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TERZIARI DI BOLCA

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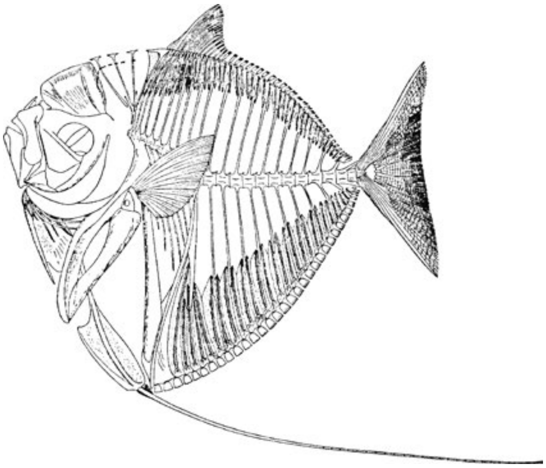

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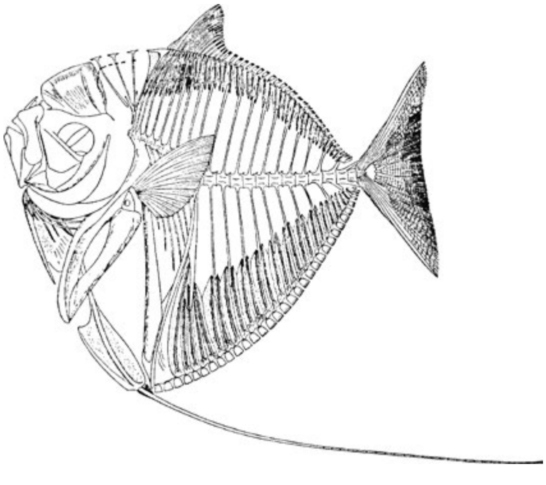

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An unexpected Cenozoic record of palinurid lobsters (Achelata) from the lower Eocene of “Pesciara” (Bolca, Verona) and Monte Postale (Altissimo, Vicenza), northeastern Italy

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ABSTRACT

An in-depth study of the spiny lobsters (Palinuridae LATREILLE, 1802) from the lower Eocene (upper Ypresian) of “Pesciara” of Bolca (Verona) and Monte Postale (Altissimo, Vicenza) in Veneto (NE Italy) allowed a reappraisal of their systematic assignment. Indeed, the careful review of the type series of *Justitia desmaresti* (SECRÉTAN, 1975) plus some additional unreported specimens allowed to identify two genera within the Palinuridae, *Eolinurus* n. gen. with *E. desmaresti* (SECRÉTAN, 1975) n. comb. and *Justitia* HOLTHUIS, 1946 with *J. confusa* n. sp. A third genus, *Lessinoachela* n. gen. with *L. scaligera* n. gen., n. sp., for its peculiar morphological characters, is not assigned to any family within the Achelata. Moreover, one incomplete specimen compared with *Justitia* and one “puerulus” larval stage are reported, allowing a new look at the spiny lobster assemblage from the Monte Postale environment.
Finally, the “Pesciara” record represents the unique evidence from the Eocene of Europe due to the presence of three spiny lobster genera within the same palaeoenvironment, partially sharing morphological characters with the representatives of the Palinuridae.
Key words: Crustacea, Decapoda, Palinuridae, lower Eocene, “Pesciara”, Monte Postale, Veneto, NE Italy.

RIASSUNTO

La revisione dei palinuridi (Palinuridae LATREILLE, 1802) dell’Eocene inferiore (Ypresiano superiore) della “Pesciara” di Bolca (Verona) e del Monte Postale (Altissimo, Vicenza) in Veneto (Italia nordorientale) ha permesso una rivalutazione della loro posizione sistematica. L’attento riesame del materiale tipo e di alcuni esemplari inediti attribuiti a *Justitia desmaresti* (SECRÉTAN, 1975) ha consentito infatti di riconoscere due generi assegnati alla famiglia Palinuridae: *Eolinurus* n. gen. con *E. desmaresti* (SECRÉTAN, 1975) n. comb. e *Justitia* HOLTHUIS, 1946 con *J. confusa* n. sp. Un terzo genere, *Lessinoachela* n. gen. con *L. scaligera* n. gen., n. sp., per alcuni caratteri peculiari, non è assegnato a nessuna famiglia nell’ambito degli Achelata. Un esemplare incompleto confrontato con *Justitia* e un “puerulus” (stadio giovanile) vengono inoltre segnalati per la prima volta, ampliando le nostre conoscenze sulla composizione e varietà di palinuridi presenti nel deposito eocenico del Monte Postale.
In conclusione, il sito della “Pesciara” rappresenta l’unica testimonianza dell’Eocene europeo avente tre generi nello stesso paleoambiente che condividono in parte caratteri morfologici con i rappresentanti della famiglia Palinuridae.
Parole chiave: Crustacea, Decapoda, Palinuridae, Eocene inferiore, “Pesciara”, Monte Postale, Veneto, Italia settentrionale.

INTRODUCTION

The spiny lobsters from the lower Eocene Konservat-Lagerstätte of “Pesciara” of Bolca (Verona; Fig. 1) are known at least starting from the second decade of Eighteenth century (DESMAREST, 1817). However, the first detailed study was carried out by SECRÉTAN (1975) who described the spiny lobsters under the name “*Palinurus desmaresti* DE ZIGNO, 1915”, though she suggested the potential presence of two different taxa in the assemblage. BESCHIN *et al.* (2001, p. 93) concurred with this hypothesis, pointing out the potential presence of *Justitia* among these specimens. In the same year, GARASSINO AND NOVATI

(2001) revised and re-described *Palinurus desmaresti*, proposing to transfer it to the extant *Justitia* Holthuis, 1946 and attempting to solve the problem of the authorship of the species, subsequently disentangled by Giusberti *et al.* (2015) who assigned it to Secrétan (1975). Finally, Pasini *et al.* (2019, p. 247) confirmed *Justitia desmaresti* (Secrétan, 1975) as a valid species within the genus. However, the extensive re-examination of all the available Bolca's specimens of spiny lobsters undertaken during the preparation of the work by Pasini *et al.* (2019) led us to reappraise their systematic assignment within the Palinuridae. Indeed, the main purpose of this paper is a critical review of the diagnostic characters of the lectotype, paralectotypes, and additional specimens of Secrétan's taxon in order to verify their right assignment to *J. desmaresti*.

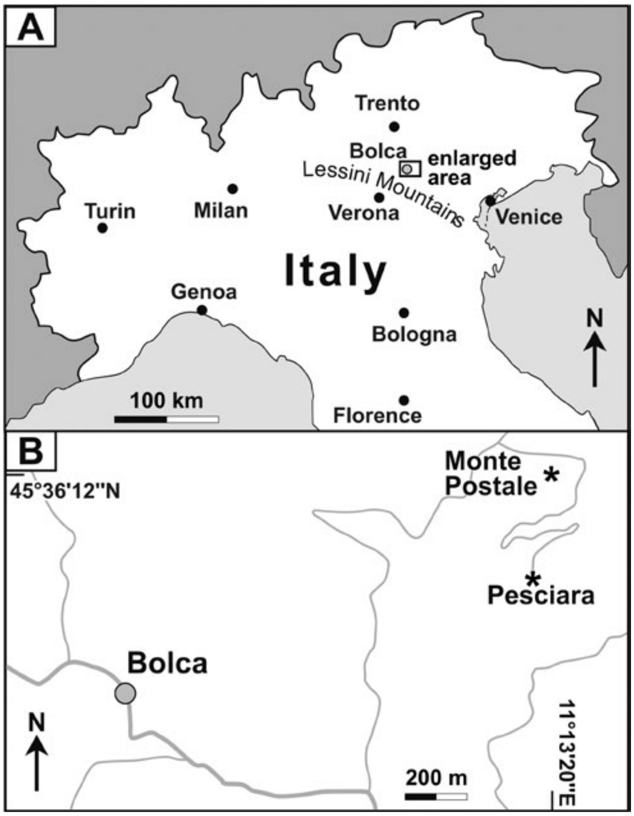

Fig. 1 – (**A**) and (**B**) Map of the fossiliferous localities of "Pesciara" and Monte Postale in the surroundings of the village of Bolca (Verona, northeastern Italy). From Pasini *et al.* (2019)

Geology and palaeoenvironment of "Pesciara" and Monte Postale

The fossiliferous site of "Pesciara" of Bolca (eastern Monti Lessini, Verona province; Fig. 1B), also known as "Monte Bolca", is a large calcareous olistolith surrounded by volcanic and volcanoclastic deposits and extending a few hundred m^2. Its stratigraphic thickness is around 19 m and it is made up of alternating fossiliferous laminites and coarse-grained biocalcarenites and biocalcirudites with molluscs and larger foraminifera (e.g., Papazzoni and Trevisani, 2006). The site is known since about five centuries and it is worldwide renowned for outstanding abundance, diversity, and exquisite preservation of its fossils, especially fishes, coming from the laminites (Papazzoni and Trevisani, 2006; Friedman and Carnevale, 2018; Marramà *et al.*, 2016, 2021). Based on its alveolinid and calcareous nannofossil content, "Pesciara" was referred to zone SBZ 11 of Serra-Kiel *et al.* (1998) and zone CNE 6 of Agnini *et al.* (2014), corresponding to a latest Ypresian age, between 48.96 and 48.5 Myr. (Papazzoni and Trevisani, 2006; Papazzoni *et al.*, 2017; Marramà *et al.*, 2021). The stratigraphic succession of the nearby Monte Postale (Vicenza province; Fig. 1B), located a few hundred meters north of "Pesciara", represents the most complete Eocene succession in the area as it consists of 130 m of limestones recording complex lateral facies changes from fine-grained limestones (laminites included) to massive coralgal bioconstructed limestones forming a discontinuous coral belt along the north side of Monte Postale (Vescogni *et al.*, 2016; Papazzoni *et al.*, 2017). At least three intervals of fossiliferous laminites with fishes, plants, and invertebrates were recognized (Papazzoni *et al.*, 2017) at Monte Postale, whose succession spans the entire CNE 5 calcareous nannofossil zone and a large part of the SBZ 11 larger foraminiferal zone (latest Ypresian, between 50.5 and 48.96 Myr.; Papazzoni *et al.*, 2017).

According to recent studies, laminites of Monte Postale were originated in a "lagoon" with at least periodic anoxic conditions at the bottom and surrounded by coralgal buildups with peri-reefal areas densely vegetated by seagrass beds and mangroves, a palaeoenvironment different from that of "Pesciara", representing a low-energy intraplatform basin with permanent bottom dysoxia or anoxia in a peri-reefal system that was strongly influenced both by coastal and pelagic environments (Marramà *et al.*, 2016, 2021; Vescogni *et al.*, 2016). Based on chondrichthyan assemblages, Marramà *et al.* (2021) recently inferred that the palaeobiotopes of both sites were likely characterized by depths reaching

40-50 m, supporting previous assumptions of a shallow-water inner shelf scenario.

Crustaceans are a significant component of the so-called "minor fauna" (arthropods, jellyfishes, annelids, and molluscs) of laminites of both "Pesciara" and Monte Postale sites (see Giusberti *et al.*, 2015; Pasini *et al.*, 2019).

A unique Cenozoic record of spiny lobsters

Based upon Schweitzer *et al.* (2015), just three genera of the Palinuridae are known to date in the fossil record from the Cenozoic of Europe, as follows: *Archaeocarabus* M'Coy, 1849 (fossil) from the Lutetian of UK; *Justitia* Holthuis, 1946 (fossil-extant) from the Lutetian of Italy; *Linuparus* White, 1847 (fossil-extant) from the Ypresian of UK, Priabonian/Rupelian of Germany, and Miocene of Japan. The fossil species of these genera were recorded as single representatives of the family in different European palaeoenvironments, fitting perfectly the main diagnostic characters of the belonging genus.

We point out that the "Pesciara" record represents the unique evidence from the Eocene of Europe including three spiny lobster genera within the same palaeoenvironment having peculiar morphological characters only partially shared with the representatives of the Palinuridae (see Systematic description).

problems related to the systematics of spiny lobsters from "Pesciara" and Monte Postale

Although Novati and Garassino (2001) and Giusberti *et al.* (2015) provided a short description of *Justitia desmaresti*, their attention was mainly focused on the nomenclatural aspects of this species, overlooking an in-depth review of the main morphological characters useful for the right systematic assignment of this species.

Indeed, the current careful review of the specimens listed by Pasini *et al.* (2019, p. 247) has raised some doubts about their assignment to *Justitia* (see Systematic description). Based upon Holthuis (1991), the main problem that we met revising the spiny lobsters from "Pesciara" and Monte Postale was the inability to clearly distinguish some diagnostic characters, especially those of the frontal region, such as the supraorbital spines and the rostrum that are badly or insufficiently preserved, strongly crushed, dorso-ventrally compressed, and usually fragmentary. As already pointed out by Secrétan (1975, p. 339), the anterior cephalic region results deformed and/or compressed in almost all specimens by the thickness of the two paired rounded, globular, and hard calcified mandibular process that makes difficult to establish the right shape of the supraorbital spines and rostrum. Based upon the lateral position of eyes and cephalic appendages, very close to the eyes, we could suppose that the supraorbital spines were very short. However, our revision of the spiny lobsters of "Pesciara" and Monte Postale has pointed out that the presence of the supraorbital spines is still unclear (Fig. 2). Indeed, based upon the fossil record of some genera, such as *Archaeocarabus*, *Linuparus*, and *Palinurus*, in which the supraorbital spines are always clearly evident and strongly calcified, the direct observation of the studied specimens by natural and UV light did not highlight clearly strong calcified supraorbital spines in the frontal region. Moreover, we could suppose that the supraorbital spines were absent based upon the preservation of some soft and delicate anatomical parts, such as the eyes, muscles, and pleopods, usually very hard to preserve.

In conclusion, we prefer for the principle of parsimony to assign two genera herein described within the Palinuridae having some morphological characters, typical of the family (see discussion of *Eolinurus* n. gen. and *Justitia*), whereas the third described genus was not assigned to any family within the Achelata Scholtz and Richter, 1995 due to its very peculiar morphological characters (see discussion of *Lessinoachela* n. gen.).

Finally, based upon Holthuis (1991), Karasawa *et al.* (2013), and Schweitzer *et al.* (2015), we have focused our attention on some characters preserved in the studied specimens not checked previously, such as the original epicuticle of carapace and pleonal somites, combined, when preserved, with the ornamentation of telson, useful for the comparison with the genera of the Achelata.

Material and nomenclatural notes

Pasini *et al.* (2019, p. 247) listed 28 specimens as belonging to *Justitia desmaresti* (lectotype, paralectotypes, and additional specimens). A careful check of Bolca's collections in Verona and Padova museums allowed us to identify two specimens previously unreported by Pasini *et al.* (2019): MCSNV 05 figured by Secrétan (1975: pl. 15, fig. 3) and MGP-PD 7445-7446 (part and counterpart), both supposed to be

Fig. 2 – Frontal region of *Eolinurus* n. gen. in dorsal view (**A**) and complete body in lateral view (**B**), and *Lessinoachela* n. gen. (**C**), showing some anatomical parts such as the distal spines of a2 segments and the pereiopods well preserved, whereas the supposed strongly calcified supraorbital spines are never evident in the genera from “Pesciara”. Holthuis (1991) and Schweitzer *et al.* (2015) clearly highlighted that all genera of the Palinuridae always have well-developed strong calcified supraorbital spines (see for instance the extant specimen of *Justitia* in lateral view illustrated in Fig. 2**D**) (specimens not in scale)

collected from “Pesciara”. Moreover, the review of literature and material listed by Pasini *et al.* (2019) allowed us to rectify some previous mistakes:

1. Giusberti *et al.* (2015, p. 116), reassessing the nomenclature of *Justitia desmaresti*, designated the lectotype of the species among ten syntypes originally figured by Secrétan (1975): the remaining specimens of the original type series became therefore paralectotypes [see the Article 74.1.3 of ICZN Code (1999)]. Giusberti *et al.* (2015, p. 116) listed only three of the ten paralectotypes figured by Secrétan (1975) stating that they were “*the best specimens in which the main morphological characters are preserved*”. The authors, however, did not make explicit that the type series of *Palinurus desmaresti* was made up of eighteen (at least) specimens, some of them only listed or cited in the text by Secrétan (1975). The type series of the nominal species, therefore, was originally listed by Secrétan (1975, pp. 338-341) as follows: specimens n. 02, 05, 17-17bis, 18-20, 23-23b, 24, 25-25bis, 92, 93-93bis, 94, 95, 96 (“Museo Civico di Storia Naturale di Verona”), specimen 6804 (Museo di Geologia e Paleontologia dell’Università di Padova) and one unnumbered specimen from the Naturhistorisches Museum of Vienna. To complicate matters, Secrétan (1975) originally introduced some mistakes in transcribing the catalogue numbers of the spiny lobsters housed in the Verona’s museum, partly due to confused numbering of part and counterpart of the same specimen (see below). Possibly because of the unintentional omission by Giusberti *et al.* (2015) and mistakes introduced by Secrétan (1975), Pasini *et al.* (2019) erroneously included some paralectotypes of *J. desmaresti* in their “additional material”;
2. the specimen MCSNV 90bis reported among the paralectotypes of *J. desmaresti* listed by Giusberti *et al.* (2015) is instead the counterpart of the lectotype MCSNV 23 designated by Giusberti *et al.* (2015);
3. the specimen MCSNV 89 figured by Secrétan (1975, pl. 13, fig. 2) and mentioned as paralectotype by Giusberti *et al.* (2015) has instead the catalogue number MCSNV Cr 57 and represents the counterpart of the specimen MCSNV 92, listed among the additional specimens by Pasini *et al.* (2019);
4. the specimen MSNM i22867 listed among the additional specimens of *J. desmaresti* by Pasini *et al.* (2019) is the counterpart of the paralectotype MCSNV 94.

The reappraisal of the specimens assigned to *J. desmaresti* by Giusberti *et al.* (2015) and Pasini *et al.* (2019) allow us to identify three genera, as follows: *Eolinurus* n. gen. with *E. desmaresti* (Secrétan, 1975) n. comb. (11 specimens) (Figs. 3A, B) and *Justitia* Holthuis, 1946 with *J. confusa* n. sp. (9 specimens) (Figs. 4A, B) (Palinuridae Latreille, 1802); and *Lessinoachela* n. gen. with *L. scaligera* n. gen., n. sp. (1 specimen) (Figs. 3C, D) (Family indeterminate). Moreover, one incomplete specimen compared with *Justitia* (Figs. 4C, D) and one specimen representing the so-called “puerulus” larval stage (Fig. 17) are herein reported for the first time from Monte Postale (Altissimo, Vicenza).

Finally, the following specimens, MSNVE 4927, MCSNV M05, MCSNV 91-91bis (part and counterpart), MGP-PD 6804, MGP-PD 7443-7444 (part and counterpart), MGP-PD 7447-7450 (part and counterpart), and GBA 2010/275/0053 (former coll. no. 2319) [paralectotype of *Justitia desmaresti* (Secrétan, 1975) not figured by Secrétan (1975)] are removed from the studied sample listed by Pasini *et al.* (2019) due to the impossibility to check the main diagnostic characters of the above-mentioned genera (see Systematic description). Moreover, the specimen MCSNV 21-21bis (part and counterpart), not considered by Pasini *et al.* (2019), is discarded due to its poor preservation.

Abbreviations are as follows:

- *Institutional*:
  CMC – Cerato collection, Bolca (Verona);
  MCSNV, MCSNV Cr, MCSNV B, MCSNV M – Museo di Storia Naturale di Verona;
  MFB, MFB IG – Museo dei Fossili, Bolca (Verona);
  MGP-PD – Museo di Geologia e Paleontologia dell’Università di Padova;
  GBA – Geological Survey of Austria, Vienna (Austria);
  MNHN – Muséum national d’Histoire naturelle, Paris (France);
  MSNM – Museo di Storia Naturale di Milano;
  MSNVE – Museo di Storia Naturale Giancarlo Ligabue, Venezia;
  RP – Museo Diocesano di Scienze Naturali “A. De Nardi”, Vittorio Veneto (Treviso);
- *Anatomical*:
  lcxp – carapace length;
  lpl – pleon length;
  lt – total length of body (excluding antennae)
  P1-P5 – pereiopods 1-5;
  s1-s5 – pleonal somites 1-5;
  wcxp – carapace width.

Fig. 3 – Ornamentation of carapace and pleon. **A**) *Eolinurus desmaresti* (Secrétan, 1975) n. comb., MCSNV 23, lectotype, carapace. **B**) *Eolinurus desmaresti* (Secrétan, 1975) n. comb., CMC6, pleon. **C**) *Lessinoachela scaligera* n. gen., n. sp., MCSNV 95, holotype, carapace. **D**) *Lessinoachela scaligera* n. gen., n. sp., MCSNV 95, holotype, pleon. Scale bar equals 1 cm

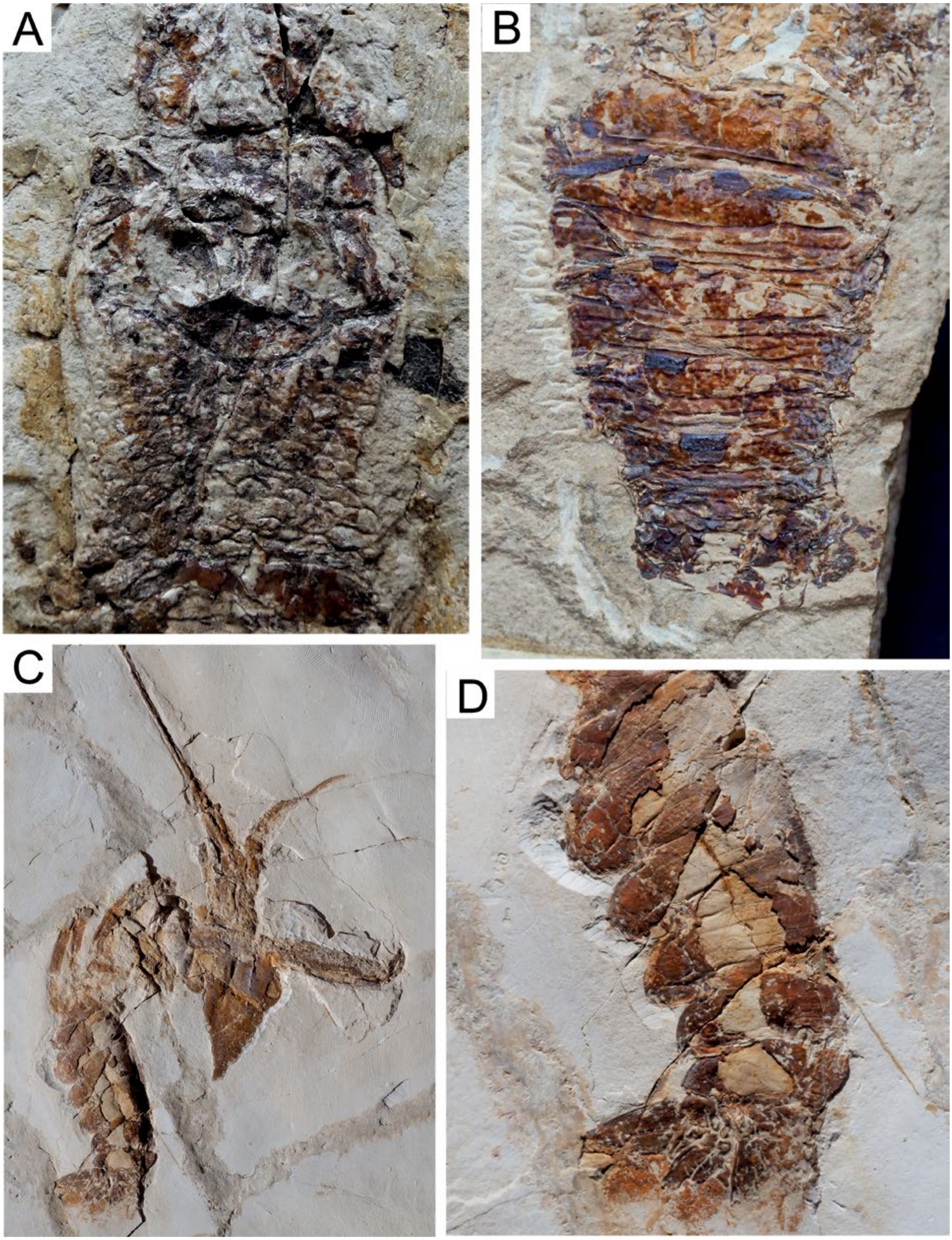

Fig. 4 – Ornamentation of carapace and pleon. **A**) *Justitia confusa* n. sp., MCSNV 17bis, paratype, carapace. **B**) *Justitia confusa* n. sp., MCSNV M02, paratype, pleon. **C**) *Justitia* sp., MFB IG 91130, general view. **D**) *Justitia* sp., MFB IG 91130, pleon. For the scale of the specimens see Figs. 11, 13 and 14

SYSTEMATIC DESCRIPTION

Infraorder Achelata SCHOLTZ AND RICHTER, 1995
Family Palinuridae LATREILLE, 1802
Genus *Eolinurus* nov.

Diagnosis

Subcylindrical carapace uniformly granulated; cervical groove slightly convex medially and located in anterior third; uniformly granulated s1-s5 with subtriangular embossed pleura; s6 with squamiform tergum and subtriangular embossed pleuron; short a1 flagellum, shorter than last segment of a1 peduncle; short, stout, and granulated P1; thin, elongate, and granulated P2-P5; telson with three parallel longitudinal ridges.

Etymology

The name is derived from Eocene, second epoch of the Palaeogene period, and *Palinurus*; hence a *Palinurus*-like spiny lobster from the Eocene; gender masculine.

Type species

Palinurus desmaresti SECRÉTAN, 1975.

Discussion

The approach to the systematics appears sometimes different between fossil and extant genera of spiny lobsters. Indeed, different is the criterion used to select the main diagnostic characters important not only to identify a genus, but also to distinguish it from the other ones. Therefore, there are sometimes some inconstancies among diagnoses provided for fossil and extant genera.

For instance, the diagnoses for the fossil genera of the Achelata SCHOLTZ AND RICHTER, 1995 provided by SCHWEITZER *et al.* (2015) result sometimes ambiguous and restrictive, due to the scarce number of characters preserved in the fossil spiny lobsters, whereas the diagnoses provided by HOLTHUIS (1991) list a wide range of characters not always observable in the fossil spiny lobsters because usually the harder main body structures are only preserved.

HOLTHUIS (1991) reported three families within the Achelata, as follows: Scyllaridae LATREILLE, 1825 (fossil-extant), Palinuridae LATREILLE, 1802 (fossil-extant), and Synaxidae BATE, 1881 (fossil-extant), whereas SCHWEITZER *et al.* (2015) reported three families, as follows: Cancrinidae BEURLEN, 1930 (fossil), Palinuridae, and Scyllaridae.

The general body shape and arrangement of the cephalic appendages clearly rule out the belonging of the studied specimens to the Cancrinidae and Scyllaridae.

The studied specimens from Bolca have a mix of characters shared with some genera within the Palinuridae and Synaxidae.

SCHWEITZER *et al.* (2015) listed 15 fossil-extant genera of the Palinuridae, nine exclusively from the Mesozoic and six reported from the Cenozoic, as follows: *Archaeocarabus* M'COY, 1849 (fossil), *Jasus* PARKER, 1883 (fossil-extant), *Justitia* HOLTHUIS, 1946 (fossil-extant), *Linuparus* WHITE, 1847 (fossil-extant), *Palinurus* WEBER, 1795 (fossil-extant), and *Panulirus* WHITE, 1847 (fossil-extant).

We exclude the belonging of the studied specimens to *Archaeocarabus* in having different carapace shape, grooves, and ornamentation.

As reported in the diagnosis of *Jasus* provided by SCHWEITZER *et al.* (2015), this genus would have subcylindrical carapace with well-marked cervical groove and subrectangular telson. These characters can't be, however, considered peculiar of the genus since they are shared among all representatives of the family. Moreover, two characters, such as the stout P1 and long slender P2-P5, are shared with *Archaeopalinurus*, *Palinurus*, *Palinurina*, *Panulirus*, *Projasus*, and *Puerulus* and so we cannot consider them as peculiar of *Jasus*.

The short a1 flagellum, shorter than last segment of a1 peduncle and the telson with tuberculate median longitudinal ridges are characters of the studied specimens shared with the species of *Jasus*, the sole genus within the Palinuridae to have these peculiar characters. However, the pleon of the studied specimens does not have the squamiform or scalloped sculpturation before transverse striae peculiar and unique of *Jasus*. Moreover, the shape of the cervical groove strongly projected backward to form two distinct elongate branches of the groove distinguish *Jasus* from the studied specimens. Finally, the spiny ornamentation of the carapace in *Jasus* rules out assignment of the studied specimens to this genus.

Justitia, known to date with four extant species and one fossil species (see discussion below) has the carapace with heavy squamiform sculpturing that rules out assignment of the studied specimens to this genus.

Linuparus has the subrectangular carapace with the median longitudinal ridge forming the typical Y shape that exclude the belonging of the studied specimens to this genus.

As reported in the diagnosis of *Palinurus* provided by SCHWEITZER *et al.* (2015), this genus would have subcylindrical carapace with well-marked cervical groove, P1 shorter than P2-P5, long slender P2-P5, and subrectangular telson. However, the subcylindrical carapace with well-marked cervical groove and the subrectangular telson cannot be considered peculiar of the genus since they are shared among all representatives of the family. The P1 shorter than P2-P5 could allow to assign the studied specimens to this genus based on the diagnosis provided by Schweitzer *et al.* (2015, p. 6). This character should be considered as peculiar and unique of this genus, but it is not true. Indeed, based upon Schweitzer *et al.* (2015) and Holthuis (1991) some fossil and extant genera of the family, such as *Archaeopalinurus*, *Jasus*, *Palinurina*, *Panulirus*, *Projasus*, and *Puerulus*, share the same character. The presence of P1 shorter than P2-P5 in some genera of the family raises a doubt about the assertion that "*P1 almost always same length or only slightly longer than other pereiopods*" reported by Schweitzer *et al.* (2015, p. 1) in the diagnosis of the Palinuridae, pointing out a general lacking uniformity in the diagnostic evaluations. Finally, the granulated ornamentation of the carapace, and s6 with squamiform tergum and subtriangular embossed pleuron exclude the belonging of the studied specimens to this genus.

Panulirus has the carapace with spines arranged in parallel ridges or uniformly arranged, s1-s6 terga with grooves, and s1-s6 pleura with one or two hooked spines backward directed that exclude the assignment of the studied specimens to this genus. Moreover, the smooth pereiopods, reported in the diagnosis provided by Schweitzer *et al.* (2015) rules out definitively the belonging of the studied specimens in having P1-P5 strongly granulated.

Besides the above-mentioned genera, Holthuis (1991) listed three other genera within the Palinuridae exclusively extant, as follows: *Palinustus* A. Milne-Edwards, 1880; *Projasus* George and Grindley, 1964; and *Puerulus* Ortmann, 1897.

The carapace with spines arranged in parallel ridges or uniformly arranged, s1-s6 terga with grooves, and s1-s6 pleura with one or two hooked spines backward directed typical of *Palinustus*, *Projasus*, and *Puerulus* exclude the belonging of the studied specimens to these genera.

Based upon Holthuis (1991) and Fraaije *et al.* (2020), three genera belong to the Synaxidae, as follows: *Palibythus* Davie, 1990 (extant); *Palinurellus* von Martens (1878) (fossil-extant), and *Palaeopalinurellus* Fraaije, Van Bakel, Jagt and Brochet, 2020 (fossil).

Based upon Holthuis (1991) the genera of the Synaxidae have the body covered only with granules (including pereiopods), large flat rostrum, and lack of the supraorbital spines.

Two characters, such as s6 with squamiform tergum and subtriangular embossed pleuron and telson with three parallel longitudinal granulated ridges exclude the belonging of the studied specimens to *Palibythus* and *Palinurellus*. Finally, we also exclude the assignment of the studied specimens to the fossil *Palaeopalinurellus* in having the posterior part of the carapace densely covered with scale-like tubercles.

Based upon the above-mentioned observations, we can exclude the belonging of the studied specimens to the Synaxidae. On the contrary, some characters, such as the strong multi-articulated a2 flagellum slightly longer than the body (short in the Synaxidae); the median and distal spiny a2 segments; and the shape of the cervical groove allow us to assign them to the Palinuridae.

In conclusion, we can assert that the combination of some morphological characters, such as the uniformly granulated carapace; s1-s5 uniformly granulated, with subtriangular embossed pleura; s6 with squamiform tergum and subtriangular embossed pleuron; and telson with three parallel longitudinal granulated ridges, does not fit any fossil or extant genus of the Palinuridae, justifying the description of the new genus *Eolinurus* within the family to accommodate the studied specimens.

Included fossil species
Type species only.

Eolinurus desmaresti **(Secrétan, 1975) n. comb.**

Figures 2A-B, 3A-B, 5-9

Selected synonyms

1855 *Palinurus Desmarestii* De Zigno *in litt.* – Massalongo, p. 32 [*nomen nudum*].

*1975 *Palinurus desmaresti* De Zigno. – Secrétan, pp. 339, 340, pl. 12, fig. 1; pl. 13, figs. 2, 3, 5; pl. 15, fig. 1 (non pl. 13, figs. 1, 4; pl. 14, figs. 1–4; pl. 15, figs. 2-4; pl. 16, figs. 3, 4).

1985 *Palinurus* sp. – Pinna, p. 108, fig. 7.

2001 *Justitia desmaresti* (Massalongo, 1854). – Garassino and Novati, p. 259, figs. 3, 4A, 5 (non figs. 1, 2, 6, 7).

2011 *Palinurus desmaresti* (De Zigno, 1915) – Cerato, p. 76 (text figure).

2014 *Justitia desmaresti* (Massalongo, 1854). – Giusberti *et al.*, p. 82, fig. 5.

2014 *Justitia desmaresti* (Massalongo, 1854). – De Angeli and Garassino, p. 11.

2015 *Justitia desmaresti* (Secrétan, 1975). – Giusberti *et al.*, pp. 116, 118, figs. 3 (non fig. 1).

2019 *Justitia desmaresti* (Secrétan, 1975). – Pasini *et al.*, 247, 249, fig. 9A (non figs. 9B–D).

Diagnosis
As for the genus plus median and distal a2 segments with a strong distal outer spine; a2 segments with strongly tuberculate inner margin having three small spines directed forward; P1 propodus with granulated median ridge; telson with squamiform ornamentation on the half proximal part.

Lectotype
MCSNV 23-90bis (part and counterpart, dorsal view) [illustrated by Secrétan (1975: pl. 12, fig. 1 and pl. 13, figs. 3, 5), Giusberti *et al.* (2015: fig. 3) and Pasini *et al.* (2019: fig. 9A)]. Originally designated as lectotype by Giusberti *et al.* (2015).

Paralectotypes
MCSNV 24 (dorsal view) [illustrated by Secrétan (1975: pl. 15, fig. 1)]; MCSNV 25-25bis (part and counterpart, dorsal view); MCSNV 93-93bis (part and counterpart, dorsal view) [illustrated by Secrétan (1975: pl. 14, fig. 1)]; MCSNV Cr 57-92 (part and counterpart, dorsal view) [illustrated by Secrétan (1975: pl. 13, fig. 2)]; MCSNV 94-MSNM i22867 (part and counterpart, ventral view). Herein are reported only the paralectotypes confidently ascribable to *E. desmaresti*.

Additional material
CMC 6 (dorsal view); MCSNV 96 (dorsal view), MGP-PD 7448-7449 (part and counterpart, lateral view); RP-V85 (dorsal view) [unpublished specimen not previously reported by Giusberti *et al.* (2015) and Pasini *et al.* (2019)]; MNHN F A51537 (Conte Gazola collection) (part and counterpart, dorsal view).

Type locality
“Pesciara” of Bolca (Verona).

Geological age
Late Ypresian (early Eocene).

Description
Middle-sized spiny lobster (lt between *c.* 17 cm to over 20 cm).

Carapace. Subcylindrical carapace slightly narrowing frontally; dorsal surface covered with closely spaced small granules uniformly arranged; deep cervical groove gently convex medially and located in anterior third; lateral margins slightly convex; posterior margin slightly concave; supraorbital spines and rostrum not observable.

Pleon. Subrectangular s1-s5 with granulated terga and subtriangular embossed pleura; s1-s5 slightly decreasing in size posteriorly; subtrapezoidal s6 with squamiform tergum and subtriangular embossed pleuron; telson with three granulated longitudinal ridges, one median and two lateral ridges running along its upper half length; telson with squamiform ornamentation on the half proximal part.

Cephalic appendages. Lateral subovoidal short-stalked eyes; short a1 flagellum, shorter than last segment of a1 peduncle; median and distal a2 segments with a strong distal outer spine; a2 segments with strongly tuberculate inner margin having three small spines directed forward; median and distal a2 segments covered with closely spaced small granules uniformly arranged; median and distal a2 segments with a raised, strong median ridge; strong multi-articulated a2 flagellum as long as the body length.

Thoracic appendages. Stout short P1 propodus with raised median ridge; strong hook-shaped P1 dactylus slightly curved distally; P1 elements covered with closely spaced small-medium granules uniformly arranged; thin elongate P2-P5, with closely spaced small granules uniformly arranged.

Pleonal appendages. Petaloid pleopods. Uropodal exopod and endopod proximal half outer margin with an elongate triangular hardened scale, longitudinal radiate fringed striae on the half distal part; longitudinal radiate fringed striae of uropodal exopod covered with parallel rows of small spiny tubercles proximally.

Taphonomy
The careful study of the specimens herein assigned to *Eolinurus desmaresti* n. comb. allows us to identify only one specimen (CMC 6, Fig. 9A) preserved with the original granulated ornamentation of the terga exocuticle, generally eroded or completely lacking in other specimens. Such unfavourable state of preservation exposed an underlying endocuticle that results smooth with transverse parallel striae (RP-V85, MCSNV 25-25bis, Fig. 9B), not reflecting the real granulated ornamentation of the terga typical of *Eolinurus* n. gen. (Fig. 3B). This previously undervalued taphonomic aspect created confusion for establishing the real characters of the terga ornamentation in *Eolinurus* n. gen. (uniformly granulated) and *Justitia* (transverse parallel striae).

In conclusion, this extensive review of the lectotype, paralectotypes, and additional material clearly pointed out that *Palinurus desmaresti* Secrétan (1975) does not fit the diagnostic characters of *Justitia*, allowing herein its reassignment to *Eolinurus desmaresti* (Secrétan, 1975) n. comb.

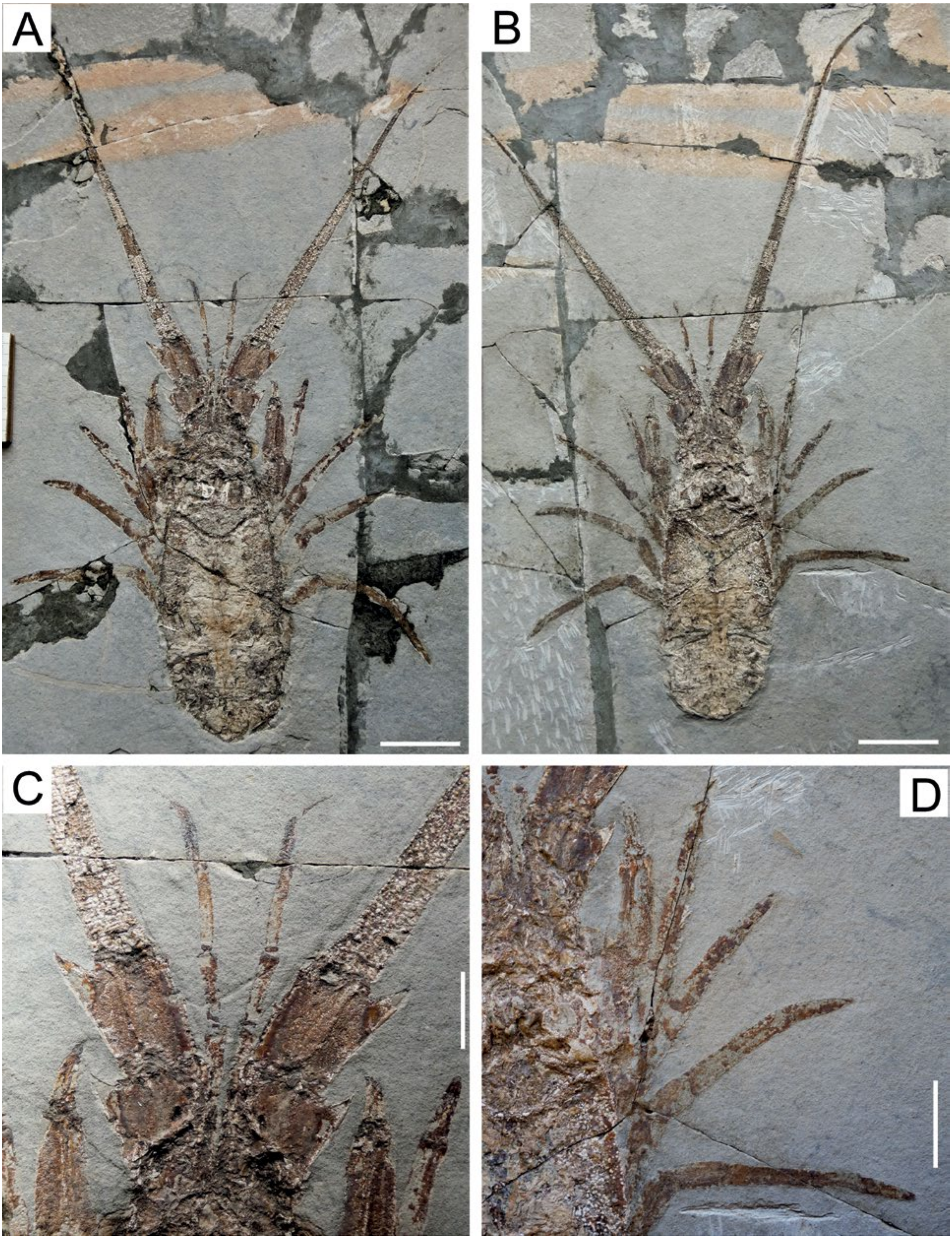

Fig. 5 – *Eolinurus desmaresti* (Secrétan, 1975) n. comb. **A**) MCSNV 23, lectotype, dorsal view (part). **B**) MCSNV 90bis, lectotype, dorsal view (counterpart). **C**) MCSNV 90bis, lectotype, close-up of the cephalic appendages. **D**) MCSNV 90bis, lectotype, close-up of the thoracic appendages. Scale bars of A and B equal 2 cm, scale bars of C and D equal 1 cm

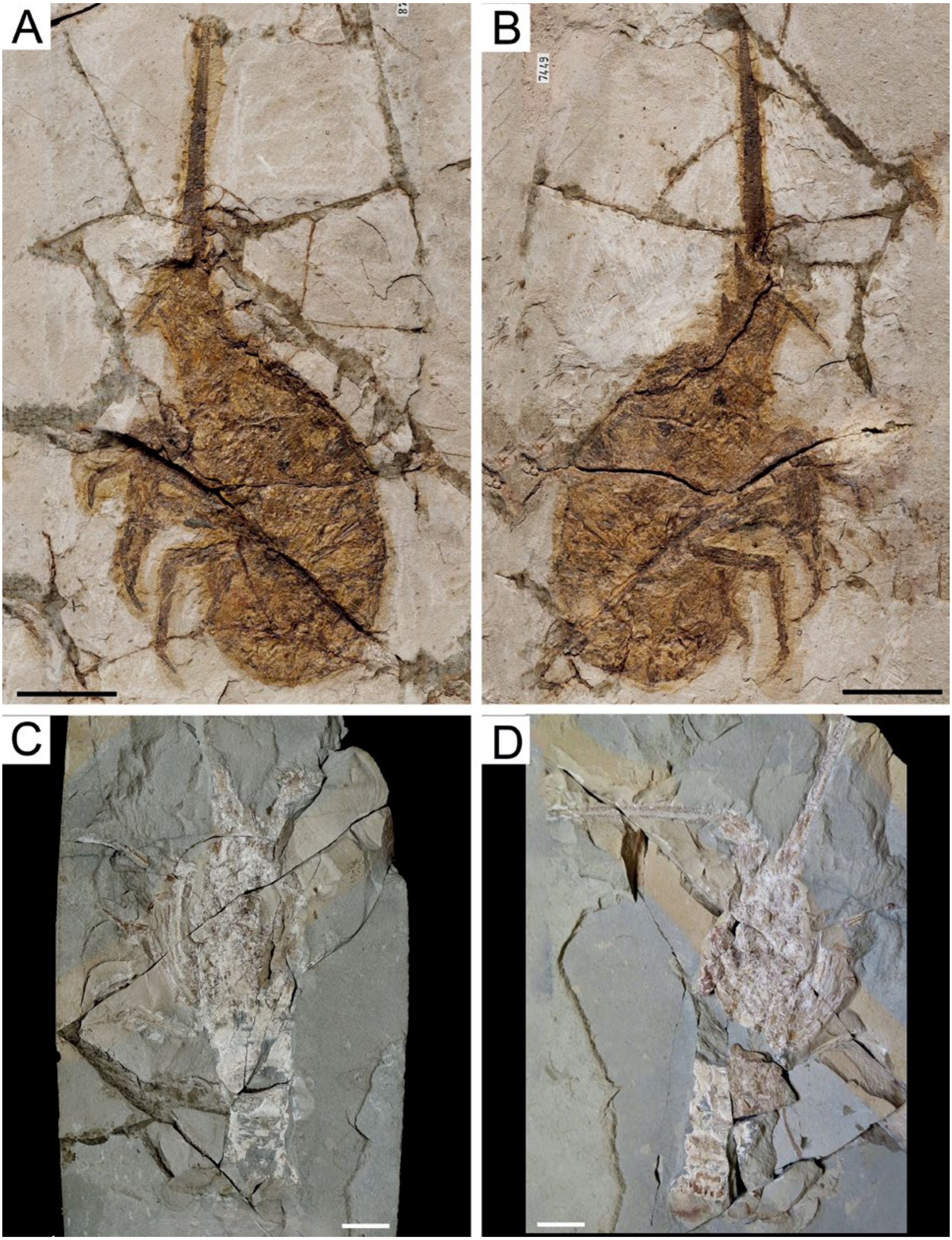

Fig. 6 – *Eolinurus desmaresti* (Secrétan, 1975) n. comb. **A**) MGP-PD 7448, lateral view (part). **B**) MGP-PD 7449, lateral view (counterpart). **C**) RP-V85, dorsal view (part). **D**) RP-V85, dorsal view (counterpart). Scale bars of A and B equal 5 cm, scale bars of C and D equal 3 cm

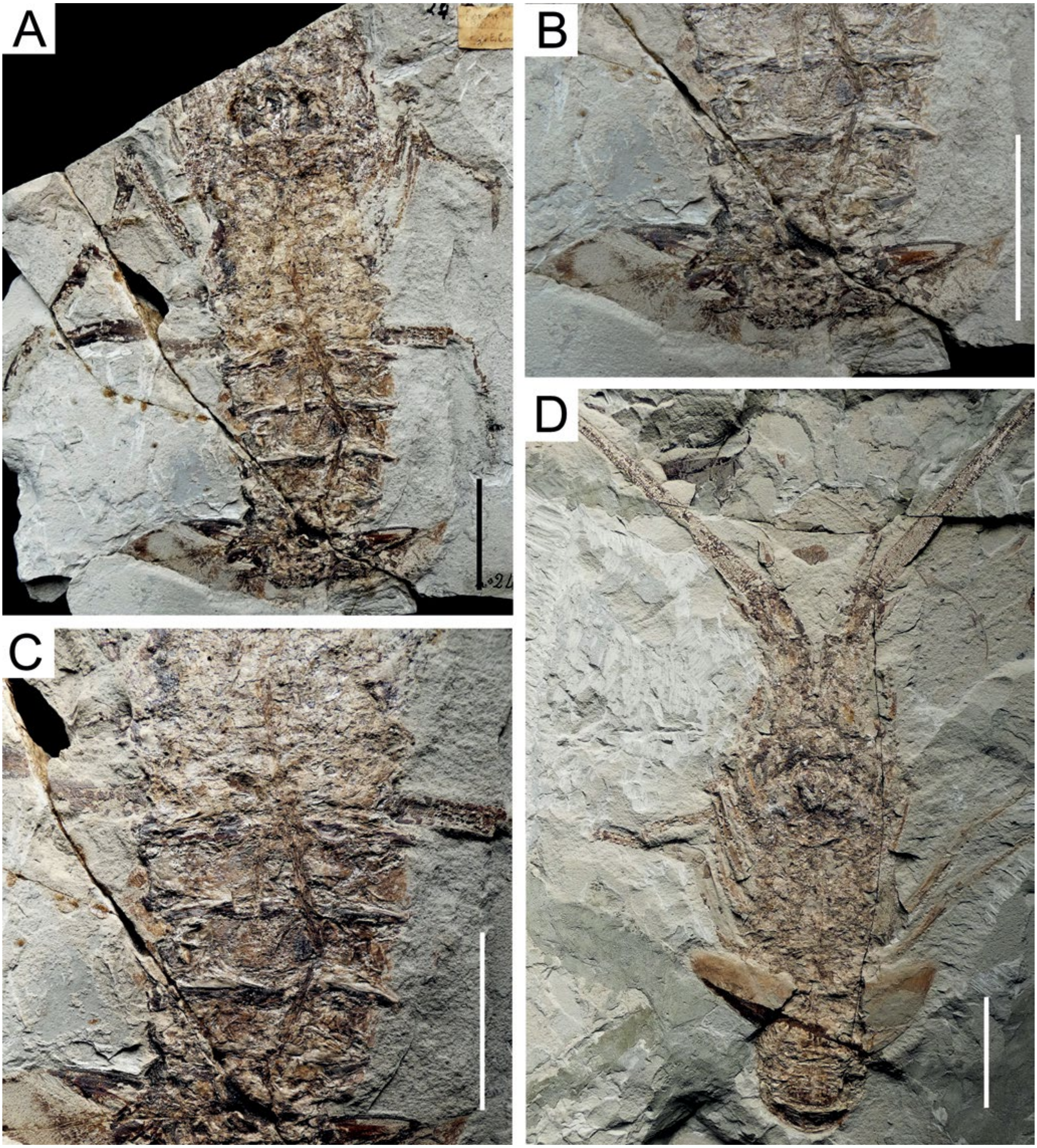

Fig. 7 – *Eolinurus desmaresti* (Secrétan, 1975) n. comb. **A**) MCSNV 24, paralectotype, dorsal view. **B**) MCSNV 24, paralectotype, close-up of the tail fan. **C**) MCSNV 24, paralectotype, close-up of the pleon. **D**) MCSNV 94, paralectotype, ventral view. Scale bars equal 5 cm

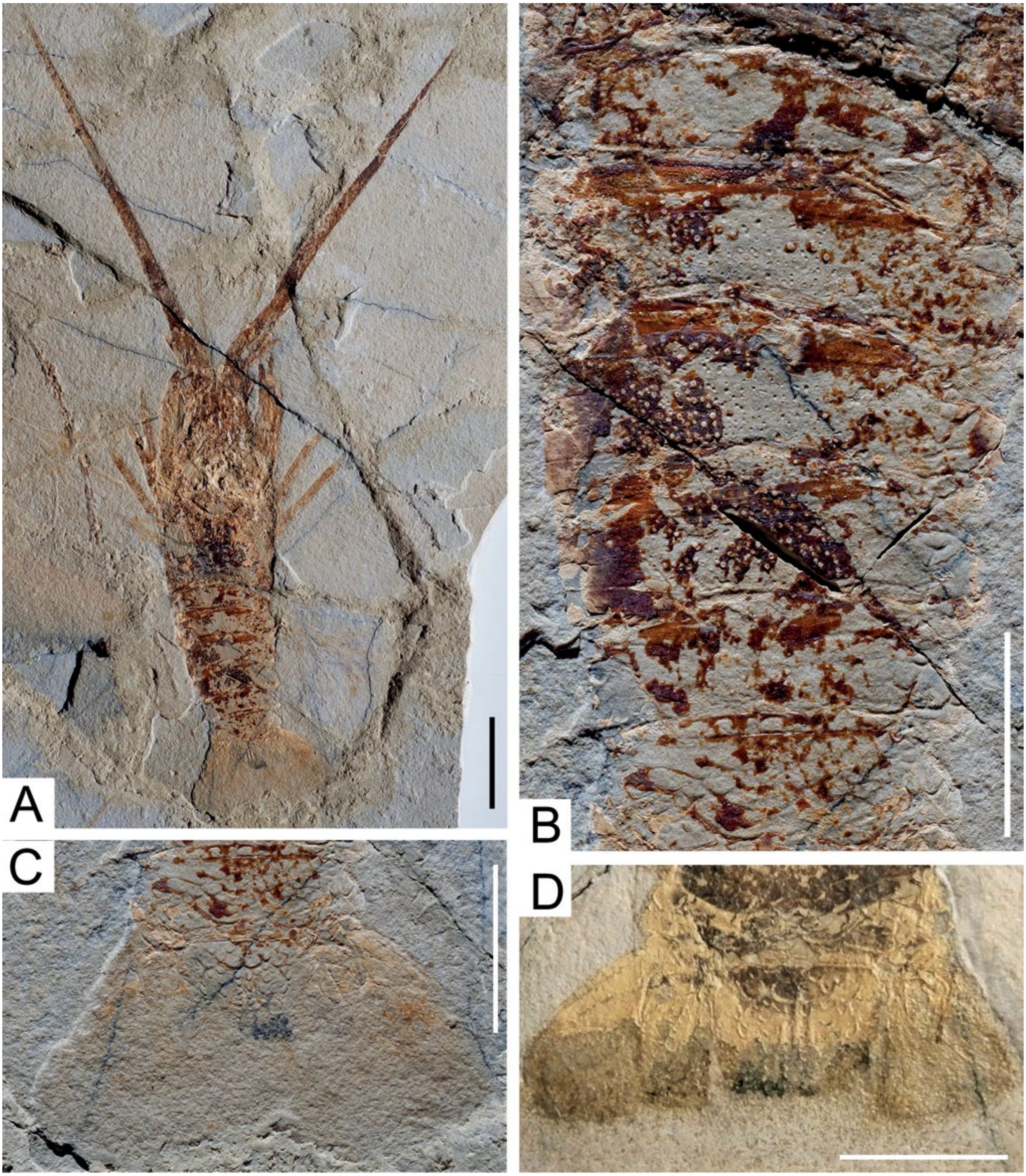

Fig. 8 – *Eolinurus desmaresti* (Secrétan, 1975) n. comb. **A**) CMC 6, dorsal view. **B**) CMC 6, close-up of the pleon. **C**) CMC 6, close-up of s6 and tail fan. **D**) CMC 6, elaborate photographic reconstruction of the tail fan. Scale bar of A equals 2 cm, scale bars of B-D equal 1 cm

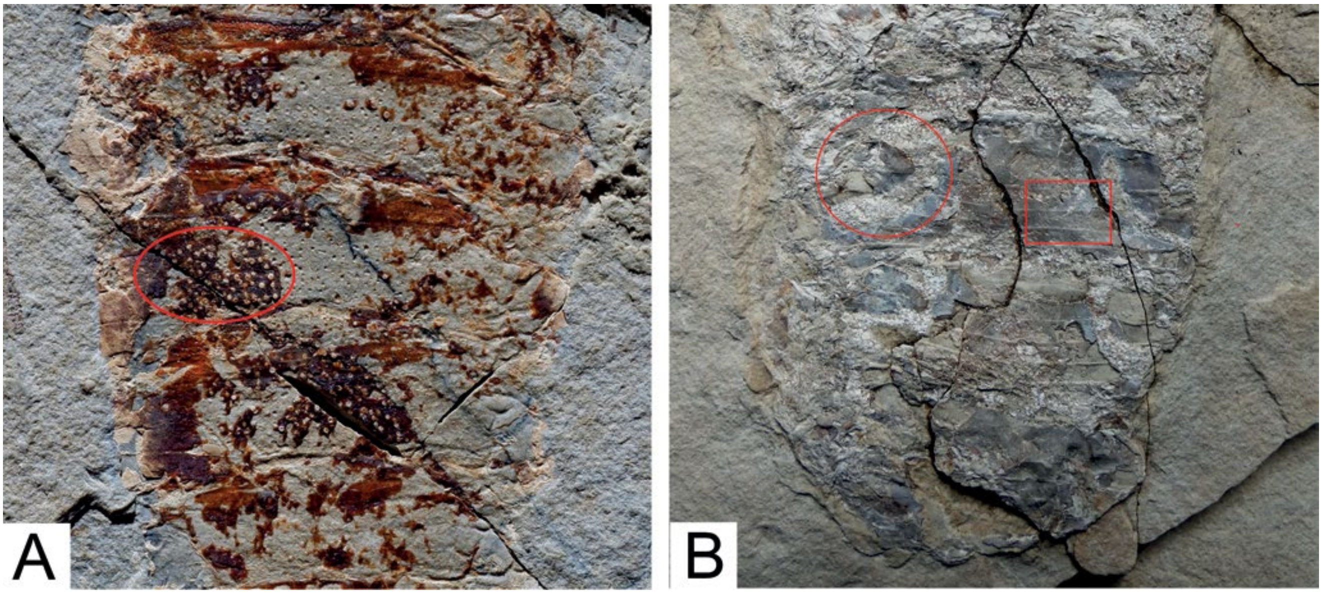

Fig. 9 – *Eolinurus desmaresti* (Secrétan, 1975) n. comb. **A**) CMC 6, close-up of the pleon, showing the original granulated ornamentation of the terga exocuticle (red circle). **B**) MCSNV 25, paralectotype, close-up of the pleon, showing the original granulated ornamentation of the terga exocuticle partially preserved on both sides of each somite (red circle) and the endocuticle that results smooth with transverse parallel striae on the medial part of each somite (red rectangular)

Genus *Justitia* Holthuis 1946

Type species
Palinurus longimanus H. Milne Edwards, 1837 by original designation.

Included fossil species
Justitia vicetina Beschin, De Angeli and Garassino, 2001; *Justitia confusa* n. sp. (herein).

***Justitia confusa* n. sp.**

Figures 4A-B, 10-13

2019 *Justitia desmaresti* (Secrétan, 1975). – Pasini *et al.*, p. 247, fig. 9B (non *Palinurus desmaresti* Secrétan, 1975).

Diagnosis
Subcylindrical granulated carapace with some scattered tubercles/spinules on the frontal and gastric regions and with imbricate scales on branchial and cardiac regions; granulated s1 tergum; granulated s2-s5 terga crossed by 2-3 complete parallel transverse striae; subtrapeziodal s6 with embossed tergum; P1 shorter and stronger than P2-P5.

Etymology
From the Latin language *confusus*, *a*, *um* (=confused), alluding to its previous systematic misinterpretation.

Holotype
MSNVE 6298 (dorsal view).

Paratypes
MCSNV M 02 (dorsal view - juvenile; paralectotype of *Palinurus desmaresti* Secrétan, 1975); MCSNV M 18 (dorsal view - juvenile; paralectotype of *Palinurus desmaresti* Secrétan, 1975); MCSNV Cr17 (lateral view - adult; paralectotype of *Palinurus desmaresti* Secrétan, 1975); MCSNV B17-17bis (part and counterpart, dorsal view - juvenile; paralectotype of *Palinurus desmaresti* Secrétan, 1975); MCSNV 20 (dorsal view - juvenile; paralectotype of *Palinurus desmaresti* Secrétan, 1975); MCSNV 23B (dorsal view - adult; paralectotype of *Palinurus desmaresti* Secrétan, 1975); MFB IG 132590-132605 (part and counterpart, dorsal view - juvenile); MGP-PD 7445-7446 (part and counterpart, dorsal view - adult).

Note 1
Three small-sized specimens (MCSNV M 02, MCSNV B17-17bis, MFB IG 132590-132605) are herein considered as intermediate juvenile stages based on morphometric evidence. In the extant spiny lobsters, for example, the carapace length of mature males and females of the Mediterranean and eastern Atlantic well-known *Palinurus elephas* (Fabricius, 1787) ranges from a minimum size respectively between 7 and 8.5 cm, reaching a total body length

of *c.* 40-60 cm in the male and *c.* 21-50 cm in the female (Gibson-Hall *et al.*, 2018), whereas the first "puerulus" not benthonic stage reaches a total body length of *c.* 5 cm (for full discussion see Guerao *et al.*, 2006). Therefore, these specimens having the carapace length under 7 cm could be considered as pertaining to juvenile (immature) specimens.

Note 2
MCSNV 19 (juvenile, lateral view; lcxp: *c.* 4 cm) is herein tentatively assigned to this species for the partially preserved imbricate scales on cardiac and branchial regions and tuberculate a2 segments with outer and inner smooth margins. However, since the pleon was restored and coloured simply to improve the specimen's appearance, it was hard to check the presence of transverse striae, diagnostic character of *Justitia*.

Type locality
"Pesciara" of Bolca (Verona).

Geological age
Late Ypresian (early Eocene).

Description
Small to middle-sized spiny lobster (lt between *c.* 6 cm to 13 cm).

Carapace. Subcylindrical granulated carapace with some scattered tubercles/spinules on the frontal and gastric regions and with imbricate scales on branchial and cardiac regions; deep cervical groove gently convex medially and located in anterior third laterally; posterior margin slightly concave; supraorbital spines and rostrum not visible.

Pleon. Subrectangular s1-s5 equal in size with subrounded rough pleura; granulated s1 tergum; granulated s2-s5 terga crossed by 2-3 complete parallel transverse striae; subtrapeziodal s6 with embossed tergum (MCSNV M 02); telson not preserved.

Cephalic appendages. Thin elongate basal a1 segment; median and distal a2 segments covered with closely spaced small granules uniformly arranged; median a2 segment with smooth outer and inner margins; distal a2 segment with smooth inner margin and outer margin with one distal spine; strong multi-articulated a2 flagellum almost as long as the body length.

Thoracic appendages. Thin elongate P2-P5; P1 shorter and stronger than P2-P5; P2-P5 equal in length; P1-P5 covered with closely spaced small granules uniformly arranged.

Pleonal appendages. Petaloid pleopods on s2-s4. Uropodal exopod and endopod not preserved.

Discussion
Justitia was established by Holthuis (1946) to accomodate the formerly known extant *Palinurus longimanus* H. Milne Edwards, 1837 and its variety *P. longimanus mauritianus* Miers, 1882, although no definition of the new genus was included and its main characters were stated in his key to the determination of the genera of the Palinuridae only (Holthuis, 1946, p. 113).

Based upon the diagnoses provided by Poupin (1994, p. 39) and Schweitzer *et al.* (2015, p. 5), we can assign some specimens previously belonging to the type series of *desmaresti* to *Justitia* for the distinctive squamiform ornamentation of the cardiac and branchial regions of the carapace and the pleonal somites with complete parallel transverse striae, characters unique of this genus.

Poupin (1994) listed the four extant species of *Justitia* that differ each other for the sculpturing of the carapace, shape of pereiopods, and number of transverse striae on s1-s5 terga.

P1 shorter and stronger than P2-P5 and thin elongate P2-P5 are characters shared between the fossil specimens and the extant *J. chani* Poupin, 1994, *J. japonica* (Kubo, 1955), and *J. vericeli* Poupin, 1994, though the fossil specimens have a different sculpturing of the carapace regions.

Beschin *et al.* (2001, p. 92) reported the only fossil species known to date, *J. vicetina* Beschin, De Angeli and Garassino, 2001, from the middle Eocene (middle Lutetian) of NE Italy. It clearly differs from the studied specimens for the gastric region covered with imbricate scales and branchial and cardiac regions covered with parallel transverse grooves (*vs.* frontal and gastric regions with some scattered tubercles/spinules and branchial and cardiac regions with imbricate scales on the studied specimens).

In conclusion, *J. confusa* n. sp. is herein proposed, representing the oldest fossil record for the genus, and supporting the close affinities already highlighted between several taxa of the lower Eocene marine fauna from the "Pesciara" and Monte Postale and the extant faunas of the Indo-Pacific tropical warm waters (see Tyler, 1975; Marramà *et al.*, 2019, 2021 among the others).

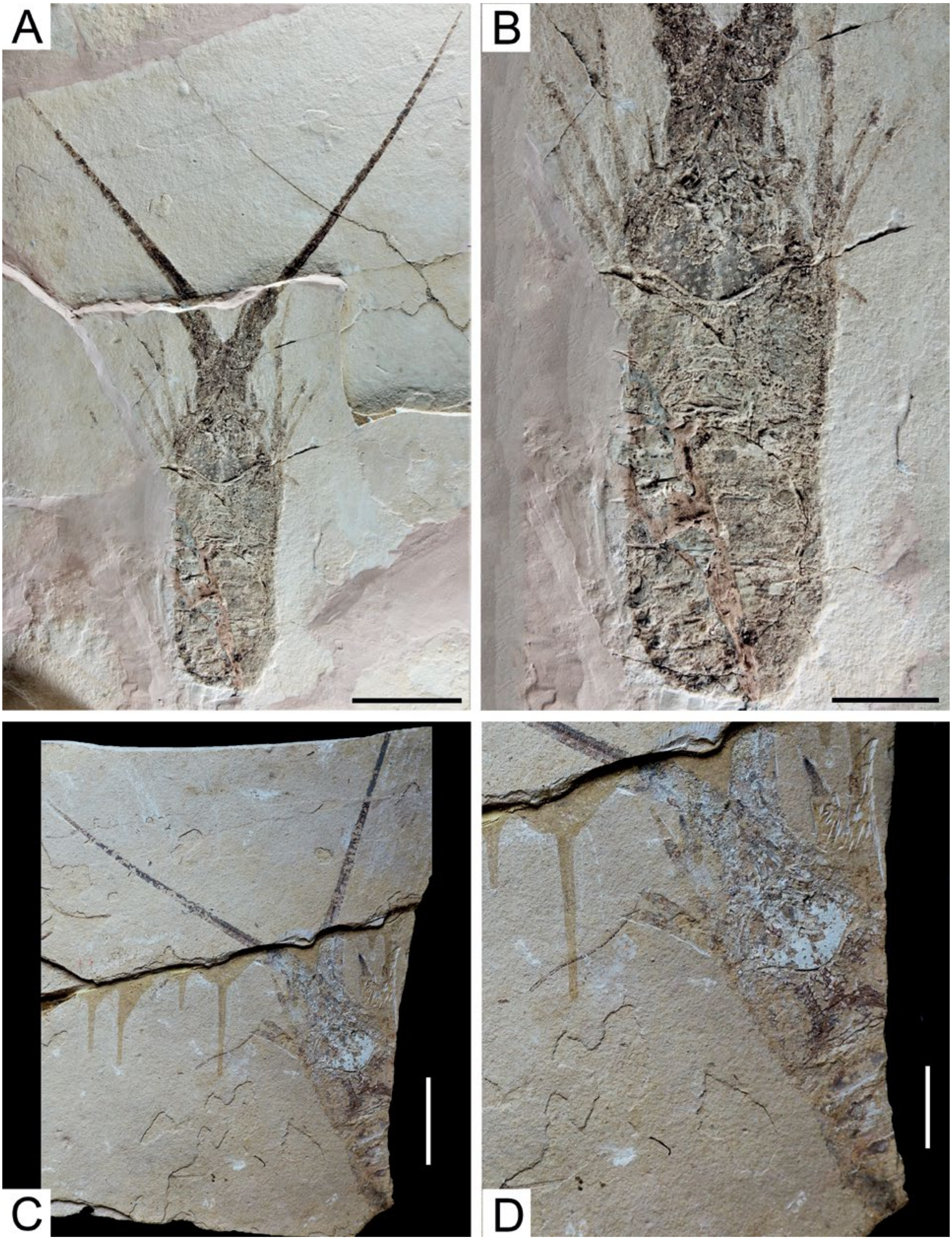

Fig. 10 – *Justitia confusa* n. sp. **A**) MSNVE 6298, holotype, dorsal view. **B**) MSNVE 6298, close-up of the carapace and pleon, dorsal view. **C**) MCSNV 23B, paratype, dorsal view. **D**) MCSNV 23B, paratype, close-up of carapace and pleon, dorsal view (UV light). Scale bars of A and C equal 2 cm, scale bars of B and D equal 1 cm

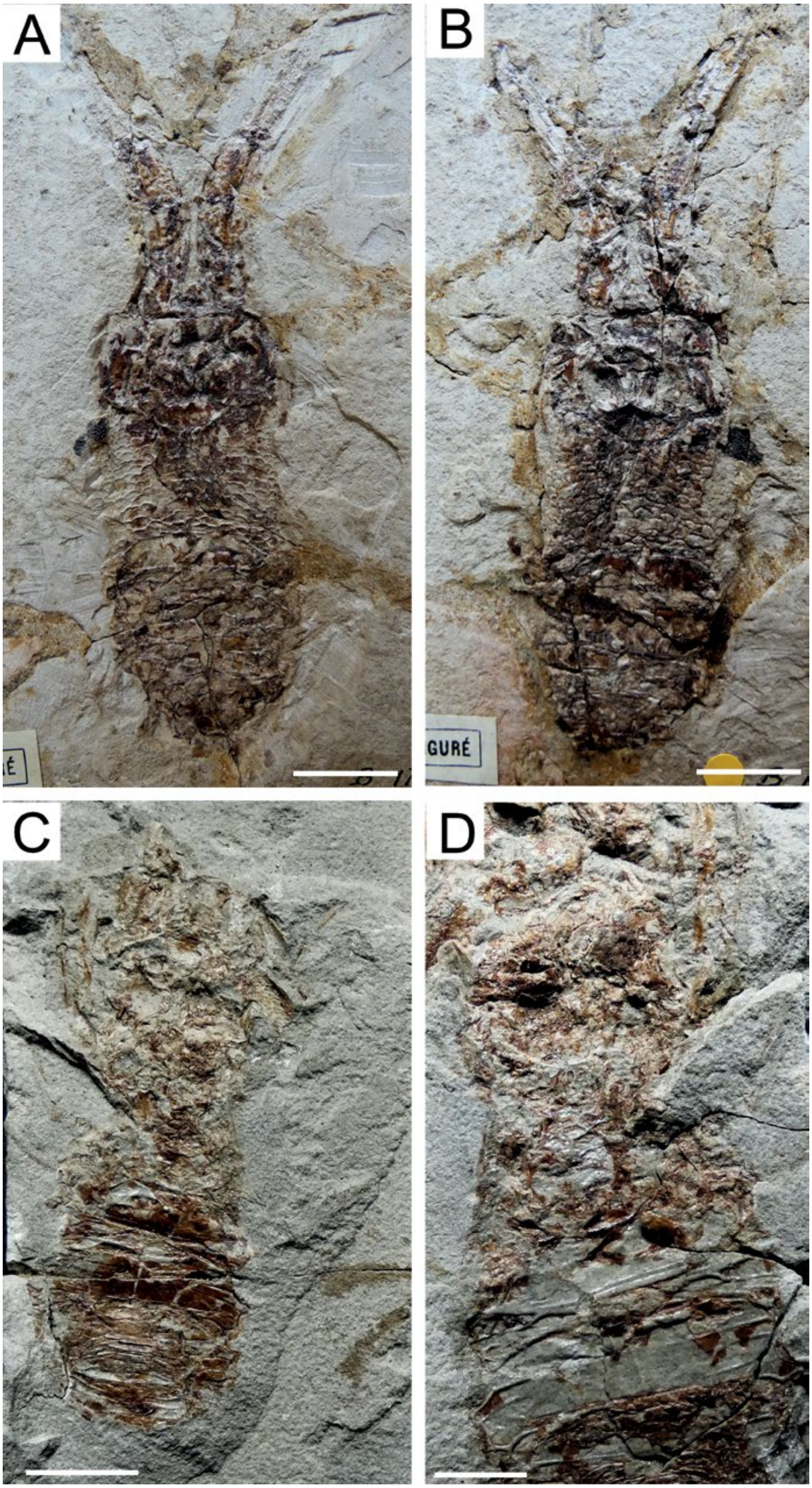

Fig. 11 – *Justitia confusa* n. sp. **A**) MCSNV B17, paratype, dorsal view (part). **B**) MCSNV B17bis, paratype, dorsal view (counterpart). **C**) MFB IG 132590, paratype, dorsal view (part). **D**) MFB IG 132605, paratype, close-up of the imbricate scales on branchial and cardiac regions and transverse striae on s2 terga, dorsal view (counterpart). Scale bars of A-C equals 4 cm, scale bar of D equals 2 cm

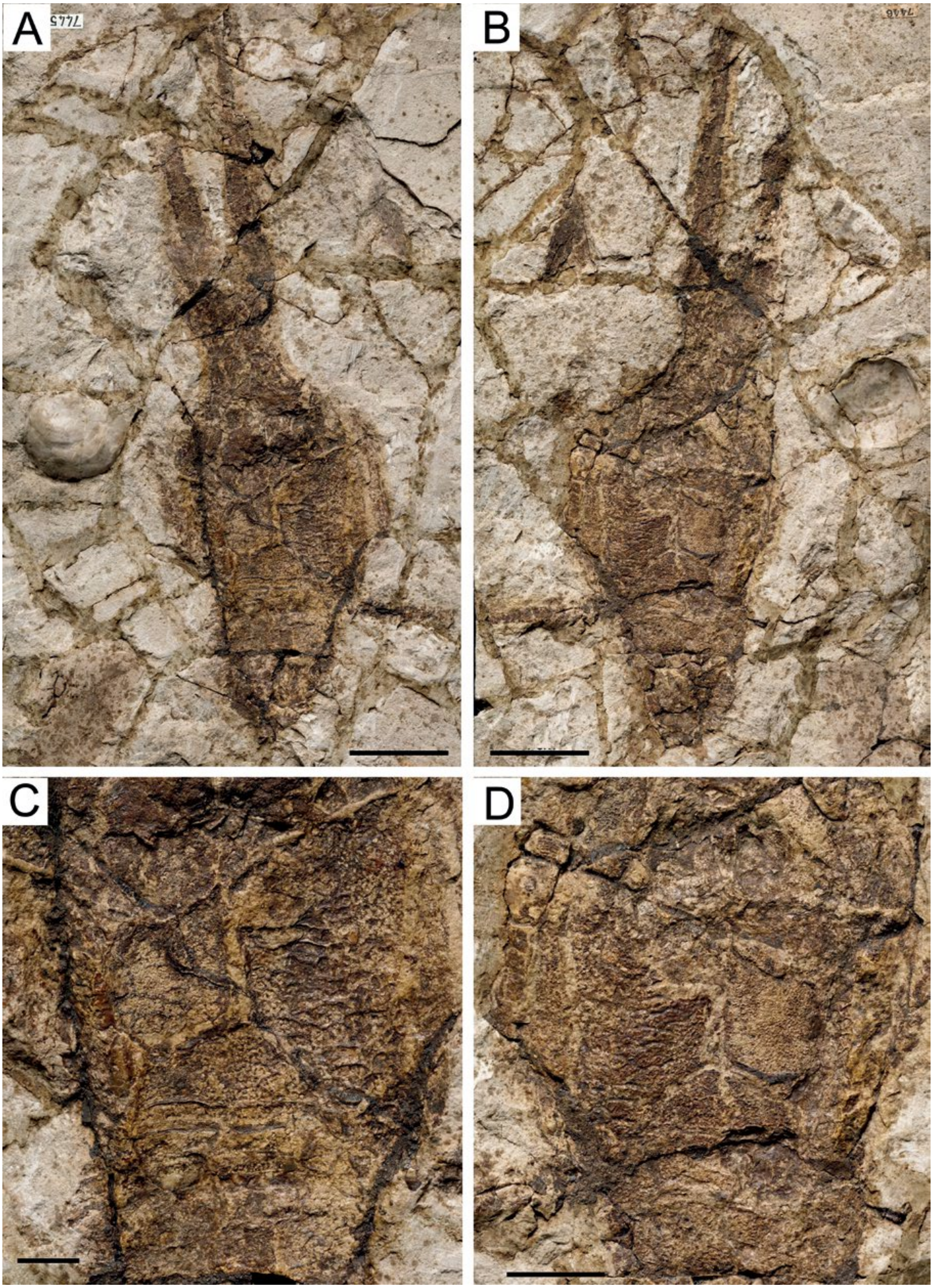

Fig. 12 – *Justitia confusa* n. sp. **A**) MGP-PD 7445, paratype, dorso-lateral view (part). **B**) MGP-PD 7446, paratype, dorso-lateral view (counterpart). **C**) MGP-PD 7445, paratype, close-up of the imbricate scales on branchial and cardiac regions. **D**) MGP-PD 7446, paratype, close-up of the imbricate scales on branchial and cardiac regions. Scale bars of A and B equal 4 cm, scale bars of C and D equal 1 cm

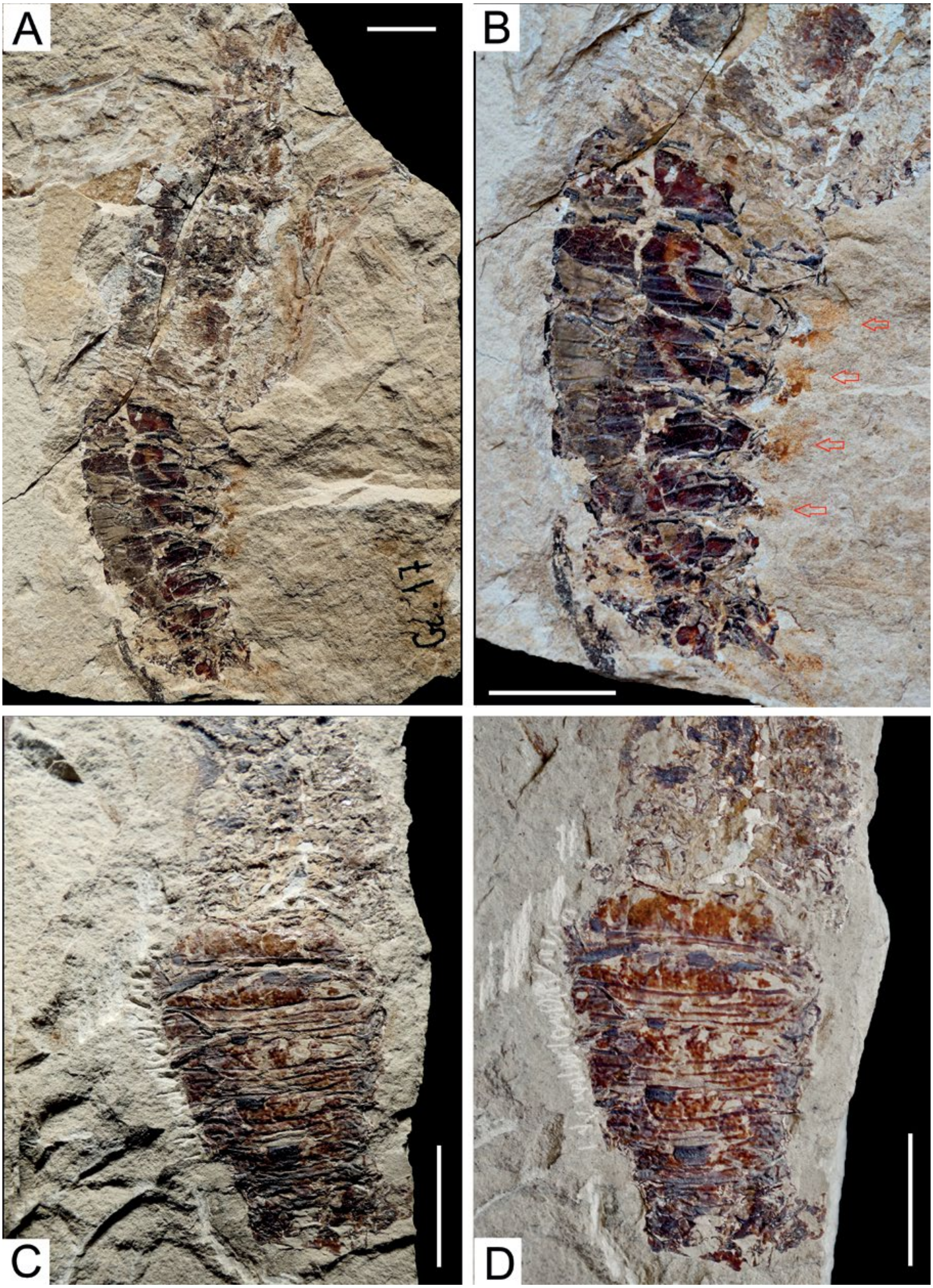

Fig. 13 – *Justitia confusa* n. sp. **A**) MCSNV Cr17, paratype, lateral view. **B**) MCSNV Cr17, paratype, close-up of the pleon with transverse striae on the terga and petaloid pleopods (red arrows) (UV light). **C**) MCSNV M 02, paratype, dorsal view. **D**) MCSNV M 02, paratype, close-up of the pleon with transverse striae on the terga (UV light). Scale bar of A equals 4 cm, scale bar of B equals 2 cm, scale bars of C and D equal 1 cm

Justitia sp.

Figures 4C-D, 14

2019 *Justitia desmaresti* (Secrétan, 1975). – Pasini *et al.*, p. 247, fig. 9D (non *Palinurus desmaresti* Secrétan, 1975).

Material
MFB IG 91130, Monte Postale (Altissimo, Vicenza).

Geological age
Late Ypresian (early Eocene).

Note
Pasini *et al.* (2019, p. 247) listed this specimen among the additional specimens of *J. desmaresti*, misinterpreting its provenance. The specimen was not collected from "Pesciara", but from Monte Postale as attested by the lithology of the matrix different between the localities: fine-grained greyish to yellow laminated micritic limestone at "Pesciara" *vs.* coarser whitish laminites with common test of *Alveolina* at Monte Postale.

Description
Medium/large-sized spiny lobster (lpl: *c.* 18 cm).

Carapace. Partially preserved; five aligned spiny tubercles forming a longitudinal ridge for which is impossible to check the precise position due to the partial and fragmentary carapace; dorsal surface finely granulated.

Pleon. Subrectangular s1-s5 slightly decreasing in size posteriorly; smooth s1 tergum; smooth s2-s3 terga with 3 complete parallel transverse striae; smooth s4-s5 terga with 4 complete parallel transverse striae; subrounded embossed s1-s5 pleura; subrectangular s6 shorter than the previous ones; subtriangular embossed s6 pleuron; telson partially preserved with embossed rigid proximal part.

Cephalic appendages. a1 not preserved; median and distal a2 segments with smooth inner and outer margins; strong multi-articulated a2 flagellum slightly longer than the body.

Thoracic appendages. Strong extremely elongate P1 (*c.* 20 cm); subrectangular elongate P1 carpus; subrectangular P1 propodus twice as long as the carpus; strong hook-shaped P1 dactylus slightly curved distally; outer surface of P1 carpus, propodus, and dactylus covered with closely spaced strong tubercles uniformly arranged; P2 not preserved; P3-P5 partially preserved; thin, relatively elongate, and smooth P3-P5 ischia; thin smooth P3-P5 meri, twice as long as ischia.

Pleonal appendages. Pleopods not preserved; uropodal exopod and endopod as long as the telson; proximal half outer margin of exopod and endopod with a triangular, hardened, and embossed scale, having a deep median transverse groove and thin tuberculate fringed striae on the half distal part.

Discussion
Based upon Holthuis (1991) we can just compare the studied specimen with *Justitia* for two shared characters: strong extremely elongate P1 with hook-shaped dactylus and s2-s5 terga with complete parallel transverse striae. Indeed, among the genera of the Palinuridae, only *Justitia* has strong extremely elongate P1 with hook-shaped dactylus as in *J. longimanus* (H. Milne Edwards, 1837) and *J. mauritiana* (Miers, 1882) although the P1 is not subchelate in the studied specimen like that of the extant species. Moreover, among the genera of the Palinuridae, only *Justitia* has complete parallel transverse striae on pleonal terga.

However, we tentatively compare the studied specimen with *Justitia* due to the lack of the carapace having the most important diagnostic characters for its precise systematic assignment, and so we leave it in open nomenclature.

Finally, we point out that the specimens herein assigned to *J. confusa* (see above) were collected from "Pesciara" layers only, whereas the studied specimen is the sole adult specimen collected from Monte Postale, representing one of the biggest spiny lobsters discovered to date. Moreover, the coarser whitish laminites of Monte Postale are supposed to be originated in a "lagoon" with at least periodic anoxic conditions at the bottom and surrounded by coralgal buildups with peri-reefal areas densely vegetated by seagrass beds and mangroves; a palaeoenvironment different than "Pesciara" that instead illustrates a low-energy basin with permanent bottom dysoxia or anoxia in a peri-reefal system strongly influenced both by coastal and pelagic environments (Marramà *et al.*, 2016; Pasini *et al.*, 2019).

In conclusion, based on the large size of the studied specimen like that of the extant representatives of *Justitia* and the different palaeoenvironments of the fossiliferous localities, we can't exclude the hypothesis that the studied specimen could represent a new taxon within *Justitia* although its systematic assignment can be solved only through discovery by better-preserved specimens from the same locality.

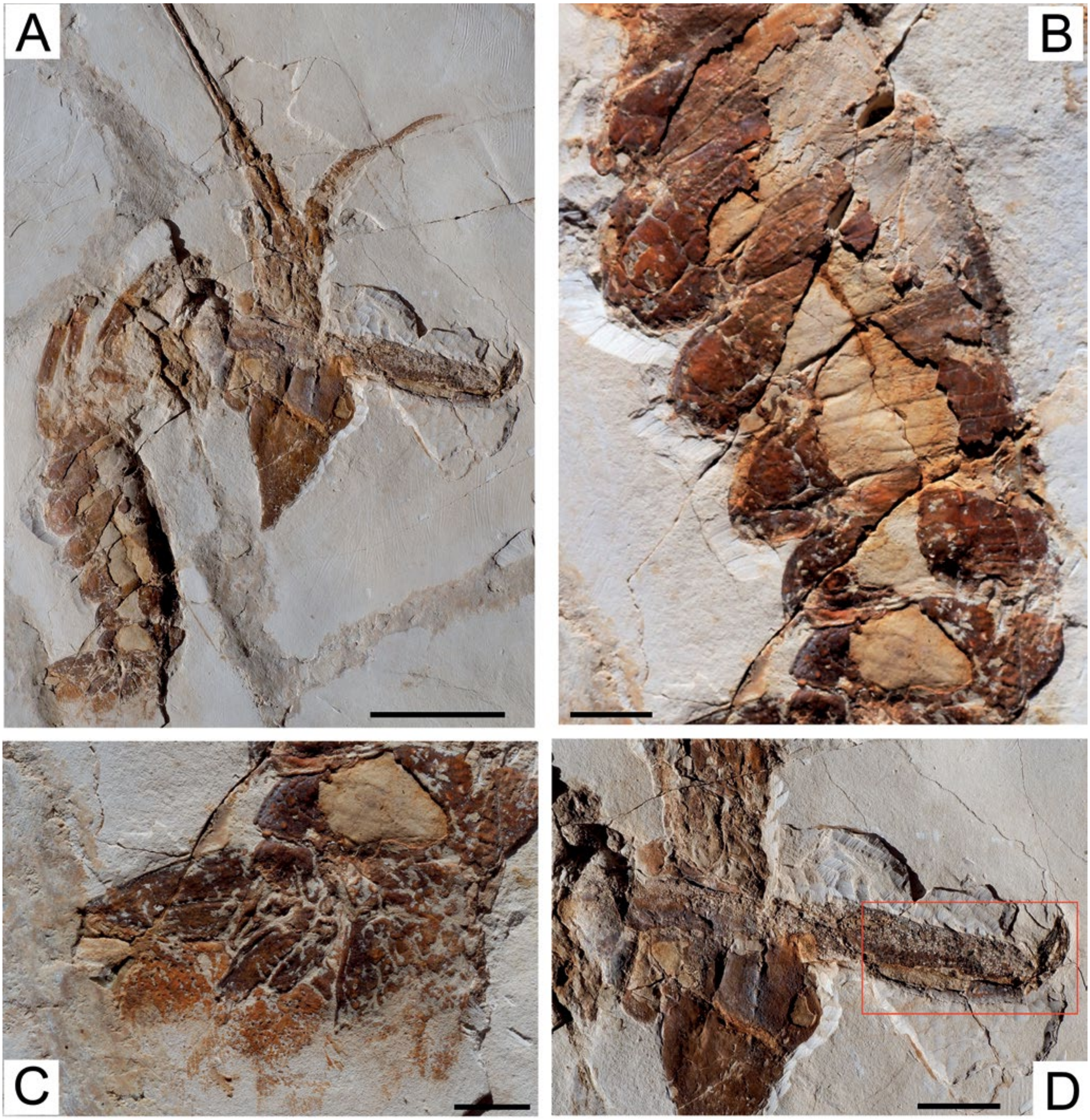

Fig. 14 – *Justitia* sp. **A**) MFB IG 91130, dorso-lateral view. **B**) MFB IG 91130, close-up of the pleon with transverse striae on the terga. **C**) MFB IG 91130, close-up of the tail fan. **D**) MFB IG 91130, close-up of the elongate superimposed P1 (red rectangular). Scale bar of A equals 10 cm, scale bars of B and C equal 2 cm, scale bar of D equals 4 cm

Family indeterminate
Genus *Lessinoachela* nov.

Diagnosis
Subcylindrical carapace with slightly inflated, convex lateral margins; carapace strongly tuberculate with small-medium-sized tubercles arranged randomly (gastric and epibranchial regions) and uniformly (branchial regions); triangular-shaped rounded gastric region strongly projected forward; supraorbital spines absent; deep, convex, smooth cervical groove, deeply V-shaped medially; posterior margin strongly concave with a smooth deep groove; raised, postfrontal, transverse rim convex frontally made by aligned strong tubercles; transverse row joined laterally to the cervical groove, forming a raised cephalic shield; subrounded s1-s5 dorsally with granulated terga crossed by two marginal transverse, rounded grooves finely crenulate posteriorly; achelate P1-P5.

Etymology
From Lessinia, the geographical area near Verona where the fossiliferous sites of Bolca crop out, and the infraorder Achelata, hence "Achelata from the Lessinia". Gender: feminine.

Type species
Lessinoachela scaligera n. gen., n. sp., by monotypy.

Discussion
Secrétan (1975, p. 340) originally discussed this specimen and although she pointed out that the dorsal ornamentation of the carapace is "*grossièrement écailleuse*" (grossly scaly) and "*… ce qui, sur la contreimpreinte, determine une sorte de reseau d'épaississiment en forme de mailles* (on the counterpart forms a kind of mail-shaped thickness), she assigned it to *Palinurus desmaresti*.

We do not concur with this interpretation. Indeed, the dorsal carapace ornamentation with well-separated strong tubercles arranged in transverse lines on branchial regions and similar in the gastric and cardiac regions, never squamiform does not fit the typical ornamentation of *Justitia* (see above). Moreover, the deep smooth cervical groove convex medially, deeply V-shaped and the peculiar ornamentation of the pleonal somites are additional characters that rule out the belonging of this specimen to *Justitia*.

Based upon Holthuis (1991), the studied specimen has dorsal carapace ornamentation with well-separated thick, large-sized tubercles arranged in transverse lines on branchial regions and similar in the gastric and cardiac regions shared with *Sagmariasus* Holthuis, 1991. We exclude, however, the belonging of the studied specimen to *Sagmariasus* in having smooth s1-s6 terga (*vs.* s1-s5 terga crossed by two marginal transverse, rounded ridge finely crenulate posteriorly in the studied specimen).

Moreover, based upon Holthuis (1991) and Schweitzer *et al.* (2015), the combination of some characters, such as the postfrontal region marked posteriorly by a transverse convex rim of closer tubercles convex frontally; the gastric and cardiac regions with granulated tubercles similar to those on the branchial region; the branchial region adorned dorsally by transverse, lined, and strong large-sized tubercles equally spaced each other, alternate with sparse small granules; and subrounded s1-s5 with smooth terga crossed by two marginal transverse, rounded ridge finely crenulate posteriorly, rule out the systematic assignment of the studied specimen to the known fossil and extant genera within the Palinuridae and Synaxidae.

In conclusion, the new genus *Lessinoachela* is herein erected to accommodate the studied specimen, leaving its assignment to the family level in open nomenclature within the Achelata.

Included fossil species
Type species only.

Lessinoachela scaligera n. gen., n. sp.

Figures 2C, 3C-D, 15, 16

1975 *Palinurus desmaresti* De Zigno. – Secrétan, p. 340, pl. 14, figs. 2–4 (non *Palinurus desmaresti* Secrétan, 1975).

Diagnosis
As for the genus.

Etymology
From Della Scala or Scaligeri, noted family that ruled Verona during the late 13th and the 14th centuries.

Holotype
MCSNV 95, paralectotype of *Palinurus desmaresti* Secrétan, 1975 [illustrated by Secrétan (1975: pl. 14, figs. 2-4)].

Type locality
"Pesciara" of Bolca (Verona).

Geological age
Late Ypresian (early Eocene).

Material and measurements
One large-sized specimen, slightly compressed dorso-ventrally, preserved as dorsal counterpart (MCSNV 95 – lcxp: *c.* 14.8 cm, from the a1 to the posterior margin; wcxp: *c.* 9.9 cm maximum width at level of cervical groove).

Note
Between the Eighteenth and Nineteenth centuries, it was customary to prepare and restore fragmentary specimens on the "Pesciara" slabs with the aim of not only reassembling the plates, but also inserting fragments to esthetically complete the fossil specimens. The inaccurate preparation techniques combined with the scarce anatomical knowledge resulted in purely subjective interpretations of the organisms' anatomy. In this specific case, the UV light aided in discovering that the presumed left antenna that appears as bifid (overlapping of two antennal flagella) was deliberately inserted to complete the first pereiopod, in order to simulate an unlikely chelate cheliped. The left antenna portion doesn't certainly belong to the studied specimen based on the actual on-site presence of the original flagellum of the right antenna, as highlighted in Fig. 15.

Fig. 15 – *Lessinoachela scaligera* n. gen., n. sp., MCSNV 95, holotype. The black lines in the upper right corner show the piece of slab preserving the supposed bifid a2 segments and flagellum erroneously joined to the P1 distal part based upon the precise anatomical position of the right a2 flagellum. Scale bar equals 3 cm

Description
Carapace. Subcylindrical carapace with slightly inflated, convex lateral margins; triangular-shaped rounded frontal region strongly projected forward; supraorbital spines absent; orbits not observable; deep, convex, smooth cervical groove, deeply V-shaped medially; posterior margin strongly concave with a smooth deep groove; raised, postfrontal, transverse rim convex frontally made by aligned strong tubercles; transverse row joined laterally to the cervical groove, forming a raised cephalic shield covered by medium-sized tubercles, larger posteriorly, arranged more or less uniformly; gastric region covered by small-medium sized tubercles arranged randomly; epibranchial regions covered by large-sized tubercles arranged randomly; branchial region covered by transverse, lined, and large-sized tubercles flatted dorsally and equally spaced each other, decreasing in size laterally and alternate with sparse smaller tubercles.

Pleon. Subrounded s1-s5 dorsally with granulated terga crossed by two marginal transverse, rounded grooves finely crenulate posteriorly; s1-s5 pleura poorly preserved; s6 and telson not preserved.

Cephalic appendages. Eyes not preserved; basal and median a1 segments preserved, the first one longer than the second one; right strong multi-articulated a2 flagellum, shorter than the body.

Thoracic appendages. Slender elongate P1 with short triangular dactylus; P2-P5 partially superimposed and preserved; strongly granulated achelate P2-P5 with submarginal ridge on propodus; P4 with setae along the margins of propodus.

Pleonal appendages. Not preserved.

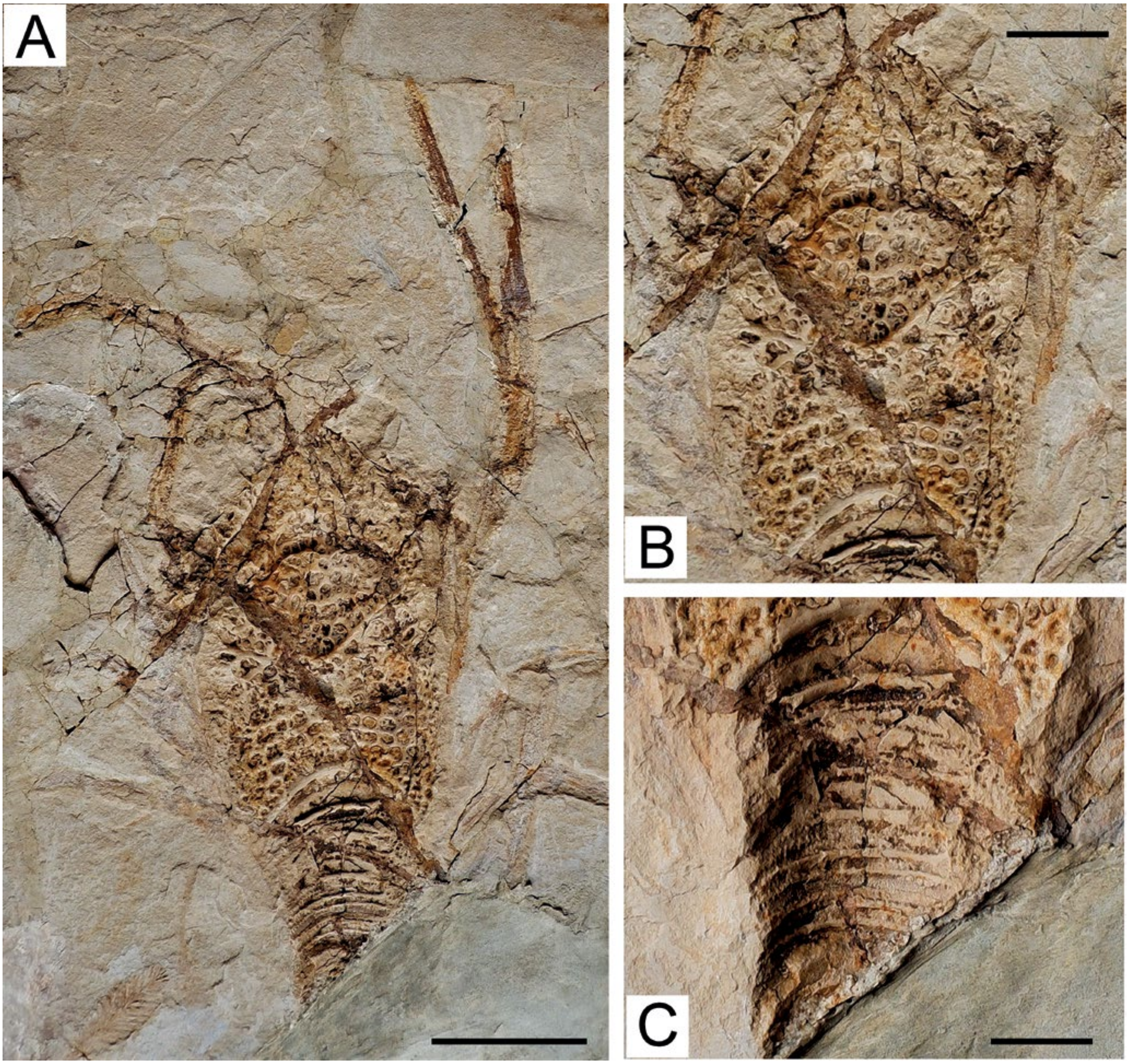

Fig. 16 – *Lessinoachela scaligera* n. gen., n. sp. **A**) MCSNV 95, holotype, dorsal view. **B**) MCSNV 95, holotype, close-up of the carapace. **C**) MCSNV 95, holotype, close-up of the pleon. Scale bar of A equals 6 cm, scale bars of B and C equal 2 cm

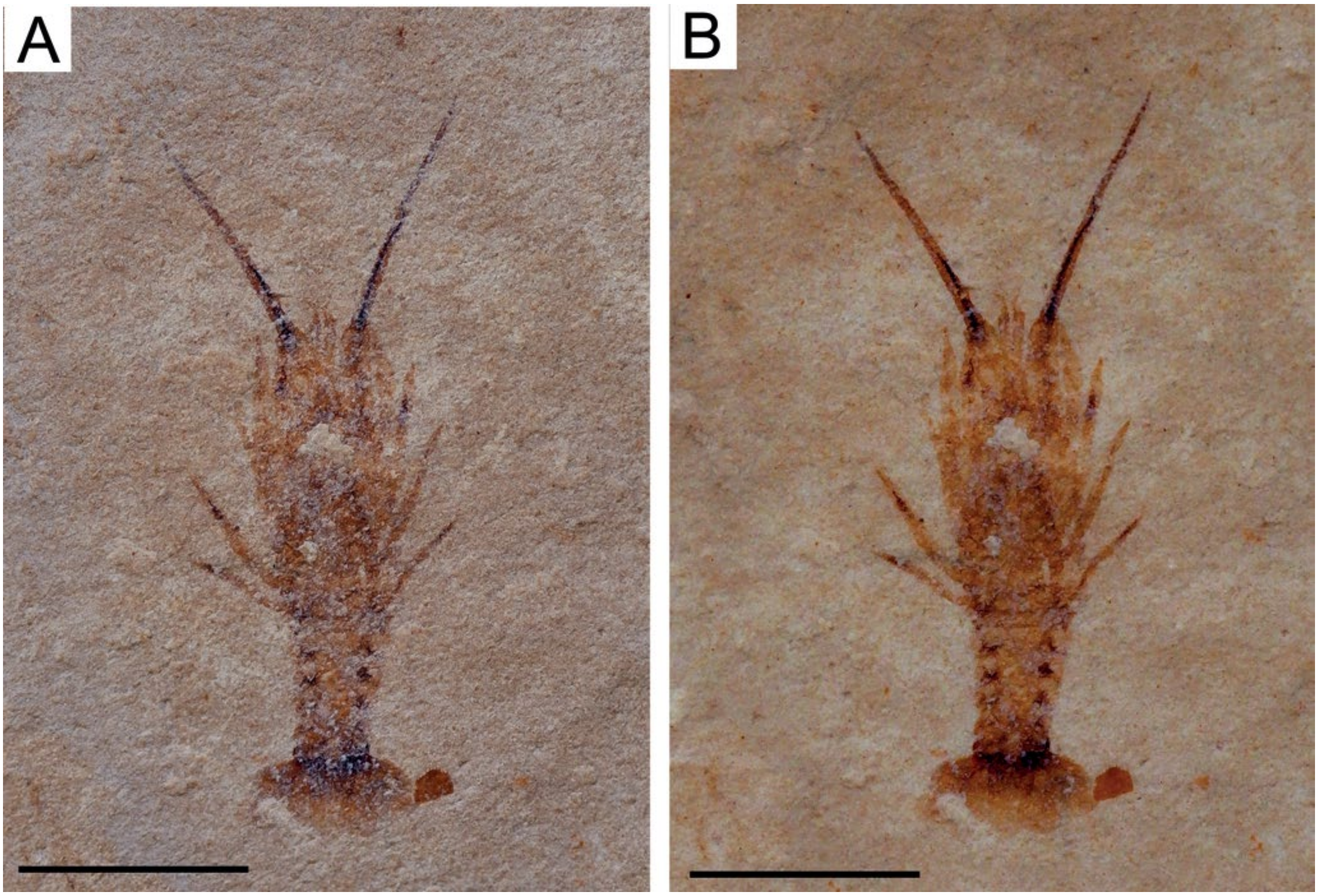

Fig. 17 – “puerulus” larval stage. **A**) MCSNV 43.2020, dorsal view (dry), UV light. **B**) MCSNV 43.2020, dorsal view (alcohol-impregnated). Scale bar equals 0.5 cm

“puerulus” larval stage

Figure 17

Material and measurements

MCSNV 43.2020 (tl: *c*. 1.5 cm, excluding antennae).

Locality

Monte Postale (Altissimo, Vicenza).

Geological age

Late Ypresian (early Eocene).

Description

Small-sized specimen with cervical groove not distinct, tail fan in dorsal view, pleonal and thoracic appendages exposed on both sides of the body; flagellate antennae shorter than the body; P1 appears longer than P2-P5. Telson divides in a rigid proximal part and a flexible distal part; subrectangular proximal part with two small distal spines, three thin longitudinal ridges (one median and two lateral), and inverted V-shaped inferior margin; subrounded flexible part with thin parallel longitudinal striae.

Discussion

The very small specimen from Monte Postale represents the “puerulus” larval stage (see note 1 in *J. confusa* n. sp.), largely resembling the adult features (see Haug and Haug, 2013, 2016). Indeed, the carapace morphology and the dorsal ornamentation resemble those of the mature specimens of *Eolinurus desmaresti* (Secrétan, 1975) n. comb.

The presence of larval, juvenile, and adult (mature) specimens of spiny lobsters in the “Pesciara” and Monte Postale palaeoenvironments allows us to attest that close to both “basin” conditions were favourable to the post benthic-stages life and development of several different spiny lobster taxa, showing at the same time some diversity in the composition of the spiny lobster communities in the two different depositional contexts.

Conclusions

Despite the problematic runs in the systematic arrangement and its relative incompleteness due to the impossibility of recognize some main characters of the frontal shape in the studied specimens, this study allows us to point out several inconsistences in the previous studies with a reappraisal of the spiny lobsters from the "Pesciara" and Monte Postale Konservat-Lagerstätten.

The review of the specimens previously assigned to *Justitia desmaresti* (Secrétan, 1975) allowed to highlight the real status of this species and to identify two distinct, previously undetected taxa within this species, enlarging our knowledge on the spiny lobster assemblage of the lower Eocene "Pesciara" and Monte Postale palaeoenvironments.

The different depositional conditions and slightly different age between "Pesciara" and Monte Postale basins can partially explain the reasons of the presence of three taxa of spiny lobsters (*Eolinurus desmaresti*, *Justitia confusa* n. sp., and *Lessinoachela scaligera* n. gen., n. sp.) from "Pesciara" than in the Monte Postale basin where the crustacean record seems instead scarcer and less differentiate (see also discussion in Pasini *et al.*, 2019: 264 and list below). For instance, the extant *Justitia* species are widespread in several localities from Indo Pacific and in western Atlantic Oceans (for full data see Poupin, 1994), mostly living on rocky or sandy coral limestone bottoms, usually reported from around 50 to 300 m depth, an environment more comparable with the "Pesciara" basin conditions as reconstructed by Marramà *et al.* (2016).

Indeed, the sole adult spiny lobster specimen reported from Monte Postale (*Justitia* sp.), though not assigned at specific level, clearly shows characters different from those observed in the species from "Pesciara".

Moreover, a very small, complete "puerulus" larval stage was herein reported for the first time from Monte Postale.

Finally, a new updated complete list of the decapod species reported to date from the "Pesciara" and Monte Postale Konservat-Lagerstätten (Veneto, N Italy), is herein provided (Appendix 1).

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We wish to thank B. Favaretto (Museo di Storia Naturale Giancarlo Ligabue, Venezia) and I. Tomelleri (Museo di Storia Naturale di Verona) for the photos of the specimens housed in the palaeontological collections under their care; M. Cerato (Bolca, Verona) who allowed us the study of two specimens housed in the collection of the Museo dei Fossili di Bolca; M. Camerin (Museo Diocesano di Scienze Naturali "A. De Nardi", Vittorio Veneto, Treviso) who allowed us the study of the specimen of *Eolinurus desmaresti*, housed in the collections; S. Castelli (Dipartimento di Geoscienze dell'Università di Padova) for accurate photographic documentation and figures preparation; M. Fornasiero (Museo di Geologia e Paleontologia dell'Università di Padova) for her precious help during "excavation" in the deposits of the Museo di Geologia e Paleontologia dell'Università di Padova; R. Sigismondo (Varese) for additional photos useful to complete the iconographic section. We are also very grateful to F. Rossi (Director of the Museo di Storia Naturale di Verona) and to L. Latella (editor of "Studi e Ricerche sui Giacimenti Terziari di Bolca") for hosting this article. Finally, we thank F.J. Vega (Instituto de Geología, Universidad Nacional Autónoma de México, Coyoacán, Mexico) for careful review and criticism.

Appendix 1

Complete updated list of the Decapoda genera and species and distribution in the laminites of "Pesciara" – Monte Postale Konservat-Lagerstätten, based upon present review (from Pasini *et al.*, 2019, modified).

	"Pesciara"	Monte Postale
Order Decapoda Latreille, 1803		
Genus *Bolcacalliax* Hyžný *in* Pasini *et al.*, 2019 ***Bolcacalliax eocenica*** (Secrétan, 1975)	X	
Genus *Penaeus* Fabricius, 1798 ***Penaeus bolcensis*** Secrétan, 1975	X	
Genus *Eolinurus* n. gen. ***Eolinurus desmaresti*** (Secrétan, 1975) n. comb.	X	
Genus *Justitia* Holthuis, 1946 ***Justitia confusa*** n. sp.	X	
Genus *Justitia* Holthuis, 1946 ***Justitia*** sp.		X
Genus *Lessinoachela* n. gen. ***Lessinoachela scaligera*** n. gen., n. sp.	X	
Genus *Scyllarides* Gill, 188 ***Scyllarides bolcensis*** De Angeli and Garassino, 2008		X
Genus *Archaeocypoda* Secrétan, 1975 ***Archaeocypoda veronensis*** Secrétan, 1975	X	
Genus *Eotrachynotocarcinus* Beschin, Busulini, De Angeli and Tessier, 2007 ***Eotrachynotocarcinus airaghii*** Beschin, Busulini, De Angeli and Tessier, 2007	X	
Genus *Enoplonotus* A. Milne-Edwards, 1860 ***Enoplonotus armatus*** A. Milne-Edwards, 1860	X	
Genus *Lophopanopeus* Rathbun, 1898 ***Lophopanopeus bolcensis*** (Secrétan, 1975) n. comb.	X	
Genus *Lophoranina* Fabiani, 1910 ***Lophoranina maxima*** Beschin, Busulini, De Angeli and Tessier, 2004	X	X

Literature cited

Agnini C., Fornaciari E., Raffi I., Catanzariti R., Pälike H., Backman J., Rio D., 2014. Biozonation and biochronology of Paleogene calcareous nannofossils from low and middle latitudes. *Newsletters on Stratigraphy*, 47: 131-181.

Beschin C., De Angeli A., Garassino A., 2001. *Justitia vicetina* n. sp. (Crustacea, Decapoda) dell'Eocene di Chiampo (Vicenza, Italia settentrionale). *Studi Trentini di Scienze Naturali, Acta Geologica*, 76: 89-97.

Cerato M., 2011. Cerato. I pescatori del Tempo. 180 pp., San Giovanni Ilarione (Alpone).

De Angeli A., Garassino A., 2014. *Palinurellus bericus* n. sp. (Crustacea, Decapoda, Palinuridae) from the late Eocene (Priabonian) of S. Feliciano (Orgiano, Vicenza, northeastern Italy). *Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale in Milano*, 1 (1): 7-12. doi: 10.4081/nhs.2014.58

Desmarest, A.-G., 1817. Crustacés fossiles. In: Nouveau dictionnaire d'Histoire naturelle appliquée aux arts, à l'Agriculture, à l'Économie rurale et domestique, à la Médecine, etc. COR-CUN, 8: 495-519. Paris (Déterville).

Fraaije R.H.B., Van Bakel B.W.M., Jagt J.W.M., Brochet R., 2020. A new furry lobster (Crustacea, Decapoda, Synaxidae) from the Oxfordian (Upper Jurassic) of northeastern France. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, 296 (3): 327-330. doi: 10.1127/njgpa/2020/0909

Friedman M., Carnevale G., 2018. The Bolca Lagerstätten: shallow marine life in the Eocene. *Journal of the Geological Society*, 175: 569-579.

Garassino A., Novati M., 2001. *Justitia desmaresti* (Massalongo, 1854) (Crustacea, Decapoda) from the Lutetian (Middle Eocene) of Monte Bolca (Verona, N Italy). *Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale in Milano*, 141 (2): 251-268.

Gibson-Hall E., Jackson A., Marshall C., 2018. *Palinurus elephas* European spiny lobster. In: Tyler-Walters H., Hiscock K. (eds.). Marine Life Information Network: Biology and Sensitivity Key Information Reviews [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 30-07-2021].

Giusberti L., Fornasiero M., Zorzin R., 2014. The Pesciara-Monte Postale Bolca *Fossil-Lagerstätte*: 4. The "minor fauna" of the laminites. In: Papazzoni C.A., Giusberti L., Carnevale G., Roghi G., Bassi D., Zorzin R. (eds.). The Bolca *Fossil-Lagerstätten*: A window into the Eocene World. *Rendiconti della Società Paleontologica Italiana*, 4: 73-87.

Giusberti L., Garassino A., Roghi G., 2015. Nomenclatural reassessment of *Justitia desmaresti* (Crustacea, Decapoda, Palinuridae) from the lower Eocene of Bolca (Verona, NE Italy). *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, 276 (1): 111-119. doi: 10.1127/njgpa/2015/0484

Guerao G., Díaz D., Abelló P., 2006. Morphology of *puerulus* and early juvenile stages of the spiny lobster *Palinurus mauritanicus* (Decapoda: Palinuridae). *Journal of Crustacean Biology*, 26 (4): 480-494. doi: 10.1651/C-2615.1

Haug J.T., Haug C., 2013. An unusual fossil larva, the ontogeny of achelatan lobsters, and the evolution of metamorphosis. *Bulletin of Geosciences*, 88: 195-206.

Haug J.T., Haug C., 2016. "Intermetamorphic" developmental stages in 150 milion-year-old achelatan lobsters - The case of the species *tenera* Oppel, 1862. *Arthropod Structure & Development*, 45 (2016): 108-121. doi: 10.1016/j.asd.2015.10.001

Holthuis L.B., 1946. Biological results of the Snellius Expedition XIV. The Decapods Macrura of the Snellius Expedition. I. The Stenopodidiae, Nephropsidae, Scyllaridae and Palinuridae. *Temminckia*, 7: 1-178.

Holthuis L.B., 1991. FAO species catalogue. 13. Marine lobsters of the world. Rome. 291 pp.

Iczn, 1999. International Code of Zoological Nomenclature. Fourth Edition. 335 pp. The International Trust for Zoological Nomenclature, London.

Karasawa H., Schweitzer C.E., Feldmann R.M., 2013. Phylogeny and Systematics of Extant and Extinct Lobsters. *Journal of Crustacean Biology*, 33 (1): 78-123.

Marramà G., Bannikov A.B., Tyler J.C., Zorzin R., Carnevale G., 2016. Controlled excavations in the Pesciara and Monte Postale sites provide new insights about the palaeoecology and taphonomy of the fish assemblages of the Eocene Bolca Konservat-Lagerstätte, Italy. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 454: 228-245.

Marramà G., Carnevale G., Naylor G.J.P., Kriwet J., 2019. Reappraisal of the Eocene whiptail stingrays (Myliobatiformes, Dasyatidae) of the Bolca Lagerstätte, Italy. *Zoologica Scripta*, 48: 168-184. doi: 10.1111/zsc.12330

Marramà G., Carnevale G., Naylor G.J.P., Varese M., Giusberti L., Kriwet J., 2021. Anatomy, taxonomy and phylogeny of the Eocene guitarfishes from the Bolca Lagerstätte, Italy, provide new insights into the relationships of the Rhinopristiformes (Elasmobranchii" Batomorphii). *Zoological Journal of the Linnean Society*, 192 (4): 1090-1110. doi: 10.1093/zoolinnean/zlaa125

Massalongo A., 1855. Monografia delle Nereidi fossili del M. Bolca. 35 pp.; Verona (Antonelli).

Papazzoni C.A., Fornaciari E., Giusberti L., Vescogni A., Fornaciari B., 2017. Integrating Shallow Benthic and Calcareous Nannofossil Zones: the lower Eocene of the Monte Postale section (northern Italy). *Palaios*, 32 (1): 6-17.

Papazzoni C.A., Trevisani E., 2006. Facies analysis, palaeoenvironmental reconstruction, and biostratigraphy of the "Pesciara di Bolca" (Verona, northern Italy): An early Eocene Fossil Lagerstätte. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 242: 21-35. doi: 10.1016/j.palaeo.2006.05.011

Pasini G., Garassino A., De Angeli A., Hyžný M., Giusberti L., Zorzin R., 2019. Eocene decapod faunas from the Konservat-Lagerstätten laminites of "Pesciara" (Bolca, Verona) and Monte Postale (Altissimo, Vicenza) in northeast Italy: a review and update. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, 293 (3): 233-270. doi: 10.1127/njgpa/2019/0840

Pinna G., 1985. Enciclopedia illustrata dei fossili. 232 pp., Novara (Istituto Geografico De Agostini).

Poupin J., 1994. The genus *Justitia* Holthuis, 1946, with the description of *J. chani* and *J. vericeli* spp. nov. (Crustacea: Decapoda: Palinuridea). *Journal of Taiwan Museum*, 47 (1): 37-56.

Secrétan S., 1975. Les crustacés du Monte Bolca. *Studi e Ricerche sui Giacimenti Terziari di Bolca, Museo Civico di Storia Naturale di Verona*, 2: 315-388.

Serra-Kiel J., Hottinger L., Caus E., Drobne K., Ferrandez C., Jauhri A.K., Less G., Pavlovec R., Pignatti J., Sams´O J.M., Schaub H., Sirel E., Strougo A., Tambareau Y., Tosquella J., Zakrevskaya E., 1998. Larger foraminiferal biostratigraphy of the Tethyan Paleocene and Eocene. *Bulletin de la Société Géologique de France*, 169: 281-299.

Schweitzer C.E., Feldmann R.M., Karasawa H., Garassino A., 2015. Part R, Revised, Volume 1, Chapter 8H: Systematic descriptions: Infraorder Achelata. *Treatise Online*, 67: 1-17.

Tyler J.C., 1975. A new species of boxefish from the Eocene of Monte Bolca, Italy, the first unquestionable fossil record of the Ostraciontidae. *Studi e Ricerche sui Giacimenti Terziari di Bolca, Museo Civico di Storia Naturale di Verona*, 2: 103-118.

Vescogni A., Bosellini F.R., Papazzoni C.A., Giusberti L., Roghi G., Fornaciari E., Dominici S., Zorzin R., 2016. Coralgal buildups associated with the Bolca Fossil-Lagerstatten: new evidence from the Ypresian of Monte Postale (NE Italy). *Facies*, 62: 21. doi: 10.1007/s10347-016-0472-x.

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†*Pavarottia astescalpone* sp. nov., a new percoid fish (Perciformes s.l.) from the Eocene of Bolca, northern Italy, representing a new extinct family

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Abstract

A new species of the percoid fish genus †*Pavarottia* (Perciformes s.l.), †*P. astescalpone*, is described based on a single skeleton from the Eocene locality of Bolca (Monte Postale site) in northern Italy. This is the third species of the genus †*Pavarottia* Bannikov & Zorzin, 2011 recorded from Bolca. †*Pavarottia astescalpone* sp. nov. differs from the type species of the genus, †*P. lonardonii* Bannikov & Zorzin, 2011 (from the same Monte Postale site), in having: a less deep body with a shallower head; and somewhat shorter spines in both the unpaired and pelvic fins. At the same time, the new species differs from †*P. maiseyi* Bannikov, 2016 (from the Pesciara cave site), in having its fifth dorsal-fin spine longer than the last spine and by its shorter base length of the soft dorsal fin. Additionally, the new species has one more dorsal-fin spine and more numerous anal-fin rays than recorded for both †*P. lonardonii* and †*P. maiseyi*, and a smaller orbit. The new monotypic percoid family †Pavarottiidae is established to accommodate the genus †*Pavarottia*.

Key words: Perciformes, †*Pavarottia*, new species, new family, Eocene, northern Italy, Bolca locality.

Riassunto

Una nuova specie di pesci percoidi del genere †*Pavarottia* (Perciformes s.l.), †*P. astescalpone*, è descritto sulla base di un unico scheletro proveniente dalla località eocenica di Bolca (giacimento di Monte Postale) nell'Italia settentrionale. Questa è la terza specie del genere †*Pavarottia* Bannikov & Zorzin, 2011 registrata a Bolca. *Pavarottia astescalpone* sp. nov. differisce dalla specie tipo del genere, †*P. lonardonii* Bannikov & Zorzin, 2011 (dallo stesso sito del Monte Postale), nell'avere un corpo meno alto con una testa più bassa, spine un po' più corte in entrambe le pinne spaiate e pelviche. Allo stesso tempo, la nuova specie differisce da †*P. maiseyi* Bannikov, 2016 (dal giacimento della Pesciara), nell'avere la quinta spina dorsale della pinna dorsale più lunga dell'ultima spina dorsale e per una più corta base della pinna dorsale morbida. Inoltre, la nuova specie ha una spina dorsale in più della pinna e raggi della pinna anale più numerosi di quelli registrati per entrambi i †*P. lonardonii* e †*P. maiseyi* e un'orbita più piccola. Viene istituita una nuova famiglia di percoidi monotipici †Pavarottiidae per accogliere il genere †*Pavarottia*.

Parole chiave: Perciformi, *Pavarottia*, nuova specie, nuova famiglia, Eocene, Italia settentrionale, Bolca.

Introduction

The Eocene marine fishes from Monte Bolca (northern Italy) have been known since the mid-sixteenth century for their extraordinary preservation. The latest lists of the Monte Bolca fishes (Bannikov, 2014; Carnevale et al., 2014) include 238 taxa, among which 222 represent actinopterygians. These numbers have increased subsequently, and now 237 species-level taxa of actinopterygians are recorded from Bolca (forthcoming revisions of certain higher taxa perhaps could reduce this number). The first comprehensive monographic work on these fishes, the "Ittiolitologia Veronese", was published by the Abbot G.S. Volta in 1796. Some years later, Agassiz (1833-1844) published his monumental treatise on comparative paleoichthyology, which was largely based on materials from Monte Bolca. Since that time a rather large number of papers have been devoted to the Monte Bolca fish fauna, based on the thousands of specimens extracted from this locality and now disseminated in museums and research institutes around the world. The fish fauna is strongly dominated by acanthomorphs (more than 190 species), with a diversity foreshadowing that of today (Patterson, 1993).

The Eocene acanthomorphs of Bolca were referred to both extant and extinct families (Bannikov, 2014; Carnevale *et al.*, 2014), whereas the systematic positions of 32 genera remain uncertain; most of the latter certainly belong to extinct families. One of these genera, †*Pavarottia* Bannikov & Zorzin, 2011, was recently established as a percoid of uncertain, but perhaps priacanthid, relationships (Bannikov and Zorzin, 2011). Its type species, †*P. lonardonii* Bannikov & Zorzin, 2011, was described based on a single specimen found in 2004 at the Monte Postale site (a few hundred meters across a ravine from the classic Pesciara site) of the Monte Bolca locality. Subsequently, the second species of †*Pavarottia*, †*P. maiseyi* Bannikov, 2016, was described based on five specimens from the Pesciara cave site. The quantitative and taphonomic analyses of the Pesciara and Monte Postale fish assemblages performed recently (Marramà *et al.*, 2016) clearly defined two distinctive paleocommunities and two different depositional settings.

During the field excavations executed by the staff of the Museo Civico di Storia Naturale di Verona and the Cerato family (Bolca township) in 2021 at the Monte Postale site, among the other materials, the specimen (in part and counterpart) representing the genus †*Pavarottia* was discovered. This specimen is described below as a new species, †*Pavarottia astescalpone*. The morphological peculiarities of the genus †*Pavarottia* justify the establishment of a new monotypic percoid family for it.

MATERIAL AND METHODS

The specimens were studied using a stereomicroscope WILD Heerbrugg with attached camera lucida drawing arm. Some details of the specimens examined were best seen when the specimens were moistened with alcohol. Measurements were taken with a dial caliper to the nearest 0.1 mm.

Interneural and interhaemal spaces are numbered based on the vertebra whose neural or haemal spine forms the anterior border of the space, with the first space being between the first and second neural or haemal spines (following Baldwin and Johnson, 1993; Bannikov and Tyler, 1995; Tyler and Bannikov, 1997; etc.).

All extinct taxa are marked with daggers (†) preceding their names.

Comparative material examined:

- †*Pavarottia lonardonii* Bannikov & Zorzin, 2011; MCSNV IGVR71259 (holotype), 48.5 mm SL; Monte Postale site.
- †*Pavarottia maiseyi* Bannikov, 2016; AMNH 9529 (holotype), 51 mm SL; MCSNV T99/T100 (paratype), 48 mm SL; MCSNV T101/T102, 47 mm SL; MCSNV T103/T104, 53 mm SL; MCSNV T105/T106, 57 mm SL; Pesciara cave site.

Abbreviations are as follows:

- *Institutional*:
  AMNH – American Museum of Natural History, New York;
  MCSNV – Museo Civico di Storia Naturale di Verona;
- *Anatomical*:
  cl – cleithrum;
  HL – head length;
  PU – preural vertebra;
  scl – supracleithrum;
  SL – standard length;
  U – ural vertebra.

SYSTEMATIC DESCRIPTION

Order Perciformes
Suborder Percoidei
Family †Pavarottiidae fam. nov.

Diagnosis

Body relatively deep, head rather large (head length 2.6 times in SL). Head length equal to or less than body depth. Supraoccipital crest thin and relatively low. Snout relatively short. Eye large, orbit diameter equal to or exceeds snout length. Mouth relatively wide, terminal. Ascending premaxillary process short. Jaw teeth small, conical. Lower jaw articulation at a level behind middle of orbit. Opercular region narrow. Vertebrae 28 (11 + 17); four posterior abdominal vertebrae with strong parapophyses. Pleural ribs moderately long. Hypurals unfused. Two supraneurals. Dorsal fin single, relatively long-based; soft part being as long as spinous part or slightly shorter. Dorsal fin with 11 to 12 strong spines and 15 to 16 soft rays. First dorsal-fin pterygiophore precedes neural spine of second vertebra. Anal fin with three spines and 12 to 14 soft rays. Anal fin base of moderate length. Dorsal and anal fins form rounded lobes posteriorly. Pectoral fins attached relatively low. Pelvic fins long, situated below pectorals or slightly anteriorly. Caudal fin truncate to slightly concave, with 17 principal rays. Scales moderately large, cycloid.

Type genus
†*Pavarottia* Bannikov & Zorzin, 2011, by monotypy and original designation.

Genus †*Pavarottia* Bannikov & Zorzin, 2011

†*Pavarottia*: Bannikov and Zorzin, 2011: 19; Bannikov, 2016: 6.

Diagnosis
Coincides with the diagnosis of the family.

Type species
†*Pavarottia lonardonii* Bannikov & Zorzin, 2011, by monotypy and original designation.

Composition
Type species, †*P. maiseyi* Bannikov, 2016 and †*P. astescalpone* sp. nov. from the Lower Eocene of Italy.

†*Pavarottia astescalpone* sp. nov.

Figures 1-3

Diagnosis
A species of the genus †*Pavarottia* which differs from both †*P. lonardonii* and †*P. maiseyi* in having: one more dorsal-fin spine and one less dorsal-fin soft ray than recorded for both †*P. lonardonii* and †*P. maiseyi*, more numerous anal-fin soft rays (14 rays vs. 12 rays in †*P. lonardonii* and 13 rays in †*P. maiseyi*), and smaller eye (orbit diameter 11.5% of SL vs. 14-15% of SL in †*P. maiseyi* and 17% of SL in †*P. lonardonii*). The new species also differs from †*P. lonardonii* in having a less deep body (maximum body depth 0.39 of SL vs. 0.51 of SL in †*P. lonardonii*) with shallower head and somewhat shorter spines in both the unpaired and pelvic fins. The new species differs from †*P. maiseyi* in its fifth dorsal-fin spine being longer than the last spine (vs. the last dorsal-fin spine longest in †*P. maiseyi*), larger lower jaw, and shorter base length of its soft dorsal fin (which is 19% SL vs. 25% SL in †*P. maiseyi*).

Etymology
The species is dedicated to the Associazione Temporanea di Scopo (AsTeSc) "Val d'Alpone – faune, flore e rocce del Cenozoico", which in 2021 obtained the inclusion of the Eocene paleontological localities of the Alpone Valley and upper Chiampo Valley into the Italian UNESCO Tentative List.

Holotype
MCSNV 21.702/21.703, part and counterpart, complete articulated skeleton, 44 mm SL (Fig. 1).

Referred specimens
None.

Type locality and horizon
North-eastern Italy, Bolca locality, Monte Postale site; upper part of the Lower Eocene, upper Ypresian, about 50 Ma (Papazzoni *et al.*, 2014).

Description
The body is relatively deep, with a shallow and relatively short caudal peduncle. The caudal peduncle depth is ca. 25% of the body depth. The head is relatively large; its length equal to the body depth. The head length is contained 2.6 times in SL. The dorsal profile of the body is almost as equally convex as the ventral profile of the body.

Head. The length of the head only slightly exceeds its depth. The orbit is moderately large; the diameter of the orbit almost equals the snout length and is contained about 3.5 times in HL. There are sclerotic ossifications in the orbit. Traces of the eyeball are preserved as a thin carbonaceous film. The mouth is wide, oblique and terminal; the lower jaw articulation is situated at a level behind the middle of the orbit. The neurocranium depth is almost 1.7 times less than its length; the moderate ovoid otolith is outlined in the otic bulla region. The frontals form the upper margin of the orbit and overhang the ethmoids. The pterotic forms a longitudinal ridge in the upper portion of the neurocranium. The thin and low supraoccipital crest is only partially preserved. The ethmoid region is evidently short; the lateral ethmoids form the anterior border of the orbit, whereas the mesethmoid has a rounded anterior margin. The parasphenoid is exposed in the lowermost portion of the orbit as a slender, stout, only slightly curved shaft. The parasphenoid has a flattened dorsal surface and no prominent ventral flange. None of the infraorbital bones are preserved except for faint remains. The premaxilla has a very short pointed ascending process and a wide articular process. The premaxillary teeth are very poorly preserved in the material examined, but these are definitely very small and conical. The maxilla has a relatively narrow shaft and an expanded distal end.

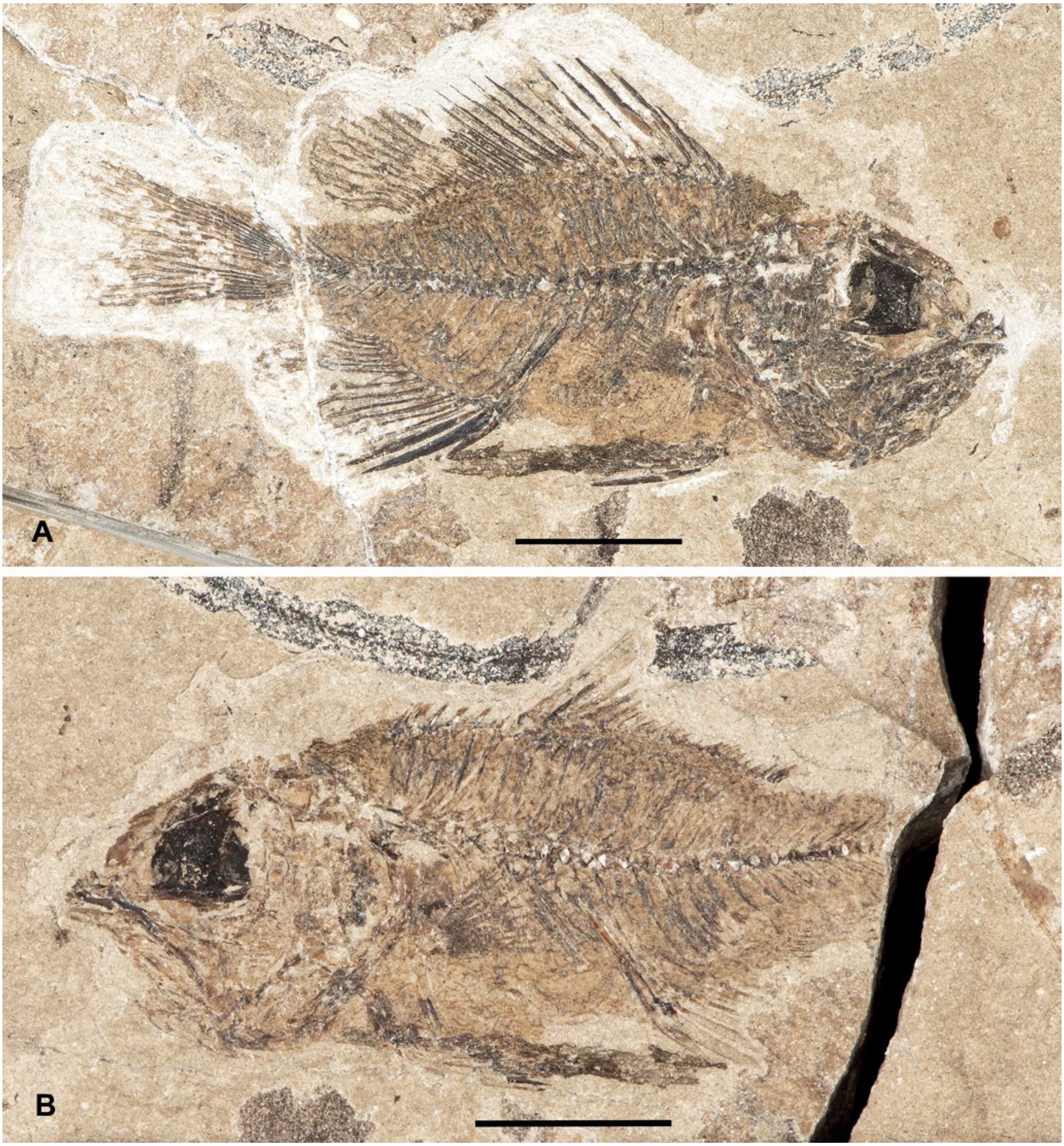

Fig. 1 – †*Pavarottia astescalpone* sp. nov., general view of holotype: **A** – MCSNV 21.702, **B** – MCSNV 21.703; Lower Eocene of Bolca in northern Italy, Monte Postale. Scale bar: 1 cm

No supramaxilla is evident. The lower jaw is relatively long; its length is about 69% of HL. The dentary occupies the anterior half of the lower jaw; it is remarkably shallow near its symphysis. Posteriorly the dentary is deeply notched. Only some of the lower jaw teeth are preserved; these are very small and conical. The angulo-articular is large; it fits tightly into the notch of the dentary. The hyomandibular shaft is almost vertical; the anterodorsal (for sphenotic) and extended dorsal (for pterotic) condyles of the hyomandibular head are recognizable in the MCSNV 21.702 counterpart. Among the pterygoids, the flat endopterygoid (mesopterygoid) is relatively well recognizable, extending below the orbit. The quadrate is evidently narrow and triangular in shape. The opercular region is relatively narrow. The preopercle is apparently slightly curved and bears short and flat serrations, as evidenced by MCSNV 21.703. The hyoid bar and branchial bones are mostly indistinguishable; although several relatively short branchiostegal rays are partially traceable; their total complement is unknown. Some pharyngeal teeth are recognizable in MCSNV 21.702; these are blunt and both big and smaller.

Axial skeleton. There are 28 vertebrae, eleven abdominal and seventeen caudal, including the urostyle. The vertebral column is slightly curved and elevated anteriorly. The vertebral centra are shortened anteroposteriorly, and bear a longitudinal ridge on the lateral surface. The length of the caudal portion of the vertebral column is 1.75 times greater than the length of the abdominal portion of the vertebral column. The neural spines of the anterior abdominal vertebrae are widened anteroposteriorly (especially those of the third to sixth vertebrae), whereas all the other neural spines are slender, both posteriorly in the abdominal region and in the caudal region. Among the thickened neural spines the fourth is the longest; subsequently, a few spines of the abdominal vertebrae decrease in length, and then increase in length again posteriorly in the series. In addition to the fourth spine, the longest neural spines are those of the anterior caudal vertebrae. The haemal spines of the caudal vertebrae are relatively long, slender and pointed. The neural spines of the anterior caudal vertebrae are shorter than the corresponding haemal spines. The last three or four abdominal vertebrae have prominent parapophyses which rapidly become longer posteriorly in the series. Most of the pleural ribs are moderately long and slender, and moderately inclined posteriorly; a few of the anterior ribs are stronger and attached high to the vertebral centra. As evidenced by the MCSNV 21.703 counterpart, the first pair of ribs is attached to the first vertebra; thus, there are a total of 11 pairs of ribs. The ribs occupy the upper half of the abdominal cavity. A few epineurals are distinguishable below the abdominal centra.

Pectoral fin and girdle. The pectoral-fin base is situated slightly closer to the vertebral column than to the ventral profile of the body, below the sixth vertebra. The pectoral fin is best seen in MCSNV 21.703; at least 12 moderately long pectoral-fin rays are recognizable. The posttemporal is evidently forked; its upper branch is easier to recognize than is the lower branch. The elongated supracleithrum bears two short retrorse spines, as evidenced by MCSNV 21.703 (Fig. 2). The cleithrum is large and mostly straight, being curved anteriorly in its upper portion; it has an extended posterodorsal projection above the pectoral-fin base. The ventral postcleithrum is robust, wedge-like in shape and pointed distally; it is oriented posteroventrally close to a vertical line. The dorsal postcleithrum seems to be recognizable in MCSNV 21.702 in the ventral portion of a posterodorsal projection of the cleithrum; it has a pointed anterodorsal process. The coracoid is relatively small; there is evidently a gap between the coracoid and cleithrum. The pectoral radials are poorly recognizable; these are slightly constricted in the middle.

Pelvic fin and girdle. The pelvic bones are relatively short and rather broad ventrally. The basipterygium extends anterodorsally to the cleithrum at an angle of ca. 57% to the body axis. The pelvic fin is very long; it is inserted anterior to the pectoral-fin base. There are five soft rays in each pelvic fin, in addition to the rather strong smooth pelvic-fin spine. The pelvic-fin spine is almost as long as the last dorsal-fin spine. The distal end of the pelvic fin reaches to far behind the anal-fin origin.

Supraneurals and dorsal fin. There are two relatively short and very slender supraneurals (predorsal bones); both supraneurals are situated behind the upper tip of the neural spine of the first vertebra.

The dorsal fin is relatively long-based and continuous, with no indentation or space between the spiny and soft parts. The origin of the dorsal fin is above the third vertebra. The spiny part of the dorsal fin consists of 12 smooth spines; the first spine is shortest and the fifth or sixth spine is longest. The second dorsal-fin spine is 2.5 times, and the last spine 1.1 times, shorter than the fifth spine. The dorsal-fin spines are relatively stout. The longest spine is 1.17 times shorter than the length of the base of the

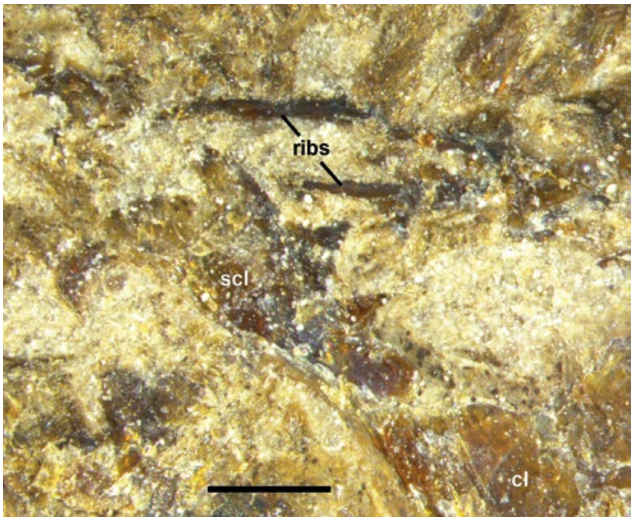

Fig. 2 – †*Pavarottia astescalpone* sp. nov., holotype MCSNV 21.703, supracleithrum and anterior ribs; Lower Eocene of Bolca in northern Italy, Monte Postale. Scale bar: 1 mm

spiny dorsal fin. The first two spines are in non-serial secondary association (supernumerary) with the first dorsal-fin pterygiophore, which precedes the neural spine of the second vertebra. The predorsal formula (Ahlstrom *et al.*, 1976; Johnson, 1984) is /0+0+2/1+1/. The soft part of the dorsal fin consists of 15 segmented rays. The dorsal-fin soft rays are branched and segmented distally. The anterior dorsal-fin soft rays are almost equal in length; after that the rays at first gradually, then more rapidly, decrease in length posteriorly in the series; thereby, the fin is rounded posteriorly. The length of the base of the soft dorsal fin is almost 1.3 times shorter than the length of the base of the spiny dorsal fin. The dorsal fin ends above the transition between the 10th and 11th caudal vertebrae. The pterygiophores of the dorsal fin penetrate down into the interneural spaces, with all the interneural spaces below the spiny dorsal fin having the ventral shaft of a single pterygiophore present, except for the second interneural space, which accommodates two pterygiophores. Few of the pterygiophores of the dorsal-fin soft rays are somewhat displaced post-mortem; however, it is clear that the interneural spaces below the soft dorsal fin have the ventral shafts of one or two pterygiophores present. The pterygiophores of the dorsal-fin spines are wide in lateral aspect whereas the pterygiophores of the dorsal-fin soft rays are narrower; the pterygiophores decrease in length posteriorly in the series. The dorsal-fin pterygiophores become more strongly inclined posteriorly in the series. The medial and proximal pterygiophores seem to be fused to one another, and each pterygiophore shaft bears a longitudinal strengthening ridge.

Anal fin. The anal fin originates below the fourth caudal vertebra; the length of the base of the anal fin slightly exceeds the length of the base of the soft part of the dorsal fin. The anal fin has three strong smooth spines and 14 soft rays. The second anal-fin spine is only slightly shorter than the third spine, which is the longest, almost 2.4 times longer than the shortest (first) spine. The first two anal-fin spines are supernumerary. The anterior anal-fin soft rays seem to slightly increase in length; after that the rays at first gradually, then more rapidly, decrease in length posteriorly in the series; thereby, the fin is rounded posteriorly. The anal fin ends under the 11th caudal vertebra. The first pterygiophore of the anal fin is strong and the longest; it is inclined obliquely posteriorly at an angle of ca. 55% to the body axis. The anterior border of the first anal-fin pterygiophore is very slightly curved. The distal ends of the anal-fin pterygiophores penetrate up into the interhaemal spaces. The pterygiophores are mostly somewhat displaced post-mortem; however, it is clear that most of the interhaemal spaces above the anal fin have the ventral shafts of two pterygiophores present.

Caudal fin and skeleton. The caudal skeleton is relatively poorly preserved because of a fracture of the matrix lying obliquely through it. The terminal centrum is composed of the fusion of PU1, U1 and U2. The neural spine of PU2 is evidently a short crest. All five hypurals, the parhypural, and the haemal spines of PU2 and PU3 seem to be autogenous. It is unclear if there are two or three epurals, as well as whether a second uroneural is present in addition to the stegural. The caudal fin is moderately long and either slightly concave or truncate posteriorly. There are 17 principal rays in the caudal fin (I,8-7,I) and about seven lower procurrent rays. The number of upper procurrent rays is unknown.

Squamation. The scales are moderately large and relatively thin. The scales appear to be cycloid; no indications of ctenii are evident. The limits of individual scales are scarcely recognizable; therefore the number of the scale rows on the body is unknown. There are both delicate concentric circuli on the scale surface and radii. The scale cover extends to the bases of the dorsal and anal fins, perhaps also to the base of the caudal fin. The lateral line is not evident.

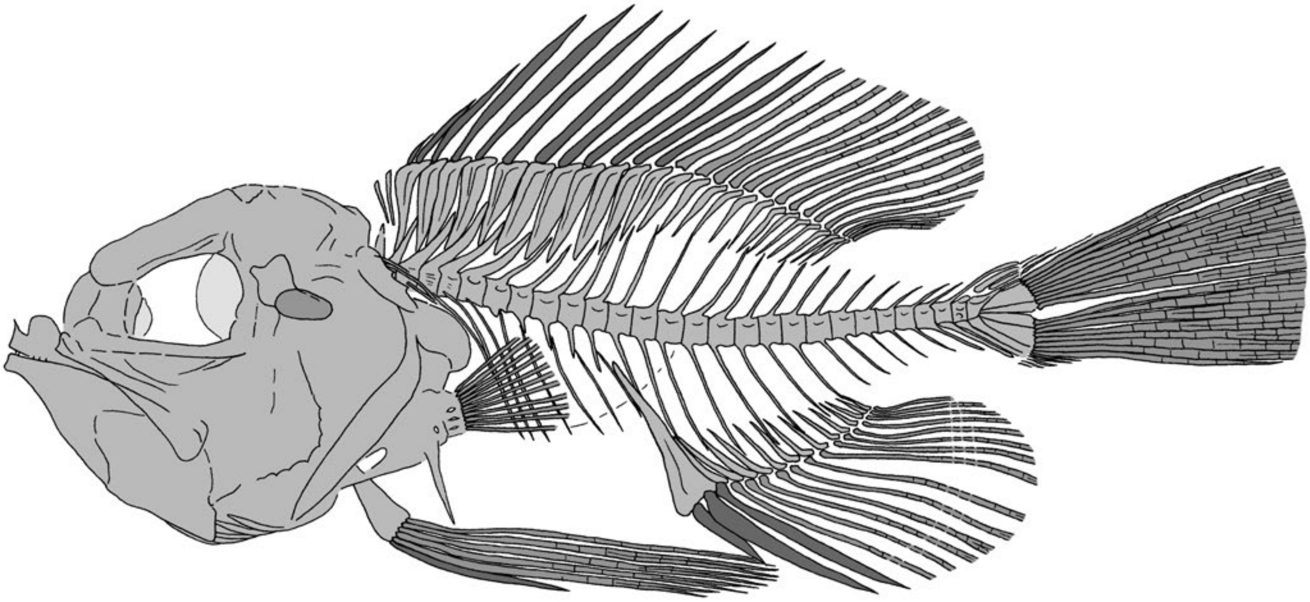

Fig. 3 – †*Pavarottia astescalpone* sp. nov., reconstruction of the skeleton based on holotype, scales omitted

Coloration. Traces of the original pigmentation pattern are preserved throughout the whole body, and on the dorsal, anal, and pelvic fins: these represent numerous small dark spots arranged more or less densely.

Measurements of the holotype, in percent of SL (44 mm) are as follows:

- Head length from tip of snout to anterior border of cleithrum: 39;
- Maximum body depth: 39;
- Depth of caudal peduncle: 9;
- Distance between tip of snout and first dorsal-fin spine: 42;
- Distance between tip of snout and first dorsal-fin soft ray: 67;
- Distance between tip of snout and anal fin: 70;
- Distance between pelvic fin and anal fin: 27.5;
- Length of base of dorsal fin: 44.5;
- Length of base of spiny dorsal fin: 25;
- Length of base of soft dorsal fin: 19;
- Length of base of anal fin: 21;
- Length of first spine of dorsal fin: 4.2;
- Length of second spine of dorsal fin: 8.7;
- Length of fifth spine of dorsal fin: 22;
- Length of last spine of dorsal fin: 20;
- Length of longest soft ray of dorsal fin: 20;
- Length of first spine of anal fin: 9.3;
- Length of longest (third) spine of anal fin: 22;
- Length of longest soft ray of anal fin: 23;
- Length of spine of pelvic fin: 19;
- Length of pelvic fin: 37;
- Length of caudal fin: ca. 28;
- Preorbital distance: 11;
- Horizontal diameter of orbit: 11.5;
- Length of lower jaw: 27.

DISCUSSION

A general overview of the morphology of the new species described above clearly supports its alignment with the genus †*Pavarottia* Bannikov & Zorzin, 2011. The genus †*Pavarottia* was regarded as a percoid of uncertain, but perhaps priacanthid, relationships (BANNIKOV and ZORZIN, 2011). Up to now the genus *Pavarottia* was known based on two Bolca species, †*P. lonardonii* Bannikov & Zorzin, 2011 from Monte Postale, and †*P. maiseyi* Bannikov, 2016 from the Pesciara. Because the genus †*Pavarottia* was represented by only a few relatively poorly preserved specimens, it was thought to be premature to either establish a new family for it or to modify the diagnoses of any of the known percoid families to accommodate this genus (BANNIKOV, 2016). The holotype of the new species described above is relatively better preserved than the material on which two other species of †*Pavarottia* were based; therefore, we believe that now there are enough data to establish a new monotypic percoid family for the genus †*Pavarottia* (see below).

Like the two previously described species of †*Pavarottia*, †*P. lonardonii* Bannikov & Zorzin, 2011 and †*P. maiseyi* Bannikov, 2016, †*P. astescalpone* sp. nov. has a relatively deep body, large eyes, oblique and wide mouth, small conical teeth, a relatively narrow opercular region, increased vertebral count with the vertebral formula typical for †*Pavarottia* (11+17=28), a caudal skeleton of the generalized percoid type, two small supraneurals, a relatively long-based and continuous dorsal fin with the similar formula (D XII, 15 vs. D XI, 16 in known species), and long pelvic fins. Also, in all three species the dorsal-fin origin is anterior in position, with the first dorsal-fin pterygiophore preceding the neural spine of the second rather than third vertebra. At the same time, †*P. astescalpone* sp. nov. differs from †*P. lonardonii* in a less deep body (maximum body depth 0.39 SL vs. 0.51 SL in †*P. lonardonii*) with a shallower head, a smaller eye (orbit diameter 11.5% SL vs. 17% SL in †*P. lonardonii*), and somewhat shorter spines in both the unpaired and pelvic fins. In these characters †*P. astescalpone* more closely resembles †*P. maiseyi* from the Pesciara than †*P. lonardonii* from the same Monte Postale locality. However, the new species differs from †*P. maiseyi* in some proportions (e.g., length of base of its soft dorsal fin is 19% SL vs. 25% SL in †*P. maiseyi*), larger lower jaw, and its fifth dorsal-fin spine is longer than the last spine (vs. the last dorsal-fin spine longest in †*P. maiseyi*). Additionally, the new species has one more dorsal-fin spine and one less dorsal-fin soft ray than recorded for both †*P. lonardonii* and †*P. maiseyi*, and more numerous anal-fin soft rays (14 rays vs. 12 rays in †*P. lonardonii* and 13 rays in †*P. maiseyi*). If it is not an artifact of preservation, the predorsal formula of †*P. astescalpone* (/0+0+2/1+1/) is different from both †*P. maiseyi* (0/0+2/1+1/) and †*P. lonardonii* (0+0/2/1+1/). The differences listed above strongly justify the establishment of a new species of the genus †*Pavarottia*, the second species of this genus for the Monte Postale site.

A general overview of the morphology of †*Pavarottia* clearly supports its alignment with percoid fishes in their traditional sense. Percoidei, the "largest and most diverse of the perciform suborders is undoubtedly polyphyletic..." (Johnson, 1993, p. 15) and is diagnosed by several features that are plesiomorphic for the Perciformes; this group includes those perciforms that cannot be placed in other suborders. More recently, citing molecular data, many families traditionally included in the Percoidei are removed from this suborder (e.g., Nelson *et al.*, 2016), or its composition is even limited to two or three families (Betancur-R. *et al.*, 2017). According to the more traditional view of Nelson (2006), the suborder Percoidei includes 79 Recent families.

As previously mentioned (Bannikov and Zorzin, 2011), the genus †*Pavarottia* especially strongly resembles the percoid family Priacanthidae (catalufas) (see Fitch and Crooke, 1984; Starnes, 1988) in its general physiognomy and in a number of its morphological features. At the same time, †*Pavarottia* lacks such important priacanthid apomorphies (Starnes, 1988) as modified spiny scales (spinoid scales: Roberts, 1993), the reduction of the supraneurals to one or none, the reduction in the vertebral number to 23, the reduction in the principal caudal-fin rays number from the primitive complement of 9+8 to 8+8, and possession of spinules on the fin elements. Additionally, the genus †*Pavarottia* has one to two dorsal-fin spines more than recorded for priacanthids, and the first pair of ribs seem to be attached to the first vertebra rather than to the third as in priacanthids. Unlike the Priacanthidae (with their reduced number of vertebrae), the vertebral count of †*Pavarottia* is somewhat increased from the plesiomorphic percoid number of 24-25 (Gosline, 1968; Johnson, 1984) to 28 (11 + 17). Therefore, †*Pavarottia* cannot be accommodated in the family Priacanthidae.

Bannikov and Zorzin (2011) stated that perhaps †*Pavarottia* is a better candidate for the priacanthid sister group, according to its general appearance and multiple shared characters. However, it is at least equally probably that the Eocene genus is not related to the Priacanthidae and obtained a number of morphological conditions in parallel with catalufas because of the similar mode of life (nocturnal feeders). The earliest articulated skeletal remains of the Priacanthidae consist of a few specimens belonging to the species †*Pristigenys substriata* (Blainville), also from Bolca (see Starnes, 1988; Carnevale *et al.*, 2017).

The vertebral count of †*Pavarottia* gen. nov. is somewhat increased from the plesiomorphic percoid number of 24-25 and is rather unusual for the Percoidei (in its traditional sense). Among 92 extant percoid families and *incertae sedis* genera listed by Johnson (1984: Table 120), only a few acanthoclinids (now regarded as a subfamily of plesiopids: Smith-Vaniz and Johnson, 1990; Nelson, 2006), centrarchids, owstoniine cepolids, girellids, opistognathids, percichthyids and pseudochromids exhibit the vertebral formula of †*Pavarottia* (11+17=28). However, representatives of these families differ greatly from the Eocene genus in many other respects.

Dorsal- and anal-fin formulas of †*Pavarottia* (D XI-XII, 15-16; A III, 12-14) both lie within the ranges recorded in a relatively few percoid groups: families Caesionidae, Centrarchidae, Dinopercidae, Haemulidae, Opistognathidae, Oplegnathidae, Pentacerotidae, Percichthyidae, Plesiopidae, Serranidae, Sinipercidae, and the *incertae sedis* genus *Hapalogenys* (Johnson, 1984: Table 120). None of these groups exhibit such diagnostic features of †*Pavarottia* as, for example, extremely large eyes. Moreover, among these groups only a few pentacerotids and serranids have an anterior shift of the dorsal fin, with the first dorsal-fin pterygiophore present in the first (rather than second) interneural space.

The Eocene *incertae sedis* percoid fish genus †*Bradyurus* from Bolca has vertebral (11+16) and dorsal-fin (XII, 16-17) formulas similar to those of †*Pavarottia* (Bannikov and Zorzin, 2012). However, in other respects †*Bradyurus* differs greatly from †*Pavarottia*, having a longer body, short anal and pelvic fins, smaller mouth with bigger teeth, etc.

Therefore, although the genus †*Pavarottia* is represented by a relatively few specimens grouped into three species, we believe that the morphological peculiarities of this genus support the establishment of a new monotypic percoid family for it.

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LITERATURE CITED

Agassiz L., 1833-1844. *Recherches sur les poissons fossiles*. Tome IV, V. Petitpierre, Neuchâtel.

Ahlstrom E.H., Butler J.L., Sumida B.Y., 1976. Pelagic stromateoid fishes (Pisces, Perciformes) of the eastern Pacific: kinds, distributions and early life histories and observations on five of these from the northwest Atlantic. *Bulletin of Marine Science,* 26: 285-402.

Baldwin C.C., Johnson G.D., 1993. Phylogeny of the Epinephelidae (Teleostei: Serranidae). *Bulletin of Marine Science,* 52 (1): 240-283.

Bannikov A.F., 2014. The systematic composition of the Eocene actinopterygian fish fauna from Monte Bolca, northern Italy, as known to date. *Miscellanea Paleontologica n. 12. Studi e Ricerche sui Giacimenti Terziari di Bolca,* 15: 23-33.

Bannikov A.F., Tyler J.C., 1995. Phylogenetic revision of the fish families Luvaridae and †Kushlukiidae (Acanthuroidei), with a new genus and two new species of Eocene luvarids. *Smithsonian Contributions to Paleobiology,* 81: 1-45.

Bannikov A.F., Zorzin R., 2011. A new priacanthid-like percoid fish (Perciformes) from the Eocene of Bolca, Italy. *Miscellanea Paleontologica n. 10. Studi e Ricerche sui Giacimenti Terziari di Bolca,* 13: 17-27.

Bannikov A.F., Zorzin R., 2012. Redescription of the percoid fish *Bradyurus* (=*Eolabroides*) *szajnochae* (De Zigno) (Perciformes, Percoidei) from the Eocene of Bolca in northern Italy. *Miscellanea Paleontologica n. 11. Studi e Ricerche sui Giacimenti Terziari di Bolca,* 14: 7-17.

Betancur-R. R., Wiley E.O., Arratia G., Acero A., Bailly N., Miya M., Lecointre G., Orti G., 2017. Phylogenetic classification of bony fishes. *BMC Evolutionary Biology,* 17: 162, pp. 1-40. DOI 10.1186/s12862-017-0958-3.

Carnevale G., Bannikov A.F., Marramà G., Tyler J.C., Zorzin R., 2014. The Pesciara-Monte Postale *Fossil-Lagerstätte*: 2. Fishes and other vertebrates. In: Papazzoni C.A. *et al.* (Editors). The Bolca Fossil-Lagerstätten: A window into the Eocene World. *Rendiconti della Società Paleontologica Italiana,* 4: 37-63.

Carnevale G., Johnson G.D., Marramà G., Bannikov A.F., 2017. A reappraisal of the Eocene priacanthid fish *Pristigenys substriata* (Blainville, 1818) from Monte Bolca, Italy. *Journal of Paleontology,* 91 (3): 554-565. doi: 10.1017/jpa.2017.19

Fitch J.E., Crooke S.J., 1984. Revision of eastern Pacific catalufas (Pisces: Priacanthidae) with description of a new genus and discussion of the fossil record. *Proceedings of the California Academy of Sciences,* 43 (19): 301-315.

Gosline W.A., 1968. The suborders of perciform fishes. *Proceedings of the United States National Museum,* 124 (3647): 1-78.

JOHNSON G.D., 1984. Percoidei: development and relationships. In: Moser H.G. *et al.* (Editors). Ontogeny and systematics of fishes. *American Society of Ichthyologists and Herpetologists. Special Publication,* 1: 464-498.

JOHNSON G.D., 1993. Percomorph phylogeny: progress and problems. *Bulletin of Marine Science,* 52 (1): 3-28.

MARRAMÀ G., BANNIKOV A.F., TYLER J.C., ZORZIN R., CARNEVALE G., 2016. Controlled excavations in the Pesciara and Monte Postale sites provide new insights about the palaeoecology and taphonomy of the fish assemblages of the Eocene Bolca Konservat-Lagerstätte, Italy. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 454: 228-245.

NELSON J.S., 2006. *Fishes of the World.* 4th edn. John Wiley & Sons, Hoboken, New Jersey: 601 pp.

NELSON J.S., GRANDE T.C., WILSON M.V.H., 2016. *Fishes of the World.* 5th edn. John Wiley & Sons, Hoboken, New Jersey: 707 pp.

PAPAZZONI C.A., CARNEVALE G., FORNACIARI E., GIUSBERTI L., TREVISANI E.,2014. The Pesciara-Monte Postale *Fossil-Lagerstätte*: 1. Biostratigraphy, sedimentology and depositional model. In: Papazzoni C.A. *et al.* (Editors). The Bolca Fossil-Lagerstätten: A window into the Eocene World. *Rendiconti della Società Paleontologica Italiana,* 4: 29-36.

PATTERSON C., 1993. An overview of the early fossil record of acanthomorphs. *Bulletin of Marine Science,* 52 (1): 29-59.

ROBERTS C.D., 1993. Comparative morphology of spined scales and their phylogenetic significance in the Teleostei. *Bulletin of Marine Science,* 52 (1): 60-113.

SMITH-VANIZ W.F., JOHNSON G.D., 1990. Two new species of Acanthoclininae (Pisces: Plesiopidae) with a synopsis and phylogeny of the subfamily. *Proceedings of the Academy of Natural Sciences of Philadelphia,* 142: 211-260.

STARNES W.C., 1988. Revision, phylogeny and biogeographic comments on the circumtropical marine percoid fish family Priacanthidae. *Bulletin of Marine Science,* 43 (2): 117-203.

TYLER J.C., BANNIKOV A.F., 1997. Relationships of the fossil and Recent genera of rabbitfishes (Acanthuroidei: Siganidae). *Smithsonian Contributions to Paleobiology,* 84: 1-35.

VOLTA G.S., 1796. *Ittiolitologia Veronese del Museo Bozziano ora annesso a quello del Conte Giovambattista Gazola e di altri gabinetti di fossili veronesi.* Stamperia Giuliari, Verona: 323 pp.

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A new species of the *incertae sedis* percoid fish †*Bradyurus* (Perciformes s.l.) from the Eocene of Bolca in northern Italy

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ABSTRACT

A new species of the percoid fish genus †*Bradyurus* (Perciformes s.l.), †*B. alessandroi*, is described based on a single skeleton from the Eocene locality of Bolca (Monte Postale site) in northern Italy. This is the second species of the genus †*Bradyurus* Gill, 1904 recorded from Bolca. †*Bradyurus alessandroi* sp. nov. differs from the type species of the genus, †*B. szajnochae* (DE ZIGNO, 1887) (from the Pesciara cave site), in having two rather than three epurals; one fewer vertebrae (26 vs. 27 in †*B. szajnochae*); 13 rather than 12 dorsal-fin spines; 8 rather than 7 anal-fin soft rays; and a different predorsal formula (0/0/0+2/1+1/1/ vs. /0/0/0+2/1+1/1/).

Key words: Perciformes, Percoidei, †*Bradyurus alessandroi* sp. nov., Eocene, northern Italy, Bolca locality, Monte Postale site.

RIASSUNTO

Una nuova specie di pesci percoidi del genere †*Bradyurus* (Perciformes s.l.), †*B. alessandroi*, è descritta sulla base di un unico scheletro proveniente dalla località eocenica di Bolca (Monte Postale) nell'Italia settentrionale. Questa è la seconda specie del genere †*Bradyurus* Gill, 1904 documentata a Bolca. *Bradyurus alessandroi* sp. nov. differisce dalla specie tipo del genere †*B. szajnochae* (DE ZIGNO, 1887) (proveniente dal giacimento della Pesciara), per avere due epurali anziché tre, un numero inferiore di vertebre (26 anziché 27 in †*B. szajnochae*); 13 spine della pinna dorsale anziché 12; 8 raggi molli della pinna anale anziché 7, e diversa formula predorsale (0/0/0+2/1+1/1/ vs. /0/0/0+2/1+1/1/).

Parole chiave: Perciformes, Percoidei, †*Bradyurus alessandroi* sp. nov., Eocene, Italia settentrionale, Bolca, Monte Postale.

INTRODUCTION

The Early Eocene fish fauna of the famous locality Monte Bolca, to the north of Verona in northern Italy, is exceptionally rich in marine fishes, especially in acanthopterygians (e.g., FRIEDMAN and CARNEVALE, 2018). The first comprehensive monographic work on these fishes, the "Ittiolitologia Veronese", was published by the Abbot G.S. Volta in 1796. Some years later, Agassiz (1833-1844) published his monumental treatise on comparative paleoichthyology, which was largely based on materials from Monte Bolca. Since that time a large number of papers have been devoted to the Monte Bolca fish fauna, based on the thousands of specimens extracted from this locality and now disseminated in museums and research institutes around the world. Monte Bolca marks the first fossil record of many groups of fishes found on modern coral reefs (BELLWOOD, 1996). The latest lists of the Monte Bolca fishes (BANNIKOV, 2014; CARNEVALE *et al.*, 2014) include 238 taxa, among which 222 represent actinopterygians.

One of the Bolca acanthomorph species was described by De Zigno (1887) as a labrid, †*Crenilabrus szajnochae*. Since the generic name *Crenilabrus* Oken (ex CUVIER, 1817) is a junior synonym of *Symphodus* Rafinesque, 1810, the fossil species was re-described by Eastman (1904) as †*Symphodus szajnochae*. Subsequently, he established the new genus †*Eolabroides* for the species *szajnochae* (EASTMAN, 1914). However, the generic name †*Eolabroides* Eastman, 1914 should be regarded as the junior synonym of †*Bradyurus* Gill, 1904 (see BANNIKOV and ZORZIN, 2012). Bellwood (1999) reviewed the status of the Bolca pharyngognath fishes and determined that the genus †*Eolabroides* Eastman is not a pharyngognath.

†*Bradyurus szajnochae* (De Zigno, 1887) was re-described by Bannikov and Zorzin (2012) from the Pesciara cave site of the Bolca locality as a percoid of uncertain but perhaps haemulid relationships. During the field excavations executed by the employees of the Museo Civico di Storia Naturale di Verona and the Cerato family (Bolca township) in 2021 at the Monte Postale site of the Bolca locality, were discovered, among the other materials, a specimen (in part and counterpart) representing the genus †*Bradyurus*. This specimen is different from †*B. szajnochae* in some morphological characters; it is described below as a new species, †*B. alessandroi*. The quantitative and taphonomic analyses of the Pesciara and Monte Postale fish assemblages performed recently (Marramà *et al.*, 2016) clearly defined two distinctive paleocommunities and two different depositional settings.

Material and methods

The specimens were studied using a stereomicroscope WILD Heerbrugg with attached camera lucida drawing arm. Some details of the specimens examined were best seen when the specimens were moistened with alcohol. Measurements were taken with a dial caliper to the nearest 0.1 mm.

Interneural and interhaemal spaces are numbered based on the vertebra whose neural or haemal spine forms the anterior border of the space, with the first space being between the first and second neural or haemal spines (following Baldwin and Johnson, 1993; Bannikov and Tyler, 1995; Tyler and Bannikov, 1997; etc.).

All extinct taxa are marked with daggers (†) preceding their names.

Comparative material examined:

- †*Bradyurus szajnochae* (De Zigno, 1887): MCSNV IG 126488, MCSNV IG 126491/126492, and MCSNV IG 43366/43367;
- CMP 5303/4340 and 4331/4331*a*; Pesciara cave site.

Abbreviations are as follows:

- *Institutional*:
  CMP – Carnegie Museum, Pittsburgh
  MCSNV – Museo Civico di Storia Naturale di Verona;
- *Anatomical*:
  Bh – basihyal;
  Ch – ceratohyal;
  HL – head length;
  PU – preural vertebra;
  Rar – retroarticular;
  SL – standard length;
  U – ural vertebra;
  Uh – urohyal.

Systematic description

Order Perciformes s.l.
Suborder Percoidei s.l.
Family *incertae sedis*
Genus †*Bradyurus* Gill, 1904

†*Bradyurus*: Gill, 1904: 846; Bannikov and Zorzin, 2012: 10.
†*Eolabroides*: Eastman, 1914: 336.

Diagnosis
Moderately elongate fish with a short and deep caudal peduncle. Head moderately large. Maximum body depth almost equals head length. Supraoccipital crest low. Lower jaw articulation under middle of orbit. Jaws with single series of strong conical teeth and few fangs. Preopercle slightly curved, with prominent retrorse spines along its posterior border. Opercle without spines. Vertebrae 26-27 (10-11+16). Hypaxial hypurals fused. Epurals 2 or 3. Ribs relatively short. Supraneurals 3, predorsal formula /0/0/0+2/1+1/1/ or 0/0/0+2/1+1/1/. Dorsal fin long-based and continuous, with 12 or 13 spines and 16 to 17 soft rays. Anal fin short-based, with 3 strong spines (2nd longest) and 7 or 8 rays. Pelvics inserted behind level of pectoral-fin base or under it. Caudal fin rounded, composed of 17 principal rays. Scales relatively large and ctenoid or cycloid, with numerous radii. Lateral line slightly arched and interrupted behind anal fin.

Type Species
†*Symphodus* (=*Crenilabrus*) *szajnochae* (De Zigno, 1887), by monotypy.

Composition
†*Bradyurus szajnochae* (De Zigno, 1887) and †*B. alessandroi* sp. nov.

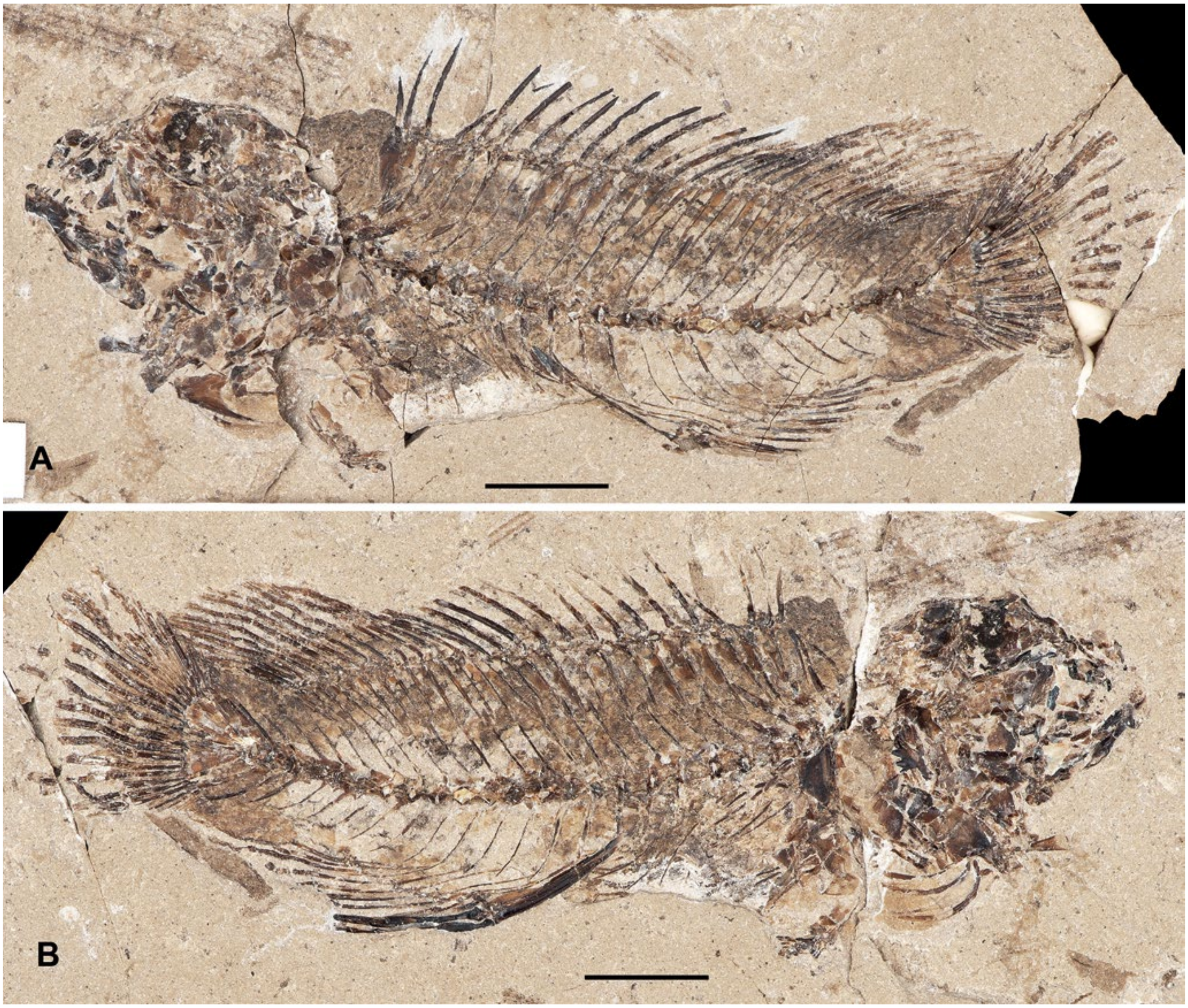

Fig. 1 – *Bradyurus alessandroi* sp. nov., holotype: **A** – MCSNV 21.690, **B** – MCSNV IG 21.689; Lower Eocene of Bolca in northern Italy, Monte Postale. Scale bar: 1 cm

†*Bradyurus alessandroi* sp. nov.

Figures 1-3

Diagnosis
As for the genus.

Etymology
The specis is named after the son of the second listed author (RZ), Alessandro.

Holotype
MCSNV 21.689/21.690, part and counterpart, complete articulated skeleton, 78 mm SL (Fig. 1).

Referred specimens
None.

Type locality and horizon
North-eastern Italy, Bolca locality, Monte Postale site; upper part of the Lower Eocene, upper Ypresian, about 50 Ma (Papazzoni *et al.*, 2014).

Description
The body is moderately deep, with a short and deep caudal peduncle. The caudal peduncle depth is about 0.43 of the body depth. The head is moderately large; its length (tip of snout to anterior edge

of upper part of pectoral girdle) is less than the body depth. The head length is contained 3.1 times in SL. The dorsal profile of the body is almost as equally convex as the ventral profile of the body.

Head. The head is relatively deep, with its depth somewhat less than its length. The skull is rather poorly preserved, with many of its bones being fractured and scarcely recognizable. The orbit is moderate and placed high in the head depth; there are sclerotic ossifications in the orbit. The horizontal diameter of the orbit is about 19% HL. The snout is much (somewhat less than twice) longer than the orbit diameter. The mouth is moderately wide and terminal. The lower jaw articulation is situated anterior to the middle of the orbit. The neurocranium is moderately deep, with the supraoccipital crest evidently poorly developed. Fragments of the posterior part of the otoliths are recognizable in the MCSNV 21.690 counterpart. The ethmoid region is moderately long. The parasphenoid is relatively slender and almost straight; it is exposed at the lower border of the orbit. The vomerine teeth and infraorbital bones are not recognizable. The upper jaw bones are badly damaged; however, a relatively long and slender ascending premaxillary process and a robust articular process are distinguishable. Only several rather strong blunt conical teeth of different size are preserved of the upper jaw. The lower jaw is moderately deep; its length is about 53-54% HL. The dentary slightly projects ventrally near the moderately deep symphysis. The oral border of the dentary bears relatively strong blunt conical teeth of different sizes. The dentary is notched posteriorly, and the anterior process of the angulo-articular enters to the posterior notch of the dentary. There seems to be a small gap between the dorsal branch of the dentary and the main body of the massive angulo-articular. The retroarticular process is thick and extended; the small retroarticular bone occupies its posterior portion. Although the hyomandibula is strongly damaged, its shaft appears to be almost vertically oriented. Among the highly fragmented pterygoids and suspensorium bones only the endopterygoid (mesopterygoid) is recognizable; it is flat and extended and situated below the orbit. The opercular region is moderately narrow. The preopercle is partly preserved in MCSNV 21.689, where it is thick, relatively narrow and probably only slightly curved; a few strong retrorse spines are present on its posterior border. The other bones of the gill cover are highly fragmented, with the opercle apparently being rather wide. The ceratohyal is relatively deep, concave anteroventrally and seems to be perforated by a narrow "beryciform foramen" (McAllister, 1968). An interdigitating suture between the ceratohyal and epihyal is not evident. The distinction between the hypohyals is obscured. The number of branchiostegal rays is unclear; the branchiostegals are sabre-like in shape. The urohyal is a flattened laminar bone thickened along its ventral margin; the bone is moderately deep and concave posteriorly, with a very long pointed posterior projection along the ventral border (Fig. 2). The basihyal (glossohyal) is narrow and wedge-shaped. Neither the branchial bones nor pharyngeal teeth are recognizable except for several small slender straight and pointed teeth in MCSNV 21.690, which represent either pharyngeal dentition or the gill rakers.

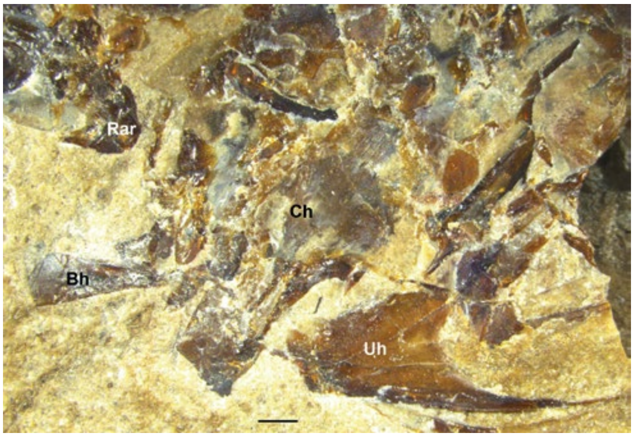

Fig. 2 – *Bradyurus alessandroi* sp. nov., holotype MCSNV 21.690, hyoid bar; Lower Eocene of Bolca in northern Italy, Monte Postale. Scale bar: 1 mm

Axial skeleton. There are 26 vertebrae, ten abdominal and sixteen caudal, including the urostyle. The axis of the vertebral column is very slightly elevated anteriorly. The vertebral centra are almost rectangular in lateral view. The length of the caudal portion of the vertebral column is about 1.6 times greater than the length of the abdominal portion of the vertebral column. The vertebral spines are only moderately long, and are straight or slightly curved. The neural spines of the five anterior abdominal vertebrae are widened anteroposteriorly, whereas all the other neural spines are slender, both posteriorly in the abdominal region and in the caudal region. Among the thickened neural spines the fourth one is the longest; subsequently, a few spines of the abdominal vertebrae decrease in length, and then increase in length again posteriorly in the series. The longest neural

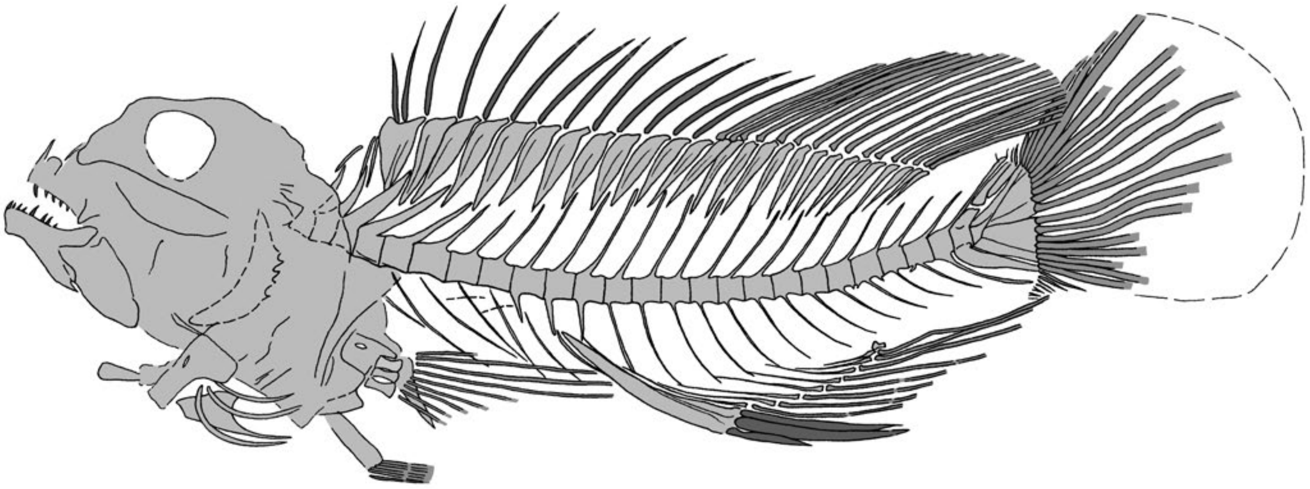

Fig. 3 – *Bradyurus alessandroi* sp. nov., reconstruction of the skeleton based on holotype, scales omitted

spines are those of the anterior caudal vertebrae. The haemal spines of the caudal vertebrae are usually as equally long as the opposite neural spines, but slightly more curved and pointed. The first two anterior haemal spines are shortened and not as pointed as the succeeding spines. Most of the neural spines arise from the middle of the centra, whereas the anterior haemal spines arise from the anterior half of the centra. Slender parapophyses are recognizable in at least the two posteriormost abdominal vertebrae, the last parapophysis being the longest. The pleural ribs are very slender and rather strongly inclined posteroventrally; they are only moderately long and occupy the upper half of the abdominal cavity. Several slender epineurals are partly recognizable below the middle abdominal vertebrae.

Pectoral fin and girdle. The pectoral girdle is strongly damaged; its details are scarcely identifiable. The posttemporal and supracleithrum are not recognizable at all. The cleithrum is strongly damaged, but it seems to be large and only moderately curved, with a posterodorsal projection. The upper part of the cleithrum is located under the third and fourth vertebrae. The ventral postcleithrum is relatively broad and short. The MCSNV 21.689 counterpart reveals that the coracoid has a well-developed wide postcoracoid process. The scapula is a dense bone penetrated by the ovoid foramen in its upper part. There is a posterior projection of the scapula above the pectoral radials. Three pectoral radials are strong and hourglass-shaped; these increase in size downward. The lowermost pectoral radial is attached to the coracoid, whereas the two upper radials adjoin the scapula. The base of the pectoral fin is subvertical and situated under the fifth vertebra, near the midpoint between the vertebral column and the ventral profile of the body. About ten pectoral-fin ray bases are recognizable in the MCSNV 21.689 counterpart; it is unclear if it is the total complement or not. According to the length of the few completely preserved rays, the pectoral fins are relatively long.

Pelvic fin and girdle. The pelvic bones are incompletely preserved; these seem to be moderately long and relatively narrow. Only the base of the pelvic fins is preserved; each fin seems to contain a spine and five soft rays. The pelvic fin is inserted approximately under the pectoral-fin base.

Supraneurals and dorsal fin. There are three slender supraneurals (predorsal bones) devoid of apical projections. The predorsal formula (Ahlstrom *et al.*, 1976; Johnson, 1980, 1984) is 0/0/0+2/1+1/1/. The dorsal fin is long-based and continuous; it originates over the fifth vertebra and terminates over the 23th/24th vertebra transition. There are 13 dorsal-fin spines and 16 soft segmented and branched rays. The dorsal-fin spines are moderately strong. The spines gradually increase in length from the first to the fourth, with the succeeding spines being almost equal in length. The (presumably) longest last spine is 1.3 times longer than the second spine and 1.9 times longer than the first spine. The first two dorsal-fin spines are supernumerary on the first dorsal-fin pterygiophore; these are rather closely spaced. The longest soft ray of the dorsal fin is 1.5 times longer than the longest dorsal-fin spine.

The length of the base of the soft portion of the dorsal fin is 1.4 times shorter than the base length of the spiny portion of the dorsal fin. The anterior dorsal-fin soft rays are almost equal in length; after that, the rays at first gradually, then more rapidly, decrease in length posteriorly in the series; thereby, the fin is rounded posteriorly. The posterior margin of the lobe of the dorsal fin reaches behind the caudal-fin base. There are a total of 27 dorsal-fin pterygiophores. The first pterygiophore is large and sturdy, expanded anteroposteriorly, and bears a longitudinal strengthening ridge; the succeeding pterygiophores gradually become narrower. Most of the dorsal-fin pterygiophores are almost equal in length and moderately inclined, but the posterior pterygiophores of the soft rays become more strongly inclined and of decreased length. The interneural spaces below the dorsal fin have the ventral shafts of one (usually anteriorly) or two (usually posteriorly) pterygiophores present. The pterygiophores have the proximal and medial elements fused.

Anal fin. The anal fin is relatively short-based; it originates under the transition between the fifth and sixth caudal vertebrae and terminates under the eleventh caudal vertebra. There are three spines and eight soft segmented and branched rays in the anal fin. The anal-fin spines are very strong. Although the distal portions of the anal-fin spines are obscured in the matrix, it is evident that the second spine is the longest, much longer than the longest dorsal-fin spine. The first two anal-fin spines are supernumerary. Most of the anal-fin soft rays are incompletely preserved distally; the few complete (posteriormost) rays seem to be not shorter than the longest anal-fin spine, but are shorter than the longest dorsal-fin soft rays. The last anal-fin soft ray reaches the caudal-fin base. The first anal-fin pterygiophore is very long and sturdy; it is strongly inclined at an angle about 28° to the body axis. The succeeding anal-fin pterygiophores are exceptionally slender and lie almost in parallel to the body axis; these decrease in length posteriorly in the series. The pterygiophores have the proximal and medial elements fused.

Caudal fin and skeleton. The caudal skeleton is weakly consolidated. The terminal centrum is composed of the fusion of PU1, U1 and U2. The parhypural and haemal spine of PU2 (and perhaps of PU3) are autogenous. A parhypurapophysis seems to be absent. Since the preservation of the material is only moderate, it is unclear if there is a fusion of the fourth and fifth hypurals, but the third hypural is evidently divided from the fourth. The hypaxial hypural plate seems to be formed from the fused first and second hypurals. The epaxial and hypaxial hypural plates are divided by a long and narrow slit. The neural and haemal spines of PU3 are longer than those of the preceding vertebra. The neural spine of PU2 is a relatively short crest. There are two epurals and a stegural; the condition of the second uroneural is unclear. The caudal fin is incomplete distally. There are 17 principal rays in the caudal fin (I,8-7,I); there are about six procurrent rays above and seven rays below. There are no indications of the presence of a procurrent spur (JOHNSON, 1975).

Squamation. Large and thin scales cover the entire body and the head, probably also the base of the dorsal and caudal fins. The limits of individual scales are scarcely recognizable; therefore the number of scale rows on the body is unknown. Each trunk scale bears numerous radii in the basal field; the number of radii varies, up to 15. The head scales are definitely cycloid and lack radii, having only circuli. Ctenii are not recognizable as well on the trunk scales, although this is perhaps due to inadequate preservation. The breast scales are smaller and especially thin. The lateral line is not recognizable.

Coloration. Vague traces of the original pigmentation pattern are preserved throughout the whole body, dorsal and anal fins.

Measurements of the holotype, in percent of SL (78 mm) are as follows:

- Head length from tip of snout to anterior border of cleithrum: 32;
- Maximum body depth: 35;
- Depth of caudal peduncle: 15;
- Distance between tip of snout and first dorsal-fin spine: 36;
- Distance between tip of snout and first dorsal-fin soft ray: 67;
- Distance between tip of snout and anal fin: 72;
- Distance between pelvic fin and anal fin: 34.5;
- Length of base of dorsal fin: 54;
- Length of base of spiny dorsal fin: 30;
- Length of base of soft dorsal fin: 22;
- Length of base of anal fin: 17;
- Length of first spine of dorsal fin: 7;
- Length of second spine of dorsal fin: 10;
- Length of fourth spine of dorsal fin: 12;
- Length of last spine of dorsal fin: 13.5;
- Length of longest soft ray of dorsal fin: 21;
- Length of last soft ray of anal fin: 18;
- Preorbital distance: 11;
- Horizontal diameter of orbit: 6;
- Length of lower jaw: 17.

Discussion

Being undoubtedly a member of the genus †*Bradyurus*, the new species differs from the type species of this genus, †*B. szajnochae* (De Zigno, 1887) (from the Pesciara cave site), in having two rather than three epurals; fewer vertebrae (26 vs. 27 in †*B. szajnochae*); 13 rather than 12 dorsal-fin spines; 8 rather than 7 anal-fin soft rays; a different predorsal formula (0/0/0+2/1+1/1/ vs. /0/0/0+2/1+1/1/); and probably in having cycloid (vs. ctenoid in †*B. szajnochae*) scales. Also, the urohyal of †*B. alessandroi* sp. nov. has a long pointed posterior projection, a feature not known for †*B. szajnochae*. These differences justify the recognition of the Monte Postale specimen of †*Bradyurus* as a new species.

Although the genus †*Bradyurus* resembles labrid fishes in some respects (overall general appearance, meristic characters, oral dentition, fused hypaxial hypurals, long and narrow hypural slit, etc.), our observations on the material from the MCSNV (Bannikov and Zorzin, 2012) supported the conclusion of Gill (1904) and Bellwood (1991, 1999) about the non-pharyngognath nature of †*B. szajnochae*. The new species †*B. alessandroi* also does not reveal any indication of a tooth-bearing lower pharyngeal bone that is characteristic for the suborder Labroidei of the order Perciformes s.l., as it was defined by Kaufman and Liem (1982) and Stiassny and Jensen (1987), as well as for some of the percoid families (see Rosen and Patterson, 1990).

In its overall general appearance, extensive serration of the preopercle, strong inclination of the first anal-fin pterygiophore, rounded caudal fin and meristic characters, †*Bradyurus* resembles some representatives of the order Scorpaeniformes [in its traditional sense (Nelson, 2006; Nelson *et al.*, 2016), whereas Imamura and Yabe (2002) rejected Scorpaeniformes s.l. as a monophyletic group, and Betancur-R. *et al.* (2017) incorporated them into the Perciformes]. This order is characterized by the presence of a suborbital stay, a posterior extension of the third suborbital bone, which extends across the cheek to the preopercle. However, none of the specimens available of either †*B. szajnochae* (see Bannikov and Zorzin, 2012) or †*B. alessandroi* sp. nov. shows the possession of a suborbital stay. Therefore, the possible relationships of †*Bradyurus* with Scorpaeniformes s.l. apparently should be rejected.

All the features of the genus †*Bradyurus* clearly indicate that it belongs to the suborder Percoidei (in its traditional sense) of the order Perciformes s.l., but the position of †*Bradyurus* amongst the percoids is uncertain. Percoidei, the "largest and most diverse of the perciform suborders is undoubtedly polyphyletic..." (Johnson, 1993, p. 15) and is diagnosed by several plesiomorphic for the Perciformes features; this group includes those perciforms that cannot be placed in other suborders. More recently, citing molecular data, many families traditionally included in the Percoidei are removed from this suborder (e.g., Nelson *et al.*, 2016), or its composition is even limited to two or three families (Betancur-R. *et al.*, 2017). According to the more traditional view of Nelson (2006), the suborder Percoidei includes 79 Recent families.

†*Bradyurus* has a somewhat increased number of vertebrae relative to the number found in generalized percoids (10-11+16=26-27). Gosline (1968) noted that the "basal number" of vertebrae in percoids is 24-25 (10+14-15). The combination of this character with the dorsal-fin formula (XII-XIII, 16), anal-fin formula (III, 7-8) and extensively serrated preopercle, is found in none of the extant genera of percoids. Also, in †*Bradyurus* the first and second hypurals are apomorphically fused into the hypaxial hypural plate. None of the synapomorphies of advanced percoid families is known to be present in †*Bradyurus* (Bannikov and Zorzin, 2012).

We already pointed out (Bannikov and Zorzin, 2012) that the vertebral count of *Bradyurus* as well as its dorsal- and anal-fin formulas lie within the range recorded in Recent haemulids (Percoidei in their traditional sense). The representatives of the Haemulidae do not have the fusion of the first and second hypurals, and extensively serrated preopercle that are characteristic of the Eocene genus. However, certain similarities of †*Bradyurus* and haemulids, including the fusion of the proximal and medial elements of the dorsal- and anal-fin pterygiophores that are characteristic for the Haemuloidea (Johnson, 1980), may reflect some distant relationships of the two groups (Bannikov and Zorzin, 2012).

The morphology of the urohyal of †*B. alessandroi* sp. nov., as a flattened laminar bone thickened along its ventral margin and forming a very long pointed posterior projection, is quite unusual. Among the multiple fish urohyals figured by Kusaka (1974) only a few have a somewhat similar contour, those being of apparently not related fishes (e.g., the trachichthyid *Gephyroberyx*, some serranids, the lutjanid *Lutjanus gibbus*, some labrids and scarids). Thus, is does not contribute much to the search of the relatives of †*Bradyurus*.

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LITERATURE CITED

AGASSIZ L., 1833-1844. *Recherches sur les poissons fossiles*. Tome IV, V. Petitpierre, Neuchtel.

AHLSTROM E.H., BUTLER J.L., SUMIDA B.Y., 1976. Pelagic stromateoid fishes (Pisces, Perciformes) of the eastern Pacific: kinds, distributions and early life histories and observations on five of these from the northwest Atlantic. *Bulletin of Marine Science*, 26: 285-402.

BALDWIN C.C., JOHNSON G.D., 1993. Phylogeny of the Epinephelinae (Teleostei: Serranidae). *Bulletin of Marine Science,* 52 (1): 240-283.

BANNIKOV A.F., 2014. The systematic composition of the Eocene actinopterygian fish fauna from Monte Bolca, northern Italy, as known to date. *Miscellanea Paleontologica n. 12. Studi e Ricerche sui Giacimenti Terziari di Bolca*, 15: 23-33.

BANNIKOV A.F., TYLER J.C., 1995. Phylogenetic revision of the fish families Luvaridae and Kushlukiidae (Acanthuroidei), with a new genus and two new species of Eocene luvarids. *Smithsonian Contributions to Paleobiology*, 81: 1-45.

BANNIKOV A.F., ZORZIN R., 2012. Redescription of the percoid fish *Bradyurus* (=*Eolabroides*) *szajnochae* (De Zigno) (Perciformes, Percoidei) from the Eocene of Bolca in northern Italy. *Miscellanea Paleontologica n. 11. Studi e Ricerche sui Giacimenti Terziari di Bolca*, 14: 7-17.

BELLWOOD D.R., 1996. The Eocene fishes of Monte Bolca: the earliest coral reef fish assemblage. *Coral Reefs*, 15: 11-19.

BELLWOOD D.R., 1999. Fossil pharyngognath fishes from Monte Bolca, Italy, with a description of a new pomacentrid genus and species. *Miscellanea Paleontologica, Studi e Ricerche sui Giacimenti Terziari di Bolca* 8: 207-217.

BETANCUR-R. R., WILEY E.O., ARRATIA G., ACERO A., BAILLY N., MIYA M., LECOINTRE G., ORTI G., 2017. Phylogenetic classification of bony fishes, *BMC Evolutionary Biology*, 17: 162, pp. 1-40. DOI 10.1186/s12862-017-0958-3.

CARNEVALE G., BANNIKOV A.F., MARRAMÀ G., TYLER J.C., ZORZIN R., 2014. The Pesciara-Monte Postale *Fossil-Lagerstätte*: 2. Fishes and other vertebrates: 37-63. In: Papazzoni C.A. *et al.* (Editors). The Bolca Fossil-Lagerstätten: A window into the Eocene World. *Rendiconti della Società Paleontologica Italiana*, 4.

DE ZIGNO A., 1887. Nuove aggiunte alla ittiofauna dell'epoca Eocena. *Memorie dell'Istituto Veneto di Scienze, Lettere ed Arti*, 23: 9-33.

EASTMAN C.R., 1904. Description of Bolca fishes. *Bulletin of the Museum of Comparative Zoology*, 46 (1): 1-36.

EASTMAN C.R., 1914. Catalog of the fossil fishes in the Carnegie Museum. Part II. Supplement to the catalog of fishes from the Upper Eocene of Monte Bolca. *Memoirs of the Carnegie Museum*, 6 (5): 315-348.

FRIEDMAN M., CARNEVALE G., 2018. The Bolca Lagerstätten: shallow marine life in the Eocene. *Journal of the Geological Society*, 175 (4): jgs2017-164.

GILL T., 1904. Extinct pediculate and other fishes. *Science*, 20 (520): 845-846.

GOSLINE W.A., 1968. The suborders of perciform fishes. *Proceedings of the U.S. National Museum*, 124 (3647): 1-78.

IMAMURA I., YABE M., 2002. Demise of the Scorpaeniformes (Actinopterygii: Percomorpha): an alternative phylogenetic hypothesis. Hokkaido University, *Bulletin of the Fisheries Science,* 53: 107-128.

JOHNSON G.D., 1975. The procurrent spur: an undescribed perciform caudal character and its phylogenetic implications. *Occasional Papers of the California Academy of Sciences*, 121: 1-23.

JOHNSON G.D., 1980. The limits and relationships of the Lutjanidae and associated families. *Bulletin of the Scripps Institution of Oceanography of the University of California*, 24: 1-114.

JOHNSON G.D., 1984. Percoidei: development and relationships, *in* Moser H.G. *et al.* (Editors), Ontogeny and systematics of fishes. *American Society of Ichthyologists and Herpetologists. Special Publication*, 1: 464-498.

JOHNSON G.D., 1993. Percomorph phylogeny: progress and problems. *Bulletin of Marine Science*, 52 (1): 3-28.

KAUFMAN L.S., LIEM K.F., 1982. Fishes of the suborder Labroidei (Pisces: Perciformes): phylogeny, ecology, and evolutionary significance. *Breviora*, 472: 1-19.

Kusaka T., 1974. *The urohyal of fishes*. University of Tokyo Press, Tokyo: 320 pