

The genus *Aporrhais* Da Costa, 1778 (Gastropoda Aporrhaidae) in the Italian Plio-Pleistocene

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ABSTRACT

The species of the genus *Aporrhais* Da Costa, 1778 (Gastropoda, Aporrhaidae) of the Italian Plio-Pleistocene are described and illustrated. To the three species known, *A. pespelecani pespelecani* (Linnaeus, 1758), *A. uttingeriana* (Risso, 1826) and *A. peralata* (Sacco, 1893), the new species *A. etrusca* n. sp., reported only for the Zanclean period of Tuscany (central Italy) and *A. pliorara* (Sacco, 1893), distributed from the Piacenzian to the Lower Pleistocene (Calabrian), elevated to species, are added; moreover, *A. pespelecani* var. *crenatulina* (Sacco, 1893), the most common in the Italian lower-middle Pliocene, widespread from the Tortonian to the Piacenzian, is elevated to subspecies. *A. serresiana* (Michaud, 1827) is considered to have occurred in the Mediterranean basin only in very recent times. The examined species were compared either with extant taxa of Mediterranean (*A. pespelecani pespelecani*, *A. serresiana*) and Afro-Atlantic origin (*A. pesgallinae* Barnard, 1963 *A. senegalensis* Gray, 1838) or with species of the European Neogene: *A. burdigalensis* (d'Orbigny, 1852), *A. meridionalis* (Basterot, 1825), *A. alata* (Von Eichwald, 1830), *A. dingdenensis* Marquet, Grigis et Landau, 2002, *A. scaldensis* Van Regteren Altena, 1954 and *A. thersites* Brives, 1897.

KEY WORDS

Gastropoda; Aporrhaidae; *Aporrhais*; Pliocene; Pleistocene; Italy.

Received 13.12.2012; accepted 18.02.2012; printed 30.03.2013

INTRODUCTION

The genus *Aporrhais* Da Costa, 1778 exists with certainty since the Eocene and, in the Oligocene, underwent a significant increase in the number of species. During the Miocene there were at least a dozen species in the European basins (Landau et al., 2004), while during the Pliocene a significant reduction in the number of species, that continued throughout the Pleistocene, occurred. Currently the genus *Aporrhais*, comprising five species, is present exclusively in the North Atlantic, the Mediterranean (including the Black Sea) and along the West African coast. *A. occidentalis* (Beck, 1836) of western and North-Eastern Atlantic has been attrib-

uted by some authors to different genera, namely *Arrhoges* Gabb, 1868 and *Drepanocheilus* Vaught, 1989, both currently considered synonyms of *Aporrhais*, or *Chenopus* Philippi, 1836 and *Pelecanus* Piette, 1876 (not Linnaeus, 1758). The main feature of this genus is the development of external digits from the peristome. The characteristics of the protoconch of extant species suggest a planktotrophic development (Bouchet & Waren, 1990).

MATERIALS AND METHODS

The examined material, collected during field researches, comes from Pliocene and Pleistocene

deposits (Table 1). For most taxa under study, more than 200 specimens were examined. For all specimens, the height of the shell was measured (on samples with well formed digits) and the number of tubercles in the penultimate whorl (NTG) counted (Table 2). Systematic nomenclature is according to Manganeli et al. (2008).

ACRONYMS AND ABBREVIATIONS. CB = M.M. Brunetti collection, Rioveggio, Bologna, Italy; CDA = B. Dell'Angelo collection, Genova, Italy; CD = G. Della Bella collection, Monterenzio, Bologna, Italy; CF = M. Forli collection, Prato, Italy; H = maximum height of the shell, measured from the apex or the end of the first digit until the front end of the siphonal canal or at the end of the last type, coll. = collection; ex = specimen; exx = specimens; MZB = Museum of Zoology, University of Bologna; MSNF = Museum of Natural Sciences in Florence; MRSNT = Regional Museum of Natural Sciences of Turin; MSNM = Museum of Natural Sciences of Milan; NMB = Naturhistorisches Museum Basel; NHMW = Naturhistorisches Museum, Geologisch - Paläontologische Abteilung, Wien.

SISTEMATIC

Classe GASTROPODA Cuvier, 1797
 Ordine Neotaenioglossa Haller, 1882
 Superfamily STROMBOIDEA, Rafinesque, 1815
 Family APORRHAIIDAE, Gray J.E., 1850
 Genus *Aporrhais* Da Costa, 1778
 type species: *Aporrhais quadrifidus* Da Costa, 1778
 = *Strombus pespeleceni* Linneus, 1758

Aporrhais pespeleceni pespeleceni (Linnaeus, 1758) (Figs. 1-10, 70, 71)

Strombus pes pelicani - Linnaeus, 1758: 742
Aporrhais quadrifidus - Da Costa, 1778: 136-138, pl. 7, fig. 7
Rostellaria ala-draconis - Perry, 1811: 11, fig. 6
Murex gracilis - Brocchi 1814: 437, pl. 9, fig. 16
Fusus fragilis - Risso, 1826: 206, pl. 6, fig. 75
Aporrhais pes-pelicani - Wood, 1848: 25, pl. 2, fig. 4
Chenopus anglicus - d'Orbigny, 1852: 38
Chenopus pespelicani var. *minor* - Bucquoy et al., 1884: 220, pl. 23, fig. 11
Chenopus pespelicani var. *oceanica* - Bucquoy et al., 1884: 220, pl. 24, figs. 4-5

Aporrhais michaudi - Locard, 1888: 11
Aporrhais pelecenipes - Locard, 1892: 123, fig. 109
Chenopus pespeleceni - Cerulli-Irelli, 1911: 275, pl. 26, figs. 29-31
Aporrhais pespeleceni - Harmer, 1918: 432, pl. 41, figs. 26-30
Aporrhais pespeleceni quadrifidus - Glibert, 1958: 25, pl. 2, fig. 21
Aporrhais (Aporrhais) pespeleceni - Malatesta, 1960: 113, pl. 6, fig. 4
Aporrhais pespeleceni - Settepassi, 1971: 1, pl. 1-8, figs. 1-68
Aporrhais michaudi - Settepassi, 1971: 14, pl. 8, fig. 69
Aporrhais pespeleceni quadrifida - Geys & Marquet, 1979: 22, pl. 28, fig. 1
Aporrhais pespeleceni - Macri, 1983: pl. 2, fig. 4
Aporrhais (A.) pespeleceni - Brambilla & Lualdi, 1988: pl. 12, fig. 1
Aporrhais (Aporrhais) pespeleceni - Travaglini, 1988: 5, figs. 2-3
Aporrhais (Aporrhais) pespeleceni - Gonzales Delgado, 1988: 130, pl. 3, figs. 5-7
Aporrhais pespeleceni - Marques da Silva, 1993: 157, pl. 3, fig. 5
Aporrhais pespeleceni - Saunders, 1995: 42, fig. 8
Aporrhais pespeleceni - Giannuzzi-Savelli et al., 1996: 132, figs. 573-587
Aporrhais pespeleceni quadrifida - Marquet, 1998: 74, fig. 49
Aporrhais pespeleceni - Solsona et al., 2000: 83, pl. 1, figs. 1-2
Aporrhais pespeleceni - Nielsen et al., 2007: 187 fig. H
Aporrhais pespeleceni - Chirli, 2007: 8, pl. 3, fig. 6

EXAMINED MATERIAL. Chiusa di Codrignano (Bologna), Gelasian-Calabrian, 104 exx. (CB, CD); Torrente Stirone (Parma), Calabrian, 42 exx (CB, CD); Porto Corsini (Ravenna), modern, 40 exx (CB, CD); Cava Lustrelle (Lecce), Calabrian, 39 exx (CB, CF); Ca' Meldola (Bologna). Calabrian 33 exx (coll. Della Bella); Spicchio (Firenze), Zanclean-Piacenzian, 32 exx (CB, CD, CF); Riparbella (Pisa), Calabrian 20 exx (CB, CF); Calambrone (Pisa), modern, 17 exx (CF); Portoazzurro (Livorno) -80, modern, 12 exx (CD); Torrente Arda (Piacenza), Calabrian, 12 exx (CB, CD, CF); Fauglia (Pisa), Calabrian 10 exx (CF); Rodi Garganico (Foggia), modern, 6 exx (CB); Lucena del Porto (Huelva - Spain), Zanclean, 5 exx (CB); Moronico (Ravenna),

LOCALITIES	AGE OF DEPOSITS	REFERENCES
Acate (Ragusa)	Calabrian	
Armaiolo (Siena, Italy)	Zanclean-Piacenzian*	
Baschi (Terni, Italy)	Piacenzian	Malatesta, 1974
Bibbiano (Siena, Italy)	Zanclean*	
Campino (Siena, Italy)	Zanclean	Laghi, 1984
Cà Bianca (Bologna, Italy)	Zanclean	Della Bella & Scarponi, 2004
Cà Lametta (Bologna, Italy)	Piacenzian	Della Bella & Scarponi, 2004
Cà Meldola (Bologna, Italy)	Calabrian	Della Bella & Scarponi, 2007
Casciana Terme (Pisa, Italy)	Gelasian	
Castelnuovo Berardenga Scalo (Siena, I)	Zanclean	Manganelli et al., 2008
Cava Campore (Parma, Italy)	Piacenzian	Cerergato, 2001
Cava Certaldo (Firenze, Italy)	Piacenzian*	
Cava Lustrelle (Lecce, Italy)	Calabrian	Dell'Angelo et al., 2007
Cava Lugagnano (Piacenza, Italy)	Zanclean	Rio et al., 1988
Cava Signorella (Lecce, Italy)	Calabrian	Macri, 1983
Cava Tacconi (Roma, Italy)	Calabrian	Malatesta & Zarlenga, 1985
Cedda (Siena, Italy)	Zanclean-Piacenzian	Brunetti M. & Della Bella, 2006
Chianello (Siena, Italy)	Zanclean-Piacenzian*	
Chiusa di Codrignano (Bologna, Italy)	Gelasian-Calabrian	Ruggieri, 1962
Ciuciano (Siena, Italy)	Zanclean	Forli & Dell'Angelo, 2000
Cossato (Biella, Italy)	Piacenzian	Aimone & Ferrero Mortara, 1983
Fauglia (Pisa, Italy)	Calabrian	Brunetti M. et al., 2008
Ficulle (Terni, Italy)	Zanclean-Piacenzian	Brunetti M. & Della Bella, 2006
Fosso della Possessione (Ravenna, Italy)	Gelasian	Della Bella & Scarponi, 2010
Guidonia (Roma, Italy)	Piacenzian	Mancini (1997)
Guistrigona (Siena, Italy)	Zanclean-Piacenzian	Bogi et al., 2002
Lagune (Bologna, Italy)	Zanclean*	
Latsia (Cyprus)	Gelasian	
Leognan (France)	Burdigalian	Cauzac et al., 1993
Letkes (Hungary)	Badenian	Csepregy-Meeznerics, 1956
Linari (Siena, Italy)	Piacenzian	Bogi et al., 2002
Lucena del Porto (Huelva, Spain)	Zanclean	Gonzales Delgado, 1988
Luciana (Pisa, Italy)	Zanclean	
Maglie (Lecce, Italy)	Calabrian	
Marzeno (Bologna, Italy)	Piacenzian*	
Masserano (Biella, Italy)	Piacenzian*	
Miste (Netherlands)	Middle Miocene	Janseen, 1984
Montecatone (Bologna, Italy)	Calabrian*	
Montegibbio (Modena, Italy)	Tortonian	Davoli, 1982
Monte Padova (Piacenza, Italy)	Piacenzian	Rio et al., 1988

LOCALITIES	AGE OF DEPOSITS	REFERENCES
Moronico (Bologna, Italy)	Calabrian*	
Orciano Pisano (Pisa, Italy)	Piacenzian	Gatto, 1997
Pianella (Siena, Italy)	Zanclean	
Poggio alla Staffa (Siena, Italy)	Zanclean	Della Bella & Scarponi, 2004
Ponte a Elsa (Pisa, Italy)	Piacenzian	Benvenuti et al., 1997
Pradalbino (Bologna, Italy)	Piacenzian	Della Bella & Scarponi, 2007
Rio Albonello (Ravenna, Italy)	Piacenzian	Tabanelli, 1994
Rio Carbonaro (Piacenza, Italy)	Piacenzian	Della Bella & Scarponi, 2007
Rio Crevalese (Piacenza, Italy)	Piacenzian	Brunetti M. & Vecchi, 2005
Rio Merli (Ravenna, Italy)	Piacenzian	Tabanelli, 2008
Rio Stramonte (Piacenza, Italy)	Piacenzian	Brunetti M. & Vecchi, 2003
Rio Torsero (Savona, Italy)	Zanclean	Violanti, 1997
Riparbella (Pisa, Italy)	Calabrian	Dell'Angelo & Forli, 1995
San Faustino (Terni, Italy)	Zanclean-Piacenzian	Malatesta, 1974
San Lorenzo in collina (Bologna, I)	Piacenzian	Brunetti M. & Soccio, 2006
San Martino a Maiano (Firenze, Italy)	Zanclean*	
Spicchio (Firenze, Italy)	Zanclean-Piacenzian	Dominici et al., 1997
Strolla (Siena, Italy)	Zanclean-Piacenzian	Bossio et al., 1992
Szob (Pest, Hungary)	Badenian	Csepregy-Meeznerics, 1956.
Šentjernež (Slovenia)	Tortonian*	
Tabiano Bagni (Parma, Italy)	Zanclean	Pelosio, 1967
Tabiano Castello (Parma, Italy)	Zanclean-Piacenzian*	
Torrente Arda (Piacenza, Italy)	Gelasian-Calabrian	Brunetti M. & Vecchi, 2005
Torrente Stirone (Parma, Italy)	Zanclean-Gelasian-Calabrian	Papani & Pelosio, 1962
Treppie (Siena, Italy)	Zanclean	Pantoli & Raffi, 1981
Vignola (Modena, Italy)	Piacenzian	Della Bella & Scarponi, 2004

Table 1. Localities from which the present study material comes, age of deposits and references (when available). Age indications marked with a star are proposed by the authors of the present work basing on the malacological assemblage.

Calabrian, 5 exx (CB); Castiglione della Pescaia (Grosseto), modern, 4 exx (CD); Cava Tacconi (Roma), Calabrian, 4 exx (CB); Ciuciano (Siena), Zanclean, 3 exx (CD); Poggio alla Staffa (Siena), Zanclean, 3 exx (CB); Acate (Ragusa) Calabrian, 2 exx (CF); Camaret sur Mer (France), modern, 2 exx (CF); Casciana Terme (Pisa), Gelasian, 2 exx (CF); Bibbiano (Siena), Zanclean 1 ex (CB); Cecina (Livorno), modern, 1 ex (CB); Lagune (Bologna), Piacenzian, 1 es., (CD); Maglie (Lecce) Calabrian, 1 ex (CD); Malaga (Spain), modern, 1 ex (CB); Ponza (Latina), modern, 1 ex (CB).

Aporrhais burdigalensis (d'Orbigny, 1852), Leognan (France), Burdigalian, 12 exx (CB, CF).

DESCRIPTION. Shell medium sized (average H = 28.5-36.6 mm), spindle-shaped loop consisting of 9 to 10 whorls. Protoconch smooth, of 2.5 whorls; the beginning of the teleoconch is characterized by a dense spiral sculpture consisting of ten equally-spaced spiral tracks, in the next whorl there are numerous ribs that, crossing the tracks, form a thin spiral cancelled sculpture. In the subsequent whorls, ribs increase in thickness and decrease in number up to 13-15 on the penultimate whorl, forming ver-

tical pleats that, starting at the adapical suture, subside and eventually disappear before the abapical suture. These ribs, first straight, become more and more inclined and protruding into the abapical part of the whorls, forming a tubercular keel; it is often present a small pre-sutural thread more or less noticeable. The last whorl, which occupies about half of the total, is crossed by two nodulose hulls, plus a third one, little noticeable in the rear part of the whorl, and by numerous spiral, sub-equal threads. Aperture elongated, very large, lip expanded with four digits, the first of which separate and divergent; basal digit folded forward. The second and third digits generally elongate. Operculum horny, elliptical.

DISTRIBUTION. Based on available data, *A. pespeleceni pespeleceni* is a species living in the Mediterranean and north-eastern Atlantic, with stratigraphic distribution from the Zanclean to present. *A. pespeleceni pespeleceni* inhabits sandy-muddy circalittoral bottoms (Sabelli & Spada, 1977).

REMARKS. In this species, as in the whole Stromboidea Superfamily, the development of keystrokes outside the peristome shows the successful sexual maturity of the individual. Juvenile specimens analyzed herein have no digits and correspond to *Murex gracilis* Brocchi, 1814 (Figs. 1, 2) and *Fusus*

fragilis Risso, 1826. *A. pespeleceni pespeleceni* shows variability in shape and, sometimes, in the number of digits (see Settepassi, 1971; Filippi, 1984; Giannuzzi Savelli et al., 1996), while the sculpture of the teleoconch and the shape of the mouth are overall pretty constant.

In line with Bouchet & Wären (1990, p. 708) we consider *A. michaudi* Locard, 1890 as a simple form of *A. pespeleceni pespeleceni* with five digits. With respect to *A. pespeleceni minor* Bucquoy, Dautzenberg et Dollfus, 1884, the examination of the original iconography (Bucquoy, Dautzenberg & Dollfus, 1884, p. 220, pl. 23, fig. 11) shows clearly that it is a juvenile specimen. There are many reports in the literature of *A. pespeleceni pespeleceni* relating to the Italian Plio-Pleistocene, most of these may, however, be referring to *A. pesp. crenatulina* Sacco (see below), especially those relating to the Zanclean period. In the lands of Pleistocenic origin *A. pespeleceni pespeleceni* is very common from Norway to the Mediterranean. Currently, in the North Atlantic there is a morph, rather rare in the Mediterranean, *A. pespeleceni* var. *bilobata* Clement, 1873 [= var. *oceanica* Bucquoy, Dautzenberg et Dollfus, 1884, see illustrations by Wood (1848, pl. 2, fig. 4), Saunders, (1995, p. 42, fig. 8) Settepassi, (1971, p. 8, pl. 3, figs. 17-18), Malatesta, (1960, p. 113, pl. 6,

<i>Aporrhais</i> species	Nd	H min.	H max	H med.	NTG min.	NTG max	NTG med	T	Z	P	G	C	A
<i>A. pespeleceni pespeleceni</i> - Pliocene	4	21	38	28,5	12	13	12,5		▲	▲			
<i>A. pespeleceni pespeleceni</i> - Pleistocene	4	25,5	45	36,6	10	16	13,2				▲	▲	
<i>A. pespeleceni pespeleceni</i> - modern	4	27,5	48,5	39,4	10	15	11,9						▲
<i>A. pespeleceni crenatulina</i>	4	14,5	33	24,4	14	19	18	?	▲	▲			
<i>A. etrusca</i> n. sp.	5	14,5	31	21,4	12	16	13,8		▲				
<i>A. uttingeriana</i> - Pliocene	4	18,5	39,5	29,2	15	18	16	▲	▲	▲			
<i>A. uttingeriana</i> - Pleistocene	4	31,5	75	44,6	18	22	20				▲	▲	
<i>A. peralata</i>	5	18	23	20	19	26	22		▲	▲			
<i>A. pliorara</i>	5	28,5	50	38,8	19	21	20		▲	▲	▲	▲	
<i>A. serresiana</i>	5	30	40	36	12	16	15						▲

Table 2. Morphological characteristics and stratigraphic distribution of the species treated. Abbreviation: Nd = numero digitazioni, NTG = numero dei tubercoli sul penultimo giro, T = Tortonian, Z = Zanclean, P = Piacenzian, G = Gelasian, C = Calabrian, A = modern.

fig. 4)] characterized by the second and third digits partially fused and little expanded. This morph is quite common in the early Pleistocene of Northern Italy (Fig. 10) and, while not being able to consider it as a valid species or subspecies, nevertheless, it may be some sort of paleoclimate indicator - i.e. a "Nordic guest" (sensu Ruggieri, 1967). This morph corresponds to the populations of the Pliocene of Northern Europe known as *A. pespeleceni quadrifidus* Da Costa, 1778 (Wood, 1848; Harmer, 1918; Glibert, 1959; Geys & Marquet, 1979; Marquet, 1998).

Reports of *A. pespeleceni pespeleceni* of the Miocene (Friedberg, 1914; Baluk, 1975; Marquet et al., 2002; Landau et al., 2004), are thought to be all referable to different species. Among the noticeable miocenic examined species, *A. burdigalensis* (d'Orbigny, 1852), as understood in Marquet et al. (2002), (Fig. 11), while similar to *A. pespeleceni pespeleceni*, shows however very distinct characters including: smaller size, a more elaborate sculpture of the loop and different shape of digits. Therefore, we do not agree with Solsona (1998) who considers both *A. burdigalensis* and *A. meridionalis* (Basterot, 1825) identical to *A. pespeleceni pespeleceni*. We also noted that specimens in MRSNT, catalogued by Sacco as both *A. meridionalis* (Basterot, 1825) (Fig. 30) and *A. meridionalis* var. *taurinensis* Sacco, 1893 (Fig. 32), are likely to refer to a different species with sculpture and shape of digits that differ markedly from the typical specimens of French Miocene (Fig. 31). In the Italian Pliocene *A. pespeleceni pespeleceni* consists of rather small populations that coexist with the subspecies treated below, significantly more widespread. Finally, We emphasize an increase in the average size of specimens from the Zanclean to the Present.

Aporrhais pespeleceni crenatulina (Sacco, 1893) (Figs. 12-14, 18-22, 23-26, 72)

Chenopus pes-pellicani - Fontannes, 1879: 153, pl. 9, fig. 3

Chenopus pespellicani var. *crenatulina* - Sacco, 1893: 30, pl. 2, fig. 32

Chenopus pespellicani var. *parvecincta* - Sacco 1893: 30, pl. 2, fig. 33

Chenopus pespellicani var. *turritolonga* - Sacco, 1893: 30, pl. 2, fig. 34

Chenopus pespellicani var. *variecincta* - Sacco 1893: 30, pl. 2, fig. 35

Chenopus pespellicani var. *basicincta* - Sacco, 1893: 31, pl. 2, fig. 36

Chenopus pespellicani var. *apicevoluta* - Sacco, 1893: 31, pl. 2, fig. 34

Aporrhais pes-pellicani minor - Glibert, 1949: 208, pl. 12, fig. 19

Aporrhais uttingeriana miosubulatus - Settepassi 1971: 18, pl. 17, figs. 52-63

Aporrhais pespeleceni - Malatesta, 1974: 215, pl. 16, fig. 2

Aporrhais pespeleceni - Chirli, 1988: 17, pl. 3, fig. 8

Aporrhais pespeleceni - Cavallo & Repetto, 1992: 61, fig. 102

Aporrhais pespeleceni crenatulina - Segurini & Tabanelli 1994: 9, pl. 1, fig. 3

Aporrhais pespeleceni - Solsona et al., 2000: 83, pl. 1, fig. 3, 5-6

Aporrhais (Aporrhais) pespeleceni - Landau et al., 2004: 65, pl. 14, figs. 7a-7b

Aporrhais pespeleceni - Chirli, 2007: 8, pl. 3, figs. 1-5, 7-9

Aporrhais pespeleceni - Manganelli et al., 2008: 509, figs. 17-18, 34-45

EXAMINED MATERIAL. Lagune (Bologna), Zanclean, 40 exx (CD); 35 exx (CB, CF); Rio Carbonaro (Piacenza), Piacenzian, 30 exx (CB, CD); Poggio alla Staffa (Siena), Zanclean, 18 exx (CB, CF); San Faustino (Terni) Zanclean-Piacenzian, 22 exx (CB, CF); Cossato (Biella), Piacenzian, 21 exx (CF); Ciuciano (Siena) Zanclean, 11 exx (CB, CF); Rio Crevaiese (Piacenza), Piacenzian, 10 exx (CB, CD); Linari (Siena), Piacenzian, 10 exx (CB, CD, CF); Masserano (Biella), Piacenzian, 9 exx (CB); Guistrigona (Siena), Zanclean-Piacenzian, 5 exx (CB); Ponte a Elsa (Firenze), Piacenzian, 5 exx (CD); Baschi (Terni), Piacenzian, 4 exx (CB); Campino (Siena), Zanclean 4 exx (CB); Rio Stramonte (Piacenza), Piacenzian, 4 exx (CB); Vignola (Modena), Piacenzian, 3 exx (CD); Ficulle (Terni), Zanclean-Piacenzian, 2 exx (CB); Pradalbino (Bologna), Piacenzian, 2 exx (CB); Bibbiano (Siena), Zanclean, 1 ex (CD); San Martino a Maiano (Firenze), Zanclean, 1 ex (CB); Rio Torsero (Savona), Zanclean, 1 ex (CB). *A. senegalensis* Gray, 1838. Senegal, modern, 4 exx (CD, CF).

