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A new large *Patella* (Mollusca: Patellogastropoda) in the Pliocene of the Mediterranean Basin

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Abstract

The overall palaeontological record of the family Patellidae Rafinesque, 1815 is scant and only a few species have been recorded so far from the Late Cenozoic of the Mediterranean basin. A new limpet belonging to the family Patellidae (*Patella alessiae* n.sp.) was discovered in Early Pliocene shallow water deposits of Italy (Siena province, Tuscany). This new taxon is large for the genus and displays very strong radial ribs. The shell's general form and microstructure are consistent with the genus *Patella*. Its closest fossil relatives seem to be *Patella ambroggii* Lecointre, 1952 from the Pliocene of Atlantic Morocco, and *Patella crassicostata* Rovasenda in Sacco, 1897, from Serravallian (middle Miocene) deposits of Piedmont (Italy). Among the Recent taxa, the extant large coarse-ribbed *Patella ferruginea* Gmelin, 1791 displays some superficial resemblance to *Patella alessiae* n.sp. This finding has some biogeographic implications for continuing debate on the origin, radiation and dispersal of the antitropical family Patellidae. In fact, the Pliocene *P. alessiae* supports a certain antiquity for the presence of members of *Patella* s.s. in the North-Eastern Atlantic (including the Mediterranean).

Riassunto

Una nuova *Patella* (Mollusca: Patellogastropoda) di grandi dimensioni nel Pliocene del Bacino del Mediterraneo. La documentazione paleontologica della famiglia Patellidae Rafinesque, 1815 è piuttosto scarna. In particolare, poche sono le citazioni di patelle nel tardo Cenozoico del Bacino del Mediterraneo. Una nuova specie (*Patella alessiae*) è stata identificata in depositi litorali del Pliocene inferiore toscano delle Terre Rosse, nei dintorni di Serre di Rapolano (Siena). La nuova specie è caratterizzata da grandi dimensioni per il genere *Patella* e da ornamentazione costituita da grosse coste, irregolarmente flessuose, dapprima rilevate e poi appiattite, terminanti ciascuna con 3-4 digitazioni. Le caratteristiche conchigliari generali e la microstruttura sono consistenti con l'attribuzione di questa nuova specie al genere *Patella* s.s. Fra le specie fossili atlantiche e mediterranee, *P. alessiae* mostra affinità morfologica con *Patella ambroggii* Lecointre, 1952 originariamente descritta per il Pliocene del Marocco atlantico e *Patella crassicostata* Rovasenda in Sacco, 1897 del Serravalliano (Miocene medio) piemontese. *Patella ferruginea* Gmelin, 1791 appare invece solo superficialmente confrontabile con questa nuova specie pliocenica. In quanto testimonianza del genere *Patella* s.s. nel Pliocene inferiore europeo, questo ritrovamento ha implicazioni biogeografiche importanti in merito al dibattito su origine e dispersione dei Patellidae, famiglia caratterizzata da distribuzione antitropicale. In particolare, la pliocenica *P. alessiae* è indicativa di una presenza abbastanza antica di questo genere nella regione europea (Atlantico nord-orientale, comprendente il Mediterraneo).

Key words

Patella, new species, Pliocene, Mediterranean, Tuscany, Italy, systematics, microstructure, biogeography.

Introduction

The conical limpets belonging to the family Patellidae Rafinesque, 1815 (Patellogastropoda) are found in regions from tropical to subpolar worldwide (Powell, 1973). With few exceptions (e.g. Powell 1973), none of which belong to *Patella* s.s., most members of the family inhabit intertidal rocky substrata of high-energy shores (e.g. Powell, 1973; Branch, 1985; Lindberg, 1988).

Patellidae are represented today by at least 38 species (Koufopanou *et al.*, 1999). This figure may prove to be conservative since the taxonomic position of many other taxa assigned to Patellidae on the basis of shell and/or radular characters alone (e.g. Powell 1973) still needs to be adequately checked through more sophisticated biological means. At present, most species are established in North-Eastern Atlantic and South African waters (e.g. Branch, 1971; Powell, 1973; Christiaens, 1974; Fretter & Graham, 1994) and display a remarkable antitropical distribution (Koufopanou *et al.*, 1999).

Patellids equipped with a large shell (> 3 cm) are assigned to the genera *Patella* Linnaeus, 1758 (restricted to North-Eastern Atlantic, including Mediterranean); *Scutellastra* H. & A. Adams, 1854 (South Africa, Indo-West Pacific, eastern Pacific); *Cymbula* H. and A. Adams, 1854 (South Africa, South-Eastern Atlantic and Mediterranean). Giants in the family mainly belong to the genera *Cymbula* and *Scutellastra* and may attain a size in excess of 150 mm (e.g. Powell 1973).

