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THE OLIGOCENE MOLLUSC TYPES OF GAETANO ROVERETO FROM CARCARE, DEGO, SQUANETO, AND TAGLIOLO AREAS (TERTIARY PIEDMONT BASIN, NW ITALY)

Abstract - M.C. BONCI, A. MANDARINO, M. PIAZZA, *The Oligocene mollusc types of Gaetano Rovereto from Carcare, Dego, Squaneto, and Tagliolo areas (Tertiary Piedmont Basin, NW Italy)*.

This research represents a taxonomic revision of twelve mollusc taxa, namely 9 bivalves and 3 gastropods, described by Gaetano Rovereto in the period 1898-1914 and coming from the Oligocene sedimentary rocks of Carcare, Dego, Squaneto and Tagliolo areas (Molare Formation, Tertiary Piedmont Basin, Southern Piedmont - Central Liguria, NW Italy). The investigated specimens belong to the historical "Collezione BTP" ("BTP Collection") housed at the Department of Earth, Environment and Life Sciences of the University of Genova. The collecting sites mentioned in the Rovereto's papers and/or indicated on the original labels were verified and analysed through field surveys. A brief lithostratigraphic and biostratigraphic description is provided for currently detectable sites. The aforementioned collection represents a relevant source of data, in particular considering that most of the original collecting sites are not effectively detectable anymore, and that most of this fauna is currently known only in the Oligocene rocks of the Tertiary Piedmont Basin.

Key words - BTP Collection, Gaetano Rovereto, bivalve and gastropod type materials, Oligocene, NW Italy

Riassunto - M.C. BONCI, A. MANDARINO, M. PIAZZA, *I tipi di molluschi oligocenici di Gaetano Rovereto provenienti da Carcare, Dego, Squaneto e Tagliolo (Bacino Terziario del Piemonte, Italia nord-occidentale).*

Questo lavoro è la revisione tassonomica di dodici nuovi taxa di molluschi (9 bivalvi e 3 gasteropodi) descritti da Gaetano Rovereto tra il 1898 e il 1914, provenienti dalle successioni sedimentarie oligoceniche di Carcare, Dego, Squaneto e Tagliolo (Formazione di Molare, Bacino Terziario del Piemonte, Piemonte meridionale - Liguria centrale, Italia nord-occidentale). Gli esemplari studiati sono conservati nella storica "Collezione BTP", ospitata presso il Dipartimento di Scienze della Terra, dell'Ambiente e della Vita dell'Università di Genova. I siti di raccolta menzionati nei lavori di Rovereto e/o appuntati sui cartellini originali, sono stati ricercati e, quando ritrovati, verificati e analizzati con rilievi di terreno e qui sinteticamente descritti e datati. La Collezione BTP è una significativa fonte di informazioni, in particolare relative ai siti fossiliferi storici non più osservabili e a un elevato numero di specie che sembrano essere presenti solamente nelle rocce oligoceniche del Bacino Terziario del Piemonte.

Parole chiave - Collezione BTP, Gaetano Rovereto, tipi di bivalvi e gasteropodi, Oligocene, Italia nord-occidentale

INTRODUCTION

The Palaeontological Museum of the University of Genova (Italy), at the Department of Earth, Environment and Life Sciences, houses a large collection of fossils coming from the sedimentary rocks of the Tertiary Piedmont Basin (Bacino Terziario del Piemonte, BTP, in Italian), called the "BTP Collection". This basin is located in the north-western part of Italy, and spreads over large areas of the Southern Piedmont and Central Liguria regions. The history of the "BTP Collection" and a detailed list of its specimens are reported in Bonci *et al.* (2014). In the last years, an extensive work of re-organization and taxonomic review of the collection has been carried out. This activity aimed at (i) making the "BTP Collection" available to the national and international scientific community, (ii) verifying the status of preservation of the original collecting sites, (iii) updating the taxonomic data associated with each specimen, and (iv) valorising the whole collection also for teaching purposes (Bonci *et al.*, 2014, 2017, 2018, 2021). This paper focuses on the taxonomic revision of twelve bivalve and gastropod taxa (Tab. 1) established by the geologist and palaeontologist of the University of Genova Gaetano Rovereto (1898, 1900, 1914) and collected in four fossiliferous sites of the Tertiary Piedmont Basin: Carcare and Dego (Savona Province, Liguria Region) and Squaneto and Tagliolo (Alessandria Province, Piemonte Region). The taxa *Perotrochus isseli* (Rovereto, 1900), *Turbo (Ninella) desidiosus* Rovereto, 1914, *Terebralia fucilis* (Rovereto, 1914), and *Cardites globulaevis* (Rovereto, 1914) coming from Dego have already been revised and described by Bonci *et al.* (1991, 2000), providing also exhaustive representation of the holotypes; thus, they are not considered in this paper.

As regards *T. (N.) desidiosus*, it should be noted that Williams (2007, p. 585), discussing his "Clade 4", suggests that "... *Lunella*, *Subninella*, and *Ninella* should be treated as distinct from *Turbo* s.s.", and states that these

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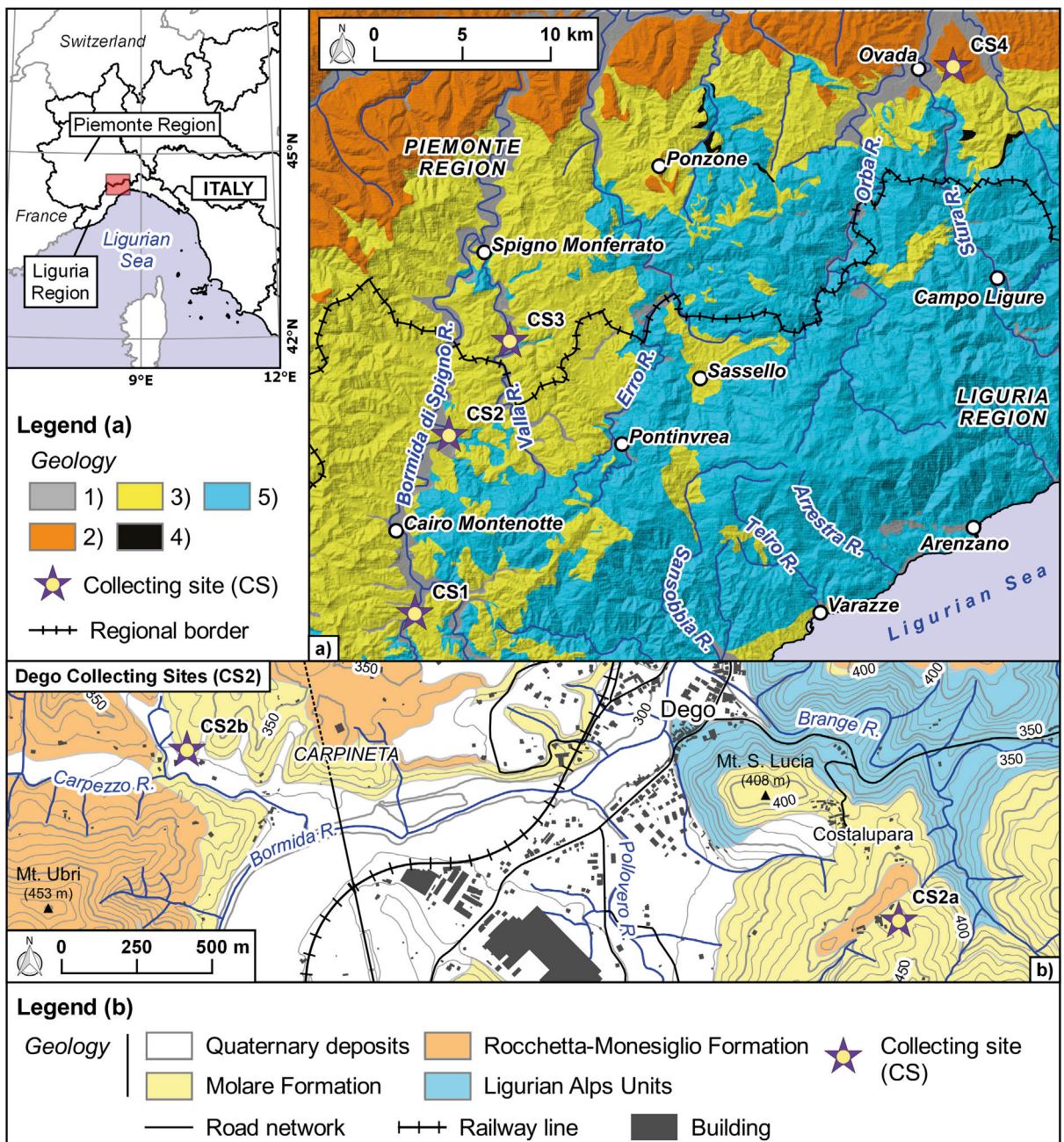


