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Late Triassic (Tuvalian – Carnian, *Tropites subbullatus/Anatropites spinosus* zones) ostracods from Monte Gambanera (Castel di Iudica, Central-Eastern Sicily, Italy)

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Abstract – Ostracod associations coming from the Upper Triassic (*Tropites subbullatus/Anatropites spinosus* zones of the Tuvalian substage) clays and sandstones of the Mufara Formation outcropping along the west side of Monte Gambanera (Castel di Iudica, central-eastern Sicily) have been analysed for the first time. The specimens are relatively abundant, silicified, well preserved and often preserved as complete carapaces. Over 200 specimens have been determined. They belong to the families Healdiidae, Bairdiidae, Bythocyprididae, Acratiidae, Cytheruridae, Limnocytheridae, Candonidae, Cavellinidae, Polycopidae and Thaumatocyprididae. Thirty-seven species are identified of which nine species are new: *Hungarella forelae* n.sp., *Hungarella siciliiensis* n.sp., *Bairdia andrecrasquini* n.sp., *Bairdia gambaneraensis* n.sp., *Ptychobairdia iudicaensis* n.sp., *Ptychobairdia* leonardoi n.sp., *Petasobairdia jeandercourti* n.sp., *Kerocythere dittainoensis* n.sp. and *Mockella barbroae* n.sp.

Keywords: Ostracods / systematic / Late Triassic / Neo-Tethys / Central-Eastern Sicily / Mount Gambanera / Mufara Formation

Résumé – Ostracodes du Trias supérieur (Tuvalien, Carnien, zones à Tropites subbullatus/ Anatropites spinosus) de Monte Gambanera (Castel di Iudica, Sicile Centre Est, Italie). Pour la première fois est ici analysée une association d'ostracodes provenant du Trias supérieur (zones à *Tropites subbullatus/Anatropites spinosus* du sous étage Tuvalien) dans les argiles et grés de la Formation Mufara affleurant le flanc ouest du Mont Gambanera (Castel di ludica, Sicile Centre Est). Les spécimens, silicifiés, sont relativement abondants, bien préservés et les plus souvent retrouvés sous formes de carapaces complètes. Plus de 200 spécimens ont été identifiés. Ils appartiennent aux familles Healdiidae, Bairdiidae, Bythocyprididae, Acratiidae, Cytheruridae, Limnocytheridae, Candonidae, Cavellinidae, Polycopidae and Thaumatocyprididae. Trente-sept espèces sont reconnues dont sont nouvelles: *Hungarella forelae* n.sp., *Hungarella siciliiensis* n.sp., *Bairdia andrecrasquini* n.sp., *Bairdia gambaneraensis* n.sp., *Ptychobairdia Iudicaensis* n.sp., *Ptychobairdia* leonardoi n.sp., *Petasobairdia jeandercourti* n.sp., *Kerocythere dittainoensis* n.sp. and *Mockella barbroae* n.sp.

Mots clés : ostracodes / systématique / Trias supérieur / Néo-Téthys / Sicile centre est / Mont Gambanera / Formation Mufara

1 Introduction

This is the second contribution on the LateTriassic ostracod fauna of the Mufara Formation outcropping in central eastern Sicily. Previously the ostracod fauna of the *Tropites dilleri* zone of the Tuvalian substage outcropping at Monte Scalpello has been analysed (Crasquin *et al.*, 2018).

Now, a sedimentary level which is stratigraphically higher than the previous one and referable to the *Tropites subbullatus/ Anatropites spinosus* zones of the Tuvalian substage, has been identified at the western side of the Monte Gambanera, nine kilometres south of Monte Scalpello (Fig. 1). The samples provided a rich and mostly well-preserved ostracod fauna.

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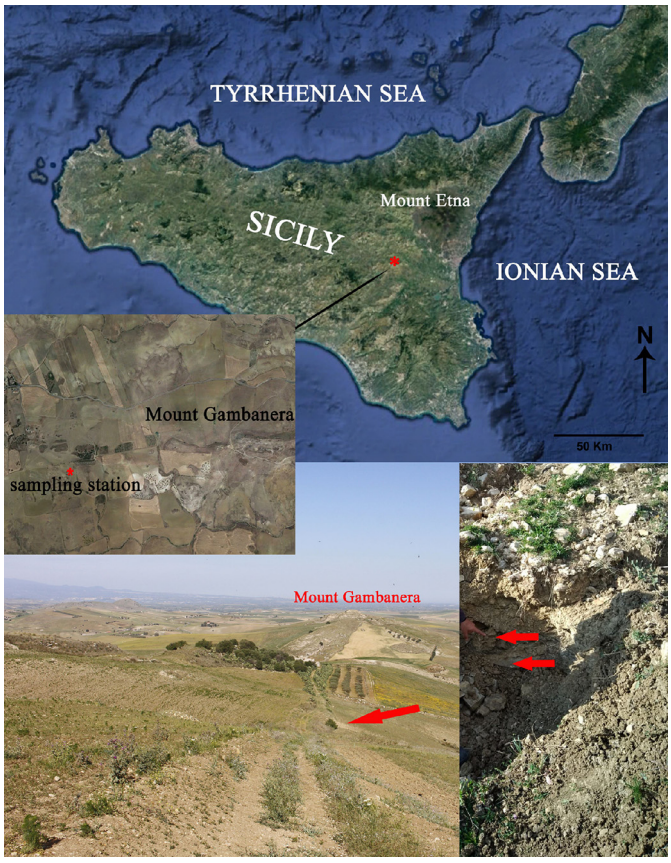

Fig. 1. Geographical location of Monte Gambanera, Sicily, Italy and sample locality.

2 Geological setting and studied samples

Monte Gambanera is a modest relief located in central eastern Sicily (F 269 III NE of the Carta d'Italia alla scala 1:25 000) to the southeast of the town of Castel di Iudica (EN), about 40 kilometres west of Catania (Fig. 1). Structurally Monte Gambanera is part of the "Monte Judica Units" (Lentini *et al.*, 1987) and is inserted along the northern margin of the Gela Foredeep, in the geodynamic context of the southern end of the Maghrebian–Sicilian Southern Apennine nappes (Lentini *et al.*, 1987; Grasso, 2001 inter alias).

In the Monte Gambanera area, the outcropping sediments are assigned to the Neo-Tethyan Mesozoic-Cenozoic complex which belongs to the so-called Imerese Succession (Lentini *et al.*, 1987; Montanari, 1987; inter alias) or Imerese-Sicano Succession (Carrillat and Martini, 2009; Di Paolo *et al.*, 2012). The Imerese Basin, where these sedimentary successions were deposited, was delimited by the Panormide Carbonate Platform to the west and the Trapanese Carbonate Platform to the east and south (Catalano and D'Argenio, 1982; Montanari, 1987; Speranza and Minelli, 2014). In this basin, therefore, occurs a transitional facies between the Panormide and Trapanese shelf facies, on the one hand, and a deep marine facies of the Neo-Tethys, on the other. The sedimentary succession of Monte Gambanera (Fig. 2) starts with the "Carnian Flysch" (Auct.) or the Mufara Formation (Schmidt di Friedberg and Trovò, 1962). This unit, outcropping in the

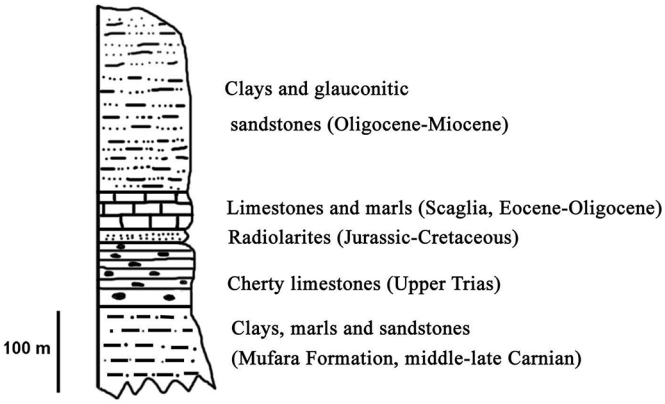

Fig. 2. Stratigraphic series of Monte Gambanera, Sicily, Italy.

southern slopes of the mount, mainly consists of dark grey pelites, which locally contain rare ammonites, with rare interbeds of fossiliferous calcarenites and fibrous calcite with *Halobia* spp. imprints. The Mufara Fm. has been analysed since the beginning of the nineteenth century by Calcara (1840, 1845), Nelli (1899a, b) and subsequently by Gemmellaro (1904), Scalia (1907a, b, 1909, 1910–1914), Maugeri Patanè (1934) and Lentini (1974). These latter authors attributed these sediments to the Carnian (Late Triassic).

Stratigraphically, the Mufara Fm. outcropping at Monte Scalpello, can be referred to the *Tropites dilleri* zone of the Tuvalian substage (Crasquin *et al.*, 2018) due to the presence of Trachyceratidae (?*Neoprotrachyceras, Trachysagenites, Pamphagosirenites*) and Tropitidae. A foraminifera, conodont and palynomorph biostratigraphical analysis, allowed to attribute the levels of the Mufara Fm. outcropping at Monte Gambanera to the *Tropites subbullatus/Anatropites spinosus* zones of the Tuvalian substage (Fig. 3) (Carrillat, 2001; Carrillat and Martini, 2009). In this stratigraphic horizon, cropping out near masseria Balconere at the west side of Mount Gambanera, two levels consisting of slightly silty clays have been sampled (Fig. 1). As they are stratigraphicaly very close and the number of specimens is quite low, we consider here the ostracod assemblages of both samples in all. They represent the ostracod association of the present study.

Twenty kilograms of sediments were collected from each of the two stratigraphic levels. Sediments were routinely washed, dried in oven and sieved. Then, ostracod specimens were picked out from the 63 µm fraction. The ostracod specimens were examined and measured under a stereomicroscope, then photographed under an LMU Tescan Vega II SEM. The material is housed in the Palaeontological Museum of the University of Catania. The repository number of the specimens are given in the systematic descriptions and/or in plate explanations. Over 200 specimens have been picked out from the two samples. The specimens are silicified, quite well preserved and often consist of complete carapaces.

