

## AN OVERVIEW OF THE JURASSIC GASTROPODS FROM ROCCA BUSAMBRA (NORTH-WESTERN SICILY, ITALY)

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**Abstract.** This paper is an overview of the gastropods from the Toarcian to lower Kimmeridgian fissure fillings of Rocca Busambra. They are the most diverse and richest Jurassic faunas known from the pelagic sediments of the western Tethys. 224 species, 137 of them new, were recognized. The main feature of the structure of these assemblages is the high number of new taxa and the concomitant presence of an archaic stock with Triassic affinities, and a group advancing the appearance of the modern caenogastropod taxa. These features give these assemblages an important place in the reconstruction of the evolution of the whole class.

**Riassunto.** Sono sinteticamente descritti i dati sui gasteropodi dei filoni sedimentari toarciaco-kimmeridgiani della Rocca Busambra. Si tratta delle faune più varie e ricche in assoluto tra quelle provenienti dai settori a sedimentazione pelagica della Tetide occidentale. Sono state riconosciute 224 specie, di cui 137 nuove. La principale caratteristica consiste nell'elevato grado di novità e nella presenza concomitante di forme arcaiche, ad affinità triassica, e forme che spostano indietro nel tempo la comparsa di gruppi moderni di Caenogastropoda. Tali aspetti rendono queste faune un riferimento importante per la ricostruzione dell'evoluzione dell'intera classe.

### Introduction

The gastropod assemblages described here are derived from the Jurassic fissure fillings in the carbonate platform deposits of the Inici Formation at Piano Pilato on the southern slope of Rocca Busambra (north-western Sicily) (Fig. 1A). The material was collected and tentatively identified by Wendt (1971). The Geological

and Palaeontological Institute of the University of Tübingen (Germany) placed it at our disposal for a monographic study.

Rocca Busambra consists mainly of carbonate platform deposits of the Inici Formation (Upper Triassic-Sinemurian, Abate et al. 1990; Martire & Bertok 2002). The top of this unit is marked by an erosional surface, overlain by a condensed succession of about ten metres of Rosso Ammonitico, a nodular limestone of upper Middle to Late Jurassic age.

Wendt (1963, 1971) recognized a polyphase complex system of neptunian dykes, of early Toarcian to Miocene age, penetrating the platform carbonates. Dykes parallel to bedding the near to the top of the platform carbonates contain a discontinuous sequence of lower Toarcian to upper Kimmeridgian red mudstones (Fig. 1B). These fissure fillings acted as sedimentary traps which preserve a highly diverse fauna consisting mainly of molluscs (Fig. 1B). Cephalopods (Nautiloidea, Coleoidea, Ammonoidea) are the dominant element followed by gastropods. The accompanying groups comprise bivalves, rare scaphopods, solitary corals, brachiopods, echinoderms (echinoids and crinoids) and, more rarely, crustaceans and worm tubes.

Faunal lists by Wendt (1971) are grouped into seventeen stratigraphical intervals from the lower Toarcian to the lower Kimmeridgian with a conspicuous gap in the Bathonian. In the following text, the numbered faunas and their corresponding stratigraphical intervals refer to the original subdivision by Wendt (1971).

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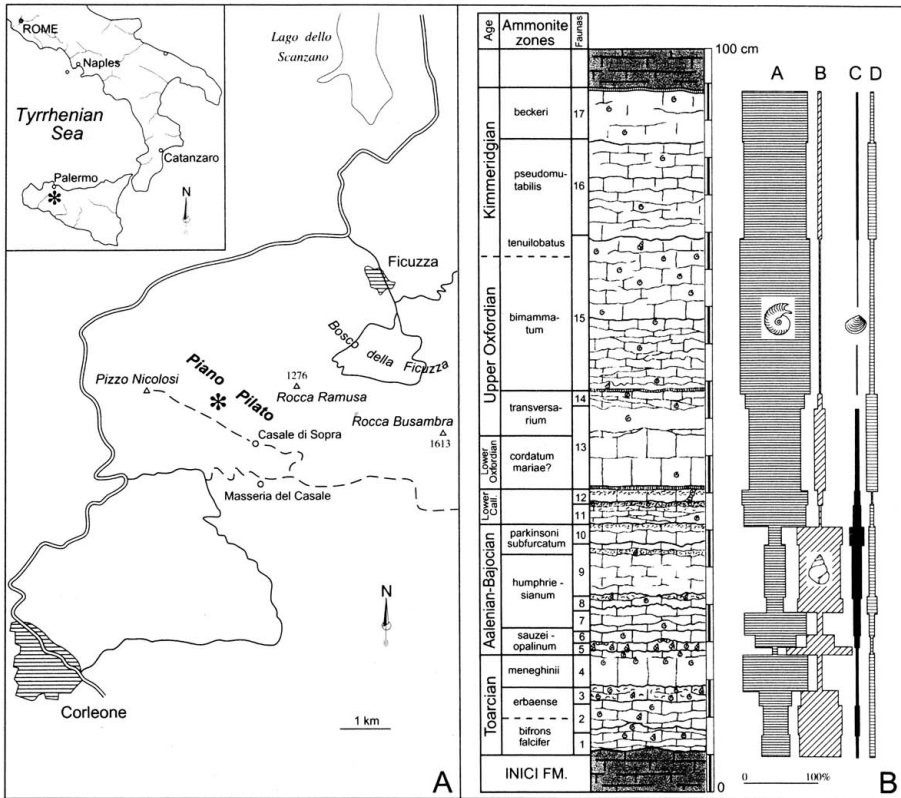


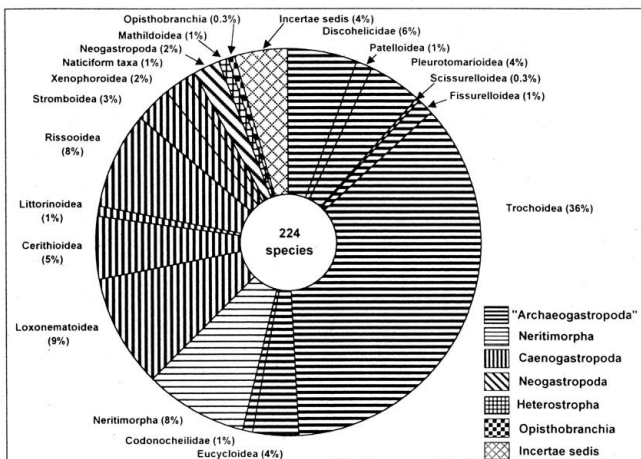
Fig. 1 - A) Location of the outcrop; B) Composite stratigraphical section of the fissure fillings, and distribution of the fossil invertebrate groups (from Wendt 1971). A: ammonites; B: gastropods; C: bivalves; D: other invertebrates.

**The gastropod fauna of the fissure fillings**

The gastropod fauna is composed of about 2500 specimens belonging to 224 species, 137 of them are new. The *Discohellicidae* Schröder, 1995 [data on this group taken from the systematic study made by Wendt (1968)], the *Trochoidea* Rafinesque, 1815, the *Neritimorpha* Golikov & Starobogatov, 1975, the *Loxonematoidea* Koken, 1889 and the *Rissooidea* Gray, 1847 are the dominant groups (Fig. 2). A relatively large number of species could not be clearly assigned systematically (*Incertae sedis*). These forms show peculiar morphological features, and ambiguous or transitional characters between different taxonomic groups. The presence of these forms contributes to increase the overall diversity, which is much high-

er than in other Jurassic gastropod faunas of the pelagic sediments of the western Tethys.

Considering the number of specimens (Fig. 1B), maximum frequencies occur in three main intervals: lower-middle Toarcian (faunas 1-3), Aalenian-lower Bajocian (fauna 5) and upper middle Bajocian-upper Bajocian (faunas 8-10), respectively. Fig. 3 shows the distribution of 186 species, which have an exact position within the seventeen stratigraphical levels defined by Wendt (1971). From this figure, it is clear that three intervals show a maximum differentiation. They correspond to the fauna 3 (middle Toarcian to lowermost upper Toarcian), fauna 5 (Aalenian to lower Bajocian) and fauna 10 (upper Bajocian). The diversity decreases abruptly in the post-Bajocian deposits.



HIGHER TAXA	GEN.	SPECIES
DISCOHELICIDAE	1	13 (6)
PATELLOIDEA	2	3 (1)
PLEUROTOMARIOIDEA	5	10 (6)
SCISSURELLOIDEA	1	1 (1)
FISSURELLOIDEA	1	3 (1)
TROCHOIDEA	25	80 (45)
EUCYCLOIDEA	3	9 (6)
CODONOCHELIDAE	1	2 (1)
NERITIMORPHA	9	19 (13)
LOXONEMATOIDEA	8	21 (12)
CERITHIOIDEA	6	12 (7)
LITTORINOIDEA	1	2 (2)
RISSOOIDEA	4	18 (13)
STROMBOIDEA	3	7 (5)
XENOPHOROIDEA	1	4 (2)
NATICIFORM TAXA	2	2 (2)
NEOGASTROPODA	4	5 (4)
MATHILDOIDEA	1	2 (1)
OPISTHOBANCHIA	1	1 (0)
INCAETAE SEDIS	7	10 (9)
TOTAL	86	224 (137)

Fig. 2 - Composition of the gastropod fauna based on a total of 224 species. In the table, the numbers in brackets refer to the new species.