Figure 1. Geological sketch map of the central part of the TPB showing the location of the collecting sites. 1) Quaternary deposits; 2) Early Miocene deposits; 3) Molare Formation, Oligocene; 4) Costa di Cravara Breccia, late Eocene-early Oligocene; 5) Ligurian Alps Units.

three taxa have been “used inconsistently in the past at either generic or subgeneric rank.”. Moreover, Williams (2007, p. 585) fixes *Lunella* as genus name (because it is the oldest) and suggests that the aforementioned three names can “be applied in their traditional sense, at the subgeneric rank.”. Therefore, the species is here renamed *Lunella (Ninella) desidiosa* (Rovereto, 1914).

THE TERTIARY PIEDMONT BASIN

The Tertiary Piedmont Basin (TPB) is a late- to post-orogenic basin that unconformably rests on the inner part of the tectonic pile (the arcuate belt of the Western and Ligurian Alps) resulting from the main alpine orogenic deformation phases (Pasquare, 1968;

Gelati & Gnaccolini, 1988, 2003; Bernini & Zecca, 1990; Mutti *et al.*, 1995; Giglia *et al.*, 1996; D'Atri *et al.*, 1997; Capponi *et al.*, 2001, 2009, 2016; Seno *et al.*, 2005; Spagnolo *et al.*, 2007; Mosca *et al.*, 2010; Federico *et al.*, 2016). The basin deposits include non-marine to marine sediments spanning in age from the upper Eocene? to the upper Miocene (Lorenz, 1969, 1984; Turco *et al.*, 1994; Gelati & Gnaccolini, 1988; Mutti *et al.*, 1995; D'Atri *et al.*, 1997; Bonci *et al.*, 2011, 2014, 2017, 2018, 2021; Quaranta *et al.*, 2009; Gelati *et al.*, 2010; Capponi *et al.*, 2013; Ghibaudo *et al.*, 2014a, b; Federico *et al.*, 2016). In the areas from which the investigated specimens come (Fig. 1), the sedimentation started with fine to very coarse non-marine siliciclastic sediments (Molare Formation, Oligocene), locally preceded by slope and scree deposits (Costa di Cravara Breccia, Upper Eocene? - Lower Oligocene?). Subsequently, these sediments were covered by shallow marine sandstones and conglomerates and local coral reef limestones (Molare Fm.). These bodies grade upward to fine-to-medium sandstones followed by siltstones and marly siltstones (Molare Fm.). The Molare Formation records a deepening phase whose maximum is represented by the deposition of the Rocchetta-Monesiglio Formation (Upper Oligocene - Lower Miocene). This last is made of silty sandstones, siltstones and marls, in which sandstone and conglomerate thick lenses are interbedded. For more detailed information about the geology of the surrounding area of Carcare, Dego, Squaneto and Tagliolo refer to Lorenz (1969), Quaranta *et al.* (2009), Gelati *et al.* (2010), Capponi *et al.* (2013), Ghibaudo *et al.* (2014a, 2014b), Briguglio *et al.* (2021a, 2021b).

THE COLLECTING SITES

The collecting-site-related data of the investigated specimens were retrieved from both Rovereto's papers and his original handwritten labels. The field survey activity performed by the authors in the Carcare (Savona Province, Liguria Region), Dego (Savona Province, Liguria Region), Squaneto (Alessandria Province, Piemonte Region) and Tagliolo (Alessandria Province, Piemonte Region) areas (Fig. 1) allowed to rediscover the majority of the collecting sites (CS), and to verify their state of preservation. All the sites exhibit stratigraphic features that fit with those of the Molare Formation as recently reported on by Capponi *et al.* (2013) and Federico *et al.* (2016).

Carcare

The mollusc types of the Carcare area (CS1) come from two collecting sites: Villa Giorello and Colletta di Carcare. Unluckily, they both cannot be sampled anymore. The fossiliferous site of Villa Giorello is lo-

cated in the Carcare's city centre and, in particular, in the backyards of the country mansion of the Giorello family, currently known as Relais Villa degli Aceri. At the present day, this collecting site is hidden by new buildings. The fossiliferous site of Colletta di Carcare may be located close to a pass over the hills south of Carcare, but currently the entire area is densely covered by arboreal vegetation. However, the few observable outcrops in the surroundings of Villa Giorello and Colletta di Carcare confirm the presence of sedimentary rocks belonging to the Molare Formation (Oligocene).

Dego

The mollusc types of the Dego area (CS2) are from two collecting sites, for which a well-defined topographic position is provided: "Costalupara, dietro C. Ciapeirù" (Costalupara, behind Case Ciapeirù) (CS2a) and Carapezzo (CS2b).

Costalupara, behind Case Ciapeirù, also known as Case Ciappeioli (site coordinates: latitude 44.441571° N, longitude 8.321026° E, elevation 440 m a.s.l.), is a well-known stratigraphic section about 50 m thick, already described and discussed by Lorenz (1969) and Bonci *et al.* (1991) and considered by Montanari (1979) from a biostratigraphic point of view. According to these authors, this section is composed by coarse, badly sorted, polymict, and poorly fossiliferous (only pectinid fragments) conglomerates grading upward to an alternation of coarse, fossiliferous sandstones and richly fossiliferous marly sandstones, grading in turn to poorly fossiliferous (few foraminifers) siltstones and marly siltstones. The fossil content of the sandstone beds includes bivalves, gastropods, corals, bryozoans, echinoids, foraminifers, and calcareous red algae. According to the aforementioned authors, these rocks have yielded the following age-diagnostic fossils: *Nummulites fichteli* Michelotti, 1841, *Nummulites vascus* Joly & Leymerie, 1848, *Nephrolepidina praemarginata* (Douville, 1908). These taxa suggest a SB22 Zone assignment, i.e., a Late Rupelian - Early Chattian age (according to Cahuzac & Poignant, 1997).

The Carapezzo fossiliferous site, nowadays known as Carapezzo (site coordinates: Latitude 44.446509° N, longitude 8.291220° E, elevation 335 m a.s.l.), is a relatively wide area, where irregular alternations of poorly sorted, polymict, fossiliferous conglomerates and medium to coarse, fossiliferous sandstones discontinuously crop out. The fossil content includes bivalves, gastropods, coral and echinoid fragments, serpulids and foraminifers. Among the latter, rare and badly preserved lepidocyclinids and abundant individuals of *Operculina complanata* (Defrance, 1822) were documented. The occurrence of lepidocyclinids, together with the absence of *Nummulites* might suggest the as-

signment of this site to the middle-late Chattian. The Case Cné sections (belonging to the Molare Fm.), located about 500 m to the East of this collecting site, have been recently dated to the Middle-Late Chattian (Briguglio *et al.*, 2021a, 2021b).

