



**Revision of  
*Ostrea (Gigantostrea) gigantica* SOLANDER var. *oligoplana* SACCO and  
*Ostrea (Ostrea) isseli* ROVERETO  
(Oligocene, Tertiary Piedmont Basin, NW Italy)**

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**Abstract:** The aim of this paper is the revision and redocumentation of *Ostrea (Gigantostrea) gigantica* SOLANDER var. *oligoplana* SACCO, 1897, *Ostrea (Ostrea) isseli* n. denom. ROVERETO, 1897, and *Ostrea (Ostrea) isseli* n. denom. var. *elongata* ROVERETO, 1897. These taxa are from the Oligocene strata of the Molare Formation (Tertiary Piedmont Basin, southern Piedmont - central Liguria, NW Italy). The syntypes of *O. (G.) gigantica* var. *oligoplana* are in the "Collezione BELLARDI e SACCO", at the Museo Regionale di Scienze Naturali di Torino; the syntypes of *O. (O.) isseli* and *O. (O.) isseli* var. *elongata* are in the "Collezione BTP" (BTP Collection, at the Dipartimento di Scienze della Terra, dell'Ambiente e della Vita - DISTAV - of the Università di Genova). The var. *oligoplana* is here moved to the species rank and allocated to the genus *Pycnodonte* FISCHER von WALDHEIM, 1835. *O. (O.) isseli* and *O. (O.) isseli* var. *elongata* are recognized as junior synonyms of the SACCO's taxon. ROVERETO (1897) compared his new species with *Ostrea subgigantea* RAULIN & DELBOS, 1855, a poorly known taxon, that is here figured for the first time and shown to represent a species different from *P. oligoplana* (SACCO, 1897).

**Key-words:**

- ROVERETO;
- SACCO;
- bivalve type-material;
- Oligocene;
- NW Italy

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**Résumé : Révision d'*Ostrea (Gigantostrea) gigantica* SOLANDER var. *oligoplana* SACCO et d'*Ostrea (Ostrea) isseli* ROVERETO (Oligocène, Bassin tertiaire du Piémont, NO Italie).- L'objectif du présent travail est la révision et la nouvelle illustration d'*Ostrea(Gigantostrea) gigantica* SOLANDER var. *oligoplana* SACCO, 1897, d'*Ostrea (Ostrea) isseli* n. denom. ROVERETO, 1897, et d'*Ostrea (Ostrea) isseli* n. denom. var. *elongata* ROVERETO, 1897. Ces taxons proviennent des couches oligocènes de la Formation de Molare (bassin tertiaire du Piémont, Piémont méridional - Ligurie centrale, Italie du nord-ouest). Les syntypes d'*O. (G.) gigantica* var. *oligoplana* figurent dans la collection BELLARDI et SACCO du Musée Régional de Sciences Naturelles de Turin ; les syntypes d'*O. (O.) isseli* et d'*O. (O.) isseli* var. *elongata* font partie de la collection BTP (Département de Sciences de la Terre, de l'Environnement et de la Vie - DISTAV - Université de Gênes). La variété *oligoplana* est ici élevée au rang d'espèce et attribuée au genre *Pycnodonte* FISCHER von WALDHEIM, 1835. *O. (O.) isseli* et *O. (O.) isseli***

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var. *elongata* sont ici considérées des synonymes juniors du taxon de SACCO. ROVERETO a comparé sa nouvelle espèce à *Ostrea subgigantea* RAULIN & DELBOS, 1855, un taxon peu connu qui est figuré ici pour la première fois et considéré comme représentant une espèce distincte de *P. oligoplana* (SACCO, 1897).

#### Mots-clefs :

- ROVERETO ;
- SACCO ;
- matériel-type de bivalves ;
- Oligocène ;
- Italie du nord-ouest

## 1. Introduction

This paper focuses on the revision and re-documentation of *Ostrea (Gigantostrea) gigantica* SOLANDER var. *oligoplana* SACCO, 1897, *Ostrea (Ostrea) isseli* n. denom. ROVERETO, 1897 and *Ostrea (Ostrea) isseli* n. denom. var. *elongata* ROVERETO, 1897. It is part of a project of revision of new Oligocene mollusc taxa erected by Gaetano ROVERETO (geologist and paleontologist of the Genoa University) in the years 1897-1914. The SACCO's type material is from the Sassetto and Carcare (Savona Province, NW Italy, Fig. 1) and it is preserved in the "Collezione BELLARDI e SACCO" housed at the Museo Regionale di Scienze Naturali di Torino; the ROVERETO's type material is from Mioglia, Sassetto (Rio Zunini), Tagliolo (Rio Chiappino), Casaleggio Boiro, Case Morera, and Bandita (Savona and Alessandria Province, NW Italy, Fig. 1) and it is preserved in the "BTP Collection" (BTP is an abbreviation of "Bacino Terziario del Piemonte", i.e., Tertiary Piedmont Basin - TPB, the geological unit from which the specimens were collected) housed at the Museo di Paleontologia, Dipartimento di Scienze della Terra, dell'Ambiente e della Vita (DISTAV), Università di Genova. Information on the history and composition of the BTP Collection and on the molluscan taxa described by ROVERETO (1897-1914) was provided by BONCI *et al.* (2014).