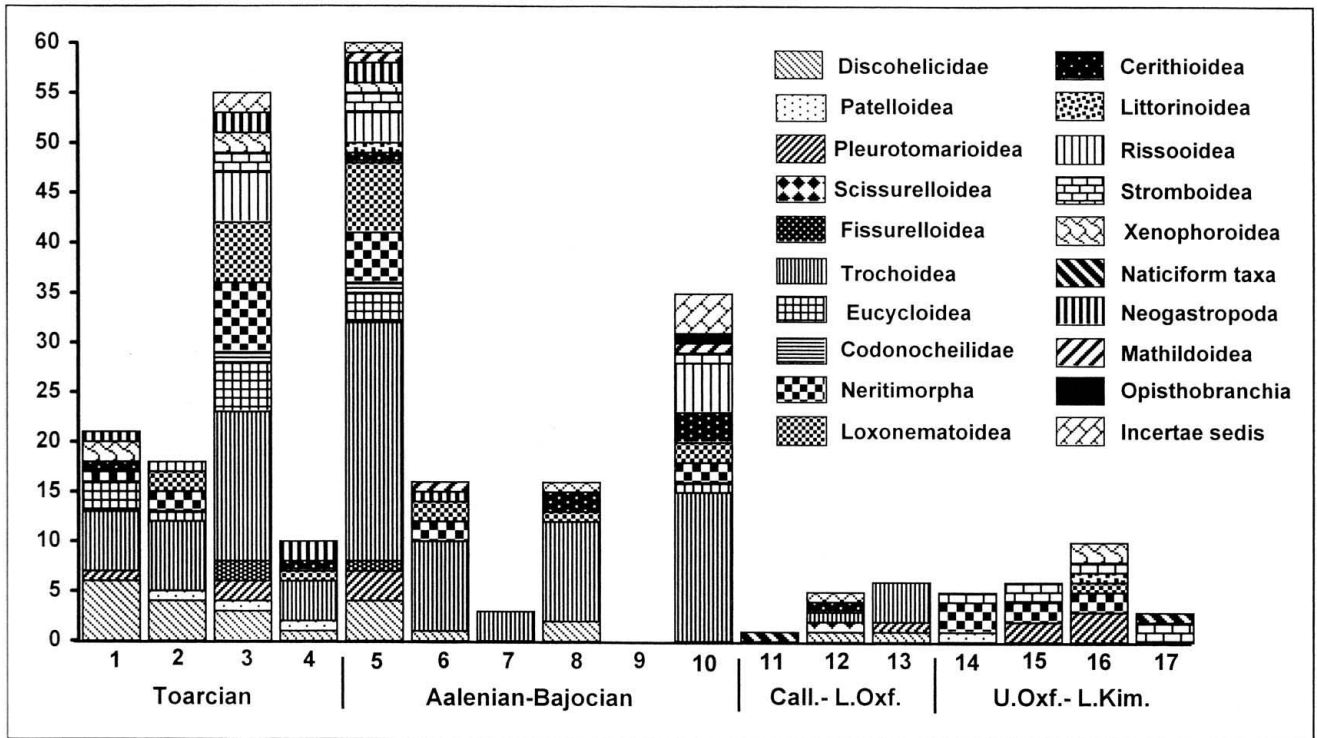


Fig. 3 - Distribution and frequency of the major gastropod groups in the seventeen stratigraphical intervals defined by Wendt (1971). Data from 186 species.

Apart from the 186 species mentioned above, 38 species are from assemblages which embrace more than one level. This mixing may be partly a result of the process of fissure filling, which involved frequent phenomena of condensation. Additionally, difficulties of precise sampling, especially in the cases of the thinnest fissure fillings, may have contributed to the mixing of the faunas. Four main larger intervals were chosen to represent the distribution of these species: Toarcian (faunas 1-4), Aalenian-Bajocian (faunas 5-10), Callovian-lower Oxfordian (faunas 11-13) and upper Oxfordian-lower Kimmeridgian (faunas 14-17). Fig. 4 shows the frequency of the major groups in three of these intervals.

#### Pleurotomarioidea Swainson, 1840

The frequency of pleurotomarioidean species is rather low if compared with that of the Jurassic faunas from western Europe [e.g. Fischer & Weber (1997) and references therein]. This aspect also characterizes the other Jurassic faunas from pelagic sediments of the Mediterranean Tethys. No Toarcian to Bajocian species are in common with the coeval western European faunas. Instead, two species from Aalenian to Bajocian fissure fillings are present in the pelagic sediments of the central part of the western Tethys, namely *Trochotomaria somhegyensis* (Szabó, 1980), from the Bakony Mountains (Hungary) and Umbria (central Italy) (Szabó 1980; Conti & Fischer 1981, 1984a; Conti & Szabó 1987), and *Bathrotomaria submandoki* Conti & Szabó, 1989, from Capo San Vigilio (northern Italy) (Vacek 1886; Conti &

Szabó 1989). Moreover, the genus *Trochotomaria* Conti & Fischer, 1981 shows a palaeogeographical distribution restricted to those areas.

Two Kimmeridgian species were quoted by Zittel (1873) in the Upper Jurassic of Stramberg and belong to a new subgenus of *Bathrotomaria* Cox, 1956.