The taxonomy of the family is complex. The systematics of the family Patellidae at specific and supraspecific level has been the focus of some recent morphological and biomolecular studies (Ridgway *et al.*, 1998; Koufopanou *et al.*, 1999, with

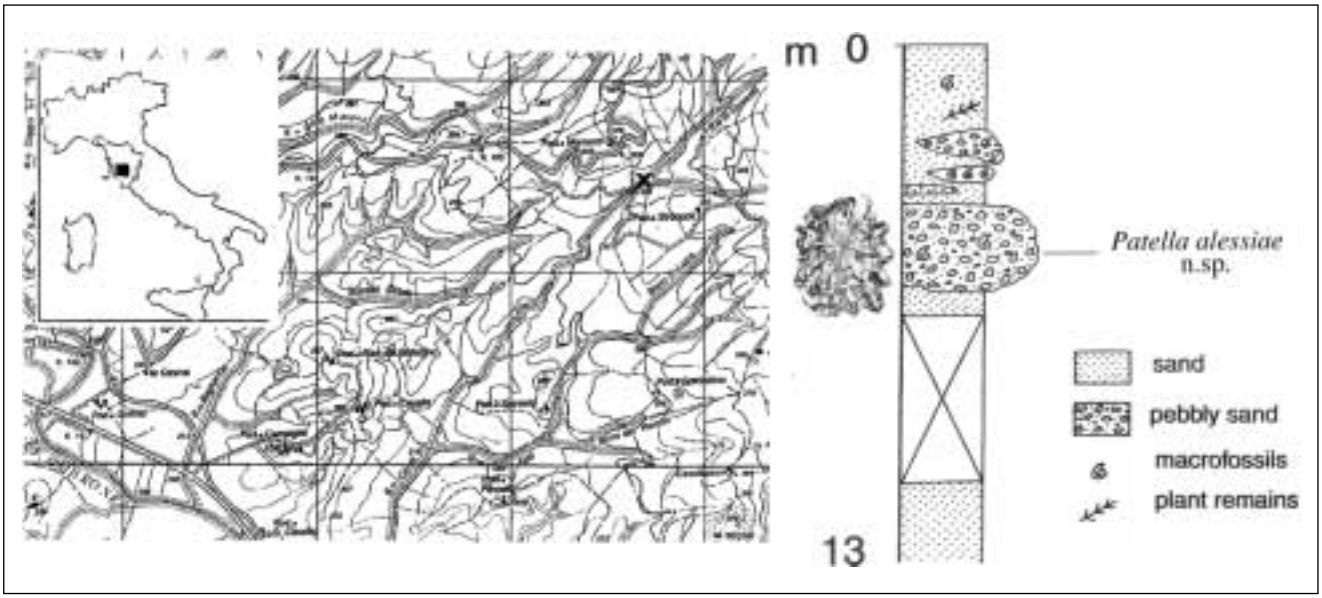

Fig. 1. Location map and lithostratigraphic log of the outcrop where *P. alessiae* n. sp. was found.

Fig. 1. Ubicazione e log litostratigrafico dell'affioramento in cui è stata trovata *P. alessiae* n. sp.

references therein). Although shell morphology may be of good diagnostic value, it proves in many cases unsatisfactory to convincingly set apart species and for generic assignments (e.g. Hedegaard *et al.*, 1997; Ridgway *et al.*, 1998). As a consequence, traditional alpha-taxonomy based on external shell characteristics alone is insufficient to establish with certainty the attribution of fossil shells to family Patellidae and to genera in the family. The implementation of microstructural studies, however, represents a significant aid for the systematics of Patellogastropoda (MacClintock, 1967; Lindberg & Hickman, 1986; Kase & Shigeta, 1996; Sasaki T., 1998; Hedegaard *et al.*, 1997).

The evolutionary and biogeographic history of the family is somewhat obscure, because intertidal organisms such as patellids are only seldom preserved as fossils (Gignoux, 1913; Lindberg & Hickman, 1986). Powell (1973) and, more recently, Koufopanou *et al.* (1999) discussed putative fossil patellids. To date, the oldest confirmed record for the family is "*Patella*" *costulata* Münster, 1869, from the S. Cassian Fm (Upper Triassic) of Northern Italy (Hedegaard *et al.*, 1997; Ridgway *et al.*, 1998).

Koufopanou *et al.* (1999) make an attempt to understand phylogenetic relationships and, hence, biogeographic patterns of Patellidae by means of bio-molecular studies of modern taxa. One of the aims of their work is to test Vermeji's (1992) hypothesis that Patellidae dispersed northwards in the Atlantic from a South African core, perhaps in the Early Pliocene, or Powell's (1973) alternative suggestion of a Tethyan dispersal. In such a perspective, Koufopanou *et al.* (1999) lament the present lack of proper palaeontological documentation of fossil patellids to test their bio-molecular indications. According to Ridgway *et al.*, (1998): "The known fossil distribution of patellids is too fragmentary to permit choice between these alternatives".

The present article is related to the recent discovery of a new species of fossil patellid in the Early Pliocene beds of the Mediterranean basin. This finding is particularly pertinent to the on-going debate about patellid origination and dispersal. In fact, it relates to a geographic area, the Mediterranean basin, and a crucial time, the Early Pliocene (Ridgway *et al.*, 1998; Koufopanou *et al.*, 1999).

To date, there are comparatively few records of European extinct Neogene patellids (e.g. Bonelli, 1824; Sismonda, 1842, 1847; Michelotti, 1847, 1861; Hoernes, 1856; Doderlein, 1862; Fontannes, 1879; Coppi, 1881; Sacco, 1897; Schaffer, 1910-1912; Cossmann & Peyrot, 1917; Lecointre, 1952; Segre, 1954; Koufopanou *et al.*, 1999; Landau *et al.*, 2003). Many such records related to the Miocene of northern Italy, while only a few concern the Pliocene, notoriously poorly represented by patellids (e.g. Fontannes, 1879-82; Sacco, 1897). Many palaeontological records of "*Patella*" in the Mediterranean Quaternary pertain to common extant taxa (e.g. Sacco, 1897; Travaglia, 1880; Gignoux, 1913; Francaviglia, 1960; Malatesta, 1960; Ruggieri & Milone, 1975; Forli *et al.*, 2002; Landau *et al.*, 2003 etc.). We are suspicious about records of pre-Quaternary extant patellids in the European (e.g. Hoernes, 1856; Fontannes, 1879; Schaffer, 1910-1912; Cossmann & Peyrot, 1917; Glibert, 1949; Lecointre, 1952) and Mediterranean (e.g. Calcara, 1841; Fontannes, 1879-82; Coppi, 1881; Almera, 1894; Malatesta, 1960; Forli *et al.*, 2003; Landau *et al.*, 2003) late Cenozoic. The final assessment of their real identity requires a critical re-examination of their taxonomic position, but such a task is beyond the scope of this article.

The new fossil patellid has been found in excavations in the fossil-rich beds of Tuscany, central Italy, and specifically in the same Terre Rosse area of the Siena province that provided and still provide a wealth of palaeontological documentation for the Early Pliocene epoch of the Mediterranean basin. The outcrop from which the new species originated is a pebbly-sandy lens in the locality Stroncoli, Serre di Rapolano (**Fig. 1**). This particular lens has proved to be of exceptional value in supplying fossil mollusc shells from littoral environments, including representatives of the intertidal zone, only rarely encountered as fossils. For instance, this lens is the source of the new species of Haliotidae described by Forli *et al.* (2003), who also provide a preliminary list of the accompanying fauna. The new taxon is recorded in that inventory as *Patella* sp.