3 Systematic palaeontology

Abbreviations. L: length; H: height; W: width; RV: right valve; LV: left valve; DB: dorsal border; VB: ventral border; AB: anterior border; PB: posterior border; PVB: postero-ventral border; AVB: antero-ventral border; PDB: postero-

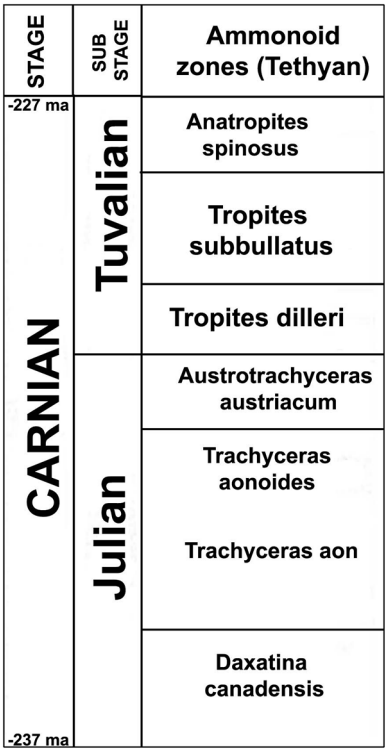

Fig. 3. Carnian ammonoid zones in Monte Scalpello (Crasquin *et al.*, 2018) and Monte Gambanera (present study) (after Lucas, 2010 modified).

dorsal border; ADB: antero-dorsal border. We follow here the general classification of Moore (1961) and Horne *et al.* (2002).

Class Ostracoda Latreille (1806)
Subclass Podocopa Müller (1894)
Order Metacopida Sylvester-Bradley (1961)
Suborder Metacopina Sylvester-Bradley (1961)
Superfamily Healdioidea Harlton (1933)
Family Healdiidae Harlton (1933)

The systematics of Mesozoic Healdiidae is quite complicated and an important revision is necessary. We can't do it here because we have not enough material and most of the discrimination between the genera were based on muscles scars which are not preserved in the present material. However, we try to establish a way to distinguish the Triassic Healdiidae genera when only the external characters of carapaces are available. Therefore we follow the work of Kristan-Tollmann (1973, 1979). The Palaeozoic forms are considered to belong to the subfamily Healdiinae Harlton (1933). The Triassic forms belong to Hungarellinae Kristan-Tollmann (1971) and Liassic ones to the subfamily Pseudohealdiinae Gründel (1964) (Kristan-Tollmann, 1971).

Subfamily Hungarellinae Kristan-Tollmann (1971)

In the Subfamily Hungarellinae, seven genera have been described so far: *Triadiohealdia* Kristan-Tollmann (1971); *Aneisohealdia* Kristan-Tollmann (1971); *Labratella* Gramm (1970); *Hungarella* Méhes (1911); *Ogmoconchella* Gründel (1964) emend Michelsen (1975); *Signohealdia* Kristan-Tollmann (1971); *Torohealdia* Kristan-Tollmann (1971).

A great confusion exists in the systematics of Late Permian – Triassic Healdiidae genera *Hungarella* – *Ogmoconcha* – *Ogmoconchella*. Some authors consider *Hungarella* Méhes (1911) (which has no type material – Gerry and Kozur (1973); but the Hungarian original material in under revision by E. Tóth, pers. com.) and *Ogmoconcha* Triebel (1941) as synonyms (Moore, 1961; Anderson, 1964). Shaver (*in* Moore 1961), Sohn (1968) and Kristan-Tollmann (1971, 1977a, b) don't agree with this synonymy. In fact, the two genera are close but the valves are strongly dissymmetric in shape in *Hungarella*. The third genus, *Ogmoconchella* was introduced by Gründel (1964) and emended by Michelsen (1975) mainly due to the presence of a spine at PVB. In a recent revision, Forel and Crasquin (submitted) considered that until the relationship of *Ogmoconcha* and *Hungarella* is clarified, *Hungarella* should only been used for Triassic species to avoid artificially rooting *Ogmoconcha* down to the Triassic. Morphologically, the left and right valves of *Hungarella* are asymmetrical contrary to those of *Ogmoconcha* (Kristan-Tollmann, 1977a, b; Lord, 1982): in the absence of observable central muscle scars, all Triassic occurrences of *Ogmoconcha* and *Ogmoconchella* are re-attributed to the genus *Hungarella*.

Genus *Hungarella* Méhes (1911)
Type species *Bairdia problematica* Méhes (1911)
Hungarella forelae n.sp.
(Plate 1A)

2018 *Ogmoconchella felsooersensis* (Kozur, 1970); Crasquin *et al.* : 133, figs. 6A-B.

Etymology. Dedicated to Dr. Marie-Béatrice Forel, Muséum national d'Histoire naturelle, Paris.

Material. Four complete carapaces.

Holotype. One complete carapace, collection number PMC O 21 H 13/10/2019, Plate 1A

Paratype. One complete carapace, collection number PMC O 77 P 13/10/2019, Crasquin *et al.* (2018), fig. 6A.

Diagnosis. A species of *Hungarella* with triangular shape carapace, a posteroventral spine at RV, delicate flattening in blade shape at anterior border of RV.

Description. Massive carapace with a symmetric triangular shape; quite symmetric relative to H max; shape of left and right valves similar; LV is significantly larger than RV and radius of curvature of PB smaller than anterior one; LV overlaps RV all around the carapace with minimum at PVB; maximum of H located in front of or at mid L; maximum of L at mid H or a little below; VB quite straight; presence of a very fine flattening all around the AB of RV in blade shape; small spine more or less distinct at PVB of RV; dorsal view biconvex with valves almost symmetric in shape and W max at or just behind mid L; surface seems to be smooth.

Dimensions. L = 706–919 μm; H = 529–622 μm (see Fig. 4).

Occurrence. Tuvalian– Carnian, *Tropites dilleri* zone (Crasquin *et al.*, 2018) and *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Remarks. The present specimens are close to *Ogmoconchella felsooersensis* (Kozur, 1970) from the early Anisian of Hungary (Kozur, 1970, Monostori, 1995) and Romania (Sebe *et al.*, 2013). In a previous paper (Crasquin *et al.*, 2018) two of the present specimens were attributed to this *O. felsooerensis*.

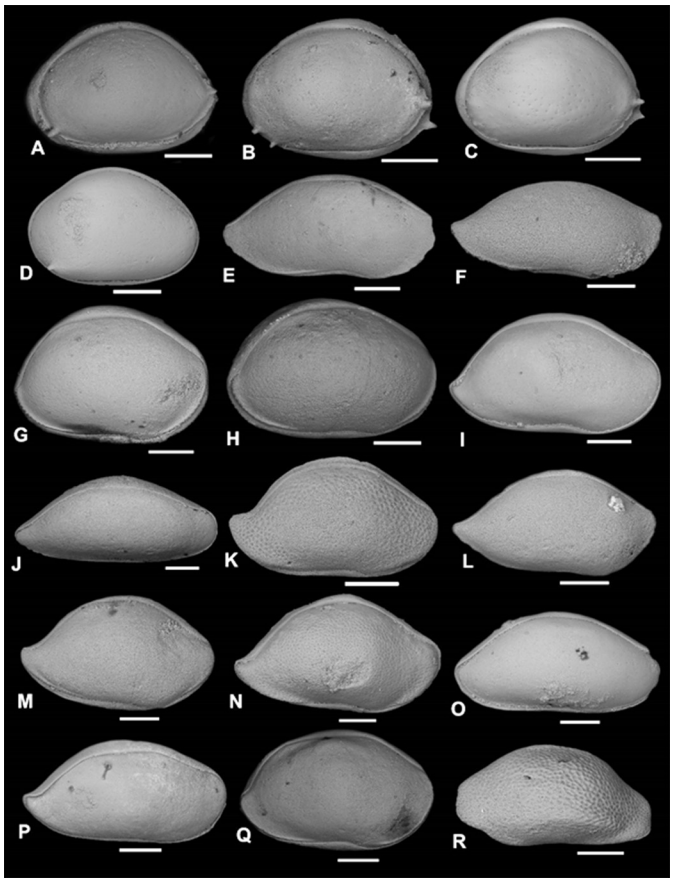

Plate 1. Ostracods from Late Triassic (Tuvalian-Carnian) of Monte Gambanera, Sicily, Italy. All the specimens are stored in the Palaeontological Museum of the University of Catania. The repository numbers are given as PCM (Palaeontological Museum Catania) O (Ostracods) X H (number of holotype) or X P (number of paratype) or FS X (Figured Specimen number) registration date. Scale bars = 200 μm. A: *Hungarella forelae* n.sp. A: holotype, right lateral view of a complete carapace, PMC O 21 H13/10/2019; paratype figured in Figure 6A (Crasquin *et al.*, 2018). B-C*: Hungarella siciliiensis* n.sp. B: holotype, right lateral view of a complete carapace, PMC O 22 H 13/10/2019; C: paratype, right lateral view of a complete carapace, PMC O 78 P 13/10/2019. D: *Hungarella* sp. A: right lateral view of a complete carapace, PCM O FS49. E-F: *Bairdia andrecrasquini* n.sp. E: holotype right lateral view of a complete carapace, PMC O 23 H 13/10/2019; F: paratype, right lateral view of a complete carapace, PMC O 79 P 13/10/2019. G-H: *Bairdia gambaneraensis* n.sp. G: holotype, right lateral view of a complete carapace, PMC O 24 H 13/10/2019; H: paratype, right lateral view of a complete carapace, PMC O 80 P 13/10/2019. I: *Bairdia cassiana* (Reuss, 1869). Right lateral view of a complete carapace, PCM O FS50. J: *Bairdia* cf. *monostorii* Forel and Grădinaru (2018). Right lateral view of a complete carapace, PCM O FS51. K: *Bairdia* sp.1 *sensu* Crasquin *et al.* (2018). Right lateral view of a complete carapace, PCM O FS52. L: *Bairdia* sp. A. Right lateral view of a complete carapace, PCM O FS53. M: *Bairdia* sp. B. Right lateral view of a complete carapace, PCM O FS54. N: *Bairdia* sp. C. Right lateral view of a complete carapace, PCM O FS55. O: *Bairdia* sp. D. Right lateral view of a complete carapace, PCM O FS56. P: *Bairdia* sp. E. Right lateral view of a complete carapace, PCM O FS57. Q: *Bairdia* sp. F. Right lateral view of a complete carapace, PCM O FS58. R: *Hiatobairdia subsymmetrica* Kristan-Tollmann (1970). Lateral view of a left valve, PCM O FS59.

Based on the new material this determination was revised and they are attributed to *Hungarella forelae*. Here the carapace is more triangular with a smaller radius of curvature of PB; the blade at AB is also more expressed here. The specimens described by Forel *et al.* (2019b; Plate 4, particularly fig. E, K) as *Hungarella gommerii* Forel, 2019 from the Carnian of Sichuan (South China) are very close to our specimens. However, the Sichuan specimens are smaller (biggest one ≈ L = 600 μm, H = 400 μm) and show a smaller radius of curvature at both extremities. The largest specimen of *H. forelae* (Fig. 4) presents some morphological variability: overlap less important, at RV: the blade is located only at the ventral part of AB and occurrence of a small spine at the upper part of it, at LV: anteroventral blade seems to be also present. We consider that these morphological variations could be the expression of ontogenic variations but some doubt remains.

Hungarella siciliiensis n.sp.
(Plate 1B and 1C)

Etymology. The species name refers to Sicily where the locus typicus is located.

Material. Four complete carapaces.

Holotype. One complete carapace, collection number PMC O 22 H 13/10/2019, Plate 1B.

Paratype. One complete carapace, collection number PMC O 78 P 13/10/2019, Plate 1C.

Diagnosis. A species of *Hungarella* with triangular shape carapace, two posteroventral spines at RV, flattening in blade shape plus a spine at anterior border of RV, spine at AB of LV.

Description. Massive stocky carapace with a symmetric triangular shape; quite symmetric relative to H max; general shape of valves similar, but LV is significantly larger than RV and radius of curvature of PB smaller than anterior one; LV overlaps RV all around the carapace with minimum at PVB; maximum of H located at mid L or in front of mid L; maximum of L at mid H or a little below mid H; VB quite straight; presence of a very fine flattening at AB of RV in blade shape and a spine located near the maximum of convexity of AB; two more or less distinct spines at PVB of RV; one spine at AB of LV; dorsal view biconvex with valves almost symmetric in shape and W max at or just behind mid L; surface seems to be smooth.

Dimensions. L = 606–760 μm; H = 503–533 μm (see Fig. 4).

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this work).

Remarks. *Hungarella siciliiensis* n.sp. is very close to *H. forelae* n.sp.. The shapes of the valves are similar. The main differences between the two species is the presence of 2 spines at PVB of RV, presence of a spine at AB of booth valves and the less distinct "blade" at the AB of *H. siciliiensis* n.sp.. We can't exclude that these differences are due to morphological variability of *H. forelae* n.sp. (sexual or ontogenic). However, for the time being we have not enough specimens to settle this question.

Hungarella sp. A
(Plate 1D)

Material. One complete carapace.

Dimensions. H = 538 μm; L = 775 μm.

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Order Podocopida Sars (1866)
Suborder Bairdiocopina Gründel (1967)
Superfamily Bairdiodea Sars (1866)
Family Bairdiidae, Sars (1866)
Genus *Bairdia* McCoy (1844)
Type species *Bairdia curta* McCoy (1844)
Bairdia andrecrasquini n.sp.
(Plate 1E and 1F)

Etymology. In memory and honour of Dr. André Crasquin, father of the first author.

Material. Three complete carapaces and one broken carapace.

Holotype. One complete carapace, collection number PMC O 23 H 13/10/2019 (Plate 1E).

Paratype. One complete carapace, collection number PMC O 79 P 13/10/2019 (Plate 1F).

Diagnosis. A species of *Bairdia* with an elongated carapace, flattened AB and PB, and a ventral ridge along the posterior part of the VB and PB.

Description. Bairdioid carapace, quite elongated (H/L = 0.44); DB straight at RV and slightly convex at LV; ADB and PDB straight and quite symmetric with respect to DB; AB with large radius of curvature and maximum located above mid-H, AB strongly flattened laterally; VB slightly concave; PB slender and pointed, maximum of curvature located at lower 1/3 of H, strongly flattened laterally; presence of the ventral ridge which begins in posterior part of VB and runs along PB.

Remarks. This species is quite original and differs from all other ones by the specific characters (flattened AB and PB, and a ventral ridge along the posterior part of the VB and PB.). The shape of carapace is comparable to *Bairdia* sp. 4 *sensu* Forel *et al.* (2019b) from the Carnian of China and to *Bairdia liviae* Forel and Grădinaru (2018) from the Anisian of North Dobrogea, Romania (Forel and Grădinaru, 2018) but this last species does not show the specific characteristics.

Dimensions. H = 372–415 μm; L = 372–415 μm.

Occurrence. Tuvalian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bairdia gambaneraensis n.sp.
(Plate 1G and 1H)

2018 *Bairdia* cf. *deformata* Kollmann (1963); Crasquin *et al.:* 134, fig. 6K-L.

Etymology. Refering to the locus typicus Monte Gambanera, Sicily, Italy.

Material. Four complete carapaces.

Holotype. One carapace, collection number PMC O 24H 13/10/2019 (Plate 1G).

Paratype. One complete carapace, collection number PMC O 80 P 13/10/2019 (Plate 1H).

Diagnosis. A species of *Bairdia* with a very compact carapace, a continuously arched dorsal boarder and flattened and crenulated ventral parts of AB and PB

Description. Bairdioid carapace, quite short (H/L = 0.6–0.7), LV overlaps RV all around the carapace with minimum at AB and anterior part of VB; LV: all the dorsal part regularly arched; AB with large radius of curvature with maximum at mid-H, VB almost straight; BP with large radius of curvature with maximum at lower 1/3 of H; PDB arched; RV: DB straight, ADB straight with an angulation of 145°–150° against DB; AB with large radius of curvature; AVB and PVB flattened laterally in its very external part and with very fine crenulation; VB slightly concave; bairdioid beak quite absent; PDB straight with an angle of 125°–130° with DB; Presence of a shoulder on medio-dorsal part of LV; carapace biconvex and quite slender in dorsal view.

Dimensions. L = 886–910 μm; H = 600–643 μm.

Occurrence. Tuvalian, *Tropites dilleri* zone (Crasquin *et al.*, 2018), *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this work).

Remarks. *Bairdia gambaneraensis* n.sp. is similar to *Bairdia deformata* Kollmann (1963) from the Rhaetian of Austria. The carapace of the present material is longer and presents a shoulder at LV. The new species has exactly the same general shape of valves as *B. penovoidea* Bolz (1971) from Late Norian–Rhaetian of Austria and differs from this species only by a larger AB, a longer DB and the ventral crenulation of AB and PB.

Bairdia cassiana (Reuss, 1869)
(Plate 1I)

1869 *Cythere cassiana* n.sp.; Reuss: 108.

1869 *Bairdia cassiana* (Reuss, 1869); Gümbel: 180, pl. 5, figs. 18-19.

1958 *Bairdia cassiana* (Reuss, 1869); Styk: 171, fig. 3/1.
1970 *Bairdia cassiana* (Reuss, 1869); Ulrichs: 705-706, pl. 1, figs. 1-2.
1978 *Bairdia cassiana* (Reuss, 1869); Kristan-Tollmann: 81, pl. 1, fig. 4; pl. 6, fig. 6.
1991 *Bairdia cassiana* (Reuss, 1869); Kristan-Tollmann *et al.*: 200, pl. 1, fig. 5.
1995 *Bairdia cassiana rotundidorsata* n.ssp.; Monostori: 42, Pl. 2, figs. 4-5.
1996 *Bairdia (Rectobairdia) garciai* n.sp.; Crasquin-Soleau and Grădinaru: 77-78, pl. 2, figs. 5, 8.
2013 *Bairdia cassiana* (Reuss, 1869); Monostori and Tóth: 310, pl. 2, figs. 7, 8, 10.
2014 *Bairdia cassiana* (Reuss, 1869); Mette *et al.*: pl. 2, fig. 1.
2014 *Bairdia cassiana* (Reuss, 1869); Monostori and Tóth: 26, pl. 1, fig. 14.
2018 *Bairdia cassiana* (Reuss, 1869) ; Crasquin *et al.*: 134, fig. 6M.
2019a *Bairdia cassiana* (Reuss, 1869), Forel *et al.*, in press, figs. 4F–H.

Material. Four complete carapaces.
Dimensions. H = 486–533 μm; L = 840–948μm.
Occurrence. Early Carnian, Late Triassic, Southern Alps, Italy (Reuss, 1869; Gümbel, 1869; Ulrichs, 1970; Kristan-Tollmann, 1978); Carnian, Late Triassic, Święty Krzyż Mountain, Poland (Styk, 1958); Carnian, Late Triassic, Transdanubian Range, Hungary (Kristan-Tollmann, 1991); Late Anisian, Middle Triassic, Balaton Highland, Hungary (Monostori, 1995); Early Anisian, Middle Triassic, North Dobrogea, Romania (Crasquin-Soleau and Grădinaru, 1996); Ladinian, Middle Triassic, Balaton Highland, Hungary (Monostori and Tóth, 2013, 2014); Middle Anisian, Middle Triassic, Northern Calcareous Alps, Austria (Mette *et al.*, 2014); Carnian, Late Triassic, Karavanke Mountains, Slovenia (Forel *et al.*, 2019b); Tuvalian – Carnian, *Tropites dilleri* zone (Crasquin *et al.*, 2018) and *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bairdia cf. *monostorii* Forel and Grădinaru (2018)
(Plate 1J)
2018 *Bairdia* cf. *humilis* Monostori (1995) ; Crasquin *et al.*: 134, figs. 6i-j.

Material. One complete carapace and one broken carapace.
Dimensions. (complete carapace) H = 311 μm; L = 806μm.
Remarks. Forel and Grădinaru (2018) renamed *Bairdia humilis* Monostori (1995) in *Bairdia monostorii* nom. nov.
Occurrence. Tuvalian – Carnian, *Tropites dilleri* zone (Crasquin *et al.*, 2018) and *Tropites dilleri* zone (Crasquin *et al.*, 2018) *and Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bairdia sp.1 *sensu* Crasquin, Sciuto, Reitano, 2018
(Plate 1K)
2018 *Bairdia* sp. 1; Crasquin *et al.*: 134, fig. 6N-O

Material. One complete carapace and one right valve.
Dimensions. (complete carapace) H = 462 μm; L = 800μm.
Remarks. This species of *Bairdia* is characterized by the BD which is underlined by a blade, and by the reticulation of the carapace. The upper part of PB is quite horizontal and its radius of curvature is small. This could be a new species.
Occurrence. Tuvalian – Carnian, *Tropites dilleri* zone (Crasquin *et al.*, 2018) and *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bairdia sp. A
(Plate 1L)
Material. Two complete carapaces.
Dimensions. H = 400–440 μm; L = 785–882μm.
Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bairdia sp. B
(Plate 1M)
Material. One complete carapace.
Dimensions. H = 600 μm; L = 1000μm.
Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bairdia sp. C
(Plate 1N)
Material. One complete carapace.
Dimensions. H = 643 μm; L = 1147μm.
Remarks. This species is characterized by its triangular shape, the flattening of the ventral borders and the reticulated surface. The PB has a very small radius of curvature.
Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bairdia sp. D
(Plate 1O)
Material. One complete carapace.
Dimensions. H = 496 μm; L = 1014 μm.
Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bairdia sp. E
(Plate 1P)
Material. One complete carapace.
Dimensions. H = 476 μm; L = 953μm.
Remarks. This elongated species shows a blade underlying the BD.
Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this work).

Bairdia sp. F
(Plate 1Q)
Material. Two complete carapaces.
Dimensions. H = 600–615 μm; L = 885–953μm.
Remarks. This compact species (H/L = 0.64–0.67) has a flattened BP and AB and a shoulder at the dorsal part of the right valve.
Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Genus *Hiatobairdia* Kristan-Tollmann (1970)

Type species: *Hiatobairdia subsymmetrica* Kristan-Tollmann (1970)

Hiatobairdia subsymmetrica Kristan-Tollmann (1970)

(Plate 1R)

1970 *Hiatobairdia subsymmetrica* n. gen. n.sp.; Kristan-Tollmann: 268, pl. 35, figs. 1–3.

1976 *Hiatobairdia subsymmetrica* Kristan-Tollmann (1970); Tollmann: 276, pl. 163, fig. 14.

1978 *Hiatobairdia subsymmetrica deformis* n.sp.; Kristan-Tollmann: 83, pl. 4, figs. 1–7.

1979 *Hiatobairdia subsymmetrica* Kristan-Tollmann (1970); Kristan-Tollmann *et al.*: 147, pl. 6, fig. 4.

2018 *Hiatobairdia subsymmetrica* Kristan-Tollmann (1970); Crasquin *et al.*: 134, figs. 6F–H.

Material. Three left valves.

Dimensions. H = 412–569 μm; L = 812–969μm.

Occurrence. Early Carnian of South Tyrol, Italy (Tollmann, 1976; Kristan-Tollmann, 1978); Rhaetian of Austrian Alps (Kristan-Tollmann, 1970) and Central Iran (Kristan-Tollmann *et al.*, 1979); Tuvalian – Carnian *Tropites dilleri* zone (Crasquin *et al.*, 2018) and *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Hiatobairdia sp. A

(Plate 2A)

Material. One complete carapace and one right valve.

Dimensions. (complete carapace) H = 533 μm; L = 948 μm.

Remarks. This species has a straight DB and presents a ridge at the dorso-median part of the RV.

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Genus *Mirabairdia* Kollmann (1963)

Type species *Mirabairdia pernodosa* Kollmann (1963)

Mirabairdia pernodosa Kollmann (1963)

(Plate 2B)

1963 *Mirabairdia pernodosa* n.sp.; Kollmann: 177-178, pl. 1, figs. 1-2, pl. 8, figs. 1–6.

1971a *Triebelina* (*Mirabairdia*) *pernodosa illyrica* n.spp.; Kozur: 17, fig. 1G.

1971a *Triebelina* (*Mirabairdia*) *balatonica* n.sp.; Kozur: 15-16, figs. 2I, 3C.

1971 *Mirabairdia pernodosa* Kollm.; Kristan-Tollmann: text-fig. 1/8.

1984 *Triebelina* (*Mirabairdia*) *pernodosa illyrica* Kozur; Salaj and Jendrejakova: pl. 2, figs. 1–4.

2014 *Triebelina (Mirabairdia) pernodosa* (Kollmann, 1963); Monostori and Tóth: 27-28, pl. 2, figs. 7-8.

Material. One complete carapace, 13 RV and 2 LV.

Dimensions. (complete carapace and LV) H (without spines) = 453–507 μm; L = 826–923 μm.

Occurrence. Anisian, Western Carpathians, Slovakia (Salaj and Jendrejakova, 1984; Kozur, 1971a); Anisian, Balaton Highland, Hungary (Kozur, 1971a); Ladinian, Dolomites, South Tirol, Italy, (Kristan-Tollmann, 1971); Ladinian, Northern Calcareous Alps, Cassian beds, Austria (Kollmann, 1963); Ladinian E-Bakony, Hungary (Monostori and Tóth, 2014); Tuvalian– Carnian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Genus *Ptychobairdia* Kollmann (1960)

Type species *Ptychobairdia kuepperi* Kollmann (1960)

Ptychobairdia iudicaensis n.sp.

(Plate 2C and 2D)

Etymology. From the locus typicus Castel di Iudica, Sicily, Italy.

Material. Four complete carapaces.

Holotype. One complete carapace, collection number PMC O 25 H 13/10/2019 (Plate 2C).

Paratype. One complete carapace, collection number PMC O 81 P 13/10/2019 (Plate 2D).

Diagnosis. A species of *Ptychobairdia* with a reticulated carapace which is flattened laterally all around except at the ventral part; LV significantly higher than RV, presence of vertical sulci at antero-dorsal part of the carapace.

Description. Carapace massive, high (H/L = 0.6); surface reticulated;

LV: Flattened laterally all around with maximum at DB and PB; BD strongly arched; AB with quite large radius of curvature and maximum at mid H; VB almost straight; BP with a very small curvature; two vertical sulci in dorsal part; LV strongly overlapping RV all around with maximum at BD.

RV: Strongly flattened all around except in ventral part; presence of a sulcus in AD part; BD long; AB with quite small radius of curvature; VB gently concave at its anterior part; BP very slender; DB, ADB, AVB, PVB, PDB straight.

Remarks. *Ptychobairdia iudicaensis* n.sp. is comparable with *P. oberhauseri* Kollmann (1960) from the Rhaetian of Austria (Kollmann, 1960) and the Carnian – Norian of Queen Charlotte Island, Canada (Arias and Lord, 2000). The latter species is longer, has a smaller AB and shows a horizontal sulcus. *P. iudicaensis* n.sp. differs from *P. kristanae* Kollmann (1960) from the Rhaetian – Early Jurassic of Austria (Kollmann, 1960, 1963) and the late Carnian of Sicily (Crasquin *et al.*, 2018) by its reticulated carapace and the RV being clearly smaller than LV.

Dimensions. L = 720–1083 μm; H = 480–667 μm (see Fig. 5).

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Ptychobairdia leonardoi n.sp.

(Plate 2E and 2F)

Etymology. Dedicated to Leonardo Reitano, son of Agatino Reitano.

Material. Six right valves, eight left valves.

Holotype. One right valve, collection number PMC O 26 H 13/10/2019 (Plate 2E).

Paratype. One left valve, collection number PMC O 82 P 13/10/2019 (Plate 2F).

Diagnosis. A species of *Ptychobairdia* with a short coarse reticulated carapace, strongly compressed and finely reticulated AB and PB and a central node.

Description. Carapace with massive coarse reticulation, flattened laterally at AB and PB; DB straight at both valves and parallel to VB; ontogenic modifications of DB: at RV with nodules or blade at biggest specimens, at LV development of shoulders at each extremities in largest specimens; AB and PB with small radius of curvature, flattened laterally and covered by a fine reticulation; VB straight to slightly concave, with

