, smooth within, except for single small tubercle delimiting lateral border of siphonal canal. Columella evenly excavated, smooth, except for single small tubercle delimiting medial border of siphonal canal. Columellar callus strongly thickened, round-edged, erect abapically, not expanded over base, bearing strong parietal fold.



**Figs 33-38.** Gastropods of Estepona, Spain, lower Piacenzian, upper Pliocene. **Figs 33-34.** *Euthriofusus postumus* spec. nov. **33.** Holotype NHMW 2019/0167/0035, height 41.3 mm, width 7.4 mm, Velerín conglomerates. **34.** Paratype 1 NHMW 2019/0167/0036, height 37.1 mm, width 16.9 mm, Velerín conglomerates. **Figs 35-36.** *Andonia wilhelminamariae* spec. nov. **35.** Holotype NHMW 2019/0167/0031, height 6.9 mm, width 2.2 mm, El Lobillo. **36.** Paratype 1 NHMW 2019/0167/0032, height 5.9 mm, width 2.0 mm, El Lobillo. **Figs 37-38.** *Volvulella volvulaeformis* (Seguenza, 1880). **37.** NHMW 2019/0167/0041, height 3.7 mm, width 2.1 mm, Velerín carretera. **38.** NHMW 2019/0167/0042, height 3.9 mm, width 2.2 mm, Velerín carretera.

Discussion. — *Euthriofusus* is predominantly a European Miocene genus. It is best known by *E. burdigalensis* (de Basterot, 1825) from the lower Miocene Aquitaine Basin, which differs from *E. postumus* spec. nov. in being at least twice the size, more strongly sculptured, having denticles within the outer lip, and the equally long siphonal fasciole is twisted at the tip. *Euthriofusus virgineus* (Grateloup, 1833) and *E. anatolicus* (Toula, 1901) are both larger, thicker-shelled, and more slender than *E. postumus*. Moreover, both these species have a paucispiral protoconch. The species identified by Landau et al. (2011, pl. 14 figs 7-8) as *E. cf. virgineus* from the Atlantic lower Pliocene Guadalquivir Basin of southern Spain, is neither that species nor *E. postumus*, and may represent a *Euthria* Gray, 1850 species. As far as we are aware, this is the stratigraphically youngest representative of the genus.

Lozouet et al. (2001: 60) suggested a phylogenetic relationship between *Euthriofusus* Cossmann, 1901 and the extant West African genus *Afer* Conrad, 1858, which seems reasonable.

Distribution. — Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper).

### Superfamily Conoidea Fleming, 1822

#### Family Raphitomidae Bellardi, 1875

#### Genus *Andonia* Harris & Burrows, 1891

*Andonia* Harris & Burrows, 1891: 112. Nomen novum pro *Genea* Bellardi, 1873 (non Rondani, 1850 [Diptera]). Type species (by typification of replacement name): *Fusus bonellii* Bellardi & Michelotti, 1840. Pliocene, Italy.

#### *Andonia wilhelminamariae* spec. nov.

(Figs 35-36)

*Andonia bonellii* (Bellardi & Michelotti, 1840) — Chirli, 1997: 39, pl. 10 figs 11-12 [non *Andonia bonellii* (Bellardi & Michelotti, 1840)].

Type material. — Holotype NHMW 2019/0167/0031, height 6.9 mm, width 2.2 mm (Fig. 35); paratype 1 NHMW 2019/0167/0032, height 5.9 mm, width 2.0 mm (Fig. 36); paratype 2 NHMW 2019/0167/0033, height 7.0 mm, width 2.0 mm; paratype 3 NHMW 2019/0167/0034, height 5.8 mm, width 1.8 mm.

Other material. — Known only from type series.

Type locality. — El Lobillo, Estepona, Andalusia, S. Spain.

Type stratum. — Lower Piacenzian, upper Pliocene.

Etymology. — Named after Wilhelmina Maria van der Stoel, wife of the second author (HM), in recognition of her

long suffering patience. *Andonia* gender feminine.

Diagnosis. — *Andonia* species of small size, slender fusiform, solid, paucispiral protoconch of two whorls with spiral rows of micropustules, teleoconch with convex whorls, shoulder not developed, sculpture of axial that weaken on penultimate whorl, obsolete last whorl, overrun by narrow spiral cords.

Description. — Shell small, slender fusiform. Protoconch paucispiral, dome-shaped, composed of two convex whorls, bearing fine, close-set spiral rows of micropustules. Junction with teleoconch delimited by beginning of adult sculpture. Teleoconch of 3.5 tall convex whorls, separated by impressed suture. Axial sculpture of rounded opisthoclinal ribs, broadening towards abapical suture, about half width of their interspaces, overrun by narrow spiral cords, slightly narrower than their interspaces, six on first teleoconch whorl, nine on penultimate whorl. Single secondary spiral developed in some interspaces. Close-set growth lines give finely cancellate appearance in spiral interspaces. Axials weaken on second half of penultimate whorl, obsolete on last whorl. Last whorl slender fusiform, weakly constricted at base, sculptured by 22-26 subequal flattened cords, with single secondary in the interspaces mid-whorl in most specimens. Base and siphonal fasciole not delimited. Aperture elongate; outer lip slightly thickened by varix, smooth within; anal sinus very shallow U-shaped; siphonal canal medium length, straight, wide, open. Columella weakly excavated in upper third. Columellar callus poorly developed, forming narrow edge; parietal callus not thickened.

Discussion. — Both Moroni & Ruggieri (1981: 105) and Landau et al. (2013: 274) suggested that there were probably several species of *Andonia* Harris & Burrows, 1891 in the European Neogene that had not been formally described. *Andonia wilhelminamariae* spec. nov. is an extremely interesting find, as it is a non-planktotrophic sister species to the Miocene-Pliocene Mediterranean and adjacent Atlantic *A. bonellii* (Bellardi & Michelotti, 1840). The teleoconch of the two species is extremely similar, slender, with axials that weaken on the last two whorls. However, they are immediately separated by their protoconchs; *A. bonellii* has a multispiral protoconch of a typically planktotrophic type (Vera-Peláez, 2002, pl. 16 figs L-M), whereas *A. wilhelminamariae* has a protoconch of about two whorls with a large nucleus. The specimen illustrated by Chirli (1997, pl. 10 figs 11-12) as *A. bonellii* is probably a juvenile of *A. wilhelminamariae*, as it is only 3.5 mm in height, and only the axially ribbed early teleoconch whorls are present.

Landau et al. (2020: 42-43), described yet another non-planktotrophic *Andonia* species; *A. delgadoi* Landau, Van Dingenen & Ceulemans, 2020 from the upper Miocene Tortonian Atlantic Ligerian Basin, northwest France, but that species has a much broader teleoconch.

Distribution. — Lower Pliocene: central Mediterranean, Italy (Chirli, 1997). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper).

**Superfamily Bulloidea Gray, 1827**

**Family Rhizoridae Dell, 1952**

**Genus *Volvulella* Newton, 1891**

*Volvulella* Newton, 1891: 268. Nomen novum pro *Volvula* A. Adams, 1850 (non Gistel, 1848 [Diptera]). Type species (by typification of replaced name): *Bulla acuminata* Bruguière, 1792. Present-day, Mediterranean.

***Volvulella volvulaeformis* (Seguenza, 1880)**

(Figs 37-38)

*Cylichna volvulaeformis* Seguenza, 1880: 252, pl. 16 fig. 11.

*Volvulella* sp. — Brunetti & Cresti, 2018: 116, fig. 520.

Material and dimensions. — NHMW 2019/0167/0041 (1), height 3.7 mm, width 2.1 mm (Fig. 37); NHMW 2019/0167/0042 (1), height 3.9 mm, width 2.2 mm (Fig. 38); NHMW 2019/0167/0043-0044 (2), all VC; NHMW 2019/0167/0045 VC (7), NHMW 2019/0167/0046 CO (7).

Description. — Shell solid, broad oval, with convex sides, apex pointed. Last whorl forms entire shell. Anterior end rounded, umbilicus narrow. Aperture runs entire length of shell, wide anteriorly, narrowing rapidly apically at about two-third whorl height. Apically aperture bends towards, and extends a short distance above apex, ending in a sharp concentric ridge that fuses with apex, delimiting small apical pit. Outer lip simple; columella slightly twisted with weak fold abapically. Parietal callus narrow, not extending over apex. Sculpture of fine spiral grooves most evident at extremities, very faint or obsolete mid-whorl.

Discussion. — The European Miocene to present-day *Volvulella* specimens have all be attributed to *Volvulella acuminata* (Bruguière, 1792). As discussed by Landau et al. (2013: 340), this is either a species complex or an unusually long-lived and widely distributed species. A second species from Estepona has been at hand for many years that clearly represented a second species, but we were unable to identify. The recent publication by Brunetti & Cresti (2018: 116, fig. 520) illustrated this same species from the Italian Pliocene, also without a name. My thanks to the two reviewers (Maurizio Forli and Maurizio Sosso) for pointing out that this species was described by Seguenza (1880: 252, pl. 16 fig. 11). As far as we are aware, this is the first time this species has been discussed since its original description (apart from Brunetti & Cresti, 2018: 116, fig. 520, which is an atlas), and we therefore provide a fuller description.

*Volvulella volvulaeformis* (Seguenza, 1880) differs from *V. acuminata* in being more solid, much broader, and not having a spike of callus that usually covers the apex, but a sharp concentric ridge that develops from the apex of the outer lip and fuses with the apex, forming a small deep apical pit. The genus was reviewed by Harry (1967); the only species with an apical pit is *V. paupercula* (Watson, 1886) from the present-day Caribbean, which is closely similar to the Estepona species. However, *V. paupercula* is even broader than *V. obesa*, it has a wider umbilicus abapically, and is more rounded apically, usually without any spine. Several ‘plump’ tropical southwest Pacific *Volvulella* species were reviewed by Valdés (2008), but none have an apical pit.

Distribution. — Lower Pliocene: central Mediterranean, South Italy (Seguenza, 1879), Western Liguria (Sosso and Dell’Angelo, personal communication). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (this paper); central Mediterranean, Italy (Brunetti & Cresti, 2018).

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**REFERENCES**

- AARTSEN, J.J. VAN, 1977. Revision of the Eastern Atlantic and Mediterranean Caecidae. — *Basteria* 41 (5-6): 7-19.
- ADAM, W. & KNUDSEN, J., 1969. Quelques genres de mollusques prosobranches marins ou peu connus de l’Afrique occidentale. — *Bulletin de l’Institut Royal des Sciences Naturelles de Belgique* 44 (27): 1-69.
- AFFENZELLER, S., HAAR, N. & STEINER, G., 2017. Revision of the genus complex *Gibbula*: an integrative approach to delineating the Eastern Mediterranean genera *Gibbula* Risso, 1826, *Steromphala* Gray, 1847, and *Phorcus* Risso, 1826 using DNA-barcoding and geometric morphometrics (Vetigastropoda, Trochoidea). — *Organisms Diversity & Evolution* 17 (4): 789-812.
- ALMERA, J. & BOFILL, A., 1898. Moluscos fósiles recogidos en los terrenos pliocenos de Cataluña. Descripciones y figuras de las nuevas formas y enumeración de todas las encontradas en dichos yacimientos. — *Boletín de la Comisión del Mapa Geológico de España* (2) 4: i-xii, 1-223, pls 1-14.
- ANCONA, C. D’, 1871. Malacologia pliocenica Italiana. Fasci-

- colo I. Generi: *Strombus*, *Murex*, *Typhis*. — Memorie per Servire alla Descrizione della Carta Geologica d'Italia 1: 305-363, pls 1-7.
- ANCONA, C. D', 1872. Malacologia pliocenica Italiana. Fascicolo II. Generi: *Pisania*, *Ranella*, *Triton*, *Fasciolaria*, *Turbinella*, *Cancellaria*, *Fusus*. — Memorie per Servire alla descrizione della Carta Geologica d'Italia 2: 171-264, pls 8-15.
- ANDRADE, B.G., COSTA, P.M.S. & PIMENTA, A.D., 2011. Taxonomic review of the genus *Opaliopsis* (Gastropoda: Nystiellidae) from Brazil, with description of a new species. — Journal of the Marine Biological Association of the United Kingdom 91 (7): 1561-1566.
- ANDREOLI, G. & MARSIGLI, S., 1992. Contributo alla conoscenza della malacofauna pliocenica modenese (Introduzione e parte 1 – famiglia Muricidae). — Natura Modenese 1 ["1991"]: 3-20, pls 1-5.
- ARDOVINI, R. & COSSIGNANI, T., 2004. West African seashells (including Azores, Madeira and Canary Is.) = Conchiglie dell'Africa Occidentale (incluse Azzorre, Madeira e Canarie). English-Italian edition: 1-319. L'Informatore Piceno, Ancona, Italy.
- BELLARDI, L., 1841. Description des cancellaires fossiles des terrains tertiaires du Piémont. — Memorie della Reale Accademia delle Scienze di Torino, Serie Seconda 3: 225-264, pls 1-4.
- BELLARDI, L., 1882. I molluschi dei terreni terziari del Piemonte e della Liguria. Parte III. Gasteropoda (Buccinidae, Cyclopididae, Purpuridae, Coralliophilidae, Olividae): 1-253, pls 1-12. Ermanno Loescher, Roma/Torino/Firenze (December 10, 1882). Note: this is a reprint of the Memorie della Reale Accademia delle Scienze di Torino, Serie Seconda, 34 (1883): 219-469, pls 1-12 (published 1883).
- BEU, A.G., 2010. Neogene tonnoidean gastropods of tropical and South America: contributions to the Dominican Republic and Panama Paleontology Projects and uplift of the Central American Isthmus. — Bulletins of American Paleontology 377-378: 1-550.
- BIELER, R. & PETIT, R.E., 2010. *Thylacodes-Thylacodus-Tulaxodus*: Worm-snail name confusion and the status of *Serpulorbis* (Gastropoda: Vermetidae). — Malacologia 52 (1): 183-187.
- BOUCHET, P. & WARÉN, A., 1986. Revision of the northeast Atlantic bathyal and abyssal Acclididae, Eulimidae, Epi-toniidae (Mollusca, Gastropoda). — Bollettino Malacologico, Supplemento 2: 299-576.
- BREBION, P., 1964. Les gastéropodes du Redonien et leur signification, 1-2. Thèse de doctorat ès-Sciences: 1-775, 15 pls. Paris (Faculté des Sciences de l'Université de Paris: (27 June 1964, unpublished).
- BROCCHI, G., 1814. Conchiologia fossile subapennina, con osservazioni geologiche sugli Apennini e sul suolo adiacente. Tomo primo: 1-240; Tomo secondo: 241-712, pls 1-16. Stamperia Reale, Milano.
- BRUNETTI, M.M., 2016. On some Pliocene Cancellariidae (Mollusca Gastropoda) from the Mediterranean Basin with description of a new species. — Biodiversity Journal 7 (3): 319-324.
- BRUNETTI, M.M. & CRESTI, M., 2018. I fossili di Orciano Pisano [The fossils of Orciano Pisano]. Atlante iconografico [An Iconographic Atlas]: 1-232. Edizioni Danaus, Palermo.
- BRUNETTI, M.M. & DELLA BELLA, G., 2016. Revisioni di alcuni generi della famiglia Buccinidae Rafinesque, 1815 nel Plio-Pleistocene del Bacino Mediterraneo, con descrizione di tre nuove specie. — Bollettino Malacologico 52 (1): 3-37.
- BRUNETTI, M.M., DELLA BELLA, G., FORLI, M. & VECCHI, G., 2008. La famiglia Cancellariidae Gray, J.E., 1853 nel Pliocene italiano: note sui generi *Scalptia* Jousseume, 1887, *Tribia* Jousseume, 1887, *Contortia* Sacco, 1894, *Trigonostoma* Blainville, 1827 e *Aneurystoma* Cossmann, 1899 (Gastropoda), con descrizione di una nuova specie. — Bollettino Malacologico 44 (5-8): 51-69.
- BRUNETTI, M.M., DELLA BELLA, G., FORLI, M. & VECCHI, G., 2009. La famiglia Cancellariidae Forbes & Hanley, 1851 nel Plio-Pleistocene italiano: i generi *Bonellitia*, *Pseudobabylonella* n. gen., *Admete* e *Cancellicula* Tabanelli, 2008, con descrizione di tre nuove specie. — Bollettino Malacologico 45 (2): 55-81.
- BRUNETTI, M.M., DELLA BELLA, G., FORLI, M. & VECCHI, G., 2011. La famiglia Cancellariidae Forbes & Hanley, 1851 nel Plio-Pleistocene italiano: note sui generi *Bivetiella*, *Sveltia*, *Calcarata*, *Solatia*, *Trigonostoma* e *Brocchinia* (Gastropoda). — Bollettino Malacologico 47 (2): 85-130.
- BRUNETTI, M.M. & FORLI, M., 2010. *Murexsul zezae* n. sp. del Pliocene Italiano (Gastropoda: Muricidae). — Bollettino Malacologico 46 (1): 4-8.
- BRUNETTI, M.M., FORLI, M. & VECCHI, G., 2007. La famiglia Cancellariidae Gray J.E., 1853 nel Plio-Pleistocene mediterraneo. I generi *Tribia* Jousseume, 1887 e *Scalptia* Jousseume, 1887, con descrizione di due nuove specie. — Bollettino Malacologico 42 (5-8): 39-57.
- BRUNETTI, M.M. & VECCHI, G., 2005. Nuove specie di Gastropodi del Piacenziano di rio Crevallese, Castell'Arquato (Piacenza, Italia). — Bollettino Malacologico 41 (1-4): 1-22.
- BRUSINA, S., 1869. Gasteropodes nouveaux de l'Adriatique. — Journal de Conchyliologie 17 (3): 230-249.
- BUCQUOY, F., DAUTZENBERG, P. & DOLLFUS, G., 1882-1886. Les mollusques marins du Roussillon. Tome I<sup>er</sup>. Gastropodes, avec atlas de 66 planches. Photographées d'après nature. Fascicule 1: 1-40, pls 1-5 (1882); 2: 41-84, pls 6-10 (1882); 3: 85-136, pls 11-15 (1883); 4: 137-196, pls 16-20 (1883); 5: 197-222, pls 21-25 (1884); 6: 223-258, pls 26-30 (1884); 7: 259-298, pls 31-35 (1884); 8: 299-342, pls 36-40 (1884); 9:



- 343-386, pls 41-45 (1885); 10: 387-418, pls 46-50 (1885); 11: 419-454, pls 51-55 (1886); 12: 455-486, pls 56-60 (1886); 13: 487-570, pls 61-66 (1886). J.-B. Baillière & Ph. Dautzenberg, Paris.
- CAVALLO, O. & REPETTO, G., 1992. Conchiglie fossili del Roero. Atlante iconografico. — Associazione Naturalistica Piemontese Memorie (Associazione Amici del Museo 'Federico Eusebio'), 2: 1-251.
- CECALUPO, A. & ROBBA, E., 2010. The identity of *Murex tubercularis* Montagu, 1803 and description of one new genus and two new species of the Cerithiopsidae (Gastropoda: Triphoroidea). — Bollettino Malacologico 46 (2): 45-64.
- CEREGATO, A, DELLA BELLA, G. & TABANELLI, C., 2005. Revisione della malacofauna pliocenica di Rio Albonello. I. La presenza del genere *Pelycidion*, Fischer in Folin & Périer, 1873 (Gastropoda, Pelycidiidae). — Bollettino Malacologico 40 (9-12): 101-105.
- CERULLI-IRELLI, S., 1911. Fauna malacologica mariana. Parte quinta. Cancellariidae, Marginellidae, Mitridae, Fusidae, Chrysodomidae, Buccinidae, Nassidae, Columbellidae, Muricidae, Tritonidae, Cassidae, Cypraeidae, Chenopodidae. — Paleontographia Italica 17: 280-325, pls 38-43.
- CERULLI-IRELLI, S., 1912. Fauna malacologica mariana. Parte sesta. Cerithiidae, Cerithiopsidae, Triforidae, Diastomidae, Vermetidae, Turritellidae, Mathildidae, Caecidae. — Paleontographia Italica 18: 327-355, pls 44-46.
- CERULLI-IRELLI, S., 1916. Fauna malacologica mariana. Parte ottava. Phasianellidae, Turbinidae, Trochidae, Cyclostrematidae, Cocculinidae, Tornidae, Scissurellidae, Fissurellidae, Tecturidae. — Paleontographia Italica 22: 453-501, pls 56-60.
- CHIRLI, C., 1988. Malacofauna pliocenica di Poggibonsi, Cava delle Piaggiole: 1-89. Lalli E., Poggibonsi.
- CHIRLI, C., 1995. Il genere *Caecum* Fleming, 1817 nel Pliocene Toscano. — Bollettino Malacologico 31 (1-4): 21-27.
- CHIRLI, C., 1997. Malacofauna Pliocenica Toscana 1. Superfamiglia Conoidea: 1-129, pls 1-29. Chirli, Firenze.
- CHIRLI, C., 2000. Malacofauna Pliocenica Toscana, 2 Superfamiglia Muricoidea: 1-142, pls. 1-49. Chirli, Firenze.
- CHIRLI, C., 2002. Malacofauna Pliocenica Toscana, 3. Superfamiglia Muricoidea 2° e Cancellarioidea: 1-92, pls 1-37. Chirli, Firenze.
- CHIRLI, C., 2004. Malacofauna Pliocenica Toscana, 4. Archaeogastropoda: 1-113, pls 1-41. Chirli, Firenze.
- CHIRLI, C., 2006. Malacofauna Pliocenica Toscana, 5. Caenogastropoda: 1-144, pls 1-46. Chirli, Firenze.
- CHIRLI, C., 2009. Malacofauna Pliocenica Toscana, 7. Ptenoglossa. 1-98, pls 1-31. Chirli, Firenze.
- CHIRLI, C. & RICHARD, C., 2008. Les mollusques plaisanciens de la Côte d'Azur: 1-128, pls 1-25. Chirli, Tarnelle.
- CLAREMONT, M., VERMEIJ, G.J., WILLIAMS, S.T. & REID, D.G., 2013. Global phylogeny and new classification of the Rapaninae (Gastropoda: Muricidae), dominant molluscan predators on tropical rocky seashores. — Molecular Phylogenetics and Evolution 66 (1): 91-102.
- CLENCH W.J. & TURNER R.D., 1952. The genera *Epitonium* (part II), *Depressiscala*, *Cylindriscala*, *Nystiella* and *Solutiscala* in the western Atlantic. — Johnsonia 2 (31): 289-356.
- CORSELLI, C. & BERNOCCHI, A., 1993. On the presence of *Puncturella* (*Cranopsis*) *granulata* (Seguenza, 1862) in the Pliocene of Northern Italy. — Lavori della Società Italiana di Malacologia 24 ["1992"]: 107-118.
- COSSMANN, M., 1886-1892. Catalogue illustré des coquilles fossiles de l'Éocène des environs de Paris. — Annales de la Société Royale Malacologique de Belgique 21: 17-186, pls 1-8 (1886); 22: 3-214, pls 1-8 (1887); 23: 3-324, pls 1-12 (1888); 24: 3-381, pls 1-12 (1889); 26: 3-163, pls 1-3 (1892).
- COSSMANN, M., 1895-1925. Essais de paléoconchologie comparée. Livraison 1: 1-159, pls 1-7 (1895); 2: 1-180, pls 1-8 (1896); 3: 1-201, pls 1-8 (1899); 4: 1-292, pls 1-10 (1901); 5: 1-215, pls 1-9 (1903); 6: 1-151, pls 1-9 (1904); 7: 1-261, pls 1-14 (1906); 8: 1-248, pls 1-4 (1909); 9: 1-215, pls 1-10 (1912); 10: 1-292, pls 1-12 (1915); 11: 1-388, pls 1-11 (1918), 12: 1-349, pls 1-6, A-D (1921); 13: 1-345, pls 1-11 (1925). Cossmann, Paris.
- COSSMANN, M. & PEYROT, A., 1909-1935 (after 1924 continued by A. Peyrot). Conchologie néogénique de l'Aquitaine. — Actes de la Société Linnéenne de Bordeaux 63: 73-293, pls 1-7 (1909); 64: 235-400 (1910), 401-445, pls 8-18 (1911); 65: 51-98 (1911), 99-333, pls 19-28 (1912); 66: 121-232 (1912), 233-324, pls 1-10 (1913); 68: 5-210, 361-435, pls 23-26 (1914); 69: 157-365 (1917); 70: 5-180, pls 1-10 (1918), 181-491, pls 11-17 (1919) 73: 5-321, pls 1-7 (1922); 74: 257-342 (1923); 75: 71-318, pls 8-18 (1924); 77: 51-194 (1925); 78: 199-256, pls 1-4 (1927); 79 Suppl.: 5-263, pls 5-14 (1928); 82: 73-126 (1931); 83: 3-116, pls 1-10 (1931); 84: 3-128 (1932) + 129-288, pls 11-18 (1933); 85: 3-71 (1933); 86: 257-353 (1935). Also published as a six volume book with different pagination as Édition in-8°, Extrait des Actes de la Société Linnéenne de Bordeaux ('Ouvrages couronnés par l'Académie des Sciences, Arts et Belles-Lettres de Bordeaux'), 1: 1-220, pls 1-7 (1909); 221-428, pls 8-18 (1911); 429-718, pls 19-28 (1912); 2: 1-204, pls 1-10 (1913); 205-496, pls 11-26 (1914); 3: 1-384, pls 1-10 (1917); 385-695, pls 11-17 (1919); 4: 1-322, pls 1-7 (1922); 323-610, pls 8-18 (1924); 5: 1-206, pls 1-4 (1927); 207-465, pls 5-14 (1928); 6: 1-294, pls 1-10 (1931); 295-541, pls 11-18 (1932).
- CROVATO, P. & TAVIANI, M., 1985. *Nystiella atlantis* Clench & Turner, 1952 from the Pleistocene of Archi (Reggio Calabria: Southern Italy): First fossil record of the subfamily Nystiellinae (Gastropoda, Epitoniidae). — Bollettino Malacologico 21 (10-12): 289-294.
- CUNHA, T.J., LEMER, S., BOUCHET, P., KANO, Y. & GIRIBET, G., 2019. Putting keyhole limpets on the map: phylogeny

- and biogeography of the globally distributed marine family Fissurellidae (Vetigastropoda, Mollusca). — *Molecular Phylogenetics and Evolution* 135: 249-269.
- DALL, W.H., 1889. Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877-78) and in the Caribbean Sea (1879-80), by the U.S. Coast Survey Steamer “Blake”, Lieut.-Commander C.D. Sigsbee, U.S.N., and Commander J.R. Bartlett, U.S.N., commanding. XXIX. — Report on the Mollusca. Part II. — Gastropoda and Scaphopoda. — *Bulletin of the Museum of Comparative Zoölogy at Harvard College* 18: 1-492, pls 10-40.
- DAUTZENBERG, P. & FISCHER, H., 1896. Dragages effectués par l’Hirondelle et par la Princesse Alice, 1888-1895. 1. Mollusques Gastéropodes. — *Mémoires de la Société Zoologique de France* 9: 395-498, pls 15-22.
- DAUTZENBERG, P. & FISCHER, H., 1897. Dragages effectués par l’Hirondelle et par la Princesse Alice, 1888-1896. — *Mémoires de la Société Zoologique de France* 10: 139-234, pls 3-7.
- DAVOLI, F., 1982. Cancellariidae (Gastropoda). In: E. MONTANARO GALLITELLI (ed.), *Studi monografici sulla malacologia miocenica modenese. Parte 1. Molluschi tortoniani di Montegibbio*. — *Palaeontographia Italica* 72 (= Nuova Serie 42): 5-73, pls 1-7.
- DAVOLI, F., 1995. I molluschi del Messiniano di Borelli (Torino), 3. Cancellariidae. — *Bollettino del Museo Regionale di Scienze Naturali* 13: 221-264.
- DELLA BELLA, G., NALDAI, F. & SCARPONI, D., 2015. Molluschi marini del Plio-Pleistocene dell’Emilia-Romagna e della Toscana. Superfamiglia Conoidea. Volume 4. Marginellidae II. — *Lavori della Società Italiana di Malacologia* 26: 1-80.
- DEFRANCE, M.J.L., 1816-1830. In: CUVIER, F. (ed.). *Dictionnaire des sciences naturelles, dans lequel on traite méthodiquement des différens êtres de la nature, considérés soit en eux-mêmes, d’après l’état actuel de nos connoissances, soit relativement à l’utilité qu’en peuvent retirer la médecine, l’agriculture, le commerce et les arts. Suivi d’une biographie des plus célèbres naturalistes. Ouvrage destiné aux médecins, aux agriculteurs, aux commerçans, aux artistes, aux manufacturiers, et à tous ceux qui ont intérêt à connoître les productions de la nature, leurs caractères génériques et spécifiques, leur lieu natal, leurs propriétés et leurs usages*, 1-60, 12 unnumbered volumes of plates. F.G. Levrault / Le Norman, Strasbourg / Paris.
- DONALD, K.M., PRESTON, J., WILLIAMS, S.T., REID, D.R., WINTER, D., ALVAREZ, R., BUGE, B., HAWKINS, S.J., TEMPLADO, J. & SPENCER, H.G., 2012. Phylogenetic relationships elucidate colonization patterns in the intertidal grazers *Osilinus* Philippi, 1847 and *Phorcus* Risso, 1826 (Gastropoda: Trochidae) in the northeastern Atlantic Ocean and Mediterranean Sea. — *Molecular Phylogenetics and Evolution* 62 (1): 35-45.
- ESTES, J.A., LINDBERG, D.R. & WRAY, C., 2005. Evolution of large body size in abalones (*Haliotis*): patterns and implications. — *Paleobiology* 31 (4): 591-606.
- FEHSE, D. & LANDAU, B.M., 2002. Contributions to eratoid systematics (Mollusca, Gastropods), 1. Early Pliocene Eratoidae from the western Mediterranean. — *Cainozoic Research* 1: 13-33.
- FEHSE, D. & LANDAU, B.M., 2003. Contributions to triviid systematics (Mollusca, Gastropoda), 6. Early Pliocene Triviidae from the western Mediterranean. — *Cainozoic Research* 2: 87-108.
- FEKIH, M., 1975. Paleoeologie du Pliocène marin au nord de la Tunisie. — *Annales des Mines et de la Géologie* 27: 1-195.
- FERRERO, E., MERLINO, B. & PROVERA, A., 1998. Malacofauna plioceniche astigiane concentrate da eventi ad alta energia. — *Bollettino Malacologico* 33 (1-4): 43-57.
- FERRERO MORTARA, E.L., MONTEFAMEGLIO, L., NOVELLI, M., OPESSO, G., PAVIA, G. & TAPIERI, R., 1984. Catalogo dei tipi e degli esemplari figurati della collezione Bellardi e Sacco. Parte II. — *Museo Regionale di Scienze Naturali, Cataloghi* 7: 1-484.
- FLEMING, J., 1813. *Conchology*. Brewster’s *Edinburgh Encyclopedia* 7: 55-107.
- FOLIN, L. DE & PÉRIER, L., 1867-1887. *Les fonds de la mer*. Paris: Savy. 4 volumes. Vol. 1: 1-48 (1867), 49-112 (1868), 113-176 (1869), 177-256 (1870), 257-272 (1871), 273-316 (1872), pls 1-32, 21bis; Vol. 2: 1-64 (1872), 65-112 (1873), 113-124 (1874), 125-160 (1875), 161-208 (1873), 209-304 (1874), 305-360 (1875), 361-365 (1876), pls 1-11; Vol. 3: 1-96 (1876), 97-208 (1877), 209-337 (1879), pls 1-9, 7bis; Vol. 4: 1-48 (1881), 49-144 (1881-1884), 145-192 (1884-1887), 193-240 (1887), pls 1-11, 14, 15. Dates after Rehder (1946), *Proceedings of the Malacological Society of London* 27 (2): 74-75. Dates for plates not exactly known.
- FORESTI, L., 1876. Cenni geologici e paleontologici sul Pliocene antico di Castrocaro. — *Memoire della Accademia delle Scienze dell’Istituto di Bologna, Serie terza*, 6: 1-56, 1 pl.
- FORLI, M., DELL’ANGELO, B., MONTAGNA, P. & TAVIANI, M., 2004. A new large *Patella* (Mollusca: Patellogastropoda) in the Pliocene of the Mediterranean Basin. — *Bollettino Malacologico* 40 (1-4): 49-78.
- FORLI, M., BRUNETTI, M.M. & REITANO, A., 2013. Due specie del Pliocene italiano a confronto: *Hexaplex dumosus* (de Stefani, 1875) ed *Hexaplex praeduplex* Landau, Houart & da Silva, 2007 (Gastropoda: Muricidae). — *Bollettino Malacologico* 49 (1): 49-57.
- FORLI, M., QUAGGIOTTO, E. & GERMANÁ, A., 2014. Ridescrizione di *Gibbula anodosula* Sacco, 1896, specie valida del Pliocene italiano (Gastropoda: Trochidae). — *Bollettino Malacologico* 50 (2): 68-74.