Squaneto

The mollusc types of the Squaneto area (CS3) come from two collecting sites, whose topographic position is not clearly defined. In particular, one of these is specified to be located at the “diramazione per Squaneto della strada provinciale conducente a Pareto” (the fork to Squaneto along the provincial road leading to Pareto), and the other one “dalla strada per Squaneto sino al sommo della collina che porta i ruderī del Castello di Mioglia” (from the road to Squaneto to the top of the hill where the ruins of the Castle of Mioglia are located). Even if the field survey did not permit to rediscover the right sites, the presence of outcropping rocks belonging to the Molare Formation (Oligocene) was overall documented.

Tagliolo

The mollusc types of the Tagliolo area (CS4) come from five collecting sites: Cascina Sette Venti (farmhouse Sette Venti); Ville delle More a ponente del Castello Cattaneo (Ville delle More west of Cattaneo Castle); Rio Chiappino presso Cascina Boxi (Chiappino Creek close to Boxi farmhouse), currently named I Bosi; Bric Cochera, tra Tagliolo e Monte Colma (Mt. Cochera, between Tagliolo and Mt. Colma); Rio delle Gabbete presso Mongiardino (Gabbete Creek close to Mongiardino). All these sites are no longer detectable because of the urban sprawl in the first two cases and of the vegetation dense cover in the other ones. The lithological features of the rare outcrops exposed in the surroundings of the aforementioned localities are those of the Molare Formation (Oligocene).

SYSTEMATIC PALEONTOLOGY

The classification schemes here adopted are those proposed by Bouchet *et al.* (2010, 2017). Additional sources were Cox (1960), Cox *et al.* (1969a, 1969b), CLEMAM, Fossilworks, and WoRMS that also provided useful taxonomic and nomenclatural information. Measurements on gastropod shells were performed according to Pedriali & Robba (2005): H = shell height, D = maximum diameter, SH = spire height, AH = aperture height, AW = aperture width, SA = spire angle. Measurements on bivalve shells are according to Berezovsky (2015): L = valve length, H = valve height, C = valve convexity, EE = elongation extent (= H/L), CE = convexity extent (= C/H), A = apical angle.

Class Gastropoda Cuvier, 1795
 Subclass Caenogastropoda Cox, 1960
 Unassigned Order
 Superfamily Epitonioidea Berry, 1910 (1812)
 Family Epitonidae Berry, 1910 (1812)
 Genus *Cirsotrema* Mörcz, 1852
 Type species: *Cirsotrema varicosum* (Lamarck, 1822), type by monotypy, Recent, Indo-West Pacific.

Cirsotrema descobinata (Rovereto, 1914)
 Figs 2A, 2B

1914 *Scalaria (Cirsotrema) descobinata* Rovereto, p. 143, pl. III fig. 4.
 1967 *Scala (Cirsotrema) descobinata* Rovereto; Lorenz, p. A77.

Type material - One damaged shell. The original label states: “*Scalaria* (n.sp.?) *descobinata* n.sp. (gruppo S. *antiquovaricosa*) Sacco, Carcare (racc. Ighina) 901”. Holotype (by monotypy) 2140/CM-VII-C 42.

Type locality - Carcare, Molare Formation, Tertiary Piedmont Basin.

Description - Shell dextral, turritulate, short and stocky; first whorls and part of the body whorl lacking. Whorls slightly convex. Aperture probably round. Suture linear, impressed. Sculpture: blade-like, erected, 23 smooth axial costae; inner spaces between costae with fine, close-packed, raised spiral striae crossed by collabral, raised, very fine lines. Size: H = about 37.00 mm; D = about 23.00 mm; SH = about 28.00 mm; AH = about 9.00 mm; AW = about 8.00 mm; SA = 30°.

Remarks - The holotype is figured by Rovereto (1914, pl. III, fig. 4). The characters of this species fit with the description reported for the genus *Cirsotrema* Mörcz, 1852 as synthesized by Clench & Turner (1950) and Amitrov (2013). The species in hand differs from any and all other *Cirsotrema* described from the Eocene and Oligocene European basins in having spiral striae only in the spaces between costae and smooth, blade-like axial costae.

Distribution - Oligocene: Carcare (NW Italy), Molare Formation (Tertiary Piedmont Basin). Late Oligocene: Millesimo (NW Italy), Rocchetta-Monesiglio Formation (Tertiary Piedmont Basin).

Genus *Sthenorytis* Conrad, 1862

Type species: *Sthenorytis (Scalaria) expansa* Conrad, 1862, type by subsequent designation, Miocene, Maryland.

Sthenorytis subpyrenaica (Tournouër in De Bouillé, 1876)
 Figs 2E, 2F

1876 *Scalaria subpyrenaica* Tournouër in De Bouillé, p. 44-45, pl. III fig. 2.

1911 *Scalaria subpyrenaica* Tournouër in De Bouillé; Boussac, p. 83, pl. XXI fig. 5.

1912 *Scalaria subpyrenaica* Tournouër; De Boury, p. 234, pl. XII figs 14, 20, 21.

1914 *Scalaria (Sthenorytis) subpyrenaica* Tourn. var. *depexa* Rovereto, p. 142-143, pl. III fig. 3.

Type material - One damaged shell. The original label has been lost. Holotype (by monotypy) 2142/CM-VII-C 44.

Type locality - Carcare, Molare Formation, Tertiary Piedmont Basin.

Remarks - The specimen (size: H = about 35.00 mm; D = about 22.00 mm; SH = about 23.00 mm; AH = about 12.00 mm; AW = about 11.00 mm; SA = 43°) is figured only by Rovereto (1914, pl. III, fig. 3). Rovereto distinguished the var. *depexa* from the species of Tournouër (1876) only on the base of the slightly larger dimensions. In our opinion, the measurement of one single specimen does not justify its separation from species s.s. The characters of the specimen in hand and the original diagnosis and figures of Tournouër (in De Bouillé, 1876, p. 44-45, pl. III, fig. 2) fit with the description reported for the genus *Sthenorytis* Conrad, 1862 as synthesized by Clench & Turner (1950), particularly in terms of sculpture (strong, elevated and blade-like axial costae, well defined spiral striae) and orientation of the aperture, which is prosocline, forming an angle of about 23°.

Distribution - Eocene: SW France; Oligocene: Carcare (NW Italy), Molare Formation (Tertiary Piedmont Basin).

Order Neogastropoda Wenz, 1938

Superfamily Mitroidea Swainson, 1831

Family Mitridae Swainson, 1831

Genus *Mitra* Lamarck, 1798

Type species: *Voluta mitra* Linnaeus, 1758, type by tautonomy, Recent, Indo-Pacific.

Mitra comperta Rovereto, 1900

Figs 2C, 2D

1900 *Mitra comperta* Rovereto, p. 172, pl. VIII fig. 6.

1904 *Mitra comperta* Rovereto; Sacco, p. 83, pl. XVIII fig. 53.

Type material - One shell. The original label has been lost. Holotype (by monotypy) 2153/CM-VII-C 60.

Type locality - Carcare, Molare Formation, Tertiary Piedmont Basin.

Description - Shell dextral, fusiform; composed of six short, convex whorls, with acute apex. Outer lip, tip of neck and apical part of protoconch lacking. Body

whorl covering 2/3 of the entire shell. Protoconch with evenly spaced fine riblets. Spire smooth. Growth lines on the body whorl. Suture linear, impressed. Aperture elongate and narrow. Inner lip thin, sealed to the last whorl, with five columellar plicae. Size: H = 26.70 mm; D = 10.70 mm; SH = 11.40 mm; AH = 15.30 mm; AW = about 7.00 mm; SA = 41°.

Remarks - The holotype is figured for the first time by Rovereto (1900, pl. VIII, fig. 6) and the same image is reported in Sacco (1904, pl. XVIII, fig. 53). The species in hand exhibits a general similarity with *Mitra cotteaui* Coessmann & Lambert, 1884 but clearly differs in having more rounded adapical part of whorls, five columellar plicae and longer siphonal canal (for comparisons see also Lozouet *et al.*, 2012, pp. 430-431, fig. 289, 41-46).

Distribution - Oligocene: Carcare (NW Italy), Molare Formation (Tertiary Piedmont Basin).

Class Bivalvia Linnaeus, 1758

Subclass Autobranchia Grobben, 1894

Order Pteriida Newell, 1965

Superfamily Pinoidea Leach, 1819

Family Pinnidae Leach, 1819

Genus *Pinna* Linnaeus, 1758

Type species: *Pinna rudis* Linnaeus, 1758, type by subsequent designation, Recent, Indo-Pacific.

Pinna carcarea Rovereto, 1900

Figs 3A, 3B

1900 *Pinna carcarea* Rovereto, p. 71, pl. IV fig. 2.

1904 *Pinna carcarea* Rovereto; Sacco, p. 150, pl. XXIX fig. 3.

Type material - One double-valved inner mould bearing fragments of the shell, umbonal and ventral areas lacking. The damaged original label states: "Pinna *Carcarea* ... sp., tipo, Carcare (racc. I....a) 1174". Holotype (by monotypy) 2171/CM-VII-C 81.

Type locality - Carcare, Molare Formation, Tertiary Piedmont Basin.

Description - Valves wedge shaped, strongly convex and trigonal in cross section, with medial ridge. Sculpture: evenly spaced, slightly prominent radial ribs only on the posterior part. Size: L = 39.30 mm, H = 80.30 mm, C = 23.90 mm, EE = 2.04, CE = 0.30, A = 45°.

Remarks - The holotype is figured for the first time by Rovereto (1900, pl. IV, fig. 2) and the same image is reported in Sacco (1904, pl. XXIX, fig. 3). This species is different from any and all other species of *Pinna* described from the Eocene and Oligocene European basins in having strongly convex valves and wide apical angle (for comparisons see Boussac, 1911b; Coessmann, 1921; Marquet, 1995; Abad García, 2001).

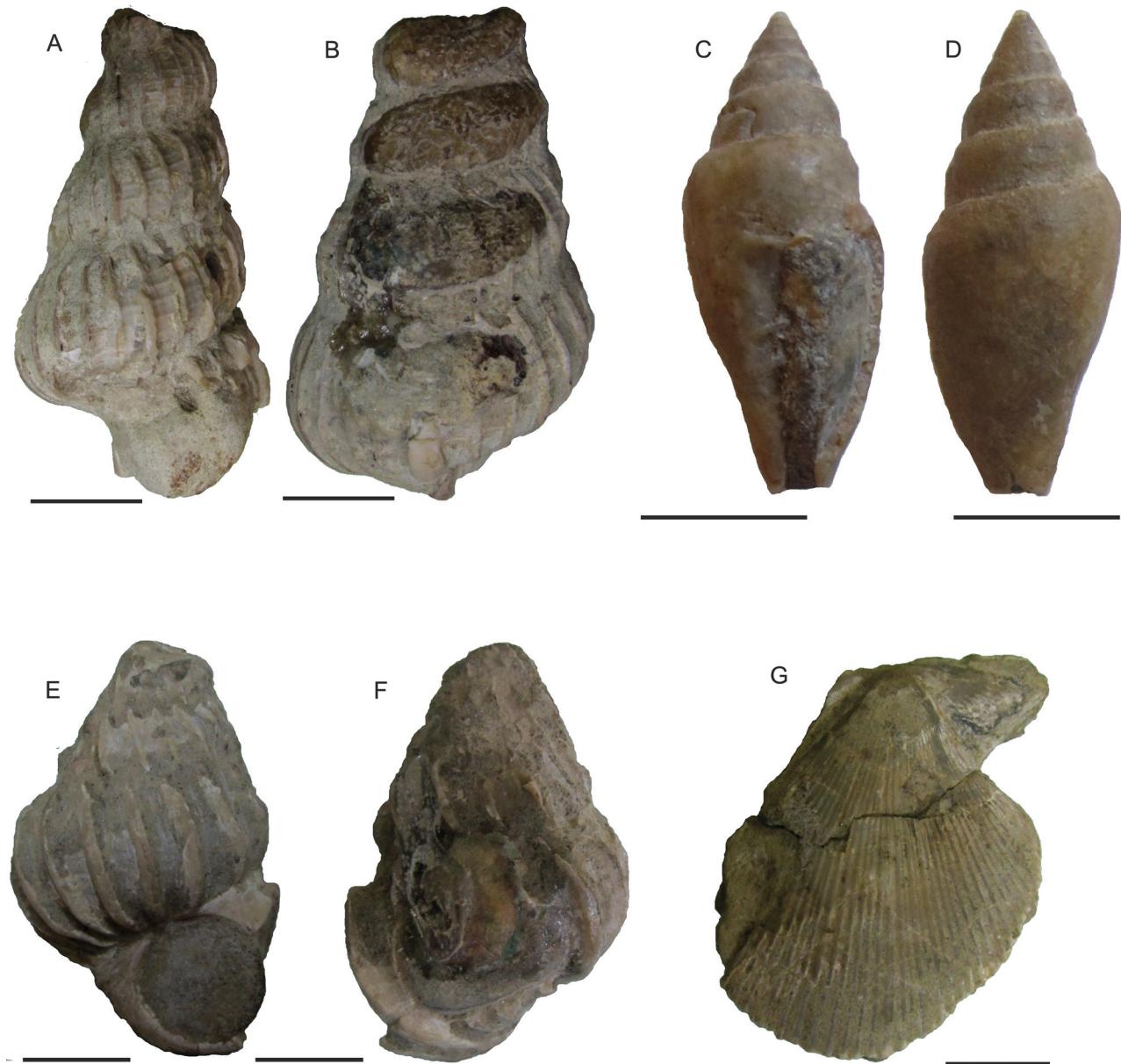


Figure 2. Rovereto's gastropod taxa. Scale bars = 1 cm.

A, B: *Cirsotrema descobinata* (Rovereto) - holotype, 2140/CM-VII-C 42.

C, D: *Mitra comperta* Rovereto - holotype, 2153/CM-VII-C 60.

E, F: *Sthenorytis subpyrenaica* (Tournouér in De Bouillé) - holotype, 2142/CM-VII-C 44.

G: *Crassadoma tauoperstriata* (Sacco) - holotype, 3085/M-I-S 2.

Distribution - Oligocene: Carcare (NW Italy), Molare Formation (Tertiary Piedmont Basin).

Order Pectinida Gray, 1854

Superfamily Pectinoidea Rafinesque, 1815

Family Pectinidae Rafinesque, 1815

Genus *Aequipecten* Fischer, 1886

Type species: *Ostrea opercularis* Linnaeus, 1758, type by monotypy, Recent, Europe.

Aequipecten prenimia (Rovereto, 1898)

Figs 3C, 3F, 3I

1898 *Chlamys prenimia* Rovereto, p. 168.

1900 *Chlamys prenimia* Rovereto; Rovereto, p. 61, pl. III fig. 9.

1904 *Aequipecten oligosquamatus* Sacco var. *perrugosa* Sacco (an var. *prenimia* Rovr), p. 141, pl. XXVIII fig. 5.