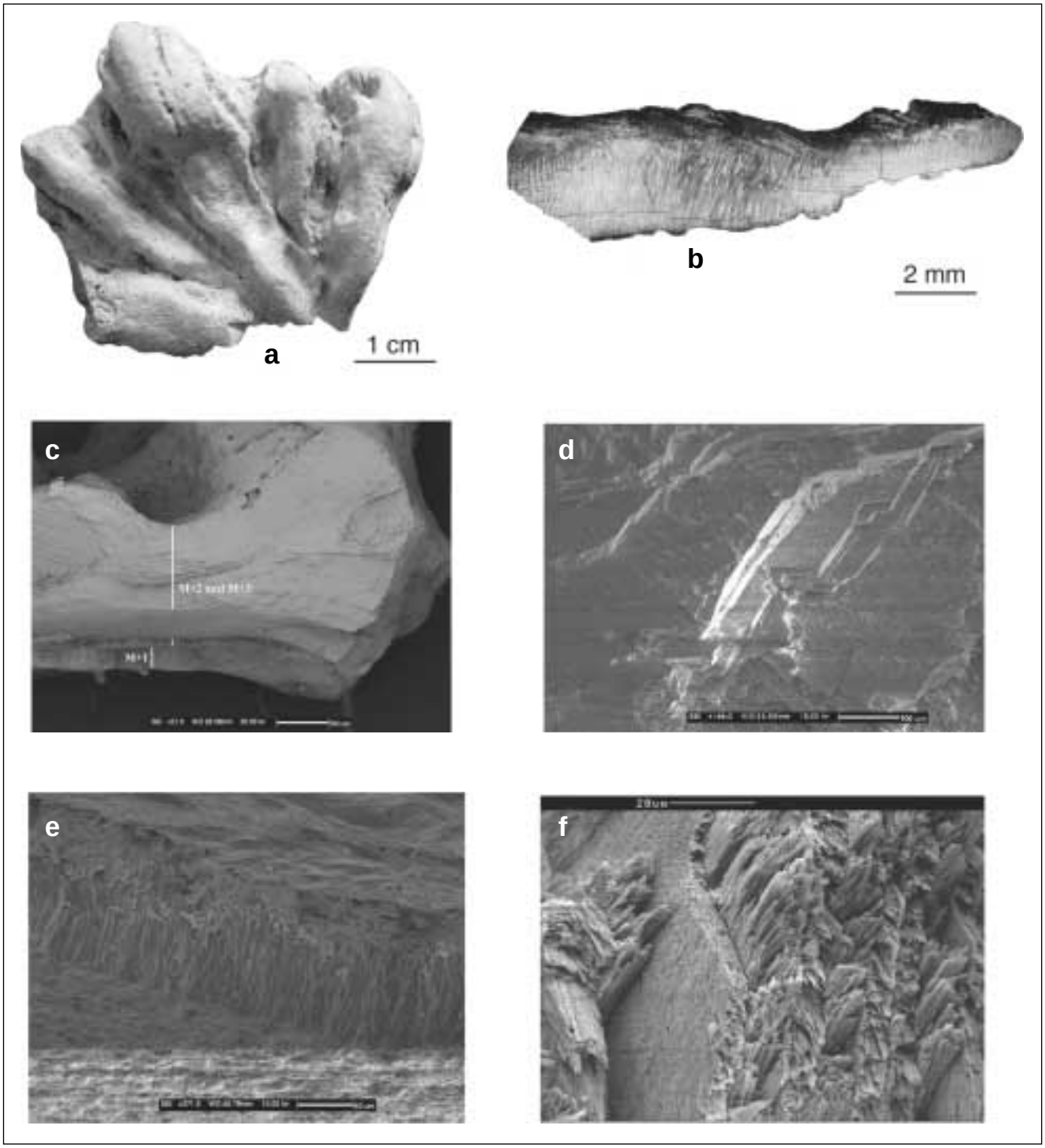

Fig. 2. **a**. *Patella alessiae* n.sp., apical view, marginal fragment showing detail of sculpture (MZB 40657); Serre di Rapolano (Siena prov., Tuscany, Italy); Early Pliocene. **b**. Radial section of *P. alessiae* taken close to the shell margin and showing a calcitic crossed-lamellar structure (M+2 and M+3). Note the narrow bands of alternating light and dark extinction. **c**. Backscattered electron image showing a cross-section of the internal margin of the shell fragment. The outermost layers (M+2 and M+3) reveal a calcitic crossed-lamellar structure (crossed-foliated of McClintock, 1967), followed by a thin simple prismatic layer, whereas the innermost layer (M+1) is aragonitic and displays a crossed-lamellar microstructure. **d**. SEM image showing the calcitic crossed-foliated microstructure of layer M+2. The first-order lamellae are parallel to the inside of the shell. **e**. SEM image showing in detail the thin simple prismatic layer existing in the lowest part of M+2 layer (dotted in Fig. 3). **f**. SEM image showing the aragonitc crossed-lamellar structure of M+1 layer. The first-order lamellae are perpendicular to the inside of the shell.

Fig 2. **a**. *Patella alessiae* n.sp., vista apicale, frammento marginale che mostra il dettaglio della scultura (MZB 40657); Serre di Rapolano (Siena, Toscana, Italia); Pliocene inferiore. **b**. Sezione radiale di *P. alessiae* vicino al margine della conchiglia, che mostra una struttura calcitica a lamelle incrociate (M+2 and M+3). Notare l'alternanza delle bande chiare e scure. **c**. Immagine al microscopio elettronico che mostra la sezione trasversale del margine interno del frammento di conchiglia. Gli strati più esterni (M+2 and M+3) rivelano una struttura calcitica a lamelle incrociate (foliata-incrociata secondo McClintock, 1967), seguita da un sottile strato prismatico; che lo strato più interno (M+1) è aragonitico e mostra una microstruttura lamellare incrociata. **d**. Immagine al microscopio elettronico che mostra la microstruttura calcitica foliato-incrociata dello strato M+2. Le lamelle del primo ordine sono parallele all'interno della conchiglia. **e**. Immagine al microscopio elettronico che mostra in dettaglio il sottile strato prismatico semplice esistente nella parte più bassa dello strato M+2 (tratteggiato in Fig. 3). **f**. Immagine al microscopio elettronico che mostra la struttura lamellare-incrociata aragonitica dello strato M+1. Le lamelle del primo ordine sono perpendicolari all'interno della conchiglia.

Microstructure

The shell microstructure of the new taxon was investigated using two fractured sections of a highly incomplete adult shell fragment representing a marginal portion of the original shell (**Fig. 2a**). The first cross-section was obtained by breaking the sample radially from the most internal part of the shell fragment to its outer edge and the second was obtained by directly breaking the internal region (**Fig. 2b**).

The fractured sections were gold coated and studied by a scanning electron microscope and a backscattered electron image (**Fig. 2a–f**). The mineralogical composition of different layers was assessed through standard X-ray diffraction analysis. Our results reveal that the M+2 and M+3 outermost layers are calcitic and not clearly separable. They show a crossed-lamellar structure, followed by a thin simple prismatic layer (**Fig. 2c** and **2e**). The innermost layer M+1 is aragonitic and displays a cross-lamellar microstructure (**Fig. 2f**); the first-order lamellae are perpendicular to the inside of the shell. The calcitic foliated layer M+2 obtained from the marginal region has a crossed-foliated microstructure (**Fig. 2d**). The first-order lamellae are parallel to the inside of the shell.

By comparison with data presented in the literature (MacClintock, 1967; Lindberg & Hickman, 1986; Hedegaard *et al.*, 1997; Ridgway *et al.*, 1998), the generic attribution to *Patella* seems reasonably substantiated by the microstructural analysis of the shell of *alessiae*, although this assignment cannot be considered as fully conclusive since it was impossible to analyse the shell structure from apex to margin. We regard, therefore, as very plausible the assignment of this new taxon to *Patella* s.s. because of the overall shell characters, that are consistent with those of *Patella*.