- FRETTER, V. & GRAHAM, A., 1978. The prosobranch molluscs of Britain and Denmark. Part 4 – Marine Rissoacea. — *The Journal of Molluscan Studies*, Supplement 6: 153-241.
- GALINDO, L.A., PUILLANDRE, N., UTGE, J., LOZOUET, P. & BOUCHET, P., 2016. The phylogeny and systematics of the Nassariidae revisited (Gastropoda, Buccinoidea). — *Molecular Phylogenetics and Evolution* 99: 337-353.
- GARILLI, V., 2008. On some Neogene to Recent species related to *Galeodina* Monterosato, 1884, *Galeodinopsis* Sacco, 1895, and *Massotia* Bucquoy, Dautzenberg & Dollfus, 1884 (Caenogastropoda: Rissoidae) with the description of two new *Alvania* species from the Mediterranean Pleistocene. — *The Nautilus* 122 (1): 19-51.
- GEIGER, D.L., 2012. Monograph of the little slit shells. Volume 1. Introduction, Scissurellidae. Volume 2. Anatomidae, Larocheidae, Depressizonidae, Sutilizonidae, Temnocinclidae. — Santa Barbara Museum of Natural History Monographs 7: 1 (1-728); 2 (729-1291).
- GEIGER, D.L. & GROVES, L., 1999. Review of fossil Abalone (Gastropoda: Haliotidae) with comparison to Recent species. — *Journal of Paleontology* 73 (5): 872-885.
- GERONIMO, I. DI & LA PERNA, R., 1997. Pleistocene bathyal molluscan assemblages from southern Italy. — *Rivista Italiana di Paleontologia e Stratigrafia* 103 (3): 389-426.
- GERONIMO, I. DI, MESSINA, C., ROSSO, A., SANFILIPPO, R., SCIUTO, F. & VERTINO, A., 2005. Enhanced biodiversity in the deep: Early Pleistocene coral communities from southern Italy: 61-86. In: FREIHWALD, A. & ROBERTS, J.M. (eds). *Cold-water corals and ecosystems*. Springer-Verlag, Berlin / Heidelberg.
- GIANNUZZI-SAVELLI, R., PUSATERI, F., PALMERI, A. & EBREO, C., 1994. Atlante delle conchiglie marine del Mediterraneo, 1. (Archaeogastropoda): 1-125. Evolver, Roma.
- GIANNUZZI-SAVELLI, R., PUSATERI, F., PALMERI, A. & EBREO, C., 1997. Atlante delle conchiglie marine del Mediterraneo, vol. 2 (Caenogastropoda parte 1: Discopoda-Heteropoda): 1-258. Evolver, Roma.
- GILI, C.V., 1991. Els Nassariidae (Gastropoda, Prosobranchia) del Pliocè de la Mediterrània Occidental: 1-563. PhD thesis, Departament d'Ecologia, Facultat de Biologia, Departament de Geologia Dinàmica, Geofísica i Paleontologia. Facultat de Geologia, Universitat de Barcelona. (unpublished).
- GITTENBERGER, A. & GITTENBERGER, E., 2005. A hitherto unnoticed adaptive radiation: epitoniid species (Gastropoda: Epitoniidae) associated with corals (Scleractinia). — *Contributions to Zoology* 74 (1-2): 125-203.
- GLIBERT, M., 1957-1958. Gastropodes du Diestien, du Scaldisien et du Merxémien de la Belgique, 1-2. — *Bulletin de l'Institut royal des Sciences Naturelles de Belgique* 33 (36): 1-27, pl. 1 (1957); 34 (15): 1-36, pl. 2 (1958).
- GOFAS, S., 2005. Geographical differentiation in *Clelandella* (Gastropoda: Trochidae) in the northeastern Atlantic. — *Journal of Molluscan Studies* 71 (2): 133-144.
- GONZÁLEZ DELGADO, J.A., 1985-1989. Estudio sistemático de los gasterópodos del Plioceno de Huelva (sw de España), 1. Archaeogastropoda; 2. Mesogastropoda. Rissoacea, Cerithiacea; 3. Mesogastropoda (Scalacea-Tonnaacea); 4. Neogastropoda (Muricacea, Buccinacea). — *Studia Geologica Salmanticensis* 20: 45-77 (1985); 23: 61-120 (1986); 25: 109-159 (1988); 26: 269-315 (1989).
- GOUGEROT, L., FEKIH, M. & LE RENARD, J., 1977. Le genre *Allixia* Cossmann (Gastropoda Rissoidae) sa position systématique et sa longévité. — *Cahiers des Naturalistes* 31 (2) ["1975"]: 41-48.
- GRAY, J.E., 1847a. The classification of the British Mollusca, by W. E. Leach, M. D. — *Annals and Magazine of Natural History* (1) 20 (133): 267-273 [1 October].
- GRAY, J.E., 1847b. A list of the genera of Recent Mollusca, their synonyma and types. — *Proceedings of the Zoological Society of London* 15 (178): 129-219 [November].
- GUERRA-MERCHÁN, A., SERRANO, A. & RAMALLO, D., 2002. Evolución sedimentaria y paleogeográfica pliocena del borde septentrional de la cuenca de Alborán en el área de Estepona (provincia de Málaga, Cordillera Bética). — *Pliocénica* 2: 31-43.
- HARMER, F.W., 1914-1925. The Pliocene Mollusca of Great Britain, being supplementary to S.V. Wood's Monograph of the Crag Mollusca. Volume 1 Part 1: 1-200, pls 1-24 (1914); part 2: 201-302, pls 25-32 (1915); part 3: 303-461, pls 33-44 (1918); part 4: 463-483, i-xii (1919). Volume 2 Part 1: 485-652, pls 45-52 (1920); part 2: 653-704, pls 53-56 (1921); part 3: 705-856, pls 57-64 (1923); part 4: 857-900, i-xiv, pl. 65 (1925). Palaeontological Society, London.
- HARRIS, G.F. & BURROWS, H.W., 1891. The Eocene and Oligocene Beds of the Paris Basin: viii + 129 pp. Geologist's Association, London.
- HARRY, H.W., 1967. A review of the living tectibranch snails of the genus *Volvulella*, with descriptions of a new subgenus and species from Texas. — *The Veliger* 10 (2): 133-147.
- HARZHAUSER, M. & KRONENBERG, G.C., 2013. The Neogene strombid gastropod *Persististrombus* in the Paratethys Sea. — *Acta Palaeontologica Polonica* 58 (4): 785-802.
- HARZHAUSER, M. & LANDAU, B.M., 2019. Turritellidae (Gastropoda) of the Miocene Paratethys Sea with considerations about turritellid genera. — *Zootaxa* 4681 (1): 1-136.
- HERRMANNSEN, A.N., 1846-1852. *Indicis generum malacozoorum primordia. Nomina subgenerum, generum, familiarum, tribuum, ordinum, classium: adjectis auctoribus, temporibus, locis systematicis atque literariis, etymus, synonymis. Praetermittuntur Cirripedia, Tunicata et Rhizopoda.* 1 (1): I-XXVII, 1-104 (1846); 1 (2): 105-232 (1846); 1 (3): 233-360 (1847); 1 (4): 361-488 (1847); 1 (5): 489-

- 616 (1847); 1 (6): 617-637 (1847); 2 (6): 1-104 (1847); 2 (7): 105-232 (1847); 2 (8): 233-352 (1847); 2 (9): 353-492 (1848); 2 (10): 493-612 (1849); 2 (11): 613-717, XXIX-XLIII (1849); Supplementa et corrigenda: I-V, 1-140 (1852). T. Fischeri, Cassel.
- INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE, 1999. International Code of Zoological Nomenclature. Fourth Edition: xxix + 306 pp. International Trust for Zoological Nomenclature, London.
- INZANI, A., 1993. La Famiglia Cancellariidae nel Pliocene italiano. Part 3. — *World Shells* 5: 82-85.
- INZANI, A. & BERTARELLI, C., 1985. La famiglia Muricidae nel Pliocene italiano (seconda parte). — *Hobby Fauna* 1 (12): 27-35.
- IREDALE, T., 1915. A commentary on Suter's Manual of the New Zealand Mollusca. — *Transactions and Proceedings of the New Zealand Institute* 47 ["1914"]: 417-497.
- JANSSEN, A.W., 2004. Holoplanktonic molluscan assemblages (Gastropoda, Heteropoda, Thecosomata) from the Pliocene of Estepona (Spain, Malaga). — *Palaeontos* 5: 103-131.
- JEFFREYS, J.G., 1862-1869. *British Conchology*. 1: cxiv + 341 pp, pls 1-8 [1862]; 2: xiv + 566 pp, pls 1-8 [1864: titlepage states date as 1863, but published 1864]; 3: 394 pp, pls 1-8 [1865]; 4: 487 pp, pls 1-8 [1867]; 5: 259 pp, pls 1-8, 1-120 [1869]. Van Voorst, London.
- JOUSSEAUME, F.P., 1887. La famille des Cancellariidae (Mollusques gastéropodes). — *Le Naturaliste* (2) 9 (13): 155-157; (16): 192-194; (18): 213-214; (19): 221-223.
- KOKSHOORN, B., GOUD, J., GITTENBERGER, E. & GITTENBERGER, A., 2007. Epitoniid parasites (Gastropoda, Caenogastropoda, Epitoniidae) and their host sea anemones (Cnidaria, Actiniaria, Cerantharia) in the Spermonde archipelago, Sulawesi, Indonesia. — *Basteria* 71 (1-3): 33-56.
- KOUFOPANOU, V., REID, D.G., RIDGEWAY, S.A. & THOMAS, R.H., 1999. A molecular phylogeny of the patellid limpets (Gastropoda: Patellidae) and its implications for the origins of their antitropical distribution. — *Molecular Phylogenetics and Evolution* 11 (1): 138-156.
- LANDAU, B.M., BEU, A. & MARQUET, R., 2004b. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 5. Tonnoidea, Ficoidea. — *Palaeontos* 5: 35-102, pls 1-10.
- LANDAU, B.M., CEULEMANS, L. & VAN DINGENEN, F., 2018. The upper Miocene gastropods of northwestern France, 2. Caenogastropoda. — *Cainozoic Research* 18 (2): 177-368.
- LANDAU, B.M., CEULEMANS, L. & VAN DINGENEN, F., 2020. The upper Miocene gastropods of northwestern France, 5. Conoidea. — *Cainozoic Research* 20 (1): 3-107.
- LANDAU, B.M. & FEHSE, D., 2004. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 3. Trivioidea, Cypraeoidea. — *Palaeontos* 5: 1-34, pls 1-10.
- LANDAU, B.M., HARZHAUSER, M., BÜYÜKMERİÇ, Y. & BREITENBERGER, A., 2016. Additions to the gastropods of the middle Miocene (Serravallian) Karaman Basin, Turkey. — *Cainozoic Research* 16 (2): 221-229.
- LANDAU, B.M., HARZHAUSER, M., İSLAMOĞLU, Y. & SILVA, C.M. DA, 2013. Systematics and palaeobiogeography of the gastropods of the middle Miocene (Serravallian) Karaman Basin, Turkey. — *Cainozoic Research* 11-13: 3-584.
- LANDAU B.M., HOUART, R. & SILVA, C.M. DA, 2007. The Early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 7: Muricidae. — *Palaeontos* 11: 1-87, pls 1-15.
- LANDAU, B.M. & JANSEN, A., 2015a. Additions to the gastropod fauna of the Pliocene of Estepona, southwestern Spain, 1. Two new vetigastropod records. — *Basteria* 78 (4-6): 103-108.
- LANDAU, B.M., JANSEN, A. & SILVA, C.M. DA, 2015b. Additions to the gastropod fauna of the Pliocene of Estepona, southwestern Spain, 2. The genus *Spiricella* Rang, 1828 (Umbraculida; Umbraculidae). — *Basteria* 79 (1-3): 55-58.
- LANDAU, B.M. & JANSEN, A., 2015c. Additions to the gastropod fauna of the Pliocene of Estepona, southwestern Spain, 3. The genus *Plesiothyreus* Cossmann, 1888 (Phenacolepadidae), with a note on its presence in the Middle Miocene of Winterwijk, Miste, The Netherlands. — *Cainozoic Research* 15 (1-2): 123-126.
- LANDAU, B.M., LA PERNA, R. & SILVA, C.M. DA, 2006a. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 10. Marginelliidae, Cysticidae. — *Palaeontos* 9: 22-60, pls 1-12.
- LANDAU, B.M., LA PERNA R. & MARQUET, R., 2006c. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 6: Triphoroidea, Epitonioida, Eulimoidea. — *Palaeontos* 10: 1-96, pls 1-22.
- LANDAU, B.M. & LOZOUET, P., 2003. The genus *Heteroninella* (Mollusca: Turbinidae) from the Lower Pliocene of Estepona, southern Spain. — *Cainozoic Research* 2: 3-8.
- LANDAU, B.M. & MARQUET, R., 2000. The genus *Cymbium* (Gastropoda, Volutidae) in the Iberian Neogene. — *Contributions to Tertiary and Quaternary Geology* 37 (1-2): 23-34.
- LANDAU, B.M. & MARQUET, R., 2001. The first fossil record of the genus *Chileutomia* (Eulimidae: Gastropoda) in the Mediterranean Neogene. — *Bollettino Malacologico* 37 (9-12): 223-224.
- LANDAU, B.M., MARQUET, R. & GRIGIS, M., 2003. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 1: Vetigastropoda. — *Palaeontos* 3: 1-87, pls 1-19.
- LANDAU, B.M., MARQUET, R. & GRIGIS, M., 2004a. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 2: Orthogastropoda, Neotaenioglossa. —

- Palaeontos 4: 1-108, pls 1-20.
- LANDAU, B.M., PETIT, R.E. & MARQUET, R., 2006b. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 12: Cancellarioidea. — *Palaeontos* 9: 61-101, pls. 1-9.
- LANDAU, B.M. & SILVA, C.M. DA, 2006a. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain. Part 9: Olividae. — *Palaeontos* 9: 1-21, pls 1-2.
- LANDAU B.M. & SILVA, C.M. DA, 2006b. The genus *Scaphella* (Gastropoda: Volutidae) in the Neogene of Europe and its paleobiogeographical implications. — *The Nautilus* 120 (3): 81-94.
- LANDAU, B.M., SILVA, C.M. DA & GILI, C., 2009. The early Pliocene Gastropoda (Mollusca) of Estepona, southern Spain, 8. Nassariidae. — *Palaeontos* 17: 1-101, pls 1-22.
- LANDAU, B., SILVA, C.M. DA & MAYORAL, E., 2011. The lower Pliocene gastropods of the Huelva Sands Formation, Guadalquivir Basin, southwestern Spain. — *Palaeofocus* 4: 1-90.
- LA PERNA, R., LANDAU, B.M. & MARQUET, R., 2002. Species of *Granulina* (Gastropoda, Marginellidae) from the Pliocene of Málaga (southern Spain) with descriptions of four new species. — *Cainozoic Research* 1: 111-120.
- LINDEN, J. VAN DER, 1986. Het genus *Caecum* in Europa. — *Vita Marina* (Juli-Augustus): 403-414.
- LINNAEUS, C., 1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*, 1. Editio decima, reformata: 1-824. Laurentii Salvii, Holmiae [facsimile reprint, British Museum (Natural History), 1956].
- LOWE, R.T., 1827. On *Balanus punctatus*, *Puncturella flemingii*, together with some corrections relative to *Turbo carneus*, and some of the *Chiton* before described. — *Zoological Journal* 3 (9): 76-80.
- LOZANO-FRANCISCO, M.C. & VERA-PELAEZ, J.L., 2002. Estudio preliminar del orden Archaeogastropoda (Gastropoda, Prosobranchia) del Plioceno de la Cuenca de Estepona (Málaga, S España) con la descripción de doce especies nuevas. — *Pliocénica* 2: 157-175.
- LOZANO-FRANCISCO, M.C. & VERA-PELÁEZ, J.L., 2006. Catálogo del material tipo del Museo Municipal Paleontológico de Estepona, parte I. Mollusca, Gastropoda. Descripción de nuevas especies del Plioceno de las cuencas de Estepona (Málaga) y del Guadalquivir (Huelva) (España). — *Pliocénica* 5: 105-124.
- LOZOUET, P., LESPORT, J.F., & RENARD, P., 2001. Révision des Gastropoda (Mollusca) du stratotype de l'Aquitainien (Miocène inf.): site de Saucats "Lariev", Gironde, France. — *Cossmanniana*, Hors série 3: 1-189.
- MALATESTA, A., 1974. Malacofauna pliocenica Umbra. — *Memorie per Servire alla Carta Geologica d'Italia* 13: 1-498, pls 1-32.
- MARQUET, R., 1997. Pliocene gastropod faunas from Kallo (Oost-Vlaanderen, Belgium). Part 2. Caenogastropoda: Potamididae to Tornidae. — *Contributions to Tertiary and Quaternary Geology* 34 (1-2): 9-29.
- MARQUET, R., 1998. De Pliocene gastropodenfauna van Kallo (Oost-Vlaanderen, België): 1-246. Belgische Vereniging voor Paleontologie v.z.w., Antwerpen.
- MARTINELL, J., 1980. Archaeogastropoda del Plioceno del Empordà (Girona). Descriptiva y sistemática. — *Acta Geológica Hispánica* 13 (4): 119-124.
- MARTINELL, J., 1982. Estudio de los Buccinacea (Neogastropoda, Gastropoda) del Plioceno de l'Empordà (Catalunya). Descriptiva y sistemática. — *Butlletí de la Institució Catalana d'Història Natural* 48 (Secció de Geologia 3): 61-90.
- MARTINELL, J. & DOMÈNECH, R., 1986. Malacofauna du Pliocène marin de Saint-Isidore (Bassin du Var, Alpes-Maritimes). — *Geobios* 19 (1): 117-121.
- MERLE, D., GARRIGUES, B. & POINTIER, J.P., 2011. Fossil and recent Muricidae of the world. Part Muricinae: 1-648. ConchBooks, Hackenheim.
- MICALI, P. & VILARI, A., 1989. Il deposito fossilifero di Salice (Messina) con particolare riguardo alle specie istituite da Giuseppe Seguenza. — *Bollettino Malacologico* 25 (1-4): 77-84.
- MIFSUD, C., 1993. Recent Mediterranean findings, *Opaliopsis atlantis* (Clench & Turner, 1952). — *La Conchiglia* 25 (268): 61-62.
- MIFSUD, C., 1994. More records for the presence of *Opaliopsis atlantis* (Clench & Turner, 1952) in the Mediterranean Sea. — *La Conchiglia* 26 (273): 61.
- MIFSUD, C., 2009. *Opaliopsis atlantis* (Clench & Turner, 1952) (Gastropoda: Epitoniidae) found on an actinarian in the Mediterranean. — *Bollettino Malacologico* 45 (1): 1-3.
- MONEGATTI, P. & RAFFI, S., 2001. Taxonomic diversity and stratigraphic distribution of Mediterranean Pliocene bivalves. — *Palaeogeography Palaeoclimatology Palaeoecology* 165 (3-4): 171-193.
- MONEGATTI, P. & RAFFI, S., 2007. Mediterranean-Middle Eastern Atlantic Façade: molluscan biogeography and ecobiostatigraphy throughout the Late Neogene. — *Açoreana*, Suplemento 5: 126-139.
- MONTANARO, E., 1935. Studi monografici sulla malacologia Miocenica Modenese, 1. I molluschi Tortoniani di Montegibbio. — *Palaeontographia Italica* 35 (n. s. 5): 1-84.
- MONTANARO, E., 1939. Studi monografici sulla malacologia Miocenica Modenese, 3. I molluschi Tortoniani di Montegibbio. — *Palaeontographia Italica* 39 (n. s. 5): 101-142.
- MONTEROSATO, T.A. DI, 1878. Enumerazione e sinonimia delle conchiglie Mediterranee. — *Giornale di Scienze Naturali ed Economiche di Palermo* 13: 61-115.
- MONTEROSATO, T.A. DI, 1883-1885. Conchiglie littorali mediterranee. — *Naturalista Siciliano* 3 (3): 87-91 (1883); 3

- (4): 102-111 (1884); 3 (5): 137-140 (1884); 3 (6): 159-163 (1884); 3 (8): 227-231 (1884); 3 (10): 277-281 (1884); 4 (1-2): 21-25 (1884); 4 (3): 60-63 (1884); 4 (4): 80-84 (1885); 4 (8): 200-204 (1885).
- MÖRCH, O.A.L., 1857. Fortegnelse over Grønlands Bløddyr: 75-100. In: RINK, H. (ed.) Grønland geographisk og statistisk beskrevet. Naturhistoriske Bidrag til en Beskrivelse ad Grønlan, 4. Louis Klein, Kjøbenhavn.
- MORONI, M.A. & RUGGIERI, G., 1981. Sulla posizione sistematica del genere *Andonia* Harris & Burrows, 1891 (Neogastropoda). — Bollettino Malacologico 17 (5-6): 99-108.
- MUÑIZ SOLÍS, R., 1996. El género *Calliostoma* Swainson, 1840 y *Astele* Swainson, 1855 (Archaeogastropoda, Mollusca) en el Plioceno de Estepona (Málaga, España). — Malakos 5: 3-26.
- MUÑIZ SOLÍS, R., 1998. Las subfamilias Fasciolarinae Gray, J.E., 1853 y Peristerniinae Tryon, 1880 (Gastropoda, Neogastropoda) del Plioceno de Estepona (Málaga, España). — Malakos 6-7: 1-15.
- MUÑIZ SOLÍS, R., 1999. El género *Conus* L., 1758 (Gastropoda, Neogastropoda) del Plioceno de Estepona (Málaga, España). — Iberus 17 (1): 31-90.
- MUÑIZ SOLÍS, R., 2002. Estudio de las Familias Cystiscidae Stimpson, 1865 y Marginellidae Fleming, 1828 (Gastropoda, Neogastropoda) del Plioceno de Estepona (Málaga, España). — Pliocénica 2: 263-306.
- MUÑIZ SOLÍS, R. & GUERRA-MERCHÁN, A., 1994. Estudio malacológico del Plioceno de Estepona (Málaga). La familia Muricidae, Rafinesque, 1815 (Gastropoda, Prosobranchia). — Iberus 12 (1): 7-44.
- NAKANO, T. & OZAWA, T., 2007. Worldwide phylogeography of limpets of the order Patellogastropoda: molecular, morphological and paleontological evidence. — Journal of Molluscan Studies 73 (1): 79-99.
- NEVILL G., 1885. [After 25 January] Hand list of Mollusca in the Indian Museum, Calcutta. Part 2, Gastropoda. Prosobranchia – Neurobranchia (contd.): x + 306 pp. Office of Superintendent of Government Printing, Calcutta.
- NEWTON, R.B., 1891. Systematic list of the Frederick E. Edwards collection of British Oligocene and Eocene Mollusca in the British Museum (Natural History), with references to the type-specimens from similar horizons contained in other collections belonging to the Geological Department of the Museum: i-xxviii + 1-365. British Museum, London.
- OLIVER, J.D. & ROLÁN, E., 2011. The family Tornidae (Gastropoda, Rissooidea) in the East Atlantic, 2. Circulinae. — Iberus 29 (1): 9-33.
- PANETTA, P., 1980. La famiglia Caecidae in Mediterraneo. — Bollettino Malacologico 16 (7-8): 277-300.
- PAVIA, G., 1976. I molluschi del Pliocene inferiore di Monteu Roero (Alba, Italia NW). — Bollettino della Società Paleontologica Italiana 14 (2): 99-175.
- PELOSIO, G., 1967. La malacofauna dello stratotipo del Tabianiano (Pliocene inferiore) di Tabiano Bagni (Parma). — Bollettino della Società Paleontologica Italiana 5 (2): 101-183, pls 35-47.
- PÉREZ FARFANTE, I., 1947. The genera *Zeidora*, *Nesta*, *Emarginula*, *Rimula* and *Puncturella* in the western Atlantic. — Johnsonia 2 (24): 93-148.
- PEYROT, A., 1925; see COSSMANN, M. & PEYROT, A., 1909-1935.
- PHILIPPI, R.A., 1836. Enumeratio molluscorum siciliae cum viventium tum in tellure tertiaria fossilium quae in itinere suo observavit auctor: i-xiv, 1-268, pls 1-12. Schropp, Berolini.
- PINNA, G., 1971. I Tipi delle specie di Gasteropodi terziari istituite de Giuseppe De Cristofori e Giorgio Jan nel 1832 conservati nelle collezioni del Museo Civico di Storia Naturale di Milano. — Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano 112 (4): 421-440, pls 76-77.
- PINNA, G. & SPEZIA, L., 1978. Catalogo dei tipi del Museo Civico di Storia Naturale di Milano, 5. I tipi dei Gasteropodi fossili. — Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano 119 (2): 125-180, pls 5-68.
- PIZZINI, M., NOFRONI, I. & OLIVERIO, M., 1995. Contribution to the knowledge of the family Caecidae. 2. *Caecum auriculatum* de Folin, 1868 (Caenogastropoda: Rissooidea). — Apex 10 (2-3): 79-86.
- PONDER, W.F., 1985. A review of the genera of the Rissoidae (Mollusca: Mesogastropoda: Rissooidea). — Records of the Australian Museum, Supplement 4 [“1984”]: 1-221.
- PORTA, J., MARTINELL, J. & GONZÁLEZ-DELGADO, J.A., 1993. Caecidae (Gastropoda Mesogastropoda) del Neógeno y Cuaternario marinos del Mediterráneo Noroccidental y de la Península Ibérica. — Revista Española de Paleontología 8 (1): 1-13.
- REGTEREN ALTENA, C.O. VAN, BLOKLANDER, A. & POUDEROYEN, L.P., 1954-1956. De fossiele schelpen van de Nederlandse stranden en zeegeten, 1-3. — Basteria 18 (4): 54-64, pls 1-4 (1954); 19 (2-3): 27-34, pls 5-8 (1955); 20 (4-5): 81-90, pls 9-12 (1956).
- RIO E. DE CARVALHOS, 2009. Compendium of Brazilian sea shells: 1-676. Rio Grande, Evangraf.
- RISSE, A., 1826. Histoire naturelle des principales productions de l'Europe méridionale et principalement de celles des environs de Nice et des Alpes-Maritimes, 4. Mollusques: i-vii, 1-439, pls 1-12. Levrault, Paris.
- RÖDING, P.F., 1798. Museum Boltenianum, sive catalogus cimeliorum e tribus regnis naturae quae olim collegerat Joa. Fried. Bolten, M.D.p.d. per XL annos proto physicus Hamburgensis. Pars secunda. Conchyliia sive Testacea univalvia, bivalvia et multivalvia: 1-199. Johan. Christi. Trappii, Hamburgi.

- ROSSI-RONCHETTI, C., 1955. I tipi della 'Conchiologia Fossile Subappennina' di G. Brocchi, 2. Gastropodi, Scafopodi. — *Rivista Italiana di Paleontologia e Stratigrafia*, Memorie 5: 91-343.
- RUBIO, F. & ROLÁN, E., 1994. Vanikoridae de la costa occidental africana (Mollusca, Gastropoda). — *Iberus* 11 (2) ["1993"]: 45-57.
- RUGGIERI, G., 1994. Due parole su *Caecum decurtatum* Monterosato. — *Bollettino Malacologico* 30 (1-4): 1-4.
- SACCO, F., 1894. I molluschi dei terreni terziarii del Piemonte e della Liguria. Parte XVI. Fam. Cancellariidae H. e A. Adams 1853. — *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino* 9 (171): 68-70 (published consecutively with part 15) (April 27, 1894).
- SACCO, F., 1904. I Molluschi dei terreni terziari del Piemonte e della Liguria, 30. Aggiunte e correzioni (con 1400 figure). Considerazioni generali. Indice generale dell'opera: 203 + xxxvi pp., pls 1-31. C. Clausen, Torino.
- SEGERS, W., SWINNEN, F. & DE PRINS, R., 2009. Marine Molluscs of Madeira: 1-612. Snoeck Publishers, Heule.
- SEGUENZA, G., 1863. Paleontologia malacologica delle rocce terziarie del distretto di Messina studiata nei suoi rapporto zoologici e geognostici. — *Annali dell'Accademia degli Aspiranti Naturalisti* 3 (2): 77-95.
- SEGUENZA, G., 1880. Le formazioni terziarie nella provincia di Reggio (Calabria). Memorie della Classe di Scienze Fisiche Matematiche e Naturali della Regia Accademia del Lincei 3 (6): 1-445, pls 1-17.
- SILVA, C.M. DA, 2001. Gastrópodes pliocénicos marinhos de Portugal: sistemática, paleoecologia, paleobiologia, paleogeografia. Dissertação de doutoramento: 1-747. Faculdade de Ciências da Universidade de Lisboa (unpublished).
- SILVA, C.M. DA, LANDAU, B.M., DOMÈNECH, R., MARTINELL, J., 2006. Pliocene Atlanto-Mediterranean biogeography of *Patella pellucida* (Gastropoda, Patellidae): palaeoceanographic implications. — *Palaeogeography, Palaeoclimatology, Palaeoecology* 233 (3-4), 225-234.
- SILVA, C.M. DA, LANDAU, B., DOMÈNECH, R., MARTINELL, J., 2010. Pliocene Atlantic molluscan assemblages from the Mondego Basin (Portugal): Age and palaeoceanographic implications. — *Palaeogeography, Palaeoclimatology Palaeoecology* 285 (3-4): 248-254.
- SIMONE, L.R.L. & CUNHA, C.M., 2014. Taxonomical study on the mollusks collected in Marion-Dufresne (MD55) and other expeditions to SE Brazil: the Fissurellidae (Mollusca, Vetigastropoda). — *Zoosystema* 3835 (4): 437-468.
- SMRIGLIO, C. & MARIOTTINI, P., 1999. Molluschi del mar Tirreno centrale. Contributo XII. Segnalazione di due rari Epitoniidae batiali per le coste laziali (Gastropoda, Ptenoglossa). — *Bollettino Malacologico* 34 (9-12): 137-140.
- SOSSO, M. & DELL'ANGELO, B., 2010. I fossili del Rio Torsero: 1-95. Editing Marginalia Cartotecnica Beusi srl, Prato.
- SOSSO, M., DELL'ANGELO, B. & BONFITTO, A., 2013. New data on *Cymenorytis* Cossmann from Mediterranean-Atlantic Pliocene and Paratethyan Miocene, with the description of two new species (Gastropoda Prosobranchia: Vanikoridae). — *Archiv für Molluskenkunde* 142 (1): 157-165.
- STEWART, R.B., 1927. Gabb's California fossil type gastropods. — *Proceedings of the Academy of Natural Sciences of Philadelphia* 78: 287-447, pls 20-32.
- SWAINSON, W., 1840. A treatise on malacology or shells and shell-fish: i-viii + 1-419. Longman, London.
- TABANELLI, C., 2018. Notizie aggiuntive su *Cimenorytis landaui* Sosso, Dell'Angelo & Bonfitto, 2013. — *Quaderno di Studi e Notizie di Storia Naturale della Romagna* 48: 1-11.
- THIELE, J., 1928. Über parasitische Schnecken. — *Zeitschrift für Wissenschaftliche Zoologie* 132: 73-94.
- VALDÉS, Á., 2008. Deep-sea "cephalaspidean" heterobranchs (Gastropoda) from the tropical southwest Pacific: 587-792. In: HÉROS, V., COWIE, R.H. & BOUCHET, P. (eds.) *Tropical Deep-Sea Benthos*. Volume 25 [= Mémoires du Muséum National d'Histoire Naturelle 196].
- VAN DINGENEN, F., CEULEMANS, L. & LANDAU, B.M., 2014. *Euroscaphella* nov. gen. (Gastropoda: Volutidae) in the Neogene of Europe, with the description of a new species: *Euroscaphella namnetensis* nov. sp. from the Mio-Pliocene transition of northwestern France. — *Cainozoic Research* 14 (2): 101-111.
- VAN DINGENEN, F., CEULEMANS, L. & LANDAU, B.M., 2016. The lower Pliocene gastropods of Le Pigeon Blanc (Loire-Atlantique, northwest France), 2. Caenogastropoda. — *Cainozoic Research* 16: 109-219.
- VAN DINGENEN, F., CEULEMANS, L. & LANDAU, B.M., 2017. The lower Pliocene gastropods of Le Pigeon Blanc (Loire-Atlantique, northwest France), 4. Neogastropoda (in part). — *Cainozoic Research* 17 (1): 23-61.
- VENZO, S. & PELOSIO, G., 1963. La malacofauna Tortoniana del Colle di Vigoleno (Preappennino Piacentino). — *Palaeontographia Italica* 58: 43-213, pls 31-57.
- VERA-PELÁEZ, J.L., 2002. Revisión de la familia Turridae, excepto Clavatulinae (Gastropoda, Prosobranchia) en el Plioceno de las cuencas de Málaga y Vélez Málaga (Málaga, S España) con la descripción de 26 especies nuevas. — *Pliocénica* 2: 176-262.
- VERA-PELÁEZ, J.L. & LOZANO-FRANCISCO, M.C., 2001a. Revisión de la subfamilia Clavatulinae (Gastropoda, Turridae) con ocho especies nuevas en el Plioceno andaluz (sur de España). — *Pliocénica* 1: 1-67.
- VERA-PELÁEZ, J.L. & LOZANO-FRANCISCO, M.C., 2001b. Revisión del género *Genota* Adams & Adams, 1853 (Gastropoda, Turridae, Conorbinae) con 3 especies nuevas del Plioceno andaluz. — *Pliocénica* 1: 68-84.

- VERA-PELÁEZ, J.L., MARTINELL, J. & LOZANO-FRANCISCO, M.C., 1999. Turridae (Gastropoda, Prosobranchia) del Plioceno inferior de Málaga (España). — *Iberus* 17 (1): 1-19.
- VERA-PELÁEZ, J. L. & MUÑIZ-SOLÍS, R., 1995. Nueva especie de la subfamilia Admetulinae (Cancellariidae, Gastropoda) del Plioceno de Estepona (Málaga, España). — *Revista Española de Paleontología* 10 (2): 297-301.
- VERA-PELÁEZ, J. L., MUÑIZ-SOLÍS, R., LOZANO-FRANCISCO, M. C., MARTINELL, J., DOMÈNECH, R. & GUERRA-MERCHÁN, A., 1995. Cancellariidae Gray, 1853 del Plioceno de la provincia de Málaga, España. — *Treballs del Museu de Geologia de Barcelona* 4: 133-179.
- VERHECKEN, A., 2007. Revision of the Cancellariidae (Mollusca, Neogastropoda, Cancellarioidea) of the eastern Atlantic (40°N-40°S) and the Mediterranean. — *Zoosystema* 29 (2): 281-364.
- WATSON, R.B., 1886. Report on the Scaphopoda and Gastropoda collected by H.M.S. Challenger during the years 1873-76. — Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873-76. *Zoology* 15 (part 42): i-v, 1-756, pls 1-50.
- WEIL, A., BROWN, L. & NEVILLE, B., 1999. The Wentletrap book: Guide to the Recent Epitoniidae of the world: 1-245. Evolver, Rome.
- WOOD, S.V., 1842. A catalogue of shells from the Crag. — *The Annals and Magazine of Natural History* 9: 455-462, 527-544.
- WOOD, S.V., 1848. A monograph of the Crag Mollusca, or description of shells from the middle and upper Tertiaries of the east of England. Part I. Univalves. — *Monographs of the Paleontographical Society*: i-xii, 1-208, pls 1-21.
- Internet sources**
- MOLLUSCABASE 2019a. MolluscaBase. *Hadriania craticulata* Bucquoy & Dautzenberg, 1882. Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=387245> on 2019-09-03.
- MOLLUSCABASE 2019b. MolluscaBase. *Cerithiopsis barleei* Jeffreys, 1867. Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=139074> on 2019-09-06.
- MOLLUSCABASE 2019c. MolluscaBase. *Ampullotrochus* Monterosato, 1890. Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=465575> on 2019-09-17.
- MOLLUSCABASE 2019d. MolluscaBase. *Calliostoma laugieri* (Payraudeau, 1826). Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=141759> on 2019-09-28.
- MOLLUSCABASE 2019e. MolluscaBase. *Galeodinopsis fariyai* (Rolán & F. Fernandes, 1990). Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=993565> on 2020-01-22.
- MOLLUSCABASE 2020a. MolluscaBase. *Opalia coronata* (Philippi & Scacchi, 1840). Accessed through: World Register of Marine Species at: <http://marinespecies.org/aphia.php?p=taxdetails&id=524763> on 2020-03-01.
- MOLLUSCABASE 2020b. MolluscaBase. *Nodiscala* de Boury, 1890. Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=519425> on 2020-03-01.