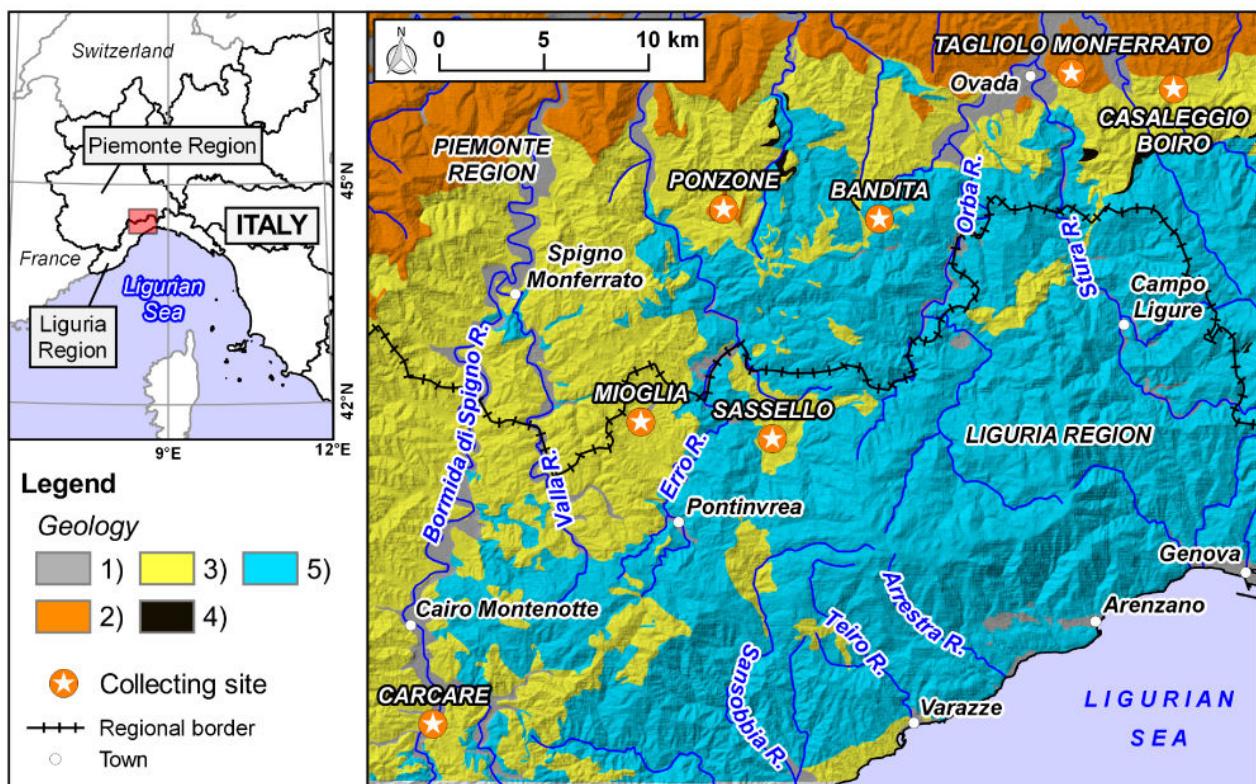
The species *Ostrea subgigantea* RAULIN & DELBOS, 1855, is also examined, because ROVERETO compared his new species with this taxon, which is very poorly known. We reproduce the photographs of the syntype of this taxon which are kindly provided by Laurent CHARLES, Muséum d'Histoire naturelle de Bordeaux (MHNB).

For information about the geology of the TPB and the localities from which ROVERETO's types come, refer to LORENZ (1969), GELATI and GNACCOLINI (1988), CAPPONI and CRISPINI (2008), QUARANTA *et al.* (2009a), GELATI *et al.* (2010), BONCI *et al.* (2011, 2014, 2017, 2018), CAPPONI *et al.* (2013), GHIBAUDO *et al.* (2014), FEDERICO *et al.* (2016), and references therein.

## 2. Taxonomic history

The taxonomic status of *Ostrea (Gigantostrea) gigantica* var. *oligoplana* SACCO, 1897, *Ostrea (Ostrea) isseli* ROVERETO, 1897, and *O. (O.) isseli* var. *elongata* ROVERETO, 1897, is ambiguous for the following reasons:

- a) SACCO (June 1897, p. 14) erected *Ostrea (Gigantostrea) gigantica* var. *oligoplana* (characterized by a small cardinal area) and included in the synonymy list the Oligocene specimens attributed to *Ostrea (Gigantostrea) gigantica* SOLANDER in BRANDER, 1776, by SISMONDA (1855) and PARETO (1855), and to *Ostrea pyrenaica* ORBIGNY by BRONN (1856);
- b) ROVERETO (July 1897, p. 311-312, 318) erected *Ostrea (Ostrea) isseli* n. denom. on the basis of the specimens erroneously identified as *Ostrea delbosi* MAYER, 1879 by MICHELOTTI (1861) and *Ostrea gigantica* SOLANDER in BRANDER, 1776, by SISMONDA (in PARETO, 1855), but he neither defined nor figured the type;
- c) ROVERETO (July 1897, p. 311-312) stated that *O. isseli* is identical to *Ostrea subgigantea* RAULIN & DELBOS, 1855, and he affirmed that this species is not validly published;
- d) ROVERETO (July 1897, p. 318) attributed to his new species the specimens collected by him and Arturo Issel in the Oligocene rocks of Sassetto, Mioglia and Casaleggio Boiro (Savona and Alessandria Province, NW Italy, TPB);
- e) ROVERETO (July 1897, p. 318) identified two varieties of *O. isseli*, i.e., var. *lamellata* and var. *elongata*;
- f) ROVERETO (1900) reviewed *O. (O.) isseli* (reproposed as n. mut.) including as a synonym *Gigantostrea gigantica* SOLANDER var. *oligoplana* SACCO and removing from the synonymous list *Ostrea delbosi* of MICHELOTTI (1861);
- g) ROVERETO (1900) confirmed the validity of *O. (O.) isseli* var. *elongata*;
- h) ROVERETO (1900) added *Ostrea delbosi* of MICHELOTTI (1861) and *O. (O.) isseli* var. *lamellata* to *Ostrea oligappenninica* (SACCO, 1897); it should be noted that *O. oligappenninica* is considered a junior synonym of *Pycnodonte rarilamella* (DESHAYES, 1864) by BOSCHELE *et al.* (2016);



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

i) SACCO (1904) reassessed *G. gigantica* (SOLANDER) var. *oligoplana* SACCO suggesting that it may be a new species ("an species distinguenda", p. 136) and including *O. isseli* ROVERETO (1897) in the synonymous list;

j) SACCO (1904) reassessed *G. gigantica* var. *elongata* (ROVERETO) suggesting that it may be a variety of *G. oligoplana* ("an *G. oligoplana* var.", p. 136);

k) LORENZ (1967, p. A28-A30) uncritically gathered *O. isseli*, *O. isseli* var. *elongata* and *O. (G.) gigantica* var. *oligoplana* in *Ostrea* (*Gigantostrea*) *gigantica* SOLANDER;

l) ABAD GARCÍA (2002, p. 560) included the var. *oligoplana* in *Pycnodonte gigantica* (SOLANDER) but ignored ROVERETO's taxa.

Finally, it should be noted that *Ostrea subgigantea* was validly erected and described, but not figured, by RAULIN & DELBOS (1855, p. 1154, lower Oligocene, Bordeaux, SW France). Subsequently, this species was recorded, but neither described nor figured by DELBOS and KOEHLIN-SCHLUMBERGER (1867, p. 43, Oligocene, Département de l'Haut-Rhin, E France) and FALLOT (1894, p. 366, Oligocene, Département de la Gironde, SW France).

### 3. Methods

The classification scheme here adopted is that proposed by BOUCHET *et al.* (2010). Additional sources were STENZEL (1971), HARRY (1985), Fossilworks, and WoRMS Editorial Board (2018) that also provide useful taxonomic and nomencla-

tural information. Measurement abbreviations are: L= length of valve, H= height of valve, EE= elongation extent (H/L), LLA= length of ligamental area, HLA= height of ligamental area, WR= width of resilifer.

## 4. Systematics

### Class Bivalvia LINNAEUS, 1758

#### Subclass Autobranchia GROBBEN, 1864

#### Superorder Pteriomorphia BEURLEN, 1944

#### Order Ostreida FÉRUSSAC, 1822

#### Superfamily Ostreoidea RAFINESQUE, 1815

#### Family Gryphaeidae VIALOV, 1936

#### Subfamily Pycnodonteinae STENZEL, 1959

#### Genus *Pycnodonte*

FISCHER von WALDHEIM, 1835

**Type species:** *Pycnodonte radiata* FISCHER von WALDHEIM, 1835, type by original designation, Upper Cretaceous, Crimea.

#### *Pycnodonte oligoplana* (SACCO, 1897)

(Figs. 2.A-H, 3.A-J)

1897 *Ostrea* (*Gigantostrea*) *gigantica* SOLANDER var. *oligoplana* SACCO, p. 14-15, Pl. IV, figs. 6-7b.

1897 *Ostrea* (*Ostrea*) *isseli* n. denom. ROVERETO, p. 318.

1897 *Ostrea* (*Ostrea*) *isseli* n. denom. var. *elongata* ROVERETO, p. 318.

1900 *Ostrea* (*Ostrea*) *isseli* n. mut. ROVERETO, p. 46.

1900 *Ostrea* (*Ostrea*) *isseli* n. mut. var. *elongata* ROVERETO, p. 46, Pl. I, fig. 2.



- 1904 *Gigantostrea gigantica* (SOL.) var. *oligoplana* SACCO, (an species distinguenda), SACCO, p. 136.
- 1904 *G. gigantica* var. *elongata* (ROVERETO) (an *G. Oligoplana* var.), SACCO, p. 136, Pl. XXVII, fig. 9.
- 1921 *Ostrea gigantica* SOL. var. *oligoplana* SACCO, STEFANINI, p. 128.
- 1967 *Ostrea (Gigantostrea) gigantica* SOLANDER, LORENZ, p. A28-A30, Pl. XXVII, fig. 3. [non SOLANDER in BRANDER, 1776]
- 1969 *Ostrea gigantica* SOLANDER, LORENZ, Pl. II, fig. 2. [non SOLANDER in BRANDER, 1776]
- 2007 *Gigantostrea gigantica* (SOLANDER in BRANDER) var. *oligoplana* SACCO, AIMASSI, p. 24, Pl. 1, fig. 2.

**Diagnosis:** Large shell; thin, concave lower valve; thin, flat upper valve; long, straight dorsal margin; small and pointed umbo; small ligamental area and shallow resilifer; short branching vermiculate chomata; growth squamae nonapressed; alternation of foliated and vesicular layers. The subcircular to vertical-oval outline (EE range= 1.05 – 1.51) and the small to relatively large attachment area represent the only intra-specific variation.

Detailed descriptions and measurements of the type material are provided separately in the text below.

**Remarks:** *Pycnodonte gigantica* (SOLANDER in BRANDER, 1776) is the type species of *Gigantostrea* SACCO, 1897, which is in turn attributed to *Pycnodonte* in a revision by STENZEL (1970) based on the similar growth patterns of the respective type species. *Pycnodonte oligoplana*, attributed originally to *Gigantostrea*, differs from *P. gigantica* in having a thin shell, small cardinal area, and shallow ligamental groove.

ROVERETO (1900) has previously stated that the typical forms of *P. gigantica* have a thick shell, large cardinal area, and very deep ligamental groove, and are restricted to the Eocene. In contrast, he considered all Oligocene specimens previously referred to *P. gigantica* to be a different species, i.e., *Ostrea (Ostrea) isseli* ROVERETO, 1897. In our opinion the characters used by ROVERETO (1897, 1900) for the erection of this species (i.e., thin shell, small cardinal area, and shallow ligamental groove) are sufficient to separate it from SOLANDER's species. In contrast, *Ostrea (Ostrea) isseli* var. *elongata* ROVERETO, 1897, differs from *O. (O.) isseli* only in having a more elongated outline (ROVERETO, 1897, 1900), a character that is within the morphological variability of the species.

The type material of *O. (O.) isseli* and *O. (O.) isseli* var. *elongata* exhibits the general morphology, muscle scar, chomata, and shell microstructure that clearly suggest allocation to the genus *Pycnodonte* FISCHER von WALDHEIM, 1835. Furthermore, comparison with the type material of *P. oligoplana* confirms their attribution to the same species, as already suggested by ROVERETO (1900) and by SACCO (1904). While *P. isseli* and *P. elongata* were both published in July 1897, *P. oligoplana* was published in June 1897 and is the valid

name of the species, based on the principle of priority.

ROVERETO (1897, p. 311-312) suggested that *O. isseli* is identical to *Ostrea subgigantea* RAULIN & DELBOS, 1855, but the similarity is restricted to general morphological characters. The former species can be easily distinguished because of a smaller ligamental area, as enlightened by data reported in Figure 6 of the present study.

Finally, the general morphology of the lower valve allows the separation of *P. oligoplana* from the thick, gryphaeiform *P. bronniarti* (BRONN, 1831) (Europe, southern Asia, northern and eastern Africa; Eocene – early Miocene), the strongly uniformly convex *P. clypeata* (ROVERETO, 1897) (northern Italy; Oligocene), the crescentic *P. callifera* (LAMARCK, 1819) (northern and central Europe; Eocene - Oligocene), and the winged, antero-posteriorly elongated *P. rarilamella* (DES-HAYES, 1864) (Europe and southern Asia; Eocene - Oligocene).

**Distribution:** Oligocene: Sassello, Carcare, Casaleggio Boiro, Mioglia, Case Morera (Ponzone), Bandita - Molare Formation, TPB, NW Italy; Sidi el Homri and Sidi Jaja (Cyrenaica, NE Libya); Algeria.

### ***Pycnodonte oligoplana* (Sacco, 1897) type series**

**Type material:** Lectotype (here designated, Fig. 2.A-H): one double-valved, relatively well-preserved shell (outer surface of valves eroded and encrusted, lower valve ventral margin damaged) with internal mould from Sassello; catalog number BS.107.03.003, illustrated by SACCO (1897, Pl. IV, figs. 7a-b) and AIMASSI (2007, Pl. 1, fig. 2). Paralectotype (Fig. 3.A-J): one double-valved, damaged shell (outer surface of valves eroded and encrusted, upper valve dorsal and posterior margins, lower valve margins are damaged) from Carcare; catalog number BS.107.03.002, illustrated by SACCO (1897, Pl. IV, fig. 6).

**Type locality:** Sassello, Molare Formation (Oligocene), TPB.

**Measurements:** Lectotype - lower valve: H= 180.00 mm, L 172.00 mm, EE= 1.05, LLA= 56.40 mm, HLA= 15.14 mm, WR= 14.86 mm; upper valve: H= 190.00 mm, L= 173.00 mm, LLA= 57.04 mm, HLA= 19.98, WR= 14.54 mm. Paralectotype - lower valve: H= 192.00 mm, L= 172.00 mm, EE= 1.12, LLA= 55.34 mm, HLA= 27.69 mm, WR= 16.67 mm; upper valve: H= 182.00 mm, L= 158.00 mm, LLA= 47.07 mm, HLA= 20.07, WR= 16.85 mm.

**Description:** Lectotype: lower valve (umbo lacking, sculpture not observable): thin, concave, subcircular in outline; long, straight dorsal margin; relatively small attachment area; small ligamental area; shallow resilifer; short, branching, vermiculate chomata; shell structure with an alternation of foliated and vesicular layers. Upper



**Figure 2:** *Pycnodonte oligoplana* (SACCO, 1897), lectotype BS.107.03.003. Scale bar = 1 cm. **A-C:** lower valve. **D-F:** upper valve. **G-H:** original labels.



**Figure 3:** *Pycnodonte oligoplana* (Sacco, 1897), paralectotype BS.107.03.002. Scale bar = 1 cm. **A-C:** lower valve. **D, G, I-J:** original labels. **E-F, H:** upper valve.



valve: thin, flat, subcircular in outline; nonappressed growth squamae.

**Paralectotype:** lower valve (margins damaged, sculpture not observable): thin, slightly concave, subcircular in outline; small and pointed umbo; relatively large attachment area; small ligamental area; shallow resilifer; short, branching, vermiculate chomata. Upper valve (sculpture not observable): thin, flat, subcircular in outline.

#### **Pycnodonte isseli (ROVERETO, 1897) type series**

**Type material:** Lectotype: (here designated, Fig. 4.A-D): articulated, damaged shell (upper valve dorsal margin, lower valve anterior and part of ventral margins lacking); catalog number 2848/M-III-M 87; this specimen is part of the Collezione Perrando, that was available to ROVERETO in 1897, and was probably taken into consideration by ROVERETO for the identification of the species.

**Type locality:** Mioglia, Molare Formation (Oligocene), TPB.

**Measurements:** Lectotype (Fig. 4.A-D; 2848/M-III-M 87): lower valve size: H= 160.00 mm, L not less than 140.00 mm, EE= 1.14, LLA= 26.47 mm, HLA= 21.14 mm, WR= 15.69 mm; upper valve size: H not less than 140.00 mm, L not less than 130.00 mm.

**Description:** Lower valve: thin, concave, subcircular in outline; long, straight dorsal margin; small and pointed umbo; small attachment area; small ligamental area; shallow resilifer; short, branching, vermiculate chomata; growth squamae nonappressed; concentric, irregular, gentle puckers; shell structure with an alternation of foliated and vesicular layers. Upper valve: thin, flat, subcircular in outline; nonappressed growth squamae.

#### **Pycnodonte elongata (ROVERETO, 1897) type series**

**Type material:** Lectotype (here designated, Fig. 4.E, .H): one lower valve from Mioglia, catalog number 1904/M-III-M 18), figured by ROVERETO (1900, Pl. I, fig. 2) as *Ostrea isseli* var. *elongata*; SACCO (1904) reported the same images of ROVERETO (1900). Paralectotypes: a) one lower valve from Mioglia, catalog number 2846/M-III-M 85 (Fig. 5.C-D); b) one lower valve from Tagliolo, catalog number 3163/OV-III-C 2 (Fig. 5.A-B); c) one damaged upper valve (posterior and part of the ventral margins lacking, umbo broken) from Sassello, catalog number 2061/Sa-II-S 157 (Fig. 4.F-G).

**Type locality:** Mioglia, Molare Formation (Oligocene), TPB.

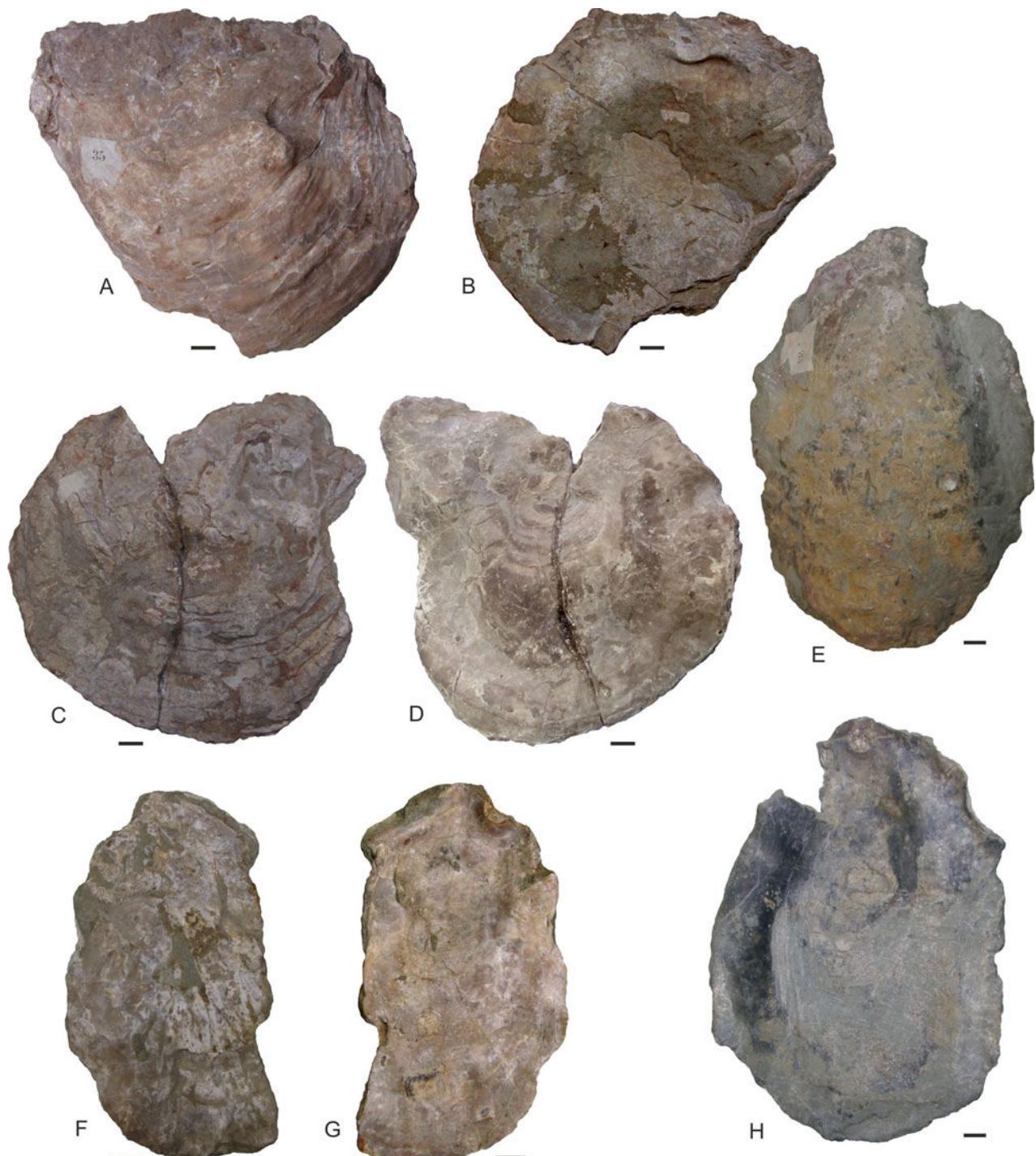
**Measurements:** Lectotype (Fig. 4.E, .H; 1904/M-III-M 18): H= 175.00 mm, L= 115.64 mm, EE= 1.51, LLA= 29.73 mm, HLA= 13.96 mm, WR= 11.29 mm. Paralectotypes: lower valve (Fig. 5.C-D; 2846/M-III-M 85): H= 163.00 mm, L= 134.58 mm, EE= 1.21, LLA= 20.97 mm (partially preserved), HLA= 16.57 mm, WR= 11.55 mm; lower valve (Fig. 5.A-B; 3163/OV-III-C 2): H= 154.00 mm, L= 140.00 mm, EE= 1.10, LLA= 27.12 mm, HLA= 14.20 mm, WR= 12.02 mm; lower valve (Fig. 4.F-G; 2061/Sa-II-S 157): H= 120.00 mm, L= 100.00 mm, EE= 1.20, LLA= 21.86 mm (partially preserved), HLA= 5.39 mm, WR= 11.11 mm.

**Description:** Lower valve: thin, concave, subcircular to vertical-oval in outline; long, straight dorsal margin; small and pointed umbo; small attachment area; small ligamental area; shallow resilifer; short, branching, vermiculate chomata; growth squamae nonappressed; concentric, irregular, gentle puckers; broad, moderately deep radial posterior sulcus (more or less evident); layered shell structure with alternating foliated and vesicular layers. Upper valve: thin, flat, subcircular in outline; nonappressed growth squamae.

## **5. Provenance of *P. oligopiana* in ROVERETO's collection**

According to ROVERETO's papers (1897, 1898, 1900, 1914) and labels, the specimens are from Mioglia (Mioglia cemetery), Sassello (Rio Zunini), Tagliolo (Rio Chiappino), Casaleggio Boiro, Case Morena, and Bandita (Savona and Alessandria Province, NW Italy, TPB). Stratigraphic information on the most probable collecting sites, obtained from surveys performed by the present authors, is recorded below.

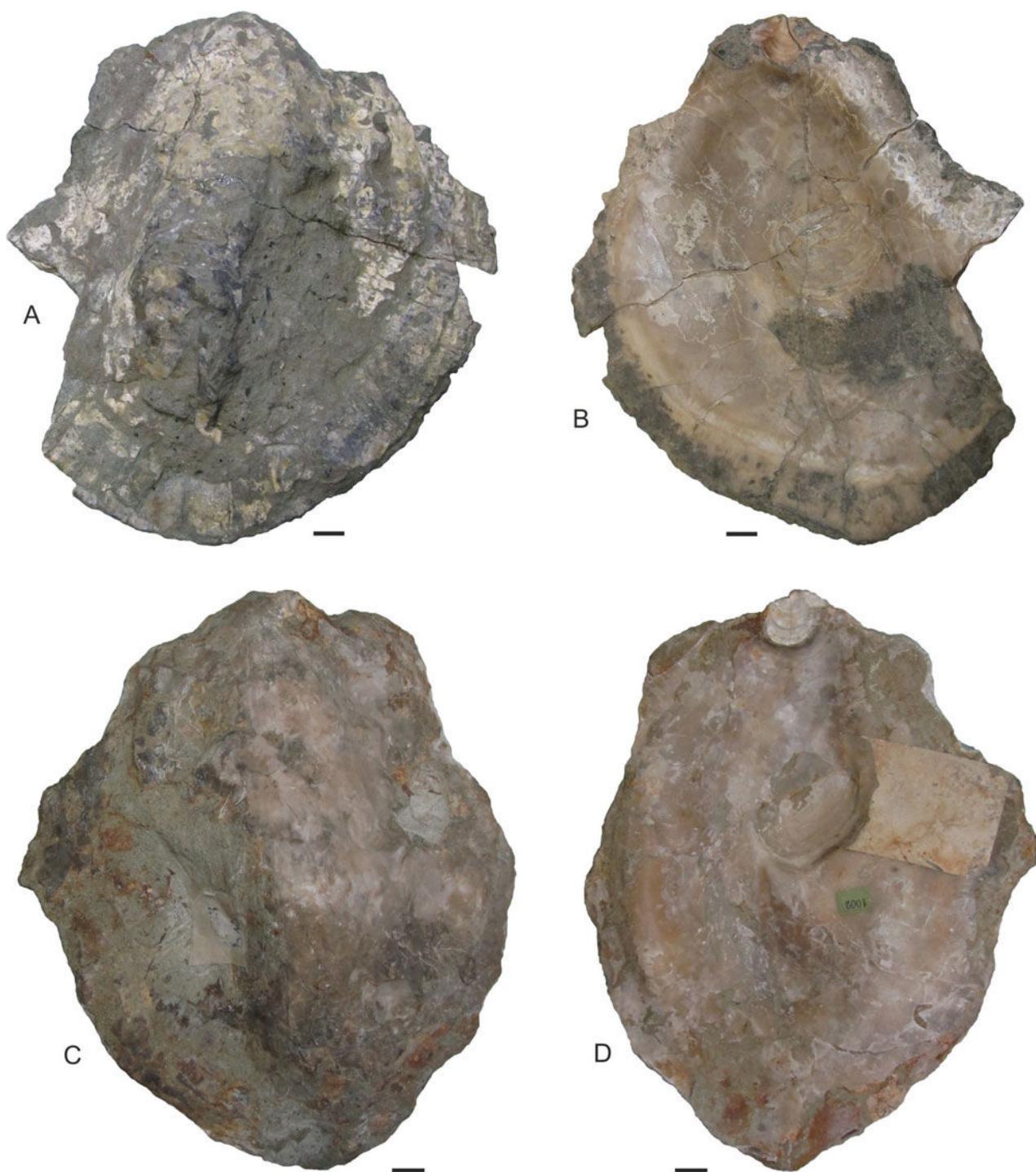
**Mioglia** - The fossiliferous locality at the cemetery at Mioglia (Lat. 44.490605, Long. 8.416042, 364 m a.s.l.) was recently described in brief by BONCI *et al.* (2017) as a 17 m-thick stratigraphic section composed of thinly bedded, burrowed, very fine sandstones and claystones followed by irregularly bedded, matrix-supported, very poorly to poorly sorted conglomerates alternating with grain-supported, very coarse to fine sandstones overlain by burrowed, richly fossiliferous, poorly sorted sandstones. Mollusc shells and moulds, solitary corals, worm tubes and foraminifers (including *Amphistegina* sp., *Neorotalia* sp., *Nummulites fichteli* MICHELOTTI, 1841 and *Operculina complanata* [DEFRENCE, 1822]) largely occur at the top of the section. According to BONCI *et al.* (2017), the section is early-middle Rupeilian in age and part of the Molare Formation (Oligocene, TPB).



**Figure 4:** *Pycnodonte oligoplana* (SACCO, 1897). Scale bar = 1 cm. **A-D:** lectotype of *P. isseli* (ROVERETO, 1897), 2848/M-III-M 87. **A-B:** lower valve. **C-D:** upper valve. **E, H:** lectotype of *P. elongata* (ROVERETO, 1897), 1904/M-III-M 18, lower valve. **F-G:** paralectotype of *P. elongata* (ROVERETO, 1897), 2061/Sa-II-S 157, upper valve.

**Sassello** - Rio Zunini (Lat. 44.498518, Long. 8.497626, 370 m a.s.l.), also known as Ponte Prina, is an historic fossiliferous site, previously described by LORENZ (1969), FRAVEGA *et al.* (1987), QUARANTA *et al.* (2009a, 2009b), and BONCI *et al.* (2018). The stratigraphic section (total thickness of about 13 m) unconformably overlies the serpentinites of the Voltri Unit and is composed of coarse conglomerates with intercalated sandy lenses and coral buildups, followed by coarse sandstones and fine conglomerates with scat-

red coral colonies, grading up to alternating thin- to medium-bedded calcarenites/hybrid arenites and coral/coralline algal limestones. Corals, moluscan shells and moulds, bryozoans, larger foraminifers (including *Nummulites fichteli* and *Eulepidina*), and coralline algae are unevenly distributed throughout the section. According to the authors referred to above, this section is late Rupeilian - early Chattian in age and is part of the Molare Formation (Oligocene, TPB).



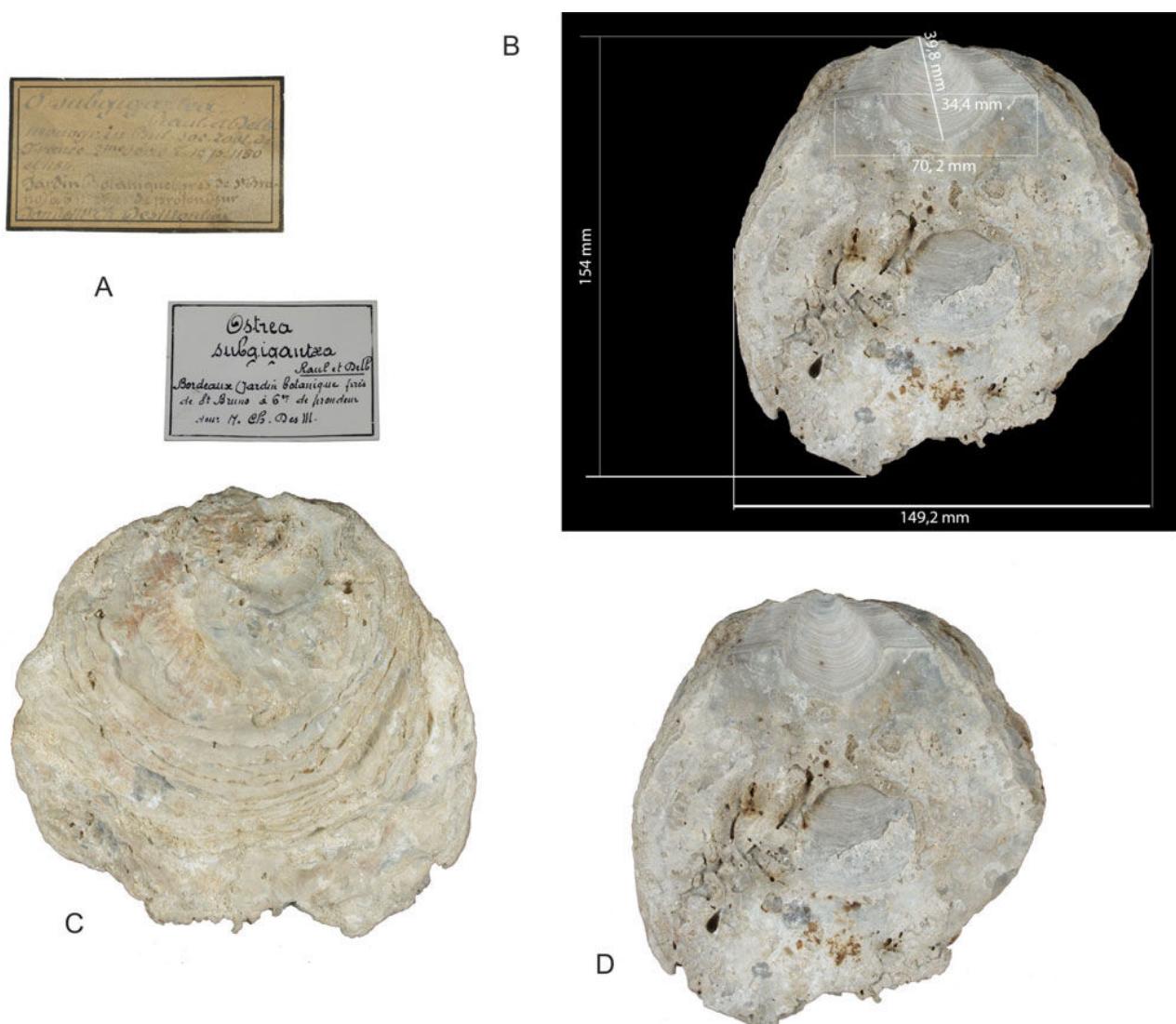
**Figure 5:** *Pycnodonte oligoplana* (SACCO, 1897). Scale bar = 1 cm. **A-B:** paralectotype of *P. isseli* (ROVERETO, 1897), 3163/OV-III-C 2, lower valve. **C-D:** paralectotype of *P. isseli* (ROVERETO, 1897), 2846/M-III-M 85, lower valve.

**Tagliolo, Casaleggio Boiro, Case Morera, Bandita** - These sites are no longer accessible because they are completely covered by vegetation or built over. Outcrops exposed nearby exhibit lithological features exactly matching those of the Molare Formation (Oligocene, TPB).