A. meridionalis (Basterot, 1825). Leognan (France), Burdigalian, 12 exx (CB).

A. dingdenensis Marquet, Grigis et Landau, 2002. Miste (Netherlands), Middle Miocene, 20 exx (CB, CF).

A. alata (Eichwald, 1829). Szob (Hungary), Badenian, 3 exx (CB); Letkes (Hungary), Badenian, 2 exx (CDA).

DESCRIPTION. Shell small to medium sized (average $H = 24.4$ mm), spindle-shaped loop composed of eight whorls. Protoconch smooth, compressed superiorly, of 2.5 whorls. The beginning of the teleoconch is characterized by a dense spiral sculpture consisting of ten equally-spaced spiral tracks, in the next whorls there are numerous ribs that, by crossing the tracks, form a thin spiral, cancelled sculpture. In subsequent whorls ribs increase in thickness and decrease in number, up to 18 on the penultimate whorl, forming vertical substraight pleats which, starting from the upper suture, subside and eventually disappear before the rear suture forming a tuberculate hull; there is always an evident pre-sutural thread. Pronounced spiral sculpture including threads separated by wider gaps that, on the penultimate whorl, amount to about twenty. The last whorl, which occupies about half of the total height of the loop, is crossed by two nodulose hulls plus a third one, little noticeable in the rear part of the whorl. Aperture elongated, narrow, with typical crenulations on both sides of the mouth. Lip expanded formed by four digits, usually leaf-like, the first of which separate and divergent; basal digit bent forward.

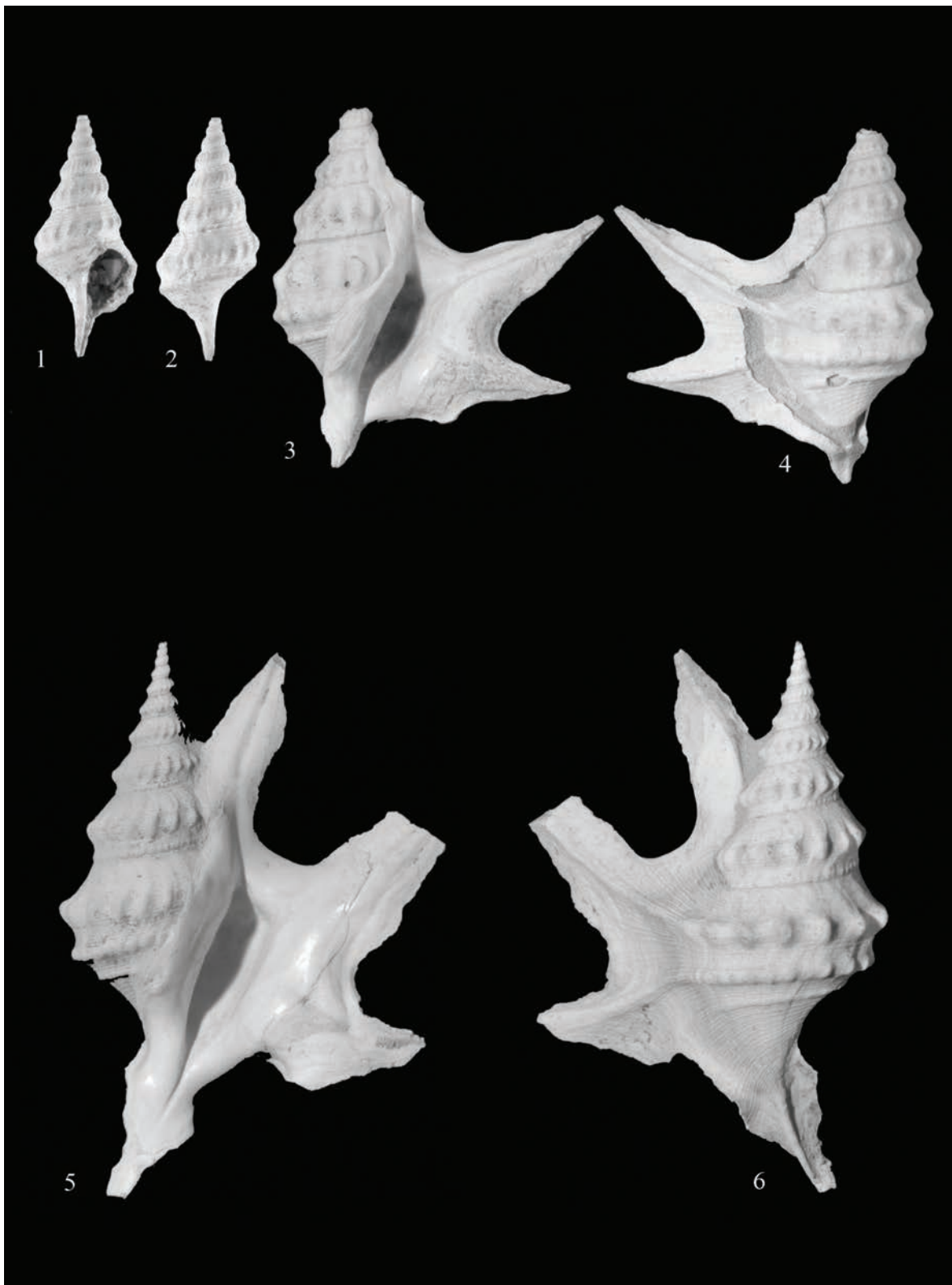
DISTRIBUTION. Based on available data, *A. pespeleceni crenatulina* is a species with an infralittoral-circalittoral bathymetry and a stratigraphic distribution from the Zanclean to the Piacenzian.

REMARKS. Sacco (1893, p. 30) relates the variety *crenatulina*, both with the var. *minor* Sacco, 1893 (in turn, according to the Author, in relation with *A. pespeleceni minor* Bucquoy, Dautzenberg et Dollfus, 1884) and the var. *dertominor* Sacco, 1893 (Figs. 15,16). This latter is, in our opinion, a completely different species, with the first digit fused to the loop, most probably related to the miocenic *A. alata* (Von Eichwald, 1830) as the var. *taurominor* Sacco, 1893 (Fig. 17). Sacco (1893) gave little importance both to difference in size and typical crenulations of the aperture and considered *A. pespeleceni crenatulina* as a simple form of *A. pespeleceni pespeleceni* noting, however, that: "among the living forms, *C. senegalensis* GRAY

presents this character very accentuated." We believe *A. pespeleceni crenatulina* shows constant features that differentiate it from *A. pespeleceni pespeleceni*: smaller size, different and more pronounced spiral sculpture, shape of the nodes on the hulls of the last whorls, hulls not tilted but substraight; never elongated digits, but flat and leaf-shaped (as already noted by Sacco, 1893, p. 30); first whorls considerably less elongated, protoconch larger and less flattened, aperture narrower and, above all, denticles more or less developed but always present on both sides of the mouth (Fig. 25), which is never the case in *A. pespeleceni pespeleceni* neither in living nor in fossil specimens.

As regards the chronostratigraphic distribution of *A. pespeleceni crenatulina*, it begins to appear with certainty only in the Zanclean and seems not to go beyond the Middle Piacenzian (unit MPMU2, Monegatti & Raffi, 1993). Based on these considerations, we therefore propose to elevate to subspecies the variety described by Sacco, and indicate as its lectotype the specimen deposited in the coll. Bellardi-Sacco, MRSNT, catalogue no. BS.041.01.021 (Figs. 12-13).

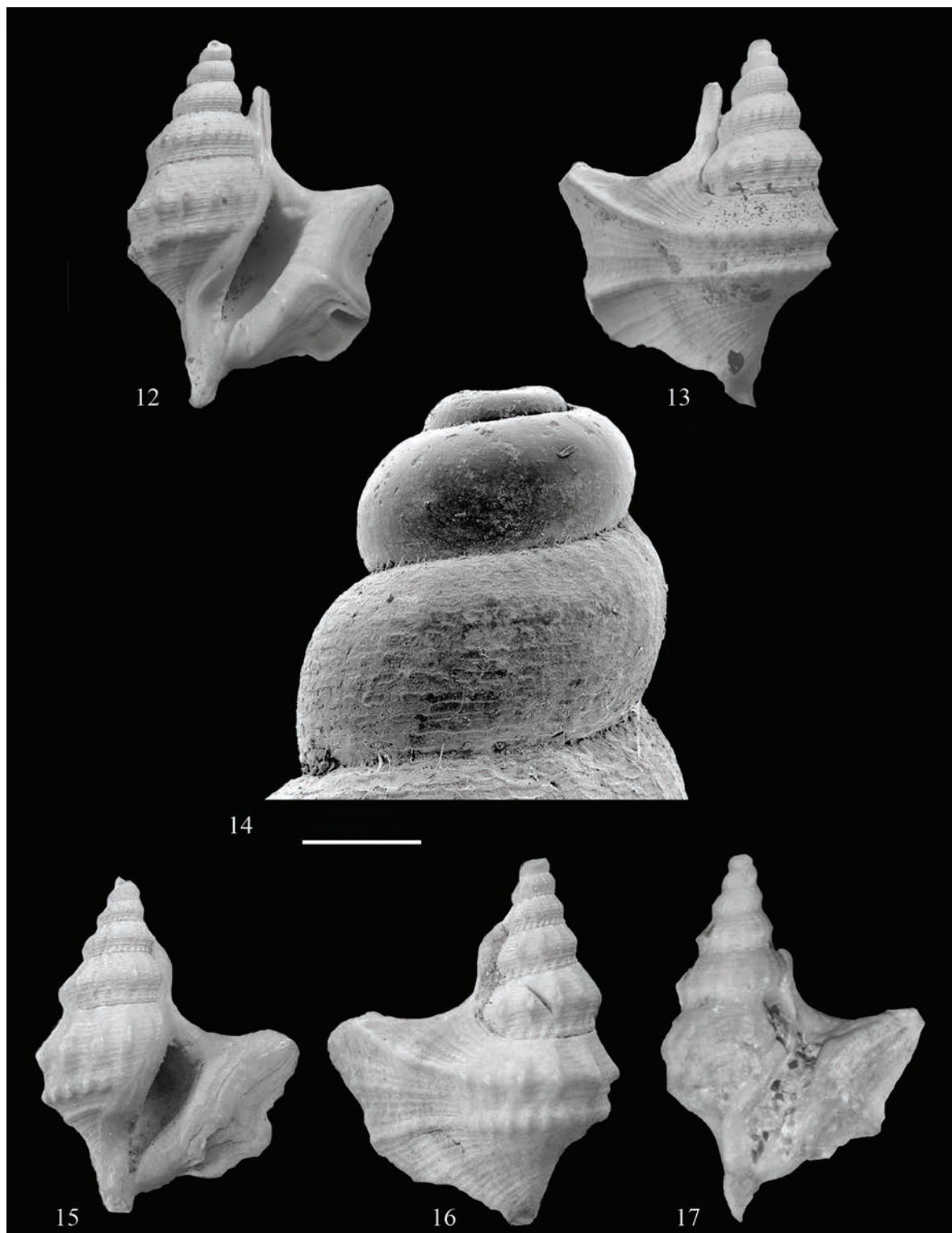
To *A. pespeleceni crenatulina* corresponds *A. pespeleceni* var. *parvecincta* Sacco, 1893 (Fig. 18), reported by the same author for several places of the Ligurian-Piedmont basin: Astigiana (Asti), Volpedo (Alessandria), Masserano (Biella), Rio Torsero (Savona), Bordighera (Savona), Bussana (Savona), Albenga (Savona). Sacco (1893) describes and illustrates several pliocenic varieties all corresponding to *A. pespeleceni crenatulina* amidst which are included *Chenopus pespeleceni* var. *apicevoluta* (Fig. 22), *C. pespeleceni* var. *basicincta* (Fig. 21), *C. pespeleceni* var. *variecincta* (Fig. 20), *C. pespeleceni* var. *turritolonga* (Fig. 19), and the var. *anglica* (d'Orbigny, 1852) (Fig. 23), which are, according to the author, pretty rare. As for *A. pespeleceni*, *A. pespeleceni crenatulina* is reported and depicted by Fontannes (1880) for the French Pliocene and by Malatesta (1974) for the Umbrian. Segurini & Tabanelli (1994) report *A. pespeleceni crenatulina* for the Piacenzian of Rio Albonello (Ravenna) and are the first to properly illustrate the species. More recently, Marquet et al. (2002) consider *A. pespeleceni crenatulina*, *A. pespeleceni parvecincta* (Sacco, 1893), *A.*



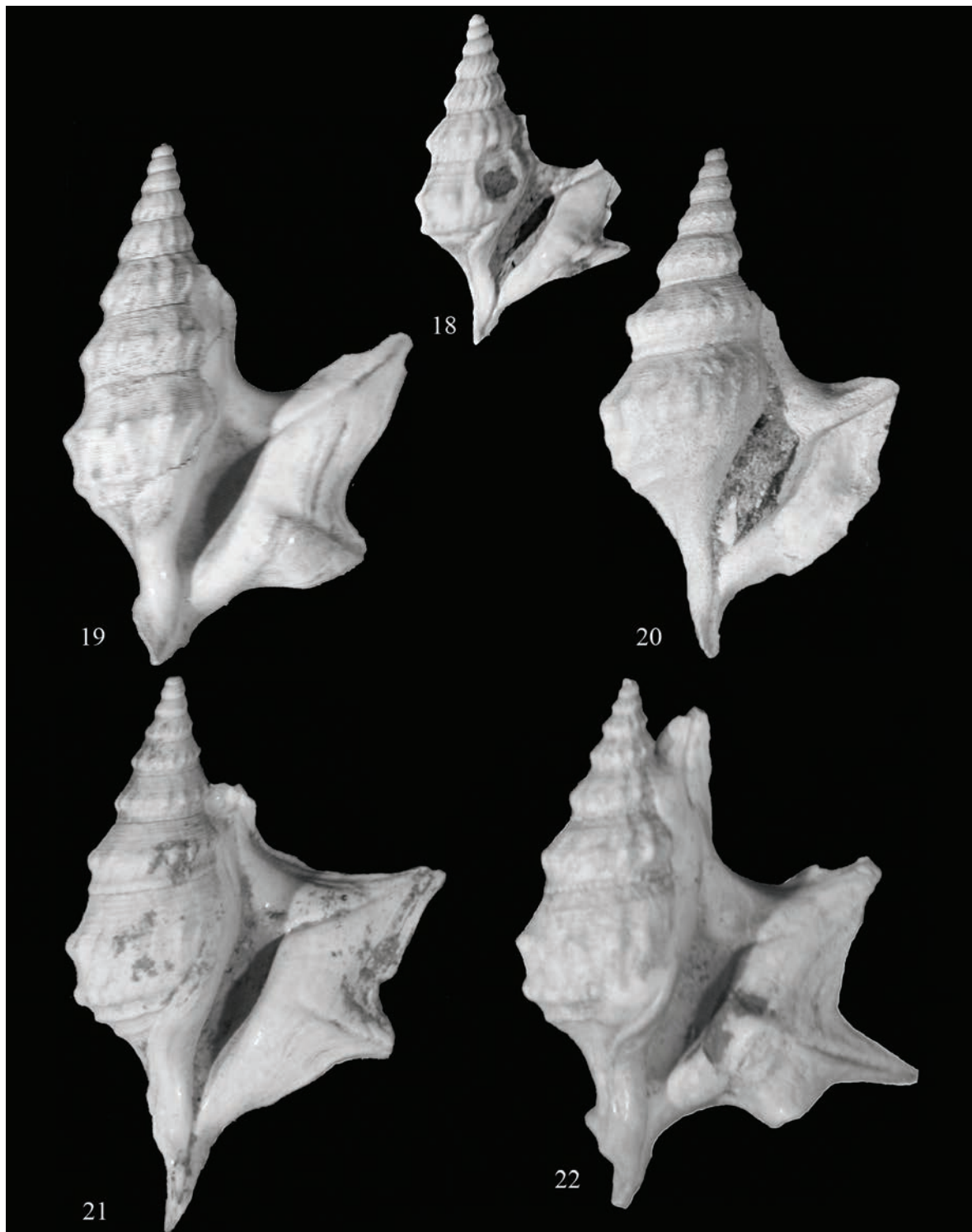
Figures. 1-6. *Aporrhais pespelecani pespelecani*. Figs. 1, 2. *Murex gracilis* Brocchi, 1814, holotypus, Piacentino, Neogene, H = 13,1 mm (MSNM, Brocchi coll., i5430). Figs. 3, 4. Spicchio (Firenze), Zanclean-Piacenzian, H = 30 mm (CB). Figs. 5, 6. Torrente Arda (Piacenza), Calabrian, H = 48 mm (CB).



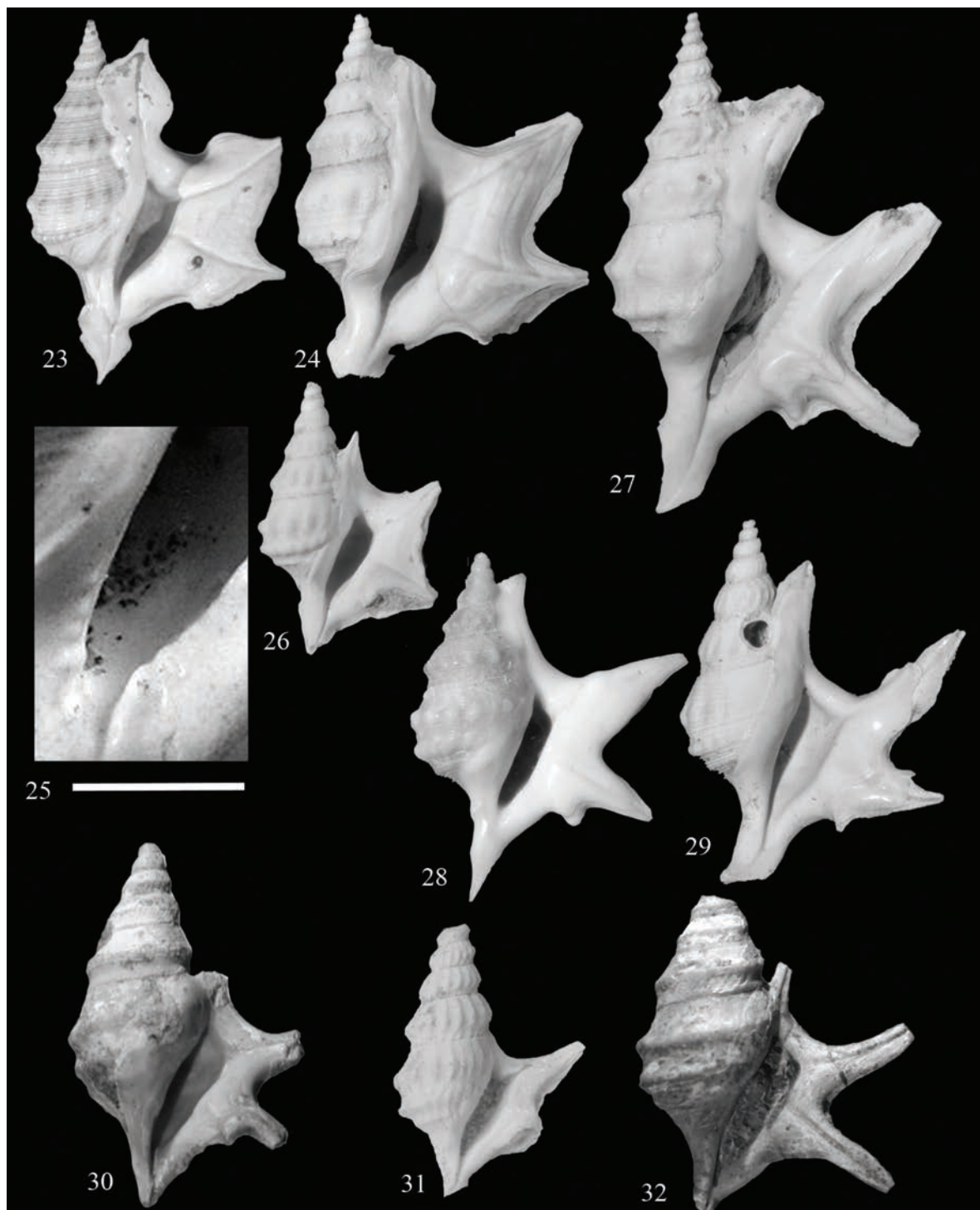
Figures 7-10. *Aporrhais pespelecani pespelecani*. Figs. 7, 8. Cecina (Livorno), modern, H= 52 mm, (CB) Fig. 9: bilobed shape, Chiusa di Codrignano (Bologna), Calabrian, (CB). Fig. 10: apical whorls, Torrente Arda (Piacenza), Calabrian, (CB) (Scale bar 100 μ m). Fig. 11. *Aporrhais burdigalensis*, Leognan (France), Burdigalian, H = 24,2 mm (CB).



Figures. 12-14. *Aporrhais pespelecani crenatulina*. Figs. 12, 13: Lectotypus, Colli Astesi (Asti), Zanclean-Piacenzian, H = 19 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.021). Fig. 14: apical whorls, Rio Carbonaro (Piacenza), Piacenzian, (CB) (Scale bar 100 µm). Figs. 15, 16. *Chenopus pespelicani dertominor*, Stazzano (Alessandria), Tortonian, H = 16,5 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.019). Fig. 17. *C. pespelicani taurominor*, Baldissero Torinese (Torino) Middle Miocene, H = 18 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.018).



Figures. 18-22. *Aporrhais pespeleceni crenatulina*. Fig. 18. *Chenopus pespelicani* var. *parvecincta*, Rio Torsero (Imperia), Zanclean, H = 16,8 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.022). Fig. 19. *C. pespelicani* var. *turritolonga* Sacco, 1893, Colli Astesi (Asti), Zanclean-Piacenzian, H = 36,9 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.025). Fig. 20. *C. pespelicani* var. *variecincta*, Colli Astesi (Asti), Zanclean-Piacenzian, H = 29 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.024). Fig. 21. *C. pespelicani* var. *basicincta*, Volpedo (Alessandria), Piacenzian, H = 32,4 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.024). Fig. 22. *C. pespelicani* var. *apicevoluta*, Colli Astesi (Asti), Zanclean-Piacenzian, H = 30,3 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.026).



Figures 23-26. *Aporrhais pespelecani crenatulina*. Fig. 23: *Chenopus pespelicani* var. *anglica*, Rocca d'Arazzo (Asti), Piacenzian, H = 33,2 mm, (MRSNT, Bellardi and Sacco coll., BS.041.01.027). Fig. 24: Rio Carbonaro (Piacenza), Piacenzian, H = 31 mm (CB). Fig. 25: Particular of the aperture, Rio Carbonaro (Piacenza), Piacenzian, (CB) (scala = 5 mm). Fig. 26: Rio Carbonaro (Piacenza), Piacenzian, H = 17 mm (CB). Fig. 27: *A. pespelecani pespelecani*, depth form, Fauglia (Pisa), Calabrian, H = 50 mm (CB). Fig. 28: *A. senegalensis*, Senegal, modern, H = 26 mm (CB). Fig. 29: *A. scaldensis*, Kallo (Belgium), Piacenzian, H = 27,2 mm (CB). Fig. 30: *C. meridionalis*, Monte Capuccini (Torino), H = 27,6 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.001). Fig. 31: *A. meridionalis*, Leognan (France), Burdigalian, H = 13 mm. Fig. 32: *C. meridionalis* var. *taurinensis*, Colli Torinesi (Torino), H = 27 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.002).

pespelecani taurominor (Sacco, 1893) (Fig. 17) and *A. pespelecani dertominor* (Sacco, 1893) (Figs. 15, 16) as forms of *A. pespelecani pespelecani*, since "these all, however have a tendency to form an extra digit between the third and the abapical digit" which is a character certainly present, but of little significance when compared to the numerous differences mentioned above.

The specimens reported by Settepassi (1971) as *A. uttingeriana miosubulatus* Sacco, 1893, of the Pliocene of Orvieto are identical to *A. pespelecani crenatulina*. Cossmann & Peyrot (1922) depict a *A. pespelecani mut. dertominor* Sacco, that, in our opinion, seems closer to *A. meridionalis*. Glibert (1949) reports a sample similar to *A. pespelecani crenatulina* of the Middle Miocene of the Loire basin (France) as *A. pespelecani minor* Bucquoy, Dautzenberg et Dollfus, 1884 which may suggest the presence of *A. pespelecani crenatulina* in the Middle Miocene as well. These data need further confirmation, however, not having been able to examine directly the material.

A. pespelecani crenatulina presents a remarkable constancy of characters, the only real variation consisting in the size of some specimens that may be significantly below the average height (Fig. 26). We have been able to examine other species of the European Miocene showing nearly the same size as *A. pespelecani crenatulina* including *A. burdigalensis* (d'Orbigny, 1852) (Fig. 11), *A. meridionalis* (Bastrot, 1825) (Fig. 30) and *A. dingdenensis* Marquet, Grigis et Landau, 2002 (Fig. 55). All these taxa show spiral sculpture and digits completely different from the species in question, and, in addition, they lack of crenulations inside the mouth as is the case of *A. scaldensis* Van Regteren Altena, 1954 (= *Chenopus pespelicani* var. *anglica* in Nyst, 1878, pl. 6 fig. 11) (Fig. 29) from Belgium.

A. senegalensis Gray, 1838 (Fig. 28), currently distributed from Senegal to Gabon on sandy bottoms (Ardovini & Cossignani, 2004), presents crenulations similar to *A. pespelecani crenatulina*, but different shape and sculpture (large and rounded tubercles, first digit fused to the loop). Previous reports of *A. senegalensis* for the Italian Pliocene (Settepassi, 1971) are wrong and probably attributable to this subspecies. Notably, different Pleistocene populations attributable to *A. pespelecani pespelecani* (Fig. 27), found in sediments corresponding to the deep circalittoral, show characters

that lead partly to *A. pespelecani crenatulina* (narrow aperture, very light crenulations) and partly to *A. pespelecani pespelecani*. This could be interpreted as a retention of primitive characters in depth-populations.

***Aporrhais etrusca* n. sp.**
(Figs. 33-40, 73)

EXAMINED MATERIAL. Holotypus (Figs. 33-35), H = 30 mm, Cedda (Siena, Tuscany, Italy), Zanclean-Piacenzian, 43° 23' 44"N, 11° 11' 52"E (MZB). Paratypes same locality of the holotypus: paratypus 1 (Fig. 36), H = 30 mm (MZB); paratypus 2 (Fig. 37), H = 32 mm (MSNF); paratypus 3 (Fig. 38), H = 32 mm (MSNF); paratypus 4 (Fig. 39), H = 27 mm (MSNF); paratypus 5 (Fig. 40), H = 31 mm (MSNF).

Other material examined. Cedda (Siena), Zanclean, 120 exx (CB, CD, CF); Chianello (Siena), Zanclean, 100 exx (CB, CD); 67 exx Strolla (Siena) Zanclean, (CB); Treppié (Siena), Zanclean, 35 exx (CB, CD, CF).

DESCRIPTION OF HOLOTYPE. Shell small to medium sized (H = 30 mm), spindle-shaped loop consisting of eight whorls. The beginning of the teleoconch is characterized, in the first two whorls, by a dense spiral sculpture consisting of ten equally-spaced spiral tracks. In subsequent whorls appear numerous nodulose ribs, sharp, sub-straight, 14 on the penultimate whorl, forming a hull with sharp nodules; always present a pre-sutural thread. The spiral sculpture is pronounced consisting of several threads separated by sub-equal interspaces, 10 on the penultimate whorl. The last whorl, which occupies half of the total height of the loop, is crossed by two nodulose hulls plus a third one, little noticeable in the rear part of the whorl. Aperture elongated. Lip expanded consisting of five digits, the second and third of which, and sometimes the fourth, fused together and thick; the first digit weakly developed, separate and divergent; basal digit very short, slightly bent forward.

VARIABILITY. The adult specimens, with outer lip formed, can vary in size and number of tubercles on the penultimate whorl (see tab. 2), while keeping constant the morphological characteristics of the teleoconch. Only very old specimens show the second, third and fourth digits welded.

ETIMOLOGY. The name derives from the ancient inhabitants of the region of discovery, the Etruscans.

DISTRIBUTION. Based on available data, *A. etrusca* n. sp. occurred at depths between the infralittoral and the circalittoral with stratigraphic distribution limited to the Zanclean.

REMARKS. In all specimens examined the protoconch was not complete for which it was not possible to describe it. *A. etrusca* n. sp. differs significantly from both *A. pespelecani pespelecani*, for the largest number of digits, the sculpture of the teleoconch and for big, pointed tubercles, while differs from *A. pespelecani crenatulina* for the lack of crenulations on the aperture and the shape and number of digits. There are no forms of transition to the one or other subspecies. At the moment it is known only for the Zanclean from a narrow area of Central Tuscany.

Aporrhais uttingeriana (Risso, 1826)
(Figs. 41-47, 49, 50, 74)

Rostellaria uttingeriana - Risso, 1826: p. 225

Rostellaria brongniartianus Risso, 1826: 226

Rostellaria pes ardeae - Sassi, 1827: 480

Chenopus Uttingeriana - Fontannes, 1880: 155, pl. 9 fig. 4

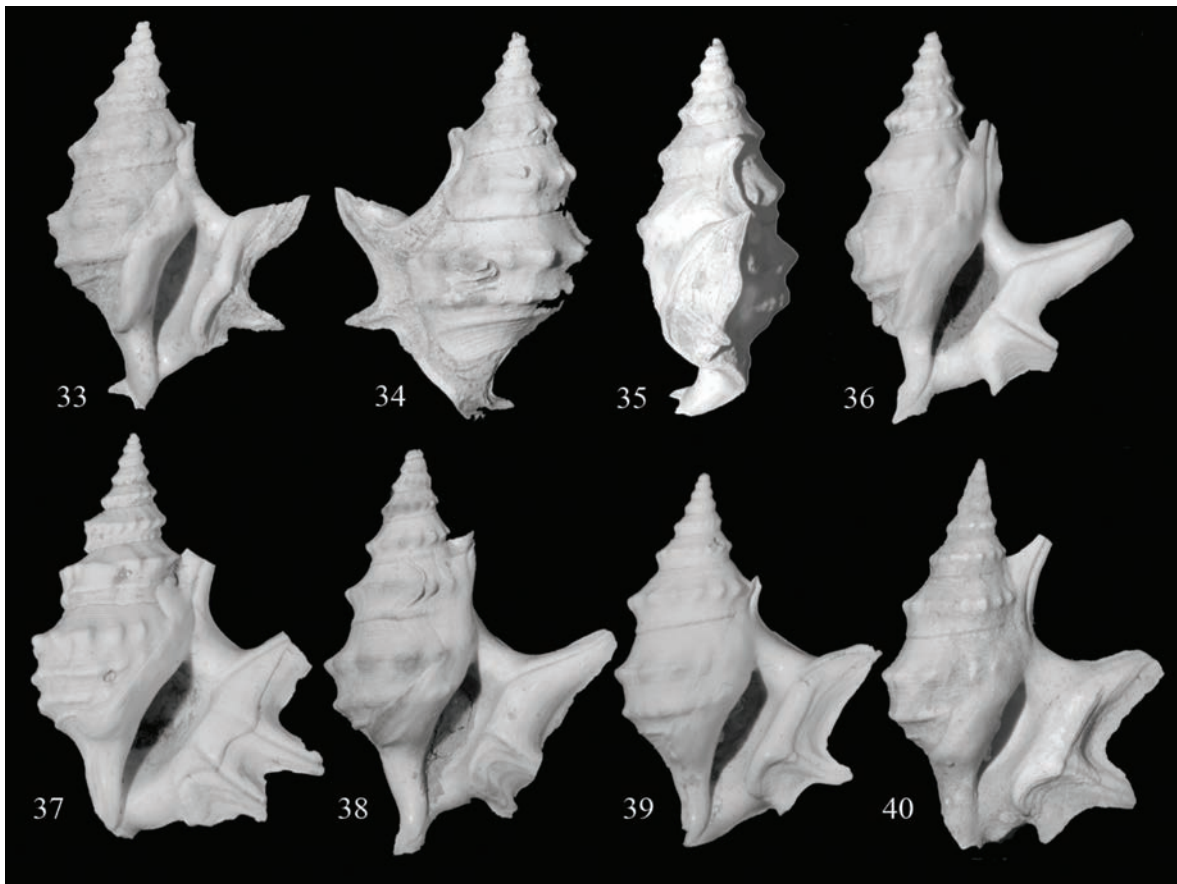
Chenopus uttingerianus - Sacco, 1893: 23, pl. 2, figs. 21-22

Chenopus uttingeriana var. *crassulosa* - Sacco, 1893: 25

Chenopus uttingeriana var. *peraraneosa* - Sacco, 1893: 26, pl. 2, fig. 23

Chenopus uttingeriana var. *percarinata* - Sacco, 1893: 24, pl. 2, fig. 24

Chenopus serresiana var. *pliotransiens* - Sacco, 1893: 27, pl. 2, fig. 26



Figures. 33-40. *Aporrhais etrusca* n. sp. from Cedda (Siena, Tuscany, Italy), Zanclean-Piacenzian. Figs. 33-35: Holotypus, H = 30 mm (MZB-). Fig. 36: Paratypus 1, H = 30 mm (MZB-). Fig. 37: Paratypus 2, H = 32 mm (MSNF-). Fig. 38: Paratypus 3, H = 32 mm (MSNF). Fig. 39: Paratypus 4, H = 27 mm (MSNF). Fig. 40: Paratypus 5, H = 31 mm (MSNF).

- Aporrhais uttingeriana* var. *mutica* - Almera & Boffill 1898: 64, pl. 4, fig. 2
- Chenopus pespelecani* - Cerulli Irelli, 1911: 275, pl. 26, figs. 26-28
- Chenopus uttingeriana* - Dieni & Omenetto, 1960: 614, pl. 62, figs. 7a-b
- Aporrhais* (*A.*) *uttingeriana* - Papani & Pelosio, 1962: 305, pl. 2, fig. 2.
- Aporrhais* (*Aporrhais*) *uttingeriana* (Risso) - Pelosio, 1967: 109, pl. 37, figs. 2-4.
- ?*Aporrhais uttingeriana peraraneosa* - Settepassi, 1971, pl. 15, fig. 39.
- Aporrhais uttingeriana mioaustriacus* Sacco - Settepassi, 1971, pl. 15, fig. 40
- Aporrhais uttingeriana longidigitatus* Settepassi, 1971, pl. 17, figs. 52-63
- Aporrhais uttingeriana* - Settepassi, 1971, pl. 16, figs. 42-47
- Aporrhais uttingeriana major* - Settepassi, 1971, pl. 16, figs. 48-49
- Aporrhais* (*Aporrhais*) *uttingeriana* - Malatesta, 1974: 215, pl. 16, figs. 3 a-c
- Aporrhais uttingeriana* - Caprotti, 1976: 8, pl. 14, figs. 2-8
- Aporrhais uttingeriana* - Chirli, 1988: 17, pl. 3, fig. 2
- Aporrhais* (*A.*) *uttingeriana* - Brambilla & Lualdi, 1988, pl. 12, fig. 3
- Aporrhais* (*Aporrhais*) *uttingeriana* - Travaglini, 1988: 9, figs. 7-9
- Aporrhais uttingeriana uttingeriana* - Cavallo & Repetto, 1992: 61, fig. 103
- Aporrhais uttingeriana* - Piccioli Resta & Prete, 2003: 50, fig. 7a-b
- Aporrhais* (*Aporrhais*) *uttingeriana* - Landau et al., 2004: 67, pl. 14 fig. 8
- Aporrhais uttingeriana* - Manganelli et al., 2008: 507, figs. 15-16, 20-31

EXAMINED MATERIAL. Rio Carbonaro (Piacenza), Piacenzian, 60 exx (CB, CD, CF); Tabiano Castello (Parma), Zanclean-Piacenzian, 47 exx (CD); Pradalbino (Bologna), Piacenzian, 27 exx (CB); Ciuciano (Siena), Zanclean, 36 exx (CB, CD, CF); San Lorenzo in collina (Bologna), Zanclean-Piacenzian, 18 exx (CD); Chiusa di Codrignano (Bologna), Gelasian - Calabrian, 18 exx (CB, CD); Cà Lametta (Bologna), Piacenzian, 17 exx (CB, CD); Cava Campore (Parma), Zanclean, 16 exx (CB, CD); Ca' Bianca (Bologna), Zanclean 15 exx (CB, CD); Armaiolo (Siena), Piacenzian, 12 exx (CB); Monte Pa-

dova (Piacenza), Piacenzian, 23 exx (CB, CD, CF); Orciano Pisano (Pisa), Zanclean-Piacenzian, 20 exx (CF); Cava Tacconi (Roma), Emilian, 10 exx (CB); Rio Torsero (Savona), Zanclean, 10 exx (CF); Spicchio (Firenze), Zanclean-Piacenzian, 10 exx (CD, CF); Torrente Stirone (Parma), Calabrian, 10 exx (CB, CD); Tabiano Bagni (Parma), Zanclean, 7 exx (CD); Cava Certaldo (Firenze), Piacenzian, 6 exx (CB); Linari (Siena), Piacenzian, 5 exx (CB, CD); Rio Crevalesse (Piacenza), Piacenzian, 4 exx (CB, CD); Lagune (Bologna), Zanclean 4 exx (CD); San Faustino (Terni), Zanclean, 8 exx (CB, CF); Latsia (Cyprus), Gelasian, 4 exx (CF); Pianella (Siena), Zanclean, 4 exx (CF); Riparbella (Pisa), Calabrian, 4 exx (CF); Strolla (Siena), Zanclean, 4 exx (CB); Torrente Arda (Piacenza), Calabrian, 4 exx (CB); Cava Lugagnano (Piacenza), Zanclean, 4 exx (CB, CD); Rio Merli (Ravenna), Zanclean, 3 exx (CD); Fauglia (Pisa), Calabrian, 2 exx (CF);

A. alata (Eichwald, 1829), Szob (Hungary), Badenian, 3 exx (CB); Letkes (Hungary), Badenian, 2 exx (CDA).

A. pesgallinae Barnard, 1963, Morocco, modern, 2 exx (CD); Guinea Bissau, modern, 2 exx (CB).

DESCRIPTION. Shell medium-large sized (average H = 29.2-44.6 mm), loop sharply angular consisting of 8-9 whorls. The teleoconch is characterized by a dense spiral sculpture made by threads of equal thickness (about fifteen on the penultimate whorl). Evident striae of growth wiggly, intersecting with the spiral threads forming, in the early whorls, a reticulated surface with a parallelogram or rumble mesh. Presutural spiral chord not grainy. Carinate, angular whorls, with very small and numerous nodules (about 28 on the penultimate whorl). The last whorl, which occupies about half of the total height of the loop, is crossed by two nodulose hulls plus a third one, little noticeable in the rear part of the whorl. Elongated aperture; lip expanded formed by four very elongated and narrow digits, the first of which is adherent and parallel to the loop; basal digit long and almost straight, without expansions.

DISTRIBUTION. According to the locality of discovery, *A. uttingeriana* occurred at depths corresponding to the circalittoral/deep circalittoral. Stratigraphic distribution seems to go from the Tortonian to the Calabrian.

REMARKS. In all specimens examined the protoconch was not complete for which it was not possi-

ble to describe it. This species, reported for the Mediterranean basin from the Tortonian (late Miocene) to the Sicilian baseline (lower Pleistocene), is extraordinarily abundant in the Piacenzian. The real presence of this taxon during the Miocene should anyway be best investigated, indeed in the Tortonian is also present a similar species: *A. thersites* (Brives, 1897) (see the material of the coll. Mayer-Eymar of Stazzano deposited in NMB, available at [http://www.stromboidea.de/?n=Species.AporrhaisThersites.](http://www.stromboidea.de/?n=Species.AporrhaisThersites)), characterized by a marked columellar callus and a more pronounced spiral sculpture; to this species also seem to correspond the specimens reported by Settepassi (1971, figs. 79-80) as *A. zancleanus* Monterosato ms. Friedberg (1914, pl. 8 fig. 2) describes for the Polish Miocene *A. uttingeriana* which we believe can be referred to another species.

As with all species of the genus, including *A. uttingeriana*, the number of digits may exceptionally be different from the norm, Travaglini (1988) depicts an example of the Calabrian from the Stirone torrent (Parma), with five digits while another, found in the Piacenzian of Rio Carbonaro (Piacenza), presents only three digits (Fig. 45). Also the length of digits can be variable, Sacco (1893) described the var. *peraraneosa* (Fig. 43) characterized by long digits. The var. *percarinata* Sacco, 1893 (Fig. 44) with more pronounced fairing, falls within the range of variability of the species.

The specimen illustrated by Sacco (1893) as *Chenopus serresiana* var. *pliotransiens* (Fig. 47), examined by us, is attributable to a teratological form of *A. uttingeriana*.

The varieties *crassulosa* Sacco, 1893 (Fig. 50) and *ornatissima* Sacco, 1893 (Fig. 51) are, according to the author, identical to the specimens figured by Hörnes (1856) as *A. pespelecani*. By the direct examination of the material it was found that, while *Chenopus uttingeriana* var. *crassulosa* Sacco, 1893 falls into the variability of *A. uttingeriana*, the variety *ornatissima* is closely related to *A. alata* as well as the examined samples of the Austrian Miocene. The var. *mutica* Almera & Bofill, 1898 of the Spanish Pliocene falls into the variability of *A. uttingeriana*. Marquet et al. (2002), consider the miocenic *A. alata* (Von Eichwald, 1829) identical to *A. uttingeriana*; on the contrary, the same species is considered by Strausz (1966) and, more recently, by Baluk (1995) attributable to *A. pespelecani*. In

our opinion there are several morphological differences between these species and we disagree with the beliefs of these Authors. Even with all the precautions due to the scantiness of examined material, we believe that *A. alata*, as we understood it, presents obvious differences from *A. uttingeriana* including in particular the sculpture of the fairings made up of elongated tubercles and short digits, the first of which is welded to the loop always not exceeding half of the second whorl.

Beyrich (1853, pl. 11 fig. 8), Sorgenfrei (1958, pl. 17 fig. 143), Schultz (1998, pl. 23, fig. 8), Marquet et al. (2002) report as *A. uttingeriana* various samples of the Middle Miocene of Central Europe all, we believe, referable to *A. alata*. While presenting an undeniable affinity with *A. uttingeriana*, we are inclined to believe that *A. alata* is to be intended as a distinct species, or perhaps as a "species group", probably related to *A. uttingeriana*, which began to spread with certainty only from the Tortonian. We do not agree with the theory of Vinassa de Regny (1896) who relates *A. meridionalis* to *A. uttingeriana*, considering the first progenitor of the second, in fact, as mentioned above, *A. meridionalis* (Fig. 31) shows dimensions, shape and sculpture completely different.

During the Pleistocene, there is a considerable increase of size of the shell of *A. uttingeriana*. Countless are the reports of *A. uttingeriana* for the Italian Pliocene, see for example, Sacco (1893) for several Pliocene localities, Fontannes (1880) for the French Pliocene, Cerulli-Irelli (1911) for the Gelasian of Monte Mario (Roma), Dieni & Omenetto (1960) for the Zanclean of Orosei (Nuoro), Di Geronimo (1969) for the Calabrian of Monte Navone (Enna), Marasti & Raffi (1976) for the Piacenzian of Maiatico (Parma), Caprotti (1976) for the Piacenzian of Castell'Arquato (Piacenza), Cavallo & Repetto (1992) for the Pliocene of Roero (Cuneo), Segurini & Tabanelli (1994) for the Zanclean of rio Albonello (Ravenna), Piccioli Resta & Prete (2000) for the Lower Sicilian of Nardò (Lecce), Landau et al. (2004) for the Zanclean of Estepona (Spagna), just to say a few.

In Morocco and Western Atlantic, there is a similar species, *A. pesgallinae* Barnard, 1963 (Fig. 48), distributed, according to Ardovalini & Cossignani (2004), from Morocco to Namibia on sandy bottoms; Malatesta (1974), Mienis (1976) and Kronenberg (1991) consider instead *A. pesgallinae* (= *A. elegantissima*

Parenzan, 1970 and *A. pseudoserresiana procerus* Settepassi, 1971) subspecies of *A. uttingeriana* or even conspecific with this species (Solsona et al., 2000; Marquet et al., (2002). Although we do not want to get in on the issue, due to the small number of specimens examined, we point out that either differences in teleoconch shape (rounded and without keeled whorls), or the different arrangement of digits (first digit separate and divergent in *A. pesgallinae*, adherent and parallel to the loop in *A. uttingeriana*) make us consider, in line with Manganelli et al. (2008), *A. pesgallinae* as a valid species, probably derived from *A. uttingeriana* from which is well differentiated (Forli, 1988, 1989).

***Aporrhais peralata* (Sacco, 1893)**
(Figs. 56-59, 75)

Chenopus uttingeriana var. *peralata* - Sacco, 1893: 26, pl. 2, fig. 25

Aporrhais pespelecani peralata - Marquet et al., 2002: 156, figs. 38-39

Aporrhais peralata - Manganelli et al., 2008: 499, figs. 4-14.

EXAMINED MATERIAL. Tabiano Castello (Parma), Zanclean-Piacenzian, 66 exx (coll. Della Bella); Cava Campore (Parma), Piacenzian, 58 exx (CB, CD); Castelnuovo Berardenga Scalo (Siena), Zanclean, 25 exx (CF); Marzeno (Ravenna), Piacenzian, 21 exx (CD); Rio Merli (Ravenna), Piacenzian, 10 exx (CD); Luciana (Pisa), Zanclean, 8 exx (CF); Orciano Pisano (Pisa), Zanclean, 6 exx (CF); Pradalbino (Bologna), Piacenzian, 2 exx (CD); Rio Albonello (Ravenna), Piacenzian, 2 exx (CB); Monte Padova (Piacenza), Piacenzian 1 ex (CD).

DESCRIPTION. Shell small to medium sized (average H = 20 mm), spindle-shaped loop consisting of 7-8 whorls. The beginning of the teleoconch is characterized by a spiral sculpture consisting of ten spiral threads of equal thickness. The teleoconch is characterized by a dense spiral sculpture consisting of ten spiral threads of equal thickness (about 15 on the penultimate whorl). Striae of growth evident, wiggly, intersecting the threads so that the first whorls have a reticulated surface with a parallelogram mesh. Whorls carinated, angular, with very tiny, pointy and numerous nodules (approximately 25 on the penultimate whorl). The last whorl, which occupies about half of the total height of the loop,

is crossed by two angulose hulls plus a third one, little noticeable in the rear part of the whorl. Aperture elongated. Lip expanded consisting of five digits, the second, third and fourth of which welded into a single flat and thin expansion; the first digit separate, partly adhering to the loop; basal digit short with a slight expansion.

DISTRIBUTION. According to the locality of discovery, *A. peralata* was living at depths corresponding to the deep circalittoral. Certain stratigraphic distribution seems to go from the Zanclean to the Piacenzian.

REMARKS. In all specimens examined the protoconch was not complete, for which it was not possible to describe it. Sacco (1893), with reference to his *A. uttingeriana* var. *peralata* (Figs. 56, 57), says: "It is a form that one might say anomalous, with adult characters although not yet fully developed". Actually, at a first glance, *A. peralata* may resemble a small-sized *A. uttingeriana*, looking good, though, there are some important differences between the two: notably the first digit is never completely welded to the loop as in *A. uttingeriana*, but always slightly separate; the second, third and fourth digits are welded together to form a wing; the basal digit is never very elongated and the striae of growth are much pronounced and visible. Some of these features, according to Landau et al. (2004), make *A. peralata* come close to *A. pespelecani pespelecani*. Given the substantial differences between the two in the early whorls, in our opinion, this hypothesis is entirely inappropriate; we think, instead, that *A. peralata* should be considered a valid species, well typical, as recently suggested by Manganelli et al., (2008). *A. peralata* is limited to the Zanclean and the Piacenzian of North-Central Italy, surely living at considerable depths. *A. peralata* is reported for the Piacenzian of Bordighera (Imperia) (Sacco, 1893) and of Cava Campore (Parma) (Landau et al., 2004).

***Aporrhais pliorara* (Sacco, 1893)**
(Figs. 60-66, 76)

Chenopus serresiana ? var. *pliorara* - Sacco, 1893: 26, pl. 2, fig. 27

Aporrhais sarsi - Settepassi, 1971: 21, pl. 11, figs. 13-15

Aporrhais sarsi palmipes - Settepassi, 1971: 21, pl. 11, figs. 16-18, 21, pl. 12, fig. 23

Aporrhais sarsi minor - Settepassi, 1971: 22, pl. 11, figs. 19-21

Aporrhais sarsi - Macri, 1983: 112, pl. 2, fig. 4

Aporrhais sarsi - Travaglini, 1988: 7, figs. 4-5

Aporrhais serresiana pliorara - Segurini & Tabanelli, 1994: 9, pl. 1, figs. 1-2

EXAMINED MATERIAL. Cava Lustrelle (Lecce), Calabrian, 30 exx (CB, CD); Cava Signorella (Lecce), Calabrian, 30 exx (CF); Chiusa di Codrignano (Bologna), Gelasian - Calabrian 15 exx (CB, CD); Montecatone (Bologna), Calabrian, 4 exx (CB); Fosso della Possessione (Ravenna) Gelasian, 1 ex (CD).

DESCRIPTION. Shell medium-large sized (average H = 38.8 mm), consisting of eight to nine whorls. Protoconch flat, smooth, of about 2.5 whorls, with a small core (nucleus). The beginning of the teleoconch is characterized by a dozen spiral threads more or less equally spaced; from about the middle of the second whorl appear striae of growth opisthocoiled with a moderately deep notch, which, by crossing the spiral cords, form a reticulate of elongated rhomboid meshes. From about half loop the axial ribs decrease and rise in thickness forming a hull made of at first 13-15 tubercles little elongated, and then about 20 on the last whorl. From about mid-loop there is a thread near the abapical suture, with the same number of tubercles of the hull, but smaller, giving rise, on the last whorl, to the second hull. The last whorl, about half of the total length, is adorned with three hulls, the most obvious of which is the adapical one. Spiral sculpture made up of flattened threads more or less similar in size, separated by narrow grooves, axial sculpture absent or little evident. Aperture elongated and rather large, lip wide forming five digits internally flattened and crossed in the middle by a crease that forms in the opposite side a hull for each digit. First digit separate and divergent from the loop, second in length, compared to the other digits. The second digit is the longest one, and the third is a little bit longer than the fourth. Abapical digit a little shorter than the opposite first adapical digit, slightly bent towards the aperture.

DISTRIBUTION. According to the locality of discovery, *A. pliorara* was living at depths corresponding to the circalittoral/deep circalittoral. Certain stratigraphic distribution seems to go from the Zanclean to the Calabrian.

REMARKS. *Chenopus serresiana* var. *pliorara* (Figs. 60, 61) has been described for the Pliocene of the

“Astigiana” (Asti). We propose herein to elevate to the species level the variety described by Sacco due to the peculiar characteristics of the shell sculpture or shape and number of digits. We consider as lectotype the specimen of the coll. Bellardi-Sacco at the MRSNT, catalogue no. BS.041.01.021. The species with which *A. pliorara* has more affinity is definitely *A. serresiana* (Figs. 67-69) that differs for shell heavier, loop more stretched, digits thinner, elongated, less in number but more prominent, and tubercles on the penultimate whorl. Strong are also affinities with *A. peralata* from which *A. pliorara* stands out mostly for larger size, angle of the major loop, shape of the digits and the ornamentation with tubercles which tend to form hulls. For the Pliocene, in addition to that of Sacco (1893, p. 26), the only report of *A. pliorara* is by Segurini & Tabanelli (1994, pl. 1, figs. 1-2), for the Piacenzian of Rio Albonello (Ravenna). For the Gelasian and the Calabrian, the species is found most frequently in the deep sediments of Romagna and into those of Southern Italy. To these populations, in our opinion, are attributable the reports of *A. serresiana* by Tabanelli (1981) for the Pliocene of Monte Gebolo (Ravenna), by Palazzi & Villari (1994), for the Lower Pleistocene of Venetico Marina (Messina) and by Vazzana (1996) for Vallone Catrica (Reggio Calabria). The largest number of reports of this species refers to the Calabrian (Emilian) of Southern Italy. To *A. pliorara* correspond the morphs named by various authors (Settepassi, 1971, Macri, 1983, Travaglini, 1988) as *A. sarsi* Kobelt, 1908.

Settepassi (1971) considers *A. sarsi* a valid species and reports its presence in the collection of Monterosato from the Lower Pleistocene of Ficarazzi (Palermo) and Monte Pellegrino (Palermo); according to his thesis, *A. sarsi* is currently living in the North Sea and belongs to the stocks of Northern species that inhabited the Pleistocenic seas during the cold periods. Interestingly, Settepassi (1971) indicates *A. sarsi palmipes* as corresponding to the pliocenic *A. pliorara*. According to Bouchet & Wären (1990, p. 708), which we agree with, *A. sarsi*, an exclusively extant species, falls perfectly in the range of variability of *A. serresiana*. It is noteworthy that in pleistocenic populations examined, no specimens of the typical form of *A. serresiana* were found. *A. serresiana* would be present in the Mediterranean basin only since very recent times. The hypothesis of Sacco (1893) of a phyletic relationship between

A. uttingeriana and *A. serresiana* lacks any foundation, as well evidenced by Malatesta (1974).

Aporrhais serresiana (Michaud, 1827)
(Figs. 67-69, 77)

Aporrhais macandreae - Jeffreys, 1867: 253

Aporrhais pes-carbonis - Sowerby, 1842: 21, pl. 5,
fig. 1 (non Brongniart, 1823)

Aporrhais pes pelecani sarsii - Kobelt, 1908: 17,
pl. 102, figs. 3, 4

Aporrhais serreseanus borealis - Kobelt, 1888: 155

Aporrhais serreseanus hexapoda - Nordsieck,
1968: 97, pl. 15, figs. 57, 17

EXAMINED MATERIAL. Isola Capraia (Livorno) - 80, modern, 36 exx (CD, CF); Isola Elba (Livorno), modern, 10 exx (CD); Portoferraio (Livorno) - 80 / - 90, modern, 8 exx (CD); Tarragona (Spain) - 14, modern, 1 ex (CB).

DESCRIPTION. Shell medium-sized (average H = 36 mm), teleoconch made of 8-9 whorls. Protoconch flat, smooth, of about 2.75 whorls, with a small core. The beginning of the teleoconch is characterized by a dozen spiral threads more or less equally spaced and equivalent in size. From about half of the second whorl appear the striae of growth, opisthocirrate, with a medium-deep hollow, fewer than in the previous species that, crossing with spirals chords, form a reticulate with a very elongated rhomboid-meshed grid. From about half loop, the axial ribs rise in thickness and decrease in number forming an abapical hull, at about two-thirds of the total height of the whorl, consisting of fifteen sickle tubercles, which become approximately 18 on the last whorl. From about the half of the loop there are, in the lower part of the main upper knots, in correspondence of the suture, small thickenings that make a little more evident the last two abapical tracks, which will form, on the last whorl, the second hull. The last whorl is about half the total length, decorated with three hulls the most evident of which is the abapical one, whereas the abapical is the least one. Spiral sculpture made up of flattened threads more or less similar in size, separated by narrow grooves, axial sculpture formed by the striae of growth, opisthocirrate, sinuous towards the anterior digit. Aperture elongated and narrow, with expanded lip forming five digits, the

first, second and fifth of which are similar in length, while the third is nearly double the fourth which is also the one with the labial groove absent or barely noticeable.

DISTRIBUTION. To our knowledge, the only specimens of *Aporrhais serresiana* fossil are those reported for the Würmian of the Northern Tyrrhenian Sea by Cecalupo (1988). Currently, *A. serresiana* is living in the Mediterranean on the circalittoral seabed at greater depths than *A. pespelecani pespelecani* (Sabelli & Spada, 1977).

REMARKS. The species differs from *A. pliorara* for a more robust shell with the columellar edge less broad, and interdigital plan less extended. As mentioned above, there are no fossil records of the species prior to the Würmian, and even these populations slightly differ from the living species (Cecalupo, 1988).

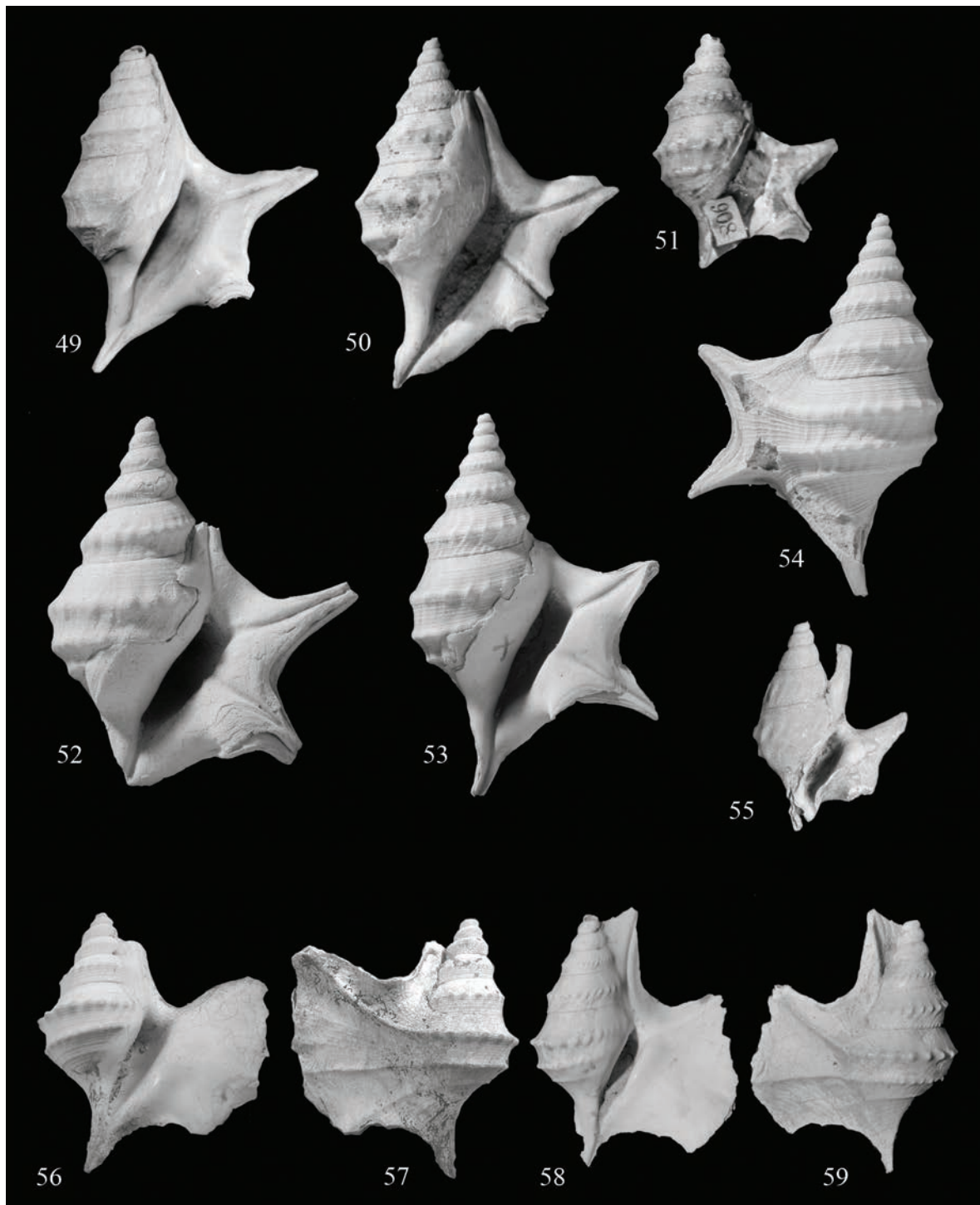
CONCLUSIONS

The Aporrhaidae fossils, found in the Italian Plio-Pleistocene, consist of five species and one subspecies. Together with the two known and universally accepted species (*Aporrhais pespelecani pespelecani*, *A. uttingeriana*) there also are three species and one subspecies often confused with the previous ones (*A. pliorara*, *A. peralata*, *A. etrusca* n. sp.). With the beginning of climate deterioration, begun during the Piacenzian, the latter three went extinct. During the late Piacenzian and the early Calabrian appear several populations attributable to the depth-morph of *A. pespelecani* and *A. pliorara*.

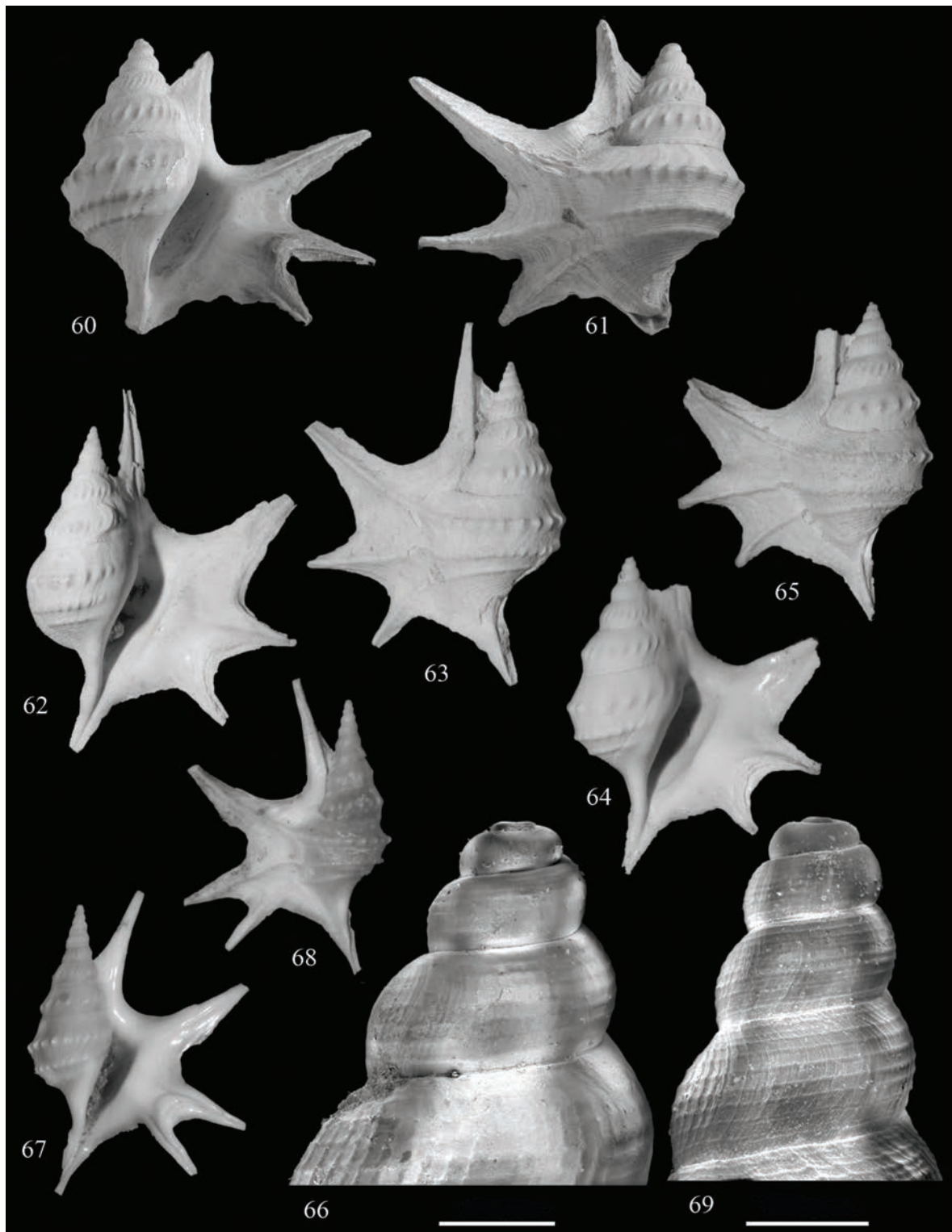
The relationships between plio-pleistocenic and miocenic species are still all to define. On the one hand, the relationships among *A. alata* of the Middle Miocene, as we intend it, *A. uttingeriana* of the Tortonian-early Pliocene-Pleistocene and the extant *A. pesgallinae* of West Africa appear pretty clear; moreover, no doubt there is a link between the Plio-Pleistocenic *A. pliorara* and the extant *A. serresiana*. On the other hand, the phyletic relationships of *A. pespelecani* group with the other species of the Miocene of Europe remain to be clarified, which, however, is definitively beyond the aim of this work.



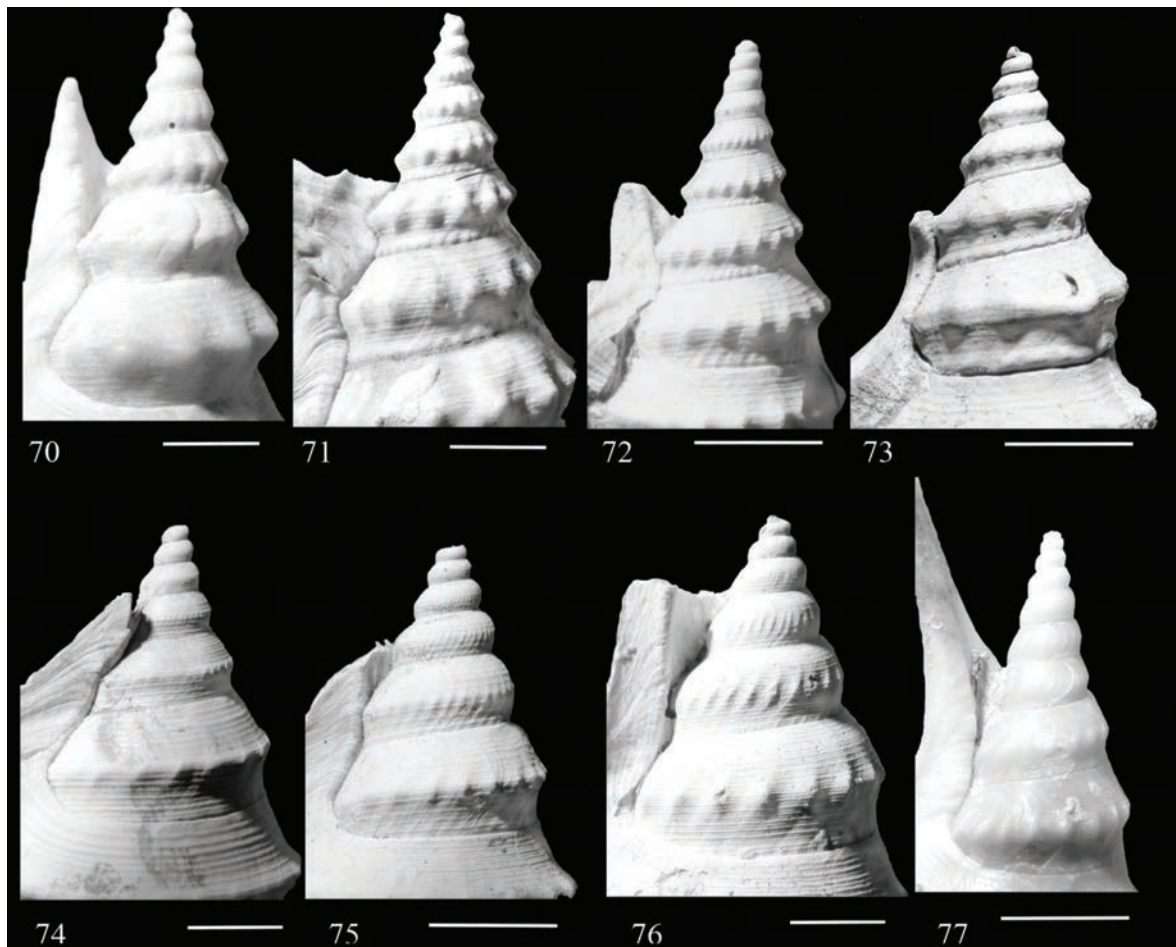
Figures. 41-47. *Aporrhais uttingeriana*. Figs. 41-42: Bordighera (Imperia), Piacenzian, H = 32 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.005). Fig. 43: *Chenopus uttingeriana* var. *peraraneosa*, Albenga (Savona), Zanclean, H = 34 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.011). Fig. 44: *C. uttingeriana* var. *percarinata*, Carrù (Cuneo), Piacenzian, H=30,3 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.012). Fig. 45: Rio Carbonaro (Piacenza) Piacenzian, H=34 mm (CB). Fig. 46: Torrente Arda (Piacenza) Calabrian, H=80 mm, (CB). Fig. 47: *C. serresiana* (an *Chenopus uttingeriana* ?) var. *pliotransiens*, Bordighera (Imperia), Piacenzian, H = 19,5 mm (MRSN, Bellardi and Sacco coll., BS.041.01.015). Fig. 48: *Aporrhais peggallinae*, Guinea Bissau, modern, H=39 mm.



Figures. 49-50. *Aporrhais uttingeriana*. Fig. 49: *Chenopus uttingeriana* var. *brogniartiana*, Colli Astesi, Zanclean-Piacenzian, H = 36 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.010). Fig. 50: *C. uttingeriana* var. *crassulosa*, Stazzano (Alessandria), H = 38 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.007). Figs. 51-54. *Aporrhais* cf. *alata*. Fig. 51: *C. uttingeriana* var. *ornatissima*, Monte Cappucini (Torino), Middle Miocene, H = 18,3 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.008). Fig. 52: *C. pes pelecani* (in Hoernes 1856 pl. 18 fig. 2a), Gainfahren (Austria), Tortonian, H = 37,5 mm (NHMW, 1846/0037/0190). Figs. 53-54: *C. pes pelecani* (in Hoernes 1856 pl. 18 fig. 3a), Baden (Austria), Tortonian, H = 34 mm (NHMW, 1846/0037/0190). Fig. 55: *A. dingdenensis*, Miste (Netherlands), Middle Miocene, H = 14 mm (CB). Figs. 56-59. *A. peralata*. Figs. 56, 57. Lectotypus, Bordighera (Imperia), Piacenzian, H = 21,5 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.013). Figs. 58, 59. Campore (Parma), Piacenzian, H = 20,5 mm (CB).



Figures. 60-66. *Aporrhais pliorara*. Figs. 60, 61: Lectotypus, Colli Astesi (Asti), Zanclean-Piacenzian, H = 28,5 mm (MRSNT, Bellardi and Sacco coll., BS.041.01.014). Figs. 62, 63. Cava Lustrelle (Lecce), Lower Pleistocene, H = 40 mm (CB). Figs. 64, 65: Cava Lustrelle (Lecce), Lower Pleistocene, H = 44 mm (CB). Fig. 66: apical whorls, Cava Lustrelle (Lecce), Lower Pleistocene, (CB) Scale bar 100 μ m. Figs. 67-69. *A. serresiana*. Figs. 67, 68: Isola d'Elba (Livorno), modern, H = 32 mm. Fig. 69: apical whorls, Anzio (Roma), (CF) Scale bar 100 μ m.



Figures. 70-77. *Aporrhais* apical whorls. Fig. 70. *A. pespelecani pespelecani*, Rodi Garganico (Foggia), modern, H = 48 mm (CB). Fig. 71. *A. pespelecani pespelecani*, depth form, Fauglia (Pisa), Calabrian, H = 50 mm (CB). Fig. 72. *A. pespelecani crenatulina*, Guidonia (Roma), Piacenzian, 36 mm. (CB). Fig. 73. *A. etrusca* n. sp., Cedda (Siena), Zanclean-Piacenzian, H = 34 mm (CB). Fig. 74. *A. uttingeriana*, Rio Carbonaro (Piacenza), Piacenzian, H = 44 mm (CB). Fig. 75. *A. peralata*, Campore (Parma), Piacenzian, H = 23 mm (CB). Fig. 76. *A. pliorara*, Cava Lustrelle (Lecce), Lower Pleistocene, H = 44 mm (CB). Fig. 77. *A. serresiana*, Isola d'Elba (Livorno), modern, H = 37 mm (CB). Scale bar = 5 mm.

ACKNOWLEDGEMENTS

Grateful thanks to Paolo Magenes (Milano, Italy), Maurizio Sosso (Genova, Italy), Bruno Dell'Angelo (Genova, Italy), Ulrich Wieneke (Murnau, Germany), M. Harzhauser (NMHW), and S. Dominici (MSNF).

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