#### Trochoidea Rafinesque, 1915

The superfamily Trochoidea Rafinesque, 1915 represents about one third of the total number of species and is by far the dominant group. Eighty species belong to this superfamily, which were grouped into 30 genera of five families (Ataphridae Cossmann, 1916, Turbiniidae Rafinesque, 1815, Trochidae Rafinesque, 1815, Nododelphinulidae Cox, 1960 and Stomatellidae Gray, 1840). Eight species of six genera exhibit particular characters or combinations of characters which do not permit their clear inclusion in known trochoidean taxa. These species were classified as Trochoidea Incertae sedis (Tab. 1).

More than three quarters of the trochoidean species, in terms of number of both specimens and species, consist of Ataphridae and Proconulinae Cox, 1960 (family Trochidae) (Fig. 5). Almost all the trochoidean species were found in Toarcian and Aalenian-Bajocian levels (Fig. 4 A, B). The post-Bajocian sediments contain only four proconulin species from Callovian to lower Oxfordian fissure fillings (faunas 11-13). The frequency of trochoideans in the upper Oxfordian-lower Kimmeridgian levels (faunas 14-17) is practically negligible (Fig. 4C).

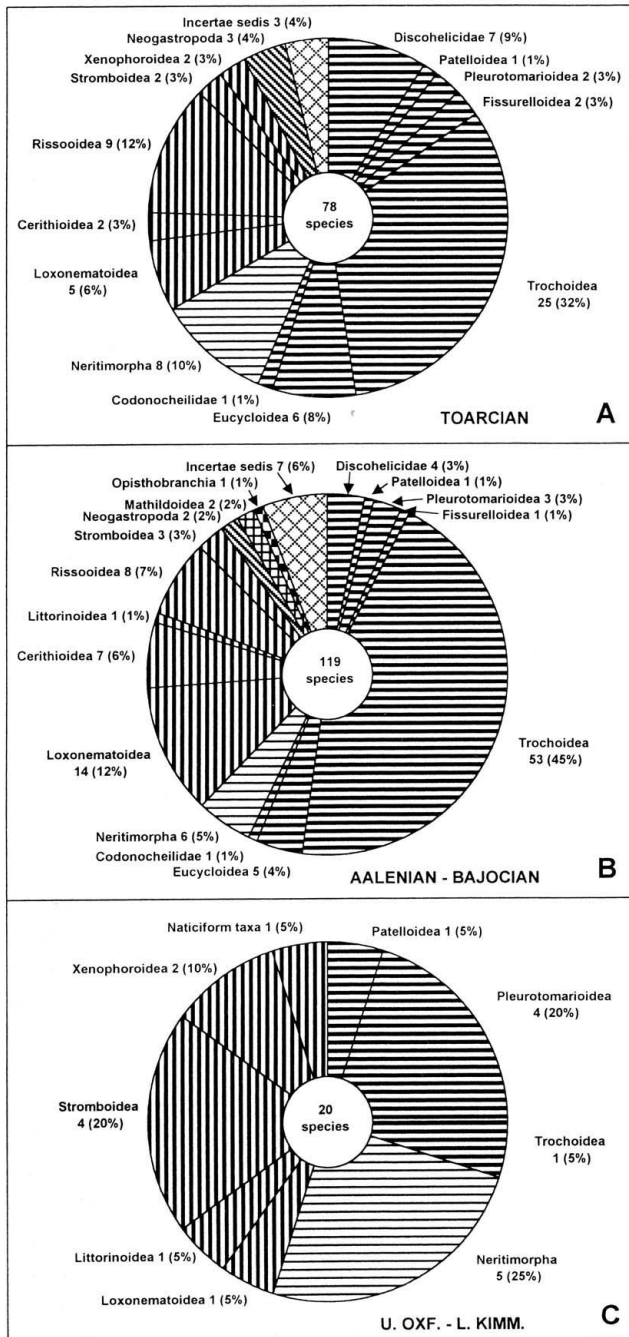


Fig. 4 - Distribution of the major gastropod groups in three main stratigraphical levels. See fig. 2 for symbols.

#### Ataphridae Cossmann, 1916

The Ataphridae are the most differentiated and frequent groups (Fig. 5). Monari et al. (1996) unified the two families Ataphridae and Colloniidae. In agreement with the ICZN rules of priority, these authors used the family-name Colloniidae Cossmann, 1916 based on the date of description of the two families reported by Cossmann (1918). However, as stated by P. Bouchet (pers. comm.), Cossmann (1918) treated the Ataphridae as a new family, but he had also (Cossmann 1916) formally introduced the taxon two years earlier as a turbinid subfamily. On the other hand, the formal founding of the family Colloniidae was published by Cossmann (in Cossmann & Peyrot 1917) recording 1916 as the year of publication; however the publication did not appear until 1917. Consequently, the family-name Ataphridae has priority over Colloniidae. The