Taxonomy

Classis GASTROPODA Cuvier, 1797
Order Patellogastropoda
Superfamilia PATELLOIDEA Rafinesque, 1815
Familia PATELLIDAE Rafinesque, 1815
Genus *Patella* Linnaeus, 1758

Patella alessiae new species
(**Fig. 3a–d**; **Fig. 4a–c**)

Diagnosis

Shell comparatively large for the genus, thick, coarsely nodose with alternating trifid primary and secondary radial ribs.

Description

Shell cap-shaped, oval, depressed, robust, moderately large for the genus (up to 67 mm in length); apex fragile, eroded, slightly directed anteriorly.

Sculpture coarse, heavy, constituted by 9 strong, nodose primary radial ribs, initially elevated, almost straight, then irregularly flexuose and trifid, flattening at the shell's margin; primary costae alternate with 9 secondary ribs arranged as the primary ones; irregular and more or less distinct interstitial threads are present between primary and secondary ribs. The ribs project at the margin and the resulting outline is noticeably corrugated. Concentric growth increments barely visible. Interior of shell marked by a large spatula with an evident callus.

Locus typicus: Serre di Rapolano (Siena province, Tuscany, Italy), 43°20,30'N, 11°35,89'E (Istituto Geografico Militare, 1994: Carta Topografica d'Italia, F. 297, Sezione I, Castelnuovo Berardenga), between Podere Marocco and Podere Stroncoli, at the confluence with Borro di Stroncoli (Stroncoli creek) with an unnamed one.

Etymology: this taxon is named after Alessia Dell'Angelo, young companion of many malacological collecting trips.

Types: Holotype (**Fig. 3a–c**: Zoological Museum of the University of Bologna, inventory n. MZB 40656a): adult shell, length 67 mm, width 53 mm, height 18 mm; Paratype (**Fig. 3d**, **Fig. 4**: MZB 40656b, temporarily retained in the particular collection of M. Forli), adult shell, length 55 mm, width 44 mm, height 15 mm.

Other material: 1 adult shell (**Fig. 4a–b**: temporarily retained in the particular collection of F. Ciappelli), length 92 mm, width 75 mm, height 28 mm; 1 adult shell (pl. 3, fig. 3: temporarily retained in the particular collection of D. Bertini), adult shell, length 72 mm, width 60 mm, height not determined; 1 marginal fragment of an adult shell (MZB 40657).

Discussion

The large size and the distinctive ornamentation of prominent radial ribs easily distinguish *Patella alessiae* from most other recent and fossil members of family Patellidae. We found no strict conchological analogies with any extant patellid species, although the highly variable South African *Cymbula oculus* Born 1778, may be represented by shells vaguely resembling *alessiae*. The extant Mediterranean species *Patella ferruginea* Gmelin, 1791 has a ribbed, comparatively large shell and warrants comparison with the new taxon described here because of their geographic location. *P. ferruginea* seems restricted to the Mediterranean Sea (Ghisotti & Melone, 1970; Giannuzzi-Savelli *et al.*, 1994; Cretella *et al.*, 1994). Its palaeontological documentation in this basin dates back to the Pleistocene at least (Gignoux, 1913; Malatesta, 1960, with references) and the taxon is a recurrent component of last-interglacial (eu-Tyrrhenian) deposits (e.g. Gignoux, 1913; Colantoni, 1970; Ruggieri & Buccheri, 1968; Ruggieri & Milone, 1975; Carobene & Pasini, 1982). The species is recorded as fossil at Cap Spartel, Morocco (Bourcart, 1927), but this single Atlantic record is considered doubtful by Lecointre (1952). There are some pre-Quaternary records of *Patella ferruginea* in the European Neogene (e.g. Calcara, 1841; Hoernes M., 1856; Schaffer, 1910-1912; Landau *et al.*, 2003) but we consider them with skepticism and they are definitely in need of taxonomic revision. Some morphotypes of *P. ferruginea* (**Fig. 4d**; see also Ruggieri & Buccheri, 1968; Giannuzzi-Savelli *et al.*, 1994: 25, figs. 12a, b), occasionally displays a remarkably coarse-ribbed ornamentation; however, such ribs are triangular in section, arranged in a regular radiate pattern, resulting also in a different marginal profile, and always more numerous than in *Patella alessiae* n.sp.