## 6. Conclusions

The revision of *Ostrea (Gigantostrea) gigantica* SOLANDER var. *oligoplana* SACCO, 1897, *Ostrea (Ostrea) isseli* n. denom. ROVERETO, 1897, and

*Ostrea (Ostrea) isseli* n. denom. var. *elongata* ROVERETO, 1897, derived from Oligocene rocks of the Molare Formation (TPB, southern Piedmont – central Liguria, NW Italy) leads to the conclusion that SACCO's species belongs to the genus *Pycnodonte* (i.e., *Pycnodonte oligoplana*) and that ROVERETO's taxa are junior synonyms of SACCO's species. *Pycnodonte oligoplana* is restricted to the Oligocene and exhibits a relatively large geographic distribution, occurring in NW Italy, Cyrenaica and Algeria.



**Figure 6:** *Ostrea subgigantea* RAULIN & DELBOS, 1855. Syntype, Muséum d'Histoire naturelle de Bordeaux, MHNBx 2007.9451. **A:** original labels. **B:** internal view with measures.

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### Bibliographic references

ABAD GARCÍA A. (2002).- Paleotaxodonta y pteriomorphia del eoceno del margen sur de la depresión central catalana.- Tesi doctoral, Universitat Autònoma de Barcelona, Departament

- de Geología, <http://ddd.uab.cat/record/37045>, <http://hdl.handle.net/10803/3432>.
- AIMASSI G. (2007).- Bivalvia Famiglia Ostreidae - 107. In: MERLINO B. (ed.), Catalogo dei tipi e degli esemplari figurati della collezione BELLARDI e SACCO Parte III.- Museo Regionale di Scienze Naturali di Torino, p. 21-29.
- BONCI M.C., DABOVE G.M. & PIAZZA M. (2018).- The Oligocene mollusc types of Gaetano ROVERETO from Santa Giustina and Sassello (NW Italy).- *Carnets Geol.*, Madrid, vol. 18, no. 12, p. 281-303.
- BONCI M.C., DAGNINO D., MAZZINI A. & PIAZZA M. (2014).- The mollusk type material of Gaetano ROVERETO in the "BTP Collection" (Museo di Paleontologia - DISTAV - Università di Genova): History of the collection and the Oligocene bivalve types from Pareto area.- *Bollettino della Società Paleontologica Italiana*, Modena, vol. 53, no. 3, p. 163-177.
- BONCI M.C., DAGNINO D., MAZZINI A. & PIAZZA M. (2017).- The mollusk type-material of Gaeta-



- no ROVERETO in the "BTP Collection" (Museo di Paleontologia - DISTAV - Università di Genova): The Oligocene types from Mioglia area.- *Bollettino della Società Paleontologica Italiana*, Modena, vol. 56, no. 3, p. 341-357.
- BONCI M.C., VANNUCCI G., TACCHINO S. & PIAZZA M. (2011).- Oligocene fossil leaves of the PERRANDO Collection: History, preservation, and paleoclimatic meaning.- *Bollettino della Società Paleontologica Italiana*, Modena, vol. 50, no. 3, p. 145-164.
- BOSCHELE S., GATTO R., BERNARDI M., BOSELLINI F.R. & AVANZINI M. (2016).- Fossili cenozoici della Valsugana. Catalogo della "Collezione BOSCHELE", parte II.- *Studi Trentini di Scienze Naturali*, vol. 95, p. 53-102.
- BOUCHET P., ROCROI J.P., BIELER R., CARTER J.G., & COAN E.V. (2010).- Nomenclator of bivalve families with a classification of bivalve families.- *Malacologia*, Chicago, vol. 52, no. 2, p. 1-184.
- BRANDER G. (1776).- *Fossilia Hantoniensia collecta, et in Musæo Britannico deposita*.- London, VI + 43 p.
- BRONN H.G. (1831).- Übersicht der Fossilien Überreste in den tertiären subappenninischen Gebirgen. Italiens Tertiär-Gebilde und deren organische Einschlüsse.- Heidelberg, XII + 176 p.
- BRONN H.G. (1853-1856).- *Lethaea Geognostica* 3.- Stuttgart, 1130 p.
- CAPONI G. & CRISPINI L. con la collaborazione di BONCI M.C., CABELLA R., CAVALLO C., CORTESOGNO L., FABBRI B., FEDERICO L., FIRPO M., GAGGERO L., NOSENGO S., OTTONELLO G., PIAZZA M., PERILLI N., PICCAZZO M., RAMELLA A., SPAGNOLO C., VANNUCCI G. & VETUSCHI ZUCCOLINI M. (2008).- *Note illustrative della Carta Geologica d'Italia alla scala 1:50.000 - Foglio "Genova" n.213-230*.- Apat-Regione Liguria, S.EL.CA., Firenze, 139 p.
- CAPONI G., CRISPINI L. & FEDERICO L. con contributi di CABELLA R., FACCINI F., FERRARIS F., FIRPO M., ROCCATI A., MARESCOTTI P., PIAZZA M., SCAMBELLURI M. e collaborazione di DABOVE G.M., POGGI E., TORCHIO S., VIGO A., VETUSCHI ZUCCOLINI M. (2013).- *Note illustrative al Foglio 212 "Spigno Monferrato" della Carta Geologica Regionale della Liguria*. Regione Liguria, <http://www.cartografia.regione.liguria.it/>
- DEFRANCE J.L.M (1822).- *Dictionnaire des sciences naturelles, minéralogie et géologie*, vol. 25.- Levraut, Paris, p. 453.
- DELBOS J. & KOECHLIN-SCHLUMBERGER J. (1867).- Description géologique et minéralogique du département du Haut-Rhin. Tome second.- Émile Perrin, Mulhouse, 547 p.
- DESHAYES G.-P. (1864).- Descriptions des animaux sans vertèbres découverts dans le Bassin de Paris pour servir de supplément à la description des coquilles fossiles des environs de Paris comprenant une revue générale de toutes les espèces actuellement connues. Tome deuxième. Mollusques Acéphalés Monomyaires et Brachipodes Mollusques céphalés. Première Partie.- J.-B. Baillière et fils, Paris, 968 p.
- FALLOT E. (1894).- Contribution à l'étude de l'éta-ge tongrien dans le département de la Gironde.- *Mémoires de la Société des Sciences Phy-siques et Naturelles de Bordeaux* (1895), p. 269-314.
- FEDERICO L., CRISPINI L., DABOVE G.M., PIAZZA M. & CAPONI G. (2016).- Stratigraphic vs structural contacts in a late orogenic basin: The case of the Tertiary Piedmont Basin in the Sassello area (Ligurian Alps, Italy).- *Journal of Maps*, London, vol. 12, no. 5, p. 959-967.
- FISCHER von WALDHEIM G. (1835).- Lettre à M. le Baron de FÉRUSSAC sur quelques genres de co- quilles du Muséum DEMIDOFF et en particulier sur quelques fossiles de la Crimée.- *Bulletin de la Société Impériale des Naturalistes de Moscou*, vol. 8, p. 99-123.
- Fossilworks (last visited 2021/01/06). Gateway to the Paleobiology Database. Available from <http://fossilworks.org>
- FRAVEGA P., GIAMMARINO S., PIAZZA M., RUSSO A. & VANNUCCI G. (1987).- Significato degli episodi coralgali a Nord di Sassello. Nuovi dati per una ricostruzione paleogeografico evolutiva del margine meridionale del Bacino Terziario del Piemonte.- *Atti della Società Toscana di Scienze Naturali, Memorie* (ser. A), Pisa, vol. 94, p. 19-76.
- GELATI R., & GNACCOLINI M. (1988).- Sequenze de- posizionali in un bacino episuturale, nella zona di raccordo tra Alpi ed Appennino Settentrionale.- *Atti Ticinensi di Scienze della Terra*, Pa- via, vol. 31, p. 340-350.
- GELATI R., GNACCOLINI M., POLINO R., MOSCA P., PIA- NA F., MORELLI M. & FIORASO G. con contributi di BAILESTRO G., TALLONE S., RAMASCO M., FONTAN D., SORZANA P., CAMPUS S. & OSSELLA L. (2010).- Note Illustrative della Carta Geologi- ca d'Italia alla scala 1:50.000, foglio 211 "De- go".- Progetto CARG, Ispra - Arpa Piemonte, Torino, 124 p.
- GHIBAUDO G., MASSARI F. & CHIAMBRETTI I. (2014).- Oligo-Miocene tectono-sedimentary evolution of the Langhe sub-basin: From continental to basinal setting (Tertiary Piedmont Basin – Northwestern Italy).- *Journal of Mediterranean Earth Sciences*, Roma, vol. 6, p. 53-144.
- HARRY H.W. (1985).- Synopsis of the supraspecific classification of living oysters (Bivalvia: Gryphaeidae and Ostreidae).- *The Veliger*, Berke- ley - CA, vol. 28, no. 2, p. 121-158.
- LAMARCK J.B. de (1819).- *Histoire Naturelle des Animaux sans Vertèbres*. Tome sixième, I<sup>re</sup> partie.- A. Belin, Paris, 343 p.
- LORENZ C.R. (1967).- Contribution à l'étude strati- graphique de l'Oligocène et du Miocène infé- rieur des confins liguro-piémontais. Livre se- cond et atlas, étude paléontologique.- Thèse de Doctorat d'État es Sciences naturelles, Fa- culté des Sciences de Paris, 217 p.
- LORENZ C.R. (1969).- Contribution à l'étude strati- graphique de l'Oligocène et du Miocène infé- rieur des confins liguro-piémontais (Italie).-



- Atti dell'Istituto di Geologia dell'Università di Genova*, vol. 6, p. 253-888.
- MICHELOTTI G. (1841).- Saggio storico dei Rizopodi caratteristici dei terreni supracretacei.- *Memoire de Fisica de la Societa Italiana delle Scienze*, Verona, vol. 22, p. 1-296.
- MICHELOTTI G. (1861).- Études sur le miocène inférieur de l'Italie septentrionale.- *Les Héritiers Loosjes*, Harlem, 184 p.
- PARETO L. (1855).- Note sur le terrain nummulitique du pied des Apennins.- *Bulletin de la Société géologique de France*, Paris, vol. 2, no. 12, p. 370-395, 1125-1127.
- QUARANTA F., PIAZZA M. & VANNUCCI G. (2009a).- Climatic and tectonic control on the distribution of the Oligocene reefs on the Tertiary Piedmont Basin.- *Italian Journal of Geosciences*, Roma, vol. 128, no. 2, p. 587-591.
- QUARANTA F., VANNUCCI G., BASSO D. & PIAZZA M. (2009b).- Post-symposium field trip guide of IFAA 6<sup>th</sup> Regional Symposium, 1-5 July 2009, Milan.- *Museologia Scientifica e naturalistica* (online), Ferrara, vol. spec. 2009, p. 15-25, <http://annali.unife.it/museologia/article/view/522/466>
- RAULIN V. & DELBOS J. (1855).- Extrait d'une monographie des *Ostrea* des terrains Tertiaires de l'Aquitaine.- *Bulletin de la Société géologique de France*, Paris, vol. 2, no. 12, p. 1144-1164.
- ROVERETO G. (1897).- Note preventive sui Pelecipodi del Tongriano Ligure - I.- *Atti della Società Ligustica di Scienze Naturali e Geografiche*, Genova, vol. VIII, p. 309-322 [published in July 1897].
- ROVERETO G. (1898).- Note preventive sui Pelecipodi del Tongriano Ligure - II e III.- *Atti della Società Ligustica di Scienze Naturali e Geografiche*, Genova, vol. IX, p. 153-187, 321-326.
- ROVERETO G. (1900).- Illustrazione dei molluschi fossili tongriani posseduti dal Museo Geologico della R. Università di Genova.- *Atti della R. Università di Genova*, Genova, vol. 15, p. 29-210.
- ROVERETO G. (1914).- Nuovi studi sulla stratigrafia e sulla fauna dell'Oligocene Ligure.- Oliveri E. & C. Soc. Tip.-Lit. Ligure, Genova, 179 p.
- SACCO F. (1897).- I molluschi dei Terreni Terziari del Piemonte e della Liguria. Parte XXIII Pelecypoda (Ostreidae, Anomiidae e Dimyidae).- C. Clausen, Torino, 67 p. [published in June 1897].
- SACCO F. (1904).- I molluschi dei Terreni Terziari del Piemonte e della Liguria. Parte XXX. Aggiunte e correzioni e considerazioni generali.- C. Clausen, Torino, XXXVI + 203 p.
- SISMONDA E. (1855).- Note sur le terrain nummulitique supérieur de Dego, des Carcare etc. de l'Apennin ligurien.- *Memorie della Reale Accademia delle Scienze di Torino*, vol. 16, p. 443-455.
- STEFANINI G. (1921).- Fossili terziari della Cirenica.- *Paleontographia Italica, Memorie di Paleontologia*, Pisa, vol. 27, p. 101-146.
- STENZEL H.B. (1971).- Oysters. In: MOORE R.C. (ed.), *Treatise on Invertebrate Paleontology*, Pt. N, Mollusca 6, volume 3.- The Geological Society of America, Boulder - CO, and The University of Kansas, Lawrence - KS, p. N1-N1224.
- WoRMS Editorial Board (2018).- World Register of Marine Species. Available from <http://www.marinespecies.org> at VLIZ.