Type material - One double-valved shell from Carcare, the damaged original label states: "Chl...s prenimia Rov. tipo 1133", lectotype (here designated) 2179/CM-VII-C 89. Paralectotypes (from Pareto): one badly preserved double-valved shell, the original label has been lost, 1331/SM-VI-P(5) 16; one damaged right valve, the original label has been lost, 1331/SM-VI-P(5) 16bis.

Type locality - Carcare, Molare Formation, Tertiary Piedmont Basin.

Description - Moderately preserved double-valved shell (left valve well preserved and observable, right valve partially embedded in sediments); rounded outline, LV more convex than RV; small, auricles nearly equal (the posterior one is truncated); byssal notch small; umbo small. Sculpture: 14 bold, flat, slightly scaly, evenly distributed radiating ribs; deep interspaces wide as the ribs. Measurements - lectotype: L = 61.32 mm, H = 59.57 mm, C (left valve) = 11.70 mm, EE = 0.93, CE = 0.20, A = 115°; paralectotype 1331/SM-VI-P(5) 16: L = 58.49 mm, H = 64.30 mm, C = 9.50 mm, EE = 1.1, CE = 0.15, A = 108°; paralectotype 1331/SM-VI-P(5) 16bis: L = 51.43 mm, H = 45.37 mm, C = 8.16 mm, EE = 0.9, CE = 0.18, A = 97°.

Remarks - The type is figured for the first time by Rovereto (1900, pl. III, fig. 9) and the same image is reported in Sacco (1904, pl. XXVIII, fig. 5). Sacco (1904, p. 141) included *Chlamys prenimia* Rovereto 1898 in the list of younger synonyms of *Aequipecten oligosquamatus* Sacco var. *perrugosa*, assuming that it may also be a new variety of *A. oligosquamatus* ("an var. *prenimia* Rovr"). We disagree with Sacco, because the Rovereto's species exhibits less scaly ribs and interspaces as wide as the ribs. The same characters allow to separate the species of Rovereto from *Chlamys (Aequipecten) cf. perrugosa* (Sacco) described by Cox (1934).

Distribution - Oligocene: Carcare and Pareto (NW Italy), Molare Formation (Tertiary Piedmont Basin).

Aequipecten degensis (Rovereto, 1914)
Figs 3D, 3E, 3G, 3H

1914 *Chlamys (Aequipecten) callifera* Rovereto; Rovereto, p. 147-148, pl. VI fig. 13.

1914 *Chlamys (Aequipecten) callifera* Rovereto var. *degeneris* Rovereto, p. 148, pl. VI fig. 14.

1967 *Chlamys (Nodipecten) callifera* Rovereto; Lorenz, p. A20-A21, pl. XXVI fig. 5.

1991 *Chlamys (Aequipecten) callifera* Rovereto - Bonci et al., p. 156-157, pl. 2 figs 6-7.

Type material - Four valves from Dego (Costalupara), two of which were figured by Rovereto (1914, Pl. VI, figs 13-14). All original labels have been lost. Lectotype (here designated): 527/DE-VIII-CL 59. Paralectotypes: 527/DE-VIII-CL 59bis, 527/DE-VIII-CL 58, 520/DE-VIII-CL 60.

Type locality - Dego, Costalupara, Molare Formation, Tertiary Piedmont Basin.

Description - One well preserved right valve, fan shaped, slightly inequilateral, quite flat; nearly equal, partly preserved auricles; very small byssal notch. Pointed umbo projecting beyond the hinge line. Sculpture: eight bold, smooth radiating ribs; narrow intervening furrows, growth lines well evident. Measurements - lectotype (right valve): L = 24.44 mm, H = 26.40 mm, C = 6.73 mm, EE = 1.08, CE = 0.26, A = 74°; paralectotype 527/DE-VIII-CL 59bis (right? valve): L = 22.20 mm, H = 19.83 mm, C = 6.27 mm, EE = 0.89, CE = 0.32, A = 81°; paralectotype 527/DE-VIII-CL 58 (left valve): L = 22.57 mm, H = 23.07 mm, C = 5.67 mm, EE = 1.02, CE = 0.25, A = 82°; paralectotype 520/DE-VIII-CL 60 (left valve): L = 31.83 mm, H = 34.86 mm, C = 9.25 mm, EE = 1.10, CE = 0.27, A = 82°.

Remarks - Rovereto (1914, p. 148) described the var. *degeneris* at the end of a long discussion on his species *Chlamys callifera* (= *Nodipecten calliferus*, according to Bonci et al. 2017) and he stated that three specimens were collected. However, he figured only two specimens: one as *C. callifera* (pl. VI, fig. 13; 527/DE-VIII-CL 58) and the other as *C. callifera* var. *degeneris* (pl. VI, fig. 14; 520/DE-VIII-CL 60). During the BTP Collection re-organization works, two additional valves labelled as *C. callifera* var. *degeneris* were found (527/DE-VIII-CL 59 and 527/DE-VIII-CL 59bis; one of which might be the third specimen of Rovereto). The well-preserved specimen 527/DE-VIII-CL 59 reveals that the absence of bulbous nodes (a distinctive character of *N. calliferus*) cannot be caused by abrasion, so the attribution of this specimen to *N. calliferus* is unjustified. Rovereto (1914) and Bonci et al. (1991) record that the specimen 527/DE-VIII-CL 58 has seven ribs, but an accurate observation of the valve revealed that the vestiges of an eighth rib are present. From these lines of evidence, we are convinced, in agreement with Bonci et al. (2017), that the var. *degeneris* cannot be

included in the variability of *N. calliferus*, but it must be considered as a distinct species.

Nodipecten calliferus (Rovereto, 1898) is the most closely related species, differing mainly in having bulbous nodes (see also Bonci *et al.*, 2017 and Boschele *et al.*, 2017). *Pecten subdiscors* d'Archiac, 1846 is also a closely related species, differing in having wider interspaces. The species in hand is similar in outline to *Chlamys venetorum* (Oppenheim, 1896) and *Chlamys bouchieri* (Dollfus, 1887), but it diverges in having a lower number of ribs and narrower intervening furrows.

Distribution - Oligocene: Dego and Cassinelle (NW Italy), Molare Formation (Tertiary Piedmont Basin).

Genus *Crassadoma* Bernard, 1986

Type species: *Lima gigantea* Gray, 1825, type by original designation, Recent, NE Pacific Ocean.

Crassadoma tauoperstriata (Sacco, 1897)
Fig. 2G

1897 *Chlamys tauoperstriata* Sacco, p. 8, pl. 1 figs 20-24.

1898 *Chlamys tauoperstriata* Sacco var. *antiquata* Rovereto, p. 168.

1900 *Chlamys tauoperstriata* Sacco var. *antiquata* Rovereto; Rovereto, p. 60, pl. III fig. 3.

1900 *Chlamys* cf. *tauoperstriata* Sacco; De Alessandri, p. 279.

1904 *Chlamys tauoperstriata* Sacco var. *antiquata* Rovereto; Sacco, p. 140, pl. XXVIII fig. 2.

1914 *Chlamys tauoperstriata* Sacco var. *antiquata* Rovereto; Rovereto, p. 149.

Type material - One fairly preserved right valve infilled by sediments, holotype (by monotypy) 3085/M-I-S 2. The original label states: "Chlamys tauoperstriata Sacco var. antiquata Rov., Squaneto, 1108".

Type locality - Squaneto, Molare Formation, Tertiary Piedmont Basin.

Remarks - The specimen (size: L = 27.30 mm, H = 32.50 mm, C = 3.30 mm, EE = 1.19, CE = 0.10, A = 85°) is figured for the first time by Rovereto (1900, pl. III, fig. 3) and the same image is reported in Sacco (1904, pl. XXVIII, fig. 2). The specimen in hand is less convex and has finer and more regular ribs than *Chlamys tauoperstriata* Sacco, 1897. However, in our opinion, it is too poorly preserved to recognize with certainty the elements that can keep it separate as a subspecies of the Sacco's species. Therefore, we prefer to refer it to *Chlamys tauoperstriata* Sacco, 1897, which has been recently assigned to the genus *Crassadoma* Bernard, 1986 (Lozouet *et al.*, 2002).

Distribution - Oligocene: Squaneto and Cassinelle (NW Italy), Molare Formation (Tertiary Piedmont Basin). Early Miocene: Acqui Terme and Cavatore (NW Italy), Visone Formation (Tertiary Piedmont Basin).

Order Lucinida Gray, 1854

Superfamily Lucinoidea J. Fleming, 1828

Family Lucinidae J. Fleming, 1828

Genus *Phacoides* Agassiz, 1846

Type species: *Lucina jamaicensis* Lamarck, 1801, type by monotypy, Recent, West Indies.

Phacoides seclusus (Rovereto, 1900)
Figs 4B, 4C

1898 *Lucina apenninica* Rovereto, p. 332-333.

1900 *Lucina seclusa* Rovereto n. mut., p. 121-122, pl. VII fig. 15.

1901 *Lucina* (*Dentilucina*?) *seclusa* Rovereto; Sacco, p. 87, pl. XX fig. 36.

1921 *Phacoides* cf. *seclusus* (Rovereto); Cossmann, p. 101, pl. VI figs 10-11, 16-17.

1967 *Lucina seclusa* Rovereto; Lorenz, p. A44, pl. XXIX figs 10a-b.

Type material - One double-valved shell. The original label has been lost. Holotype (by monotypy) 2188/CM-VII-C 99.

Type locality - Carcare, Molare Formation, Tertiary Piedmont Basin.

Description - One fairly preserved double-valved shell, subtrapezoidal in shape with prosogyrous umbo. Posterior margin rounded, anterior margin slightly concave, ventral margin crescent. Lunule well defined and asymmetric. Sculpture: evenly distributed, well-spaced, 16 bold concentric ribs. Size: L = 23.18 mm, H = 19.98 mm, C - right valve = 6.12 mm, EE = 0.86, CE = 0.31.

Remarks - The holotype is figured for the first time by Rovereto (1900, pl. VII, fig. 15, as *Lucina seclusa*) and the same image is reported in Sacco (1901, pl. XX, fig. 36). Rovereto (1900) changed the name of his species (n. mut.) to avoid homonymy with the species *Lucina apenninica* Doderlein (Doderlein in Manzoni, 1876).

The observable characters of this species fit with those reported by Blainville (1825), Agassiz (1846) and Dall (1901) for *Phacoides* which is a valid genus according to MolluscaBase (2020). The species in hand differs from any and all other *Phacoides* described from the Eocene European basins because it is less orbicular in outline and, from the Oligocene ones, in having well-spaced, evenly distributed, bold concentric ribs (for comparisons see Cossmann, 1921; Lozouet & Maestrati, 2012).

Distribution - Oligocene: Carcare (NW Italy), Molare Formation (Tertiary Piedmont Basin); Lesbarritz and Gaas (Aquitaine, SW France).

Genus *Megaxinus* Brugnone, 1880

Type species: *Lucina transversa* Bronn, 1831, type by subsequent designation, Pliocene, Italy.

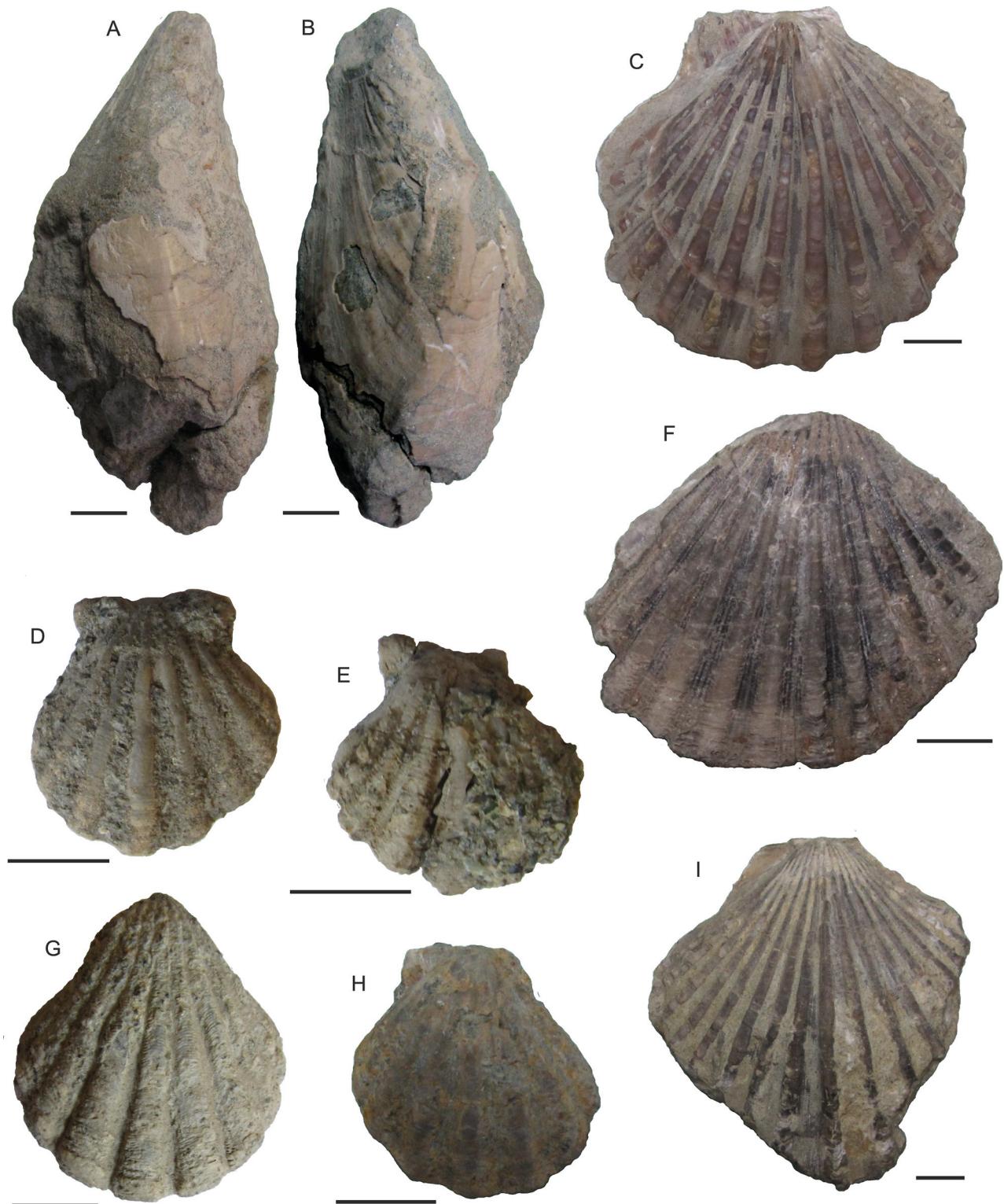


Figure 3. Rovereto's bivalve taxa. Scale bars = 1 cm.

A, B: *Pinna carcensis* Rovereto - holotype, 2171/CM-VII-C 81.

C, F, I: *Aequipecten prenimia* (Rovereto) - lectotype, 2179/CM-VII-C 89 (C); paralectotypes, 1331/SM-VI-P(5) 16bis (F), 1331/SM-VI-P(5) 16 (I).

D, E, G, H: *Aequipecten degensis* (Rovereto) - lectotype, 527/DE-VIII-CL 59 (D); paralectotypes, 527/DE-VIII-CL 59bis (E), 520/DE-VIII-CL 60 (G), 527/DE-VIII-CL 58 (H).



Figure 4. Rovereto's bivalve taxa. Scale bars = 1 cm.

A: *Megaxinus exdeletus* (Sacco) - holotype, 3084/OV-III-C 1.

B, C: *Phacoides seclusus* (Rovereto) - holotype, 2188/CM-VII-C 99, left valve (B), right valve (C).

D: *Crassatella igbinai* Rovereto - holotype, 2194/CM-VII-C 107.

E, F: *Chama vicentina* Fuchs - holotype, 2190/CM-VII-C 101, left valve (E), right valve (F).

G, H: *Crassatella oligocenica* Rovereto - holotype, 2195/CM-VII-C 108, right valve (G), left valve (H).

Megaxinus exdeletus (Sacco, 1900)

Fig. 4A

1900 *Ventricola? exdeleta* Sacco, p. 36.

1900 *Lucina (Dentilucina) tenuistria* Hébert var. *insincera* Rovereto, p. 117, pl. VII fig. 13.

1914 *Lucina (Dentilucina) insincera* Rovereto; Rovereto, p. 160.

Type material - One fairly preserved right valve. Holotype (by monotypy) 3084/OV-III-C 1). The original label has been lost.

Type locality - Tagliolo, Molare Formation, Tertiary Piedmont Basin.

Remarks - The specimen (size: L = 21.00 mm, H = 21.40 mm, C = 6.60 mm, EE = 1.02, CE = 0.31) is figured only by Rovereto (1900, pl. VII, fig. 13). The comparisons with the original images of *Lucina (Dentilucina) tenuistria* Hébert, 1849 (now named *Claibornites tenuistria*) allowed us to state that the var. *insincera* Rovereto (and therefore also the species *L. insincera* Rovereto) is a distinct taxon because of the clearly different outline. Conversely, the specimen in hand is within the morphological variability of *Megaxinus exdeletus* (Sacco, 1900), as already pointed out by Venzo (1937). The general characters of the Sacco's species and of the specimen here considered fit with those reported by Glover & Taylor (1997) for the genus *Megaxinus* Brugnone, 1880. Therefore, we consider *Lucina (Dentilucina) insincera* Rovereto, 1914 (ex *Lucina (Dentilucina) tenuistria* Hébert var. *insincera* Rovereto, 1900) a younger synonym of *Megaxinus exdeletus* (Sacco, 1900).

Distribution - Oligocene: Tagliolo (NW Italy), Molare Formation (Tertiary Piedmont Basin).

Order Carditida Dall, 1889

Superfamily Crassatelloidea Féruccac, 1822

Family Crassatellidae Féruccac, 1822

Genus *Crassatella* Lamarck, 1799

Type species: *Crassatella tumida* Lamarck, 1805, type by subsequent designation, Eocene, France.

Crassatella ighinai Rovereto, 1898

Fig. 4D

1898 *Crassatella Ighinai* Rovereto, p. 179.

1900 *Crassatella Ighinai* Rovereto; Rovereto, p. 86-87, pl. V fig. 16.

1904 *Crassatella Ighinai* Rovereto; Sacco, p. 157, pl. XXX fig. 6.

Type material - One right valve. The original label has been lost. Collezione Ighina. Holotype (by monotypy) 2194/CM-VII-C 107.

Type locality - Carcare, Molare Formation, Tertiary Piedmont Basin.

Description - Well preserved right valve infilled by sediment, subtrapezoidal, strongly inequilateral, posteriorly elongated with prosogyrous umbo. Slanting and rounded anterior margin, truncated posterior margin, almost straight ventral margin. Prominent carina close to the posterior margin. Large and elongated escutcheon. Sculpture: growth rugae. Size: L = 61.90 mm, H = 41.40 mm, C = 17.20 mm, EE = 0.67, CE = 0.42.

Remarks - The holotype is figured for the first time by Rovereto (1900, Pl. V, fig. 16) and the same image is reported in SACCO (1904, pl. XXX, fig. 6). The Rovereto's species exhibits some similarity with: a) *Crassatella (Landinia) landinensis* Nyst, 1845 (and synonyms, according to Pacaud, 2007), that differs in having a subtriangular shell, a smaller and pointed umbo, and a straight anterior margin; b) *Crassatella distincta* Deshayes 1857, that differs in having a less elongated shell and evenly spaced and crenulated growth rugae; c) *Crassatella gibbosula* Lamarck 1805, that differs in having a less elongated shell, evenly spaced and prominent growth rugae, and carina in the middle of the valves; d) *Crassatella lamellosa* Lamarck 1805, that differs in having a small and pointed umbo, and evenly spaced and prominent growth rugae.

Distribution - Oligocene: Carcare (NW Italy), Molare Formation (Tertiary Piedmont Basin).

Crassatella oligocenica Rovereto, 1898

Figs 4G, 4H

1898 *Crassatella subtumida* Bell. var. *oligocenica* Rovereto, p. 179.

1900 *Crassatella subtumida* Bell. var. *oligocenica* Rovereto; Rovereto, p. 88, pl. VI fig. 1.

1904 *Crassatella cf. subtumida* Bell. var. *oligocenica* Rovereto; Sacco, p. 157, pl. XXX fig. 7.

1911 *Crassatella oligocenica* Rovereto; Boussac, p. 202.

1921 *Crassatella pseudotumida* Benoit in schedis, Cossmann, p. 117, pl. VI fig. 85, non figs 83-84, pl. VII figs 7-8.

1937 *Crassatella oligocenica* Rovereto; Venzo, p. 121-122.

1967 *Crassatella subtumida* Bellardi var. *oligocenica* Rovereto; Lorenz, p. A36, pl. XXVIII fig. 5.

Type material - One double-valved shell. The original label states: "Crassatella subtumida Bell. var. *oligocenica* mihi Rover. Carcare (racc. Ighina) 1283". Holotype (by monotypy) 2195/CM-VII-C 108.

Type locality - Carcare, Molare Formation, Tertiary Piedmont Basin.

Description - Fairly preserved (abraded) double-valved shell, the RV is largely damaged. Subtrigonial in outline, strongly inequilateral with prosogyrous umbos; posterior and anterior margins straight and strongly sloping; ventral margin rounded. Large, deeply sunken and well-defined escutcheon with high and sharp contours. Marked carina. Sculpture: only growth

Table 1. List of the new mollusc taxa described by Rovereto (1898, 1900, 1914) coming from Carcare, Dego, Squaneto and Tagliolo, and included in the BTP Collection.