Among extinct taxa, the sculpture of *Patella alessiae* n.sp. resembles that of *Patella crassicostata* Rovasenda in Sacco, 1897, species based on a single juvenile shell from the Helvetian (Serravallian, middle Miocene) of Albugnano (Asti province, Piedmont, Italy). The specimen was part of the Rovasen-

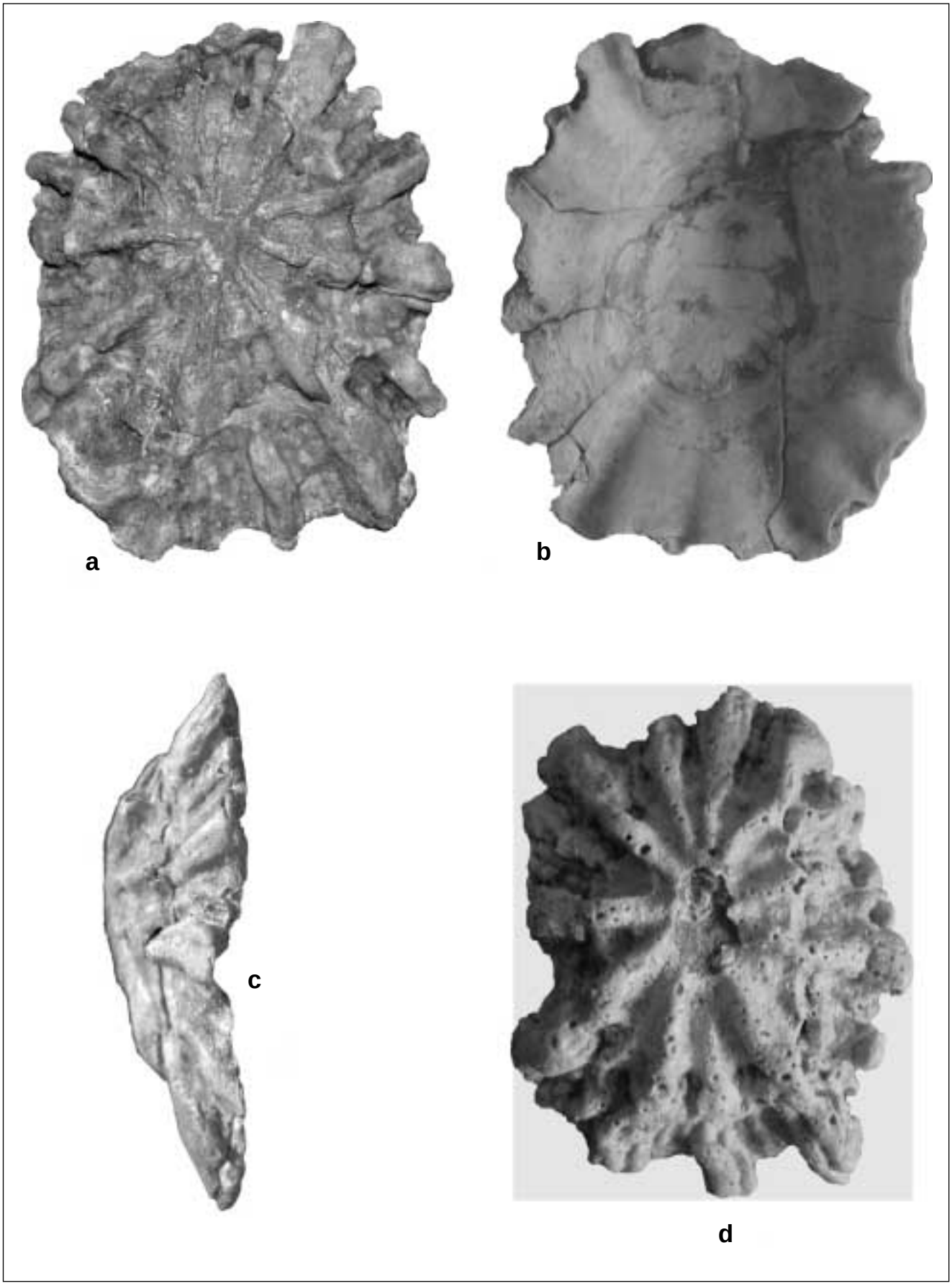

Fig. 3. **a**. *Patella alessiae* n.sp., holotype, apical view (MZB 40656a); Serre di Rapolano (Siena prov., Tuscany, Italy); Early Pliocene. Dimensions: length 67 mm, width 53 mm, height 18 mm. **b**. *Patella alessiae* n.sp., holotype, ventral view. **c**. *Patella alessiae* n.sp., holotype, lateral view. **d**. *Patella alessiae* n.sp., paratype, apical view (MZB 40656b); Serre di Rapolano (Siena prov., Tuscany, Italy); Early Pliocene. Dimensions: length 55 mm, width 44 mm, height 15 mm.

Fig. 3. **a**. *Patella alessiae* n.sp., olotipo, vista apicale (MZB 40656a); Serre di Rapolano (Siena, Toscana, Italia); Pliocene inferiore. Dimensioni: lunghezza 67 mm, larghezza 53 mm, altezza 18 mm. **b**. *Patella alessiae* n.sp., olotipo, vista ventrale. **c**. *Patella alessiae* n.sp., olotipo, vista laterale. **d**. *Patella alessiae* n.sp., paratipo, vista apicale (MZB 40656b); Serre di Rapolano (Siena, Toscana, Italia); Pliocene inferiore. Dimensioni: lunghezza 55 mm, larghezza 44 mm, altezza 15 mm.