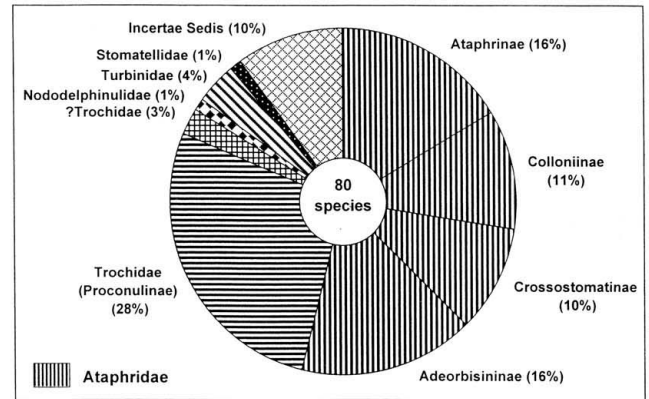


Fig. 5 - Classification of the trochoidean species into families and subfamilies.

diagnostic characters of the family and its subdivision into subfamilies are those given by Monari et al. (1996) who defined four subfamilies: Ataphrinae Cossmann, 1916, Colloniinae Cossmann, 1917, Crossostomatinae Cox, 1960 and Adeorbisinae Monari et al., 1996.

The Ataphrinae are represented by three genera among which one genus is new. The genus *Ataphrus* Gabb, 1869 was subdivided into three subgenera by adding two new subgenera. *Zircia* Szabó, 1981, up to now known only from Bajocian fissure fillings of Veneto (northern Italy), Umbria (central Italy) and Bakony Mountains (Hungary) (Szabó 1981; Conti & Fischer 1983, 1984a; Conti & Monari 1986) with two subgenera [*Zircia* s.s. and *Z. (Cycloturbo)* Conti & Fischer 1983], is further subdivided with the addition of a new subgenus.

The Colloniinae consist of two genera: *Bakonyia* Szabó, 1981, which occurs in the Bajocian deposits of the Bakony Mountains (Szabó 1981) and *Pleuratella* Moore, 1867, a genus known from the Sinemurian of England (Moore 1867) and from the lowermost Jurassic carbonate platform deposits of Rocca Busambra (Gemellaro 1878). *Pleuratella* is present in the Toarcian to Bajocian fissure fillings with two subgenera, of which one is new.

Two genera, namely *Crossostoma* Morris & Lycett, 1851 and a new genus, belong to the subfamily Crossostomatinae. *Planicollonia* Conti & Monari, 1986 is also tentatively ascribed to that subfamily (see also Monari et al. 1996). A new species of *Planicollonia* was recognized in addition to the type species (*Planicollonia macrostoma* Conti & Monari, 1986). Due to its uncertain attribution, the genus was included in the Incertae sedis in the graphics and tables of the present paper. In the fissure fillings of Rocca Busambra, *Crossostoma* occurs with the two currently known subgenera (Monari et al. 1996), namely *Crossostoma* s.s. and *C. (Paleocollonia)* Kittl, 1899. Moreover, a third new subgenus was identified. *C. (Paleocollonia)* appears in Middle Triassic. In post-Triassic sediments species of this genus were found in Middle Jurassic fissure fillings of Umbria (central Italy), Veneto (northern Italy) and Bakony Mountains (Hungary) (Parona 1894; Szabó 1982; Conti & Fischer 1983, 1984a; Conti & Monari 1986; Conti & Szabó 1987).

With respect to the subfamily Adeorbisinae, both the subgenera of the genus *Adeorbisina* Greco, 1899 listed by Monari et al. (1996), namely *Adeorbisina* s.s. and *A. (Mariottia)* Conti & Fischer, 1981, occur in the fissure fillings of Rocca Busambra. A further new genus, recorded in Aalenian to lower Bajocian levels, increases the diversity of the subfamily. The overall distribution of the subfamily is confined to Italy, Hungary and the Western Carpathian Mountains (Uhlig 1878, 1881; Greco 1899; Conti & Fischer 1981, 1984a; Conti & Szabó 1987; Szabó 1996).

#### Trochidae Rafinesque, 1815

All the species ascribed with certainty to the Trochidae belong to the subfamily Proconulinae. Moreover, a new genus is tentatively included in this family.



FAMILIES	SUBFAMILIES	GENERA	SUB-GENERA	SPECIES	A	B	C	D
ATAPHRIDAE								
	Ataphrinae	3 (1)	6 (3)	13 (6)	4	10	-	-
	Colloniinae	3	4 (1)	9 (6)	3	6	-	-
	Crossostomatinae	2 (1)	4 (1)	8 (5)	4	3	-	-
	Adeorbisinae	2 (1)	3	13 (6)	3	8	1	1
TRICHIDAE								
	Proconulinae	4 (1)	4	22 (10)	4	17	4	-
TRICHIDAE?		1 (1)	1	2 (2)	1	1	-	-
NODODELPHINULIDAE		1 (1)	1	1 (1)	1	-	-	-
TURBINIDAE		2 (1)	2	3 (2)	1	2	-	-
STOMATELLIDAE		1	1	1	-	1	-	-
INCERTAE SEDIS		6 (5)	6	8 (7)	3	5	-	-

Tab. 1 - Composition of the trochoidean taxa. Numbers in brackets refer to the new taxa. A: Toarcian species (faunas 1-4); B: Aalenian to Bajocian species (faunas 5-10); C: Callovian-lower Oxfordian species (faunas 11-13); D: upper Oxfordian-lower Kimmeridgian species (faunas 14-17).

Recently, Gründel (2000) modified the diagnosis of Proconulinae and raised it up to the family level. We agree with his diagnosis, but not at the family level, because the distinctive characters belong to those that are applied to identify subfamilies in trochid shells. Our abundant and diverse material allowed us to make a new systematic arrangement of the subfamily. Our studies are based on a re-examination of the type material and of almost all the other Jurassic species of Proconulinae.

The Proconulinae of Rocca Busambra consist of *Proconulus* Cossmann, 1918, *Muricotrochus* Cossmann, 1918, *Epulotrochus* Cossmann, 1918 and a new genus tentatively ascribed to the subfamily. The genus *Proconulus* is represented by *Proconulus baldensis* (Parona, 1894), *Proconulus scopulorum* (Uhlig, 1878), two new species, and three other forms without specific attribution. *Muricotrochus* shows a wide interspecific variability of some characters (Monari et al. 1996). One of them is the muricate ornament, which previous authors (Cossmann 1918) considered to be one of the principal diagnostic elements at the generic level. In contrast, investigations of the material from Rocca Busambra indicate its subgeneric value, whereas the presence of a columellar tooth is a character diagnostic of generic rank. On the basis of these considerations, the genus *Muricotrochus* was subdivided into two subgenera, namely *Muricotrochus* s.s., characterized by the presence, at least on the juvenile shell, of the muricate ornament, and *M. (Laeviconulus)* Conti & Fischer, 1984 in which this sculpture is absent. Eleven species belong to this genus, namely *Muricotrochus (M.) cf. subluciensis* (Hudleston, 1894), *M. (Laeviconulus) epuliformis* (Szabó, 1981), *M. (Laeviconulus) keratomorphus* (Conti & Monari, 1986) and eight new species. The subgenus *M. (Laeviconulus)* occurs only in the Middle Jurassic of central Italy and the Bakony Mountains (Szabó 1981; Conti & Monari 1986; Conti & Szabó 1987).

#### Other trochoideans

The remaining trochoideans consist of three families, namely Nododelphinulidae, Stomatellidae and Turbinidae. A new subfamily was ascribed to the latter family. The Stomatellidae are represented by *Mesogena calabra* (Greco, 1899), a species known from the Aalenian of Rossano Calabro (southern Italy) (Greco 1899).

In addition, six genera show unique characters. They seem to lack close relationships to the known trochoidean taxa and were placed in the Trochoidea Incertae sedis. Even though these taxa are a subordinate component of the assemblages, they increase the degree of differentiation of the superfamily, which reaches its maximum in the Toarcian and lower Bajocian.

#### Eucycloidea Koken, 1897

The shell characters of the Eucycloidea present an ambiguous view of their affinities and their systematic position is currently under discussion. The debate concerns mainly the presence or absence of an outlet in

the lower part of the outer lip, the structure of the shell and the significance of the ornamentation reflected on the inner shell wall. Insufficient information on the protoconch characters makes their interpretation even more difficult.

Hickman & McLean (1990) considered the group as a trochid tribe, but Szabó (1995) maintained that the general shell shape and ornament distinguish the eucycloidea from the trochoidea. That author, therefore, confirmed the opinion of Golikov & Starobogatov (1975) in accepting the validity of the superfamily Eucycloidea. More recently, Conti & Monari (2000) presented further evidence to support Szabó's (1995) opinion.

Nine eucycloidean species occur in Toarcian to Bajocian fissure fillings of Rocca Busambra. Among them, *Eucyclus (Eucyclus) ornatus* Sowerby, 1822 is the only species known. The species is common in the Middle Jurassic deposits of western Europe and north Africa (Conti & Monari 2000, and ref. therein) and it shows the typical eucyclid ornament composed of few and strong spiral keels. This type of ornament is quite frequent in the western European species whereas most of our species exhibits an ornament composed of numerous and relatively thinner spiral keels. One of these species, coming from Toarcian fissure fillings, belongs to the subgenus *Eucyclus (Lokuticyclus)* Szabó, 1995. Szabó (1995) proposed this taxon for Sinemurian to Pliensbachian species of the Bakony Mountains (Hungary). Its discovery in Rocca Busambra extends the distribution of *E. (Lokuticyclus)* to the Toarcian.

#### Neritimorpha Golikov & Starobogatov, 1975

In previous classifications based on shell characters (e.g. Wenz 1938; Knight et al. 1960) the neritaceans are ascribed to the Archaeogastropoda Thiele, 1929. The current neontological systematics treats it as a separate clade. According to Haszprunar (1988) this clade corresponds to the Neritimorpha. Instead, Ponder & Lindberg (1996) named it as Neritopsina Cox & Knight, 1960. Bandel & Frýda (1999) regarded the group as a subclass exhibiting an embryonic shell differing from that of both the Vetigastropoda Salvini-Plawen, 1980 and Docoglossa Troschel, 1866 [see also Bandel (2000) and ref. therein]. Moreover, Bandel & Frýda (1999) subdivided the subclass into two orders, Cycloneritimorpha Bandel & Frýda, 1999 and Cyrtoneritimorpha Bandel & Frýda, 1999 on the basis of the type of coiling of the protoconch. Consequently, these authors raised the families Neritopsidae and Neritidae to the superfamily rank. The resorption of the inner shell wall is one of the characters distinguishing the neritoidea from the neritopsioidea. According to that systematic arrangement, the Neritimorpha of Rocca Busambra belong to the Cycloneritimorpha.

The Neritopsidae (Neritopsioidea) of Rocca Busambra consist of two genera, namely *Neritopsis* Grateloup, 1832 and *Naticopsis* M'Coy, 1844. *Neritopsis*

includes four species, which are discontinuously present from the middle Toarcian to the lower Kimmeridgian. The genus appears in the Middle Triassic of the Alpine region and attains its maximum species differentiation during the Jurassic and Cretaceous (Batten 1984). Among the five species occurring in the fissure fillings of Rocca Busambra, *Neritopsis dumortieri* Rollier, 1918 is quoted from the middle Toarcian of the Rhone Basin (Dumortier 1869; Rollier 1918) and from the Aalenian deposits of Capo San Vigilio (northern Italy) (Vacek 1886; Conti & Szabó 1989). *Neritopsis haueri* Uhlig, 1878 occurs in the lower Oxfordian fissure fillings of Rocca Busambra. Uhlig (1878) established the species on specimens from supposed Callovian deposits of the Western Carpathian Mountains (Klippen Belt, southern Poland).

The subgenus *Naticopsis* (*Marmolatella*) Kittl, 1894 occurs in the Middle Triassic carbonate platform sediments of the Alpine region with several species. The only record of the taxon in the Jurassic deposits is *Naticopsis* (*Marmolatella*) *esui* Conti & Monari, 1986 from condensed Aalenian to lower Bajocian fissure fillings of Umbria (central Italy). This species is present in the fissure fillings of Rocca Busambra too, but in horizons referred to the middle Toarcian.

The Neritidae consist of eight genera and 13 species of which four genera and one subgenus are new. Therefore, the degree of novelty is relatively high. *Neridomus* Morris & Lycett, 1853 and *Neritaria* Koken, 1892 are among the known genera present in the fissure fillings of Rocca Busambra. While *Neridomus* is frequent in the Jurassic sediments, *Neritaria* was previously thought to be restricted to the Triassic. At Rocca Busambra *Neritaria* comprises two subgenera and five species derived from middle Toarcian to lower Bajocian levels. This diversification of the taxon appears as a final flourish of the genus before its extinction. *Onchochilus* Zittel, 1882 occurs in the Toarcian. This is the first record of the genus in the central part of the western Tethys. A new genus closely related to it, was found in the middle-upper Bajocian.

### Rissooidea Gray, 1847

The Rissoininae Stimpson, 1865 of Rocca Busambra are represented by *Zebinostoma* Conti & Fischer, 1984, with ten species, and *Rissocerithium* Conti & Fischer, 1981, with two species. Five species were ascribed to a new genus. A single species belongs to a new genus of the subfamily Rissoinae Gray, 1847. The oldest species belongs to the genus *Zebinostoma* and comes from the middle Toarcian (fauna 2). *Rissocerithium* first occurs in the upper middle Toarcian (fauna 3).

Bandel et al. (2000) suggested close phylogenetical relationships between the *Zebinostoma-Rissocerithium* group and *Canterburyella* Bandel et al., 2000, a genus from the Lower/Middle Jurassic boundary beds of New Zealand. According to these authors, *Zebinostoma* and *Rissocerithium* could belong to the Canterburyellidae Bandel

et al., 2000, a family included in the Cerithioidea Ferrussac, 1819. Recently, Gründel (1999) described numerous Rissoininae from eastern Germany and northern Poland. Among these, *Paleorissolina maeuseri* Gründel, 1999 occurs in the upper Toarcian whereas the remaining species are Bathonian and Callovian in age. Gründel (1999) also noted the differences of the peristomal characters between his species and the *Zebinostoma-Rissocerithium* group, but he did not give an explicit opinion on the systematic position of these genera due to the lack of information about the protoconch characters.

The protoconch of *Rissocerithium* consists of 2.5 globose whorls ornamented by two spiral threads. Axial ribs appear at the beginning of the teleoconch, and the transition between the protoconch and teleoconch seems gradual (Conti & Monari 1995, fig. 1g). Even though the morphology of the teleoconch of *Canterburyella* closely resembles that of *Zebinostoma* and *Rissocerithium*, its protoconch has globose whorls ornamented by axial ribs. According to Bandel et al. (2000), these characters do not correspond to the protoconch of the rissooideans.

The Rissooidea have a particular significance in the evolution of the Jurassic western Tethyan gastropods. Conti et al. (1993) discussed the presence and high frequency of Rissooidea in Jurassic pelagic sediments of the western Tethys concluding that this group represents a modern element among the Jurassic gastropods of this region. According to them, the Rissooidea presumably appeared in the central part of the western Tethys during the earliest Jurassic. In these areas, this group probably found suitable conditions, that allowed an early radiation before the Late Jurassic spreading. The study of the material from Rocca Busambra supports this assumption. In fact, in the Toarcian fissure fillings the Rissoininae occur with two genera and nine species. This relatively high taxonomic diversity confirms that this group appeared before the Toarcian.

### Higher caenogastropods

An interesting group of taxa, coming from the Toarcian to Bajocian fissure fillings, shows neogastropod characters and represent additional elements of modernity of the Jurassic gastropod faunas of Rocca Busambra. They are represented by four genera and five species, among which three come from Toarcian levels and two from Bajocian levels. From a morphological point of view, two species have characters similar to those of the Buccinidae Latreille, 1825. Two species have a high-fusiiform morphology, and one species shows relationships to *Maturifusus* Szabó, 1983. Based on this genus, Gründel (2001) founded the family Maturifusidae Gründel, 2001 and placed it in the superorder Latrogastropoda Riedel 2000, order Neomesogastropoda Bandel, 1991. As emphasised by Riedel (2000), the appearance of *Maturifusus* predates the main, post-Neocomian radiation of the Latrogastropoda. The occurrence of these forms in the

fissure fillings of Rocca Busambra significantly predates the spreading of the neogastropods in Europe, which occurred mainly during the Late Jurassic and Cretaceous (Conti & Szabó 1988; Szabó 1991; Bandel 1993).

## Conclusions

The Jurassic gastropod assemblages from Rocca Busambra represent the richest faunas known so far from pelagic sediments of the western Tethys. Because of their exact biostratigraphic attribution based on the co-occurring ammonites studied by Wendt (1971), these assemblages play an important role in the reconstruction of the evolution of Jurassic Gastropoda. Furthermore, the good preservation of the material allowed a comprehensive systematic study. On the other hand, the abundance of the material, which includes many new taxa, required enormous efforts of preparation and systematic study. Many aspects and problems, especially those concerning the revision of the systematics of the major taxa, cannot be discussed here. However, they are a considerable part of the monograph currently in preparation by the present writers.

Endemism, partly mentioned above, is a striking feature of the Jurassic gastropod faunas of Rocca Busambra. This feature seems evident also in the stromboideans of the family Aporrhaiidae Gray, 1850. Although the aporrhaiids are relatively well represented (seven species), most of the species belong to *Pietteia* (*Trietteia*) Conti & Szabó, 1987, a subgenus based on species *Pietteia* (*Trietteia*) *trispinigera* Szabó, 1983, which was found only in Middle Jurassic deposits of central Italy and the Bakony Mountains (Szabó 1983; Conti & Fischer 1984a; Conti & Monari 1986). The degree of endemism is also emphasized by the presence of several species which, due to their peculiar characters, were put into an *Incertae sedis* group. Only about twenty per cent of the total number of species could be ascribed with certainty to previously

known species. The great majority of them is restricted to the central part of the western Tethys (Central Apennines, Veneto and Bakony Mountains).

Another striking feature is the presence of archaic groups [i.e. groups which prevail in pre-Jurassic sediments (Szabó 1984)] together with modern groups [i.e. groups which spread from the Late Jurassic (Conti & Fischer 1984b)]. This co-occurrence has already been recognized in other coeval faunas from Umbria and Hungary (Conti & Szabó 1987, and references therein; Conti 1989; Szabó 1991).

The lists of archaic groups reported by Conti & Szabó (1987) is enriched by some loxonematoidean genera with close Triassic affinities, namely *Telleria* Kittl, 1894, *Coelochrysalis* Kittl, 1894 and *Allocosmia* Cossmann, 1897, in addition to *Crossostoma* (*Paleocollonia*), *Naticopsis* (*Marmolatella*) and *Neritaria*.

Among the modern groups, the Rissoidae show an evident differentiation, which took place since the Toarcian. In the deposits of this age, *Zebinostoma* occurs together with *Rissocerithium* and this evidence completes the data preliminarily given by Conti et al. (1993). Among the subordinate components, the presence of a scissurelloidean species is noteworthy because this group is otherwise extremely rare in the Jurassic (Conti & Monari 1991; Bandel 1998). Finally, the presence and relatively high frequency of genera related to the higher caenogastropods emphasizes the modern aspect of the gastropod faunas of Rocca Busambra.

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