Original name in Rovereto (1898, 1900, 1914)	New name	Catalog number
Gastropoda		
<i>Pleurotomaria Isseli</i> Rovereto, 1900	<i>Perotrochus isseli</i> (Rovereto, 1900)	509/DE-VIII-CL 39
<i>Turbo (Ninella ?) desidiosus</i> Rovereto, 1914	<i>Lunella (Ninella) desidiosa</i> (Rovereto, 1914)	476/DE-VIII-CL 2
<i>Potamides (Terebralia ?) fucilis</i> Rovereto, 1914	<i>Terebralia fucilis</i> (Rovereto, 1914)	477/DE-VIII-CL 3
<i>Scalaria (Cirsotrema) descobinata</i> Rovereto, 1914	<i>Cirsotrema descobinata</i> (Rovereto, 1914)	2140/CM-VII-C 42
<i>Scalaria (Sthenorytis) subpyrenaica</i> Tourn. var. <i>depexa</i> Rovereto, 1914	<i>Sthenorytis subpyrenaica</i> (Tournier in De Bouillé, 1876)	2142/CM-VII-C 44
<i>Mitra comperta</i> Rovereto, 1900	<i>Mitra comperta</i> Rovereto, 1900	2153/CM-VII-C 60
Bivalvia		
<i>Pinna carcarea</i> Rovereto, 1900	<i>Pinna carcarea</i> Rovereto, 1900	2171/CM-VII-C 81
<i>Chlamys prenimia</i> Rovereto, 1898	<i>Aequipecten prenimia</i> (Rovereto, 1898)	2179/CM-VII-C 89 1331/SM-VI-P(5) 16 1331/SM-VI-P(5) 16bis
<i>Chlamys (Aequipecten) callifera</i> Rovereto var. <i>degensis</i> Rovereto, 1914	<i>Aequipecten degensis</i> (Rovereto, 1914)	527/DE-VIII-CL 59 527/DE-VIII-CL 59bis 527/DE-VIII-CL 58 528/DE-VIII-CL 60
<i>Chlamys tauoperstriata</i> Sacco var. <i>antiquata</i> Rovereto, 1898	<i>Crassadoma tauoperstriata</i> (Sacco, 1897)	3085/M-I-S 2
<i>Lucina apenninica</i> Rovereto, 1898 = <i>Lucina seclusa</i> Rovereto, 1900	<i>Phacoides seclusus</i> (Rovereto, 1900)	2188/CM-VII-C 99
<i>Lucina (Dentilucina) tenuistria</i> Hébert var. <i>insincera</i> Rovereto, 1900 = <i>Lucina (Dentilucina) insincera</i> Rovereto in Rovereto (1914)	<i>Megaxinus exdeletus</i> (Sacco, 1900)	3084/OV-III-C 1
<i>Cardita (Actinobulus) globulaevis</i> Rovereto, 1914	<i>Cardites globulaevis</i> (Rovereto, 1914)	531/DE-VIII-CL 63
<i>Crassatella Ighinai</i> Rovereto, 1898	<i>Crassatella ighinai</i> Rovereto, 1898	2194/CM-VII-C 107
<i>Crassatella subtumida</i> Bell. var. <i>oligocenica</i> Rovereto, 1898	<i>Crassatella oligocenica</i> Rovereto, 1898	2195/CM-VII-C 108
<i>Chama vicentina</i> Fuchs var. <i>carcarea</i> Rovereto, 1898	<i>Chama vicentina</i> Fuchs, 1870	2190/CM-VII-C 101

rugae. Size: L = 101.60 mm, H = 92.50 mm, C - left valve = 30.00 mm, EE = 0.91, CE = 0.32.

Remarks - The holotype is figured for the first time by Rovereto (1900, pl. VI, fig. 1) and the same image is reported in SACCO (1904, pl. XXX, fig. 7). Rovereto (1898, 1900) describes the characters that allow to separate the var. *oligocenica* from the species s.s. described by Bellardi (1862, p. 245, pl. G, figs 1-2). Boussac (1911b, p. 202) raises the Rovereto's variety to the rank of species on this basis, and Venzo (1937, p. 121) confirms this change. We agree with these authors, as the posterior elongation and the pronounced inequilaterality clearly differentiate the Rovereto's taxon from the species of Bellardi. *Crassatella pseudotumida* (Benoist in schedis, Cossmann, 1921) is very similar, as already pointed out by Cossmann (1921) and Venzo (1937). The latter author includes the Benoist's species in the synonymic list of *C. oligocenica* but with a question mark. In our opinion, *C. pseudotumida* is to be regarded as a junior synonym of *C. oligocenica*, because the characters used by Cossmann (1921) to separate the two species (i.e., *C. pseudotumida* exhibits a more pointed, prominent and enveloping umbos

and a more regularly inflated shell) are too feeble and the EE and CE of the two species are nearly equivalent (*C. subtumida* EE = 0.90, CE = 0.34). Cossmann (1921) include in *C. pseudotumida* also two specimens (pl. VI, figs 83-84) that strongly differ from the others in having subtrapezoidal, strongly inequilateral, posteriorly elongated shell with a bold growth rugae; the author states that these specimens are juvenile shells, but, in our opinion, they are too much different from adults, so we prefer to not include these specimens in *C. oligocenica*.

Distribution - Oligocene: Carcare, Colle del Giovo (NW Italy), Molare Formation (Tertiary Piedmont Basin); Belluno (NE Italy), "Glauconie"; Gaas and La Souys (SW France).

Order Venerida Gray, 1854

Superfamily Chamoidea Lamarck, 1809

Family Chamidae Lamarck, 1809

Genus *Chama* Linnaeus, 1758

Type species: *Chama lazarus* Linnaeus, 1758, type by subsequent designation, Recent, Indo-Pacific.

Chama vicentina Fuchs, 1870

Figs 4E, 4F

1870 *Chama vicentina* Fuchs, p. 31, pl. 7 figs 4-5.

1898 *Chama vicentina* Fuchs var. *carcarensis* Rovereto, p. 182.

1900 *Chama vicentina* Fuchs var. *carcarensis* Rovereto; Rovereto, p. 96, pl. V fig. 12.

1904 *Chama vicentina* Fuchs var. *carcarensis* Rovereto; Sacco, p. 160, pl. XXX fig. 19.

Type material - One, partially preserved, double-valved shell. Holotype (by monotypy) 2190/CM-VII-C 101. The original label states: "1339 *Chama vicentina* Fuchs? var. *carcarensis* Rov., *Ch. squamosa* Brand.? Baccino di Carcare, Dego".

Type locality - Colletta di Carcare, Molare Formation, Tertiary Piedmont Basin.

Remarks - The specimen (size: L = 18.26 mm, H = 22.04 mm, C = 8.51 mm, EE = 1.21, CE = 0.39) is figured for the first time by Rovereto (1900, pl. V, fig. 12) and the same image is reported in Sacco (1904, pl. XXX, fig. 19). Rovereto (1898) introduces this variety only on the basis of its dextral coiling, but Campbell *et al.* (2004) and Holmes *et al.* (2015) record that the valve attachment and coiling is not species specific; therefore, this character is supposed not to be sufficient for a separation from *Chama vicentina* Fuchs, 1870.

Distribution - Oligocene: Carcare (NW Italy), Molare Formation (Tertiary Piedmont Basin).

CONCLUSIONS

This paper provides the revision of 12 mollusc taxa, namely 3 gastropods and 9 bivalves, described by Rovereto (1898, 1900, 1914), geologist and palaeontologist of the University of Genova (Italy). These fossils were collected in the Oligocene rocks of the Molare Formation (Tertiary Piedmont Basin) cropping out in the Carcare, Dego, Squaneto, and Tagliolo areas. Nowadays, these specimens are preserved in the "BTP Collection" housed at the Museum of the Department of Earth, Environment and Life Sciences, University of Genova. This taxonomic revision resulted in the designation of eight name-bearing types. Moreover, three bivalve and one gastropod taxa were identified as synonyms of other species. Regarding the stratigraphic distribution of the valid taxa, they all are restricted to the Oligocene. As concern the geographic distribution of the valid taxa, it should be noted that *Crassatella oligocenica* is present in NE Italy (Veneto Region) and SW France, *Phacoides seclusus* in SW France. So far, the other species have been found in the Tertiary Piedmont Basin only. Most of the ori-

ginal collecting sites are not effectively detectable anymore due to the site-location uncertainty and/or to the land-use and land-cover changes occurred, mainly consisting of urbanization and vegetation development.

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