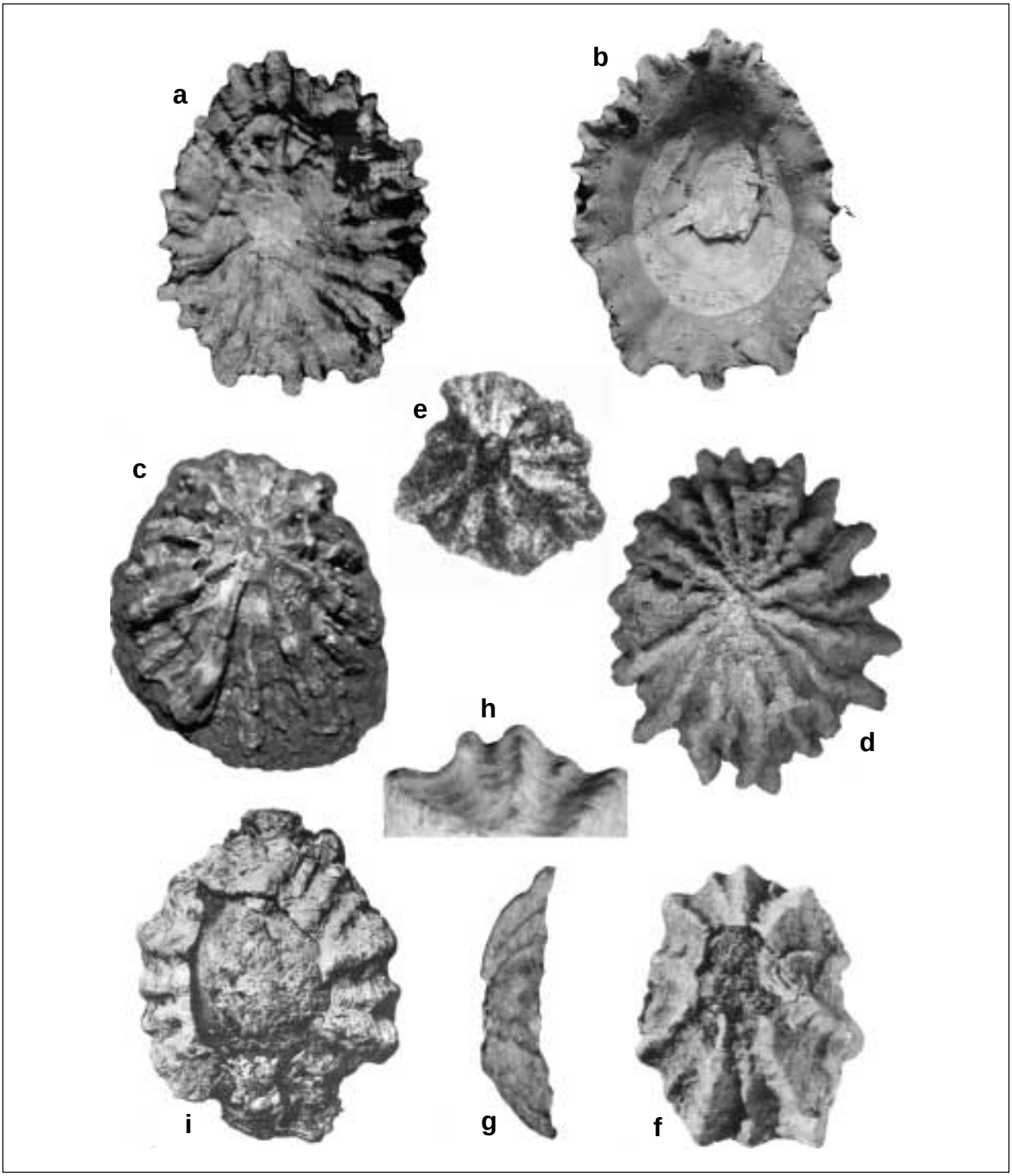

Fig. 4. **a**. *Patella alessiae* n.sp., very large shell, apical view; Serre di Rapolano (Siena prov., Tuscany, Italy); Early Pliocene. Dimensions: length 92 mm, width 75 mm, height 28 mm (particular collection F. Ciappelli). **b**. *Patella alessiae* n.sp., same as above, ventral view. **c**. *Patella alessiae* n.sp., large shell still on matrix, apical view; Serre di Rapolano (Siena prov., Tuscany, Italy); Early Pliocene. Dimensions: length 72 mm, width 60 mm, height not determined (particular collection of D. Bertini). **d**. *Patella ferruginea* Gmelin; coarse ribbed morphotype, apical view; Late Quaternary (Late Pleistocene?), Levanzo isl. (Sicily, Tyrrhenian Sea: MZB collection). **e**. *Patella crassicostata* Michelotti, apical view (reproduced from Sacco, 1897). **f**. *Patella ambroggii* Lecointre, holotype, apical view (reproduced from Lecointre, 1952). **g**. *Patella ambroggii* Lecointre, holotype, lateral view (photo courtesy of M. Oliverio). **h**. *Patella ambroggii* Lecointre, holotype, marginal area showing detail of sculpture (photo courtesy of M. Oliverio). **i**. *Patella ambroggii* Lecointre, large shell, apical view (reproduced from Lecointre, 1952).

Fig. 4. **a**. *Patella alessiae* n.sp., conchiglia di grandi dimensioni, vista apicale; Serre di Rapolano (Siena, Toscana, Italia); Pliocene inferiore. Dimensioni: lunghezza 92 mm, larghezza 75 mm, altezza 28 mm (collezione F. Ciappelli). **b**. *Patella alessiae* n.sp., stesso esemplare della figura precedente, vista ventrale. **c**. *Patella alessiae* n.sp., conchiglia di grandi dimensioni ancora sul sedimento, vista apicale; Serre di Rapolano (Siena, Toscana, Italia); Pliocene inferiore. Dimensioni: lunghezza 72 mm, larghezza 60 mm, altezza non determinata (collezione D. Bertini). **d**. *Patella ferruginea* Gmelin; morfotipo fortemente striato, vista apicale; tardo Quaternario (tardo Pleistocene?), isola di Levanzo (Sicilia, Mar Tirreno: collezione MZB). **e**. *Patella crassicostata* Michelotti, vista apicale (riprodotta da Sacco, 1897). **f**. *Patella ambroggii* Lecointre, olotipo, vista apicale (riprodotta da Lecointre, 1952). **g**. *Patella ambroggii* Lecointre, olotipo, vista laterale (foto di M. Oliverio). **h**. *Patella ambroggii* Lecointre, olotipo, marginal area showing detail of sculpture (foto di M. Oliverio). **i**. *Patella ambroggii* Lecointre, conchiglia di grandi dimensioni, vista apicale (riprodotta da Lecointre, 1952).

da collection preserved in the Geological and Palaeontological Museum of the University of Turin, and was eventually lost in the air bombing of the town during the Second World War (Ferrero Mortara *et al.*, 1982). The only available documentation of this taxon is provided by description and iconography in Sacco (1897: pl. 2, fig. 89; refigured in **Fig. 4e**). On the ground of the immatureness of the shell of *P. crassicostata* and the objective impossibility to conduct any satisfactory comparison between the two taxa, we keep them distinct.

The closest shell relationships are definitely with *Patella ambroggii* Lecointre, 1952. *P. ambroggii* is a fossil large coarse-ribbed patellid originally described from the Pliocene of Morocco, near Mogador (**Fig. 4g–i**). This taxon shows remarkable morphological analogies with, but differs from, *P. alessiae* n.sp. by having primary radial ribs triangular in section, almost straight, alternated with an equal number of minor ones; furthermore, its costae do not display digitated terminations, and finally, the shell shows a rather evident concentric ornamentation. According to Lecointre (1952), his fossil species compares well with the Recent South African taxa *Patella oculus* Born 1778, and *P. granatina* Linnaeus, 1758, presently assigned to *Cymbula* (Ridgway *et al.*, 1998). Whether *P. ambroggii* has been correctly placed in the genus *Patella* or, on the contrary, belongs to *Cymbula* cannot be ascertained on shell characters alone (Ridgway *et al.*, 1998), although we conservatively favour its placement in *Patella* as for *alessiae*. *P. ambroggii* was recorded also from the Miocene (but possibly Pliocene) of Algeria by Segre (1954). The shell figured by Segre (1954: fig. 2), however, is very similar to *Patella alessiae* n.sp. and the two taxa are possibly conspecific. Also the shell from the Early Pliocene of southern Spain attributed to *Patella ferruginea* by Landau *et al.* (2003: pl. 4, fig. 8) seems to belong instead to *alessiae*. A large series of shells belonging to *P. alessiae* and *P. ambroggii* may help to clarify their mutual relationships but it is so far unavailable to palaeontologists. At present, we prefer to keep the Atlantic *P. ambroggii* separated from the Mediterranean *P. alessiae* because of the observed shell differences and the lack of microstructural information on the latter.

Finally, two comparatively smaller species from the Miocene of the Rhone basin, i.e. *Patella delphinensis* Fontannes, 1876, and, especially, *P. vindascina* Fontannes, 1876, present a shell with a similar number and arrangement of the radial costae (Fontannes, 1879, pl. 1: figg. 9-10) and may belong to the phyletic line of *P. alessiae*.

Conclusions

Thus far, *Patella alessiae* n.sp. is a taxon only documented for the Mediterranean Pliocene. This does not necessarily imply that the taxon was endemic to this basin since its restricted distribution may be only apparent and due to the incompleteness of the Neogene paleontological record in the Eastern Atlantic area (Taviani, 2003). As a working hypothesis, we suggest that the taxon might have been already present in the upper Miocene of the Atlantic ocean and spread into the Mediterranean in the Early Pliocene.

Our finding does not lend support to Vermeji's (1992) hypothesis of a South African dispersal core of *Patella* during the late Neogene. On the contrary, it may imply a certain antiquity of the genus in European and northeastern Atlantic waters. Furthermore, a long temporal history for the presence of *Patella* in European waters seems also substantiated by molecular phylogeny (Koufopanou *et al.*, 1999).

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