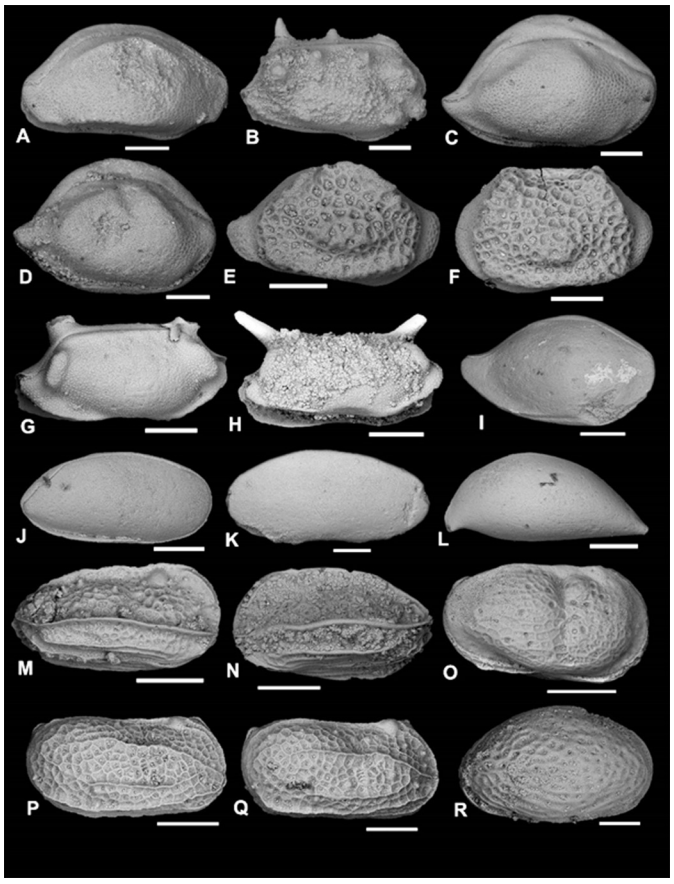

Plate 2. Ostracods from Late Triassic (Tuvalian-Carnian) of Monte Gambanera, Sicily, Italy. All the specimens are stored in the Palaeontological Museum of the University of Catania. The repository numbers are given as PMC (Palaeontological Museum Catania) O (Ostracods) X H (number of holotype) or X P (number of paratype) or FS X (Figured Specimen number) registration date. Scale bars = 200 μm except P-Q, R = 100 μm. A: *Hiatobairdia* sp. A. Right lateral view of a complete carapace, PMC O FS60. B: *Mirabairdia pernodosa* Tollmann, 1963. Right lateral view of a complete carapace, PMC O FS61. C-D: *Ptychobairdia iudicaensis* n.sp. C: holotype, right lateral view of a complete carapace, PMC O25 H 13/10/2019; D: paratype, right lateral view of a complete carapace, PMC O 81 P 13/10/2019. E-F: *Ptychobairdia leonardoi* n.sp. E: holotype, lateral view of a right valve, PMC O 26 H 13/10/2019; F: paratype, lateral view of a left valve, PMC O 82 P 13/10/2019. G-H: *Petasobairdia jeandercourti* n.sp. G: holotype, right lateral view of a complete carapace, PMC O 27 H 13/10/2019; H: paratype, left lateral view of a complete carapace, PMC O 83 P 13/10/2019. I: *Urobairdia angusta* Kollmann (1963). Right lateral view of a complete carapace, PCM O FS62. J: *Bairdiacypris triassica* Kozur (1971c). Right lateral view of a complete carapace, PCM O FS63. K: *Bythocypris* sp. A. Left lateral view of a complete carapace, PCM O FS64. L: *Acratia maugerii* Crasquin *et al.* (2018). Left lateral view of a complete carapace, PCM O FS65. M-N: *Kerocythere dittainoensis* n.sp. M: holotype, lateral view of a right valve, PMC O 28 H 13/10/2019; N: paratype, lateral view of a left valve, PMC O 84 P 13/10/2019. O: *Renngartenella sanctaecrusis* Kristan-Tollmann (1973) (♂). Right lateral view of a complete carapace, PCM O FS66. P-Q: *Mockella barbroae* n.sp. P: holotype, right lateral view of a complete carapace, PMC O 29 H 13/10/2019; Q: paratype, right lateral view of a complete carapace, number PMC O 85 P13/10/2019. R: *Simeonella brotzenorum* Sohn (1968). Lateral view of a right valve, PCM O FS67.

development of adventral structure; presence of a big node in median part of the carapace.

Remarks. *Ptychobairdia leonardoi* n.sp. differs from other species by the specific characters. *Margarobairdia zapfei* Kristan-Tollmann (1983) from the Anisian of South China (Kristan-Tollmann, 1983) has a similar valve shape but a different ornamentation.

Dimensions. L = 610–776 μm; H = 362–553 μm (see Fig. 6).

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Genus *Petasobairdia* Chen and Shi (1982)

Type species *Petasobairdia bicornuta* Chen and Shi (1982)

Petasobairdia jeandercourti n.sp.

(Plate 2G and 2H)

Etymology. Dedicated to past Pr. Jean Dercourt, who was the mentor of the first author.

Material. One broken carapace and three left valves.

Holotype. One broken carapace, collection number PMC O 27 H 13/10/2019 (Plate 2G).

Paratype. One left valve, collection number PMC O 83 P 13/10/2019 (Plate 2H).

Diagnosis. A species of *Petasobairdia* with a long reticulated carapace and elongated nodes at ADB and PDB of both valves.

Description. Carapace long (H/L ≈ 0.4), reticulated, strongly laterally compressed along AB, AVB, VB, PVB,

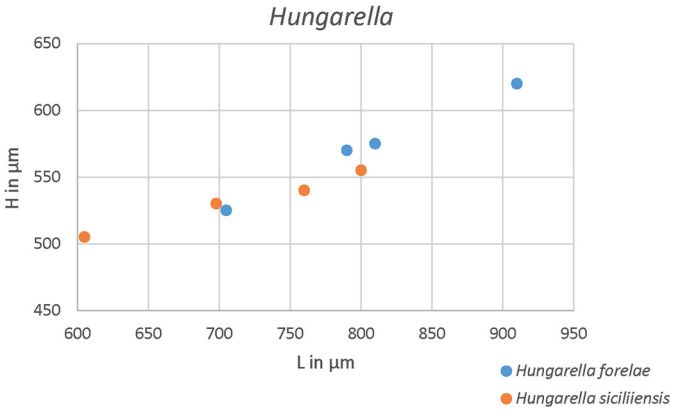

Fig. 4. Height (H)/length (L) diagram of figured specimens of the two new *Hungarella* species. In blue: *H. forelae* n.sp.; in orange: *H. siciliiensis* n.sp.

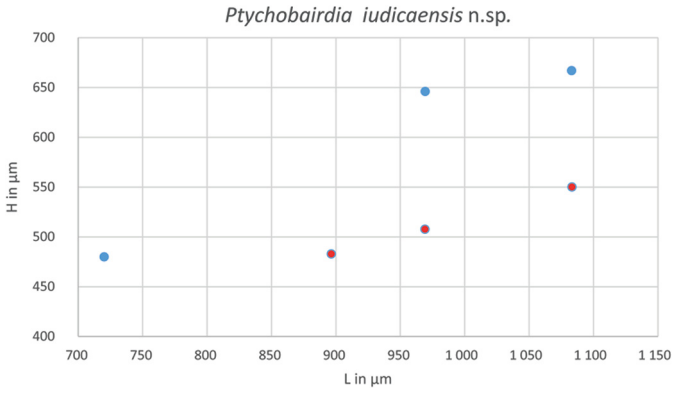

Fig. 5. Height (H)/length (L) diagram for *Ptychobairdia iudicaensis* n.sp. In red: right valves; in blue left valves.

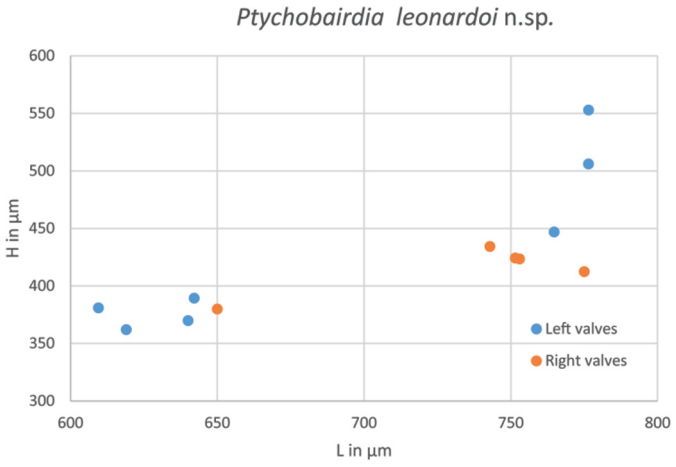

Fig. 6. Height (H)/length (L) diagram for *Ptychobairdia leonardoi* n.sp. In blue: left valves; in red: right valves.

PB; DB long and straight at both valves; presence of an elongated node at ADB and PDB of both valves; LV with two big horns with large base at each extremities of DB.

Dimensions. (holotype and paratype without spines) H = 348–373 µm; L = 826–853µm.

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Remarks. *Petasobairdia jeandercourti* n.sp. is comparable to *P. bicornuta* Chen and Shi (1982) from the Late Permian of Hubei Province (Chen and Shi, 1982) which has a much shorter DB. *P. longispinosa* (Kozur, 1971a, b, c) from Anisian of Slovakia (Kozur, 1971a), Anisian and Middle Triassic of Romania (Salaj and Jendrejakova, 1984; Crasquin-Soleau and Grădinaru, 1996; Sebe *et al.*, 2013), Anisian of Austria (Mette *et al.*, 2014), Ladinian of Hungary (Monostori and Tóth, 2013) and Carnian of Southern Turkey (Forel *et al.*, 2017) has a shorter DB and doesn‘t have AD and PD nodes.

Genus *Urobairdia* Kollmann (1963)

Typse species: *Urobairdia austriaca* Kollmann (1963)

Urobairdia angusta Kollmann (1963)

(Plate 2I)

1963 *Urobairdia angusta* n.g. n.sp.; Kollmann: 167, pl. 6, figs. 1–4.

1965 *Urobairdia angusta* Kollmann (1963); Széles: 414, pl. 6, fig. 5.

1995 *Bairdia (Urobairdia) angusta recta* n.sp.; Monostori: 43, pl.3, figs. 3-4.

2010 *Urobairdia angusta* Kollmann (1963); Zorn: 271-272, pl. 6, figs. 12–15.

2013 *Bairdia (Urobairdia) angusta* Kollmann (1963); Monostori and Tóth: 7, pl. 1, figs. 10–12.

2014 *Bairdia (Urobairdia) angusta* Kollmann (1963); Monostori and Tóth: 25-26, Pl. 1, fig. 14.

Material. Two complete carapaces

Dimensions. H = 440–500 µm; L = 826–871 µm.

Occurrence. Late Norian, Zlambach Formation, Austria (Kollmann, 1963; Zorn, 2010); Anisian, Felsőörs, Hungary (Monostori, 1995); Carnian, Nosztori Valley, Hungary (Széles, 1965); Ladinian-Carnian, Balaton Highland, Hungary (Monostori and Tóth, 2013, 2014); Tuvalian – Carnian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Genus *Bairdiacypris* Bradfield (1935)

Type species: *Bairdiacypris deloi* Bradfield (1935).

Bairdiacypris triassica Kozur (1971a, b, c)

(Plate 2J)

1911 ?*Bairdia silicula* Jones; Méhés: 16-17, pl. 1, figs. 19–21

1971 *Bairdiacypris triassica* n.sp.; Kozur: 5-6, figs. 2H–L

2013 *Bairdiacypris triassica* Kozur (1971a, b, c); Monostori and Tóth: 313-314, pl. 3, figs. 7-8

2014 *Bairdiacypris triassica* Kozur (1971a, b, c); Monostori and Tóth: 25, pl. 1, fig. 12

2017 *Bairdiacypris triassica* Kozur (1971c); Forel *et al.*: fig. 10U

Material. Two complete carapaces

Dimensions. H = 361–374 µm; L = 774–812µm

Occurrence. Early Carnian, Balaton highland, Hungary (Méhes, 1911; Kozur, 1971c), Ladinian, Nosztori Valley, Hungary (Monostori and Tóth, 2013); Ladinian – Carnien, Balaton Highland (Monostori and Tóth, 2014), Carnian, Mersin, Turkey (Forel *et al.*, 2017); Tuvalian – Carnian,

Tropites subbullatus/Anatropites spinosus zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Family Bythocyprididae Maddocks (1969)
Genus *Bythocypris* Brady (1880)
Type species: *Bythocypris reniformis* Brady (1880)
Bythocypris sp. A
(Plate 2K)

Material. Two complete carapaces and two LV.

Dimensions. H = 433–500 μm; L = 775–1090 μm.

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Family Acratiidae Gründel (1962)
Genus *Acratia* Delo (1930)
Type species: *Acratia typica* Delo (1930).
Acratia maugerii Crasquin *et al.* (2018)
(Plate 2L)

1991 *Acratia* sp.; Kristan-Tollmann: 196, pl. 1, fig. 1.

2013 *Acratia goemoeryi* (Kozur, 1970); Monostori and Tóth: 6-7, pl. 4, only fig. 2.

2018 *Acratia maugerii* n.sp.; Crasquin *et al.*: 137-138, fig. 7H–J.

Material. One complete carapace and two LV.

Dimensions. H = 373–464 μm; L = 866–1066μm.

Occurrence. Late Ladinian of NE Iran (Kristan-Tollmann, 1991), Balaton Highland, Hungary (Monostori and Tóth, 2013); Tuvalian– Carnian, *Tropites dilleri* zone (Crasquin *et al.*, 2018) and *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Superfamily Cytheroidea Baird (1850)
Family Cytheruridae Müller (1894)
Subfamily Cytherurinae Müller (1894)
Genus *Kerocythere* Kozur and Nicklas (1970)
Type species *Cythere raibliana* Gümbel (1869)
Kerocythere dittainoensis n.sp.
(Plate 2M and 2N)

Etymology. Referring to the Dittaino river which flows near to the locus typicus.

Material. Four complete carapaces.

Holotype. One complete carapace, collection number PMC O 28 H 13/10/2019 (Plate 2M).

Paratype. One complete carapace, collection number PMC O 84 P 13/10/2019 (Plate 2N).

Diagnosis. A species of *Kerocythere* Kozur and Nicklas (1970) with a subrectangular reticulate carapace, presence of a lateral thick ridge which ascends at PB and occurrence of ventral ridges, one thick and several thinner ones parallel to VB.

Description. Carapace subrectangular, almost equivalve; BD long and straight, presence of a ridge on each side of hinge; presence of an eye spot; AB with large radius of curvature with maximum located below mid-H, flattened laterally and smooth; VB almost straight; PB with small radius of curvature with maximum around mid H, upper and lower part quite straight; H max at anterior angle; L max at PB; sulcus more or less developed in anterior 1/3 of L; surface reticulated and ornamented with possible pustules and ridges: one lateral, thick, reaching from antero-ventral part of the carapace up to PB, ascending in posterior part; group of ventral ridges, one thick parallel to VB and several (at least three) below.

Dimensions. L = 651–731 μm; H = 309–376 μm.

Occurrence. *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Remarks. *Kerocythere dittainoensis* n.sp. could be compared to *Kerocythere reticulata* Kristan-Tollmann (1972) from early Carnian of the Dolomites (Italy). This species doesn't show the ventral group of ridges but has one ridge at the AD part of the carapace following the AB. The new species is also close to *Kerocythere tricostata* Forel, 2017 from the middle Carnian of southern Tauride-Anatolide platform (Turkey; Forel *et al.*, 2017). At the present material the lateral ridge is longer, ascends at its posterior part and the surface is reticulated.

Family indet.
Genus *Renngartenella* Schneider 1957 (*in* Mandelstam *et al.*, 1957)
Renngartenella sanctaecrusis Kristan-Tollmann (1973)
(Plate 2O)

1973 *Renngartenella sanctaecrucis* Kristan-Tollmann; Kristan-Tollmann and Hamedani: 215, 217–219, pl. 8, figs. 1–6; pl. 11, figs. 1, 3, 5, 6; pl. 12, fig. 10.

1979 *Renngartenella sanctaecrucis* Kristan-Tollmann (1973); Liebermann: 215, pl. 5, fig. 2.

1982 *Renngartenella sanctaecrucis* Kristan-Tollmann (1973); Basha: pl. 1, fig. 15.

1990 *Renngartenella sanctaecrucis* Kristan-Tollmann (1973); Gerry *et al.*: 96, pl. 1, figs 11–13.

1994 *Renngartenella sanctaecrucis* Kristan-Tollmann (1973); Monostori: 320, 322, figs 5/5–7.

2001 *Renngartenella sanctaecrucis* Kristan-Tollmann (1973); Keim *et al.*: fig. 8C.

2014 *Renngartenella sanctaecrucis* Kristan-Tollmann (1973); Monostori and Tóth: 29-30, pl.3, figs. 10–12.

2019a *Renngartenella sanctaecrucis* Kristan-Tollmann (1973); Forel *et al.*: fig. 7T-U, in press.

Material. Ten carapaces.

Dimensions. H = 316–439 μm; L = 567–900 μm.

Occurrence. Julian, early Carnian, Heiligkreuz Formation, Italy (Kristan-Tollmann and Hamedani, 1973); Carnian, Late Triassic, Italian Alps (Lieberman, 1979); Cordevolian, Carnian, Jordan (Basha, 1982); Carnian, Israel (Gerry *et al.*, 1990); Carnian, Balaton Highland, Hungary (Monostori 1994; Monostori and Tóth, 2014); Carnian, Dolomites, Northern Italy (Keim *et al.*, 2001); Carnian, Karavanke Mountains, Slovenia (Forel *et al.*, 2019b); Tuvalian – Carnian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Superfamily Cypridoidea Baird (1845)
Family Limnocytheridae Klie (1938)
Genus *Mockella* Bunza and Kozur (1971)
Type species: *Mockella muelleri* Bunza and Kozur (1971); subsequent designation (Kozur, 1973)
Mockella barbroae n.sp.
(Plate 2P and 2Q)

2018 *Mockella muelleri* Bunza and Kozur (1971), Crasquin *et al.*: 139, figs. 7O-P.

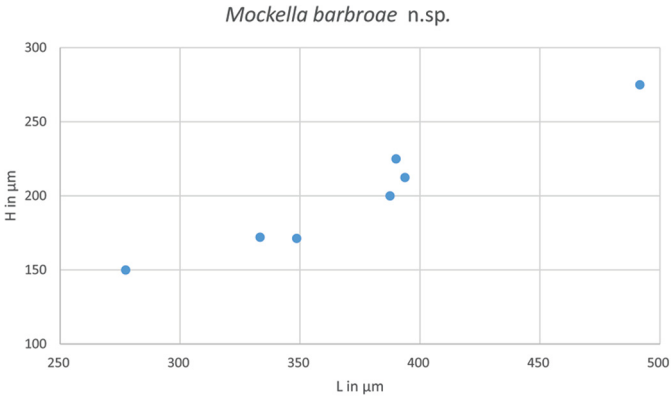

Fig. 7. Height (H)/length (L) diagram for *Mockella barbroae* n. sp.

Etymology. Personal dedication of the first author to Mrs. Barbro Lamy, in token of friendship and affection.

Material. Seven complete carapaces and two carapaces from Crasquin *et al.* (2018)

Holotype. One complete carapace, collection number PMC O 29 H 13/10/2019 (Plate 2P).

Paratype. One complete carapace, collection number PMC O 85 P 13/10/2019 (Plate 2Q).

Diagnosis. A species of *Mockella* with a long subrectangular carapace and a well-developed rib all around the carapace.

Description. Carapace sub rectangular, long (H/L = 0.535); eye spot well developed; AB with maximum of curvature located low between mid-H and lower 1/3 of H; VB straight; PB equivalent to AB in heteromorphs and smaller in tecnomorphs with maximum of curvature located above mid-H; anteromedian sulcus located in front of mid-L; posterior lobe well developed; anterior lobe less distinct; presence of a distinct ridge all around the carapace including BD; presence of additional ridges on lateral surface of the valves:

- a median ridge which begins at maximum of curvature of AB and precedes on the posterior lobe; this ridge is high and stands out on the surface;
- a lateral ridge below the lobes parallel to VB;
- a small ridge in upper part of AB and below the eye spot.

The valve surface is reticulated with 4 small pustules distributed parallel to AB; in dorsal view, the flanks are parallel. Sexual dimorphism present, expressed by the thickness of the posterior part of the carapace in heteromorphs.

Dimensions. L = 270–492 µm; H = 150–275 µm (see Fig. 7).

Occurrence. Late Carnian (*Tropites dilleri* zone), Mufara Formation, Sicily, Italy Tuvalian – Carnian (Crasquin *et al.*, 2018) and Tuvalian – Carnian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Remarks. *Mockella barbroae* n.sp. is very close to *M. muelleri* Bunza and Kozur (1971) from the late Carnian of Tyrol, Austria (Bunza and Kozur, 1971) and the Carnian of Monte Cammarata, Sicily (Cafiero and De Capoa Bonardi, 1982). In the study on the Mufara Formation (Crasquin *et al.*, 2018) we attributed the specimens to the latter species. The very well preserved present material enabled us to review our attribution. At the present specimens the BP is larger, the median ridge ends at the posterior lobe and doesn't reach the BP; an additional ridge is present below the lobes and the flanks are parallel in dorsal view.

Genus *Simeonella* Sohn (1968)

Type species: *Simeonella brotzenorum* Sohn (1968).

Simeonella brotzenorum Sohn (1968)

(Plate 2R)

1968 *Simeonella brotzenorum* n.sp.; Sohn: 23-24, pl. 2, figs. 1–4, 6–8, 12–22.

1971 *Simeonella brotzenorum alpina* n.sp.; Bunza and Kozur: 4-5, pl. 1, figs. 5–7, 13.

1971 *Simeonella brotzenorum norica* n.sp.; Bunza and Kozur: 5-6, pl. 1, fig. 3.

1973 *Simeonella brotzenorum* Sohn (1968); Kristan-Tollmann and Hamedani: text-fig. 13/2.

1974 *Simeonella brotzenorum* Sohn (1968); Hirsch and Gerry: pl. 2, figs. 1-2.

1979 *Simeonella brotzenorum* Sohn (1968); Lieberman: 103, pl. 5, figs. 6-7.

1979 *Simeonella brotzenorum alpina* Bunza and Kozur (1971); Styk: 119, pl. 28, figs. 9-10.

1982 *Simeonella brotzenorum* Sohn (1968); Basha: pl. 1, fig. 11.

1990 *Simeonella brotzenorum* Sohn (1968); Gerry *et al.*: 95, pl. 1, figs. 3–5.

1994 *Simeonella brotzenorum nostorica* n.sp.; Monostori: 324-325, text-fig. 6/1–6.

2001 *Simeonella brotzenorum nostorica* Monostori (1994); Keim *et al.*: fig. 8B.

Material. Two carapaces.

Dimensions. H = 269–296 µm; L = 446–488 µm.

Occurrence. Ladinian to Carnian, Makhtesh Ramon, Israel (Sohn, 1968; Hirsch and Gerry, 1974; Gerry *et al.*, 1990); Carnian, Northern Calcareous Alps, Austria (Bunza and Kozur, 1971; Kristan-Tollmann and Hamedani, 1973); Carnian, Julian Alps, Italy (Lieberman, 1979; Keim *et al.*, 2001); Carnian, Poland (Styk, 1958), Carnian, Jordan Valley, Jordan (Basha, 1982); Carnian, Balaton Highland, Hungary (Monostori, 1994; Monostori and Tóth, 2014); Tuvalian – Carnian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this work).

Family Candonidae Kaufmann (1900)

Genus *Paracypris* Sars (1866)

Paracypris? cf. *redcarensis* (Blake, 1876)

(Plate 3A)

Material. One complete carapace.

Dimensions. H = 257 µm; L = 561 µm.

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Paracypris? sp. A

(Plate 3B)

Material. One carapace.

Dimensions. H = 442 µm; L = 631 µm.

Plate 3. Ostracods from Late Triassic (Tuvalian-Carnian) of Monte Gambanera, Sicily, Italy. All the specimens are stored in the Palaeontological Museum of the University of Catania. The repository numbers are given as PCM (Palaeontological Museum Catania) O (Ostracods) FS X (Figured Specimen number) registration date. A, B, C, D: Scale bars = 200 μm; E, F, G, H, I: scale bars = 100μm. A: *Paracypris*? cf. *redcarensis* (Blake, 1876). Lateral view of a right valve, PCM O FS68. B: *Paracypris*? sp. A. Right lateral view of a complete carapace, PCM O FS68. C: *Bektasia* sp. A. Right lateral view of a complete carapace, PCM O FS69. D: *Bektasia* sp. B. Right lateral view of a complete carapace, PCM O FS70. E: Podocopida gen. sp. indet. Lateral view of a right valve, PCM O FS71. F: *Polycope baudi* Crasquin-Soleau and Grădinaru (1996). Lateral view of a complete carapace, PCM O FS72. G: ?*Polycope densoreticulata* Monostori and Tóth (2013). Lateral view of a complete carapace, PCM O FS73. H: *Polycope* sp. A. Lateral view of a complete carapace, PCM O FS74. I: *Thaumatomma*? sp. A. Right lateral view of a complete carapace, PCM O FS75.

Occurrence. Tuvalian – Carnian, Tropites *subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Order Platycopida Sars (1866)
Suborder Platycopina Sars (1866)
Superfamily Cavellinoidea Egorov (1950)
Family Cavellinidae Egorov (1950)
Genus *Bektasia* Özdikmen (2010)
Type species: *Reubenella avnimelechi* Sohn (1968).
Bektasia sp. A
(Plate 3C)
Material. One carapace.
Dimensions. H = 477 μm; L = 787 μm.
Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Bektasia sp. B
(Plate 3D)
Material. One carapace.
Dimensions. H = 545 μm; L = 763 μm.
Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Order, genus and species indet.
Podocopida gen. sp. indet.
(Plate 3E)
Material. One carapace.
Dimensions. H = 188 μm; L = 364 μm.

Occurrence. Tuvalian – Carnian, *Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Subclass Myodocopa Sars (1866)
Order Myodocopida Sars (1866)
Superfamily Polycopidea Sars (1866)
Family Polycopidae Sars (1866)
Genus *Polycope* Sars (1866)
Polycope baudi Crasquin-Soleau and Grădinaru (1996)
(Plate 3F)
1996 *Polycope baudi* n.sp.; Crasquin and Grădinaru: 15-16, figs. 1–3.
2013 *Polycope baudi* Crasquin and Grădinaru 1996; Sebe *et al.*: pl. 1, fig. 1.
Material. Two carapaces.
Dimensions. H = 330–328 μm; L = 357–376 μm.
Occurrences. Early – middle Anisian, Uzum Bair, Dobrogea, Roumania (Crasquin-Soleau and Grădinaru, 1996; Sebe *et al.*, 2013); Tuvalian – Carnian, *Tropites subbullatus/Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

?*Polycope densoreticulata* Monostori and Tóth (2013)
(Plate 3G)
2013 *Polycope densoreticulata* n.sp.; Monostori and Tóth: 5, pl. 1, figs. 4–7.
Material. Three carapaces.
Dimensions. H = 204–293 μm; L = 231–306 μm.
Occurrence. Ladinian, Balaton Highland, Hungary (Monostori and Tóth, 2013); Tuvalian – Carnian, *Tropites*

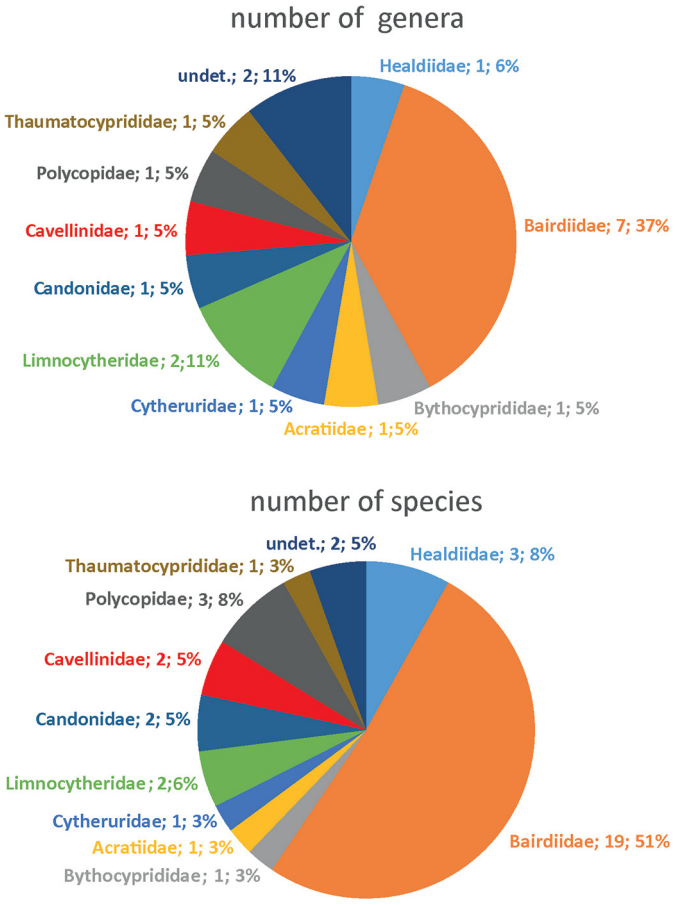

Fig. 8. Diversity of ostracod families from the *Tropites subbullatus/ Anatropites spinosus* zones represented by number of genera (A) and species (B) in the samples of Mount Gambanera.

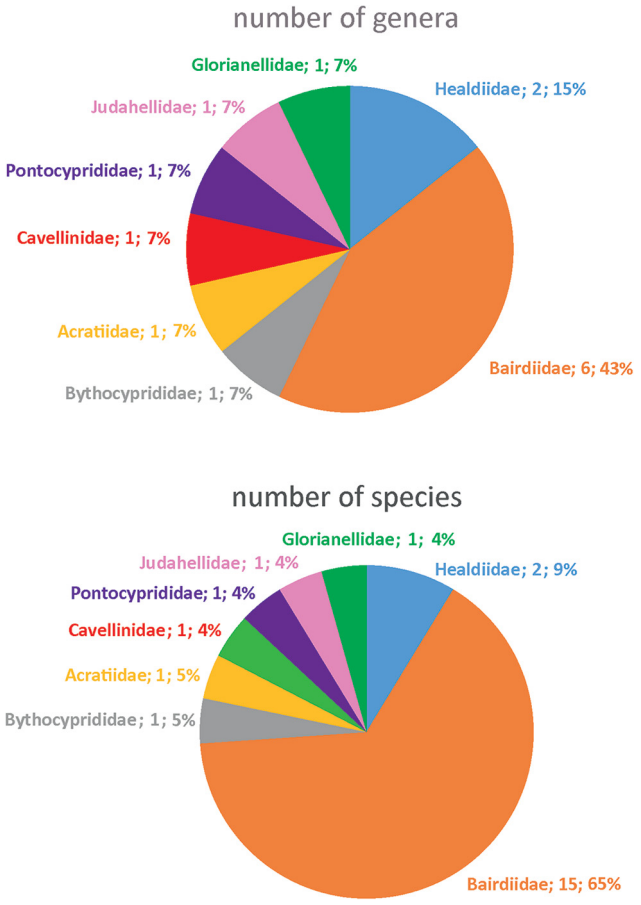

Fig. 9. Diversity of ostracod families from the *Tropites dilleri* zone represented by the number of genera (A) and species (B) in the samples of Mount Scalpello (data from Crasquin *et al.*, 2018).

subbullatus/Anatropites spinosus zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Polycope sp. A
(Plate 3H)
Material. One carapace.
Dimensions. H = 289 µm; L = 278 µm.
Occurrences. *Tuvalian – Carnian, Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

Order Halocyprida Dana (1853)
Suborder Halocypridina Dana (1853)
Superfamily Thaumatocypridoidea Müller (1906)
Family Thaumatocyprididae Müller (1906)
Genus Thaumatomma Kornicker and Sohn (1976)
Type species: *Thaumatomma piscifrons* Kornicker and Sohn (1976)
Thaumatomma ? sp.A
(Plate 3I)
Material. Two carapaces.
Dimensions. H = 525–600 µm; L = 575–600 µm.
Occurrence. *Tuvalian– Carnian, Tropites subbullatus/ Anatropites spinosus* zones, Monte Gambanera, Central-Eastern Sicily, Italy (this study).

6 Assemblage analysis

The assemblage is composed of 200 specimens belonging to 10 families (plus two undetermined families), 19 genera and 37 species. The 10 determined families present are: Healdiidae, Bairdiidae, Bythocyprididae, Acratiidae, Cytheruridae, Limnocytheridae, Candonidae, Cavellinidae, Polycopidae, Thaumatocyprididae. The relative abundance of the different families expressed by the numbers of genera and species is given in Figure 8.

The Bairdiidae, the most abundant family in number of species (53%) and genera (37%) (Fig. 8), are present in marine environments ranging from very shallow waters up to deep seas. The morphology of the family changes from massive thick-shelled forms in nearshore environments to elongate thin-shelled forms beyond continental slope (particularly in genus *Bairdia*). In the same way, the carapaces of Acratiidae lengthen with depth (as example: *Acratia goemeryi* Kozur (1970) from Early-Smithian- to Late-Carnian-Triassic; see Forel *et al.*, 2017). Here these two families present thick and ornamented shells (Plates 1E–1R and 2A–2L) which testify an open marine environment with moderate energy. The

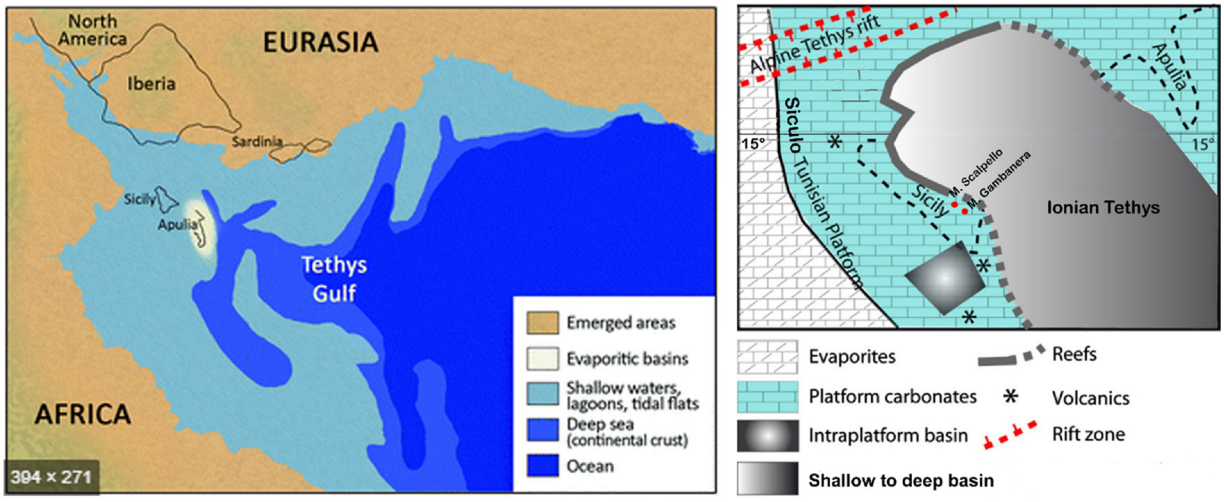

Fig. 10. Palaeogeographic reconstruction of Tethyan (left) and central Mediterranean (right) areas during Late Triassic (after Di Stefano *et al.*, 2015, modified).

Healdiidae do also show a change of morphology with depth. The specimens with massive shells and small spines are neritic inhabitants (Plate 1A–1D) of relatively nearshore muddy conditions. In the deep sea, the specimens are thin shelled, elongate with long spines (*e.g.* Palaeozoic genus *Timorhealdia* Bless, 1987). In other families, some genera also show different morphological adaptation from neritic to deep sea environments (*Healdia, Microcheilinella* etc. see synthesis Tab. 1 in Crasquin and Horne). The ratios between these different morphologies have been used to characterize the depth of ate Palaeozoic and Early Mesozoic environments since quite a long time (model of Lethiers and Raymond, 1991). The present assemblage doesn't include any unequivocal deep water taxa such as those discovered recently in the Carnian of Southern Turkey for example (Forel *et al.*, 2017) or of Sichuan, South China (Forel *et al.*, 2019b). Although the number of specimens is very low, the diversity is quite high with 10 determined families (plus 2 undetermined), 17 genera and 37 species. This biodiversity testifies normal marine conditions and absence of environmental stress. The taxon *Simeonella brotzenorum* Sohn (1968) which is characteristic of brackish – hypersaline conditions (Gerry *et al.*, 1990; Monostori, 1994) is present but with only 2 carapaces. Quite all the specimens are preserved with the complete carapace. After the death of the specimens, the carapaces tend to open in a few hours (Guernet and Lethiers, 1989). This could suggest a rapid burial in the sediments due to a high sedimentation rate. Similar taphonomic characteristics were also found by Pokorny (1964) and Oertli (1971) for pelitic layer associations deposited in basins with extremely rapid distal sedimentation. We compare the results of the *Tropites subbullatus/Anatropites spinosus* zones (this study), with the data obtained in levels just below in *Tropites dilleri* zone (Crasquin *et al.*, 2018) (Fig. 9). Through time, the assemblage became more diversified as recorded by the increasing number of families (8 to 12), genera (14 to 18) and species (23 to 36). The percentage of Bairdiidae decreases in favour of two families being absent before, Cytheruridae and Limnocytheridae which include typical genera of nearshore environments such as *Simeonella*, *Mockella* and *Kerocythere*. We observe also the presence of the brackish – hypersaline species *Renngartenella sanctaecrusis* Kristan-Tolmann, which was suggested by Gerry *et al.* (1990) to be a stenohaline ostracod.

For Monostori (1994), the dominance of three genera *Kerocythere – Renngartenella – Simeonella* seems to be a signal of salinity variability. Although these genera are not dominant here, their presence testifies a shallowing of environment from the Tropites dilleri zone to the *Tropites subbullatus/Anatropites spinosus* zones. The genus *Acratia* is a typical Palaeozoic form present both in Eifelian (neritic) and Thuringian (deep) mega-assemblages (see synthesis in Crasquin and Horne, 2018). Nevertheless, this genus survived the Permian – Triassic extinction events. In 2013, Crasquin and Forel mentioned the last occurrence of neritic *Acratia* in the Spathian and of deep marine *Acratia* in the Anisian (Crasquin-Soleau and Grădinaru, 1996). Since then, some deep marine forms were also found in the Ladinian of Balaton Highland (Monostori and Tóth, 2013), in the Carnian of Turkey (Forel *et al.*, 2017) and Slovenia (Forel *et al.*, 2019b). In 2013, Monostori and Tóth, described *Acratia goemeryi* from Ladinian neritic sediments of a borehole in Hungary. Three species of *Acratia* from the Carnian of Karavanke Mountains, Solvenia, are figured in Forel *et al.* (2019b). The occurrence of *Acratia maugerii* in the present material confirms that *Acratia* occurs in neritic environments of the Carnian.

7 Conclusion

The palaeoecological interpretation of the sedimentary facies of the Mufara Formation is extremely difficult due to the absence of intact outcrops. The original stratification and the sedimentary structures have been completely destroyed because of continuous agricultural processing of the pelitic soils and their very consistency which determines frequent drifts and landslides. In very few and limited locations parallel

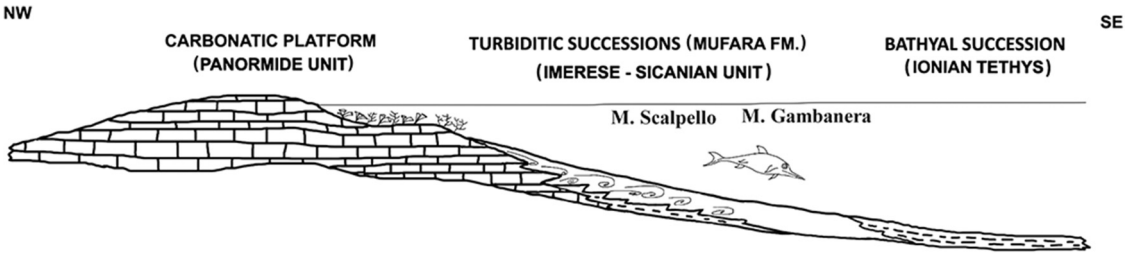

Fig. 11. Schematic palaeoenvironmental model for the late Carnian Mufara Formation basin (see also Fig. 10).

laminations and sandy levels were observed. The only useful palaeoecologic data are those obtained from the palaeontological analysis. The results of the ostracod fauna analysis allow the following conclusions:

1 The ostracod assemblage doesn't yield any evidence of deep marine taxa both at Mt. Scalpello (Crasquin *et al.*, 2018) and at Mt. Gambanera. The Mufara Basin, therefore, can be interpreted as a shallow marine basin (Fig. 10) within the deepest and most distal part of a vast continental shelf where the carbonate platforms Panormide, Trapanese, Saccense were located. The deep marine ostracod fauna discovered recently in the Carnian of Southern Turkey (Forel *et al.*, 2017) or in the South China (Forel *et al.*, 2019a) suggests a deepening of the Neo-Tethys basin towards the more eastern areas.
2 The Mufara Basin was a site of rapid and intense sedimentation probably linked to rapid bottom currents which, sometimes, displaced and transported (also *in vivo*) microfaunas from more superficial neighbouring environments. It is pointed out here that the sediments of the Mufara Basin at Monte Gambanera do not show vortex structures which were recognized in the Mufara Basin at Monte Scapello. This suggests, that the sediment environment of the Mufara Formation outcrops at Monte Gambanera (Fig. 11) was more distal and less turbulent than that of Mt which was effected by strong bottom traction and swirling currents (Crasquin *et al.*, 2018).
3 According to many authors, the Mufara basin is located in a transitional position between the bathyal Neotethys facies to the south and southeast and the carbonate platforms that surround it (Figs. 10 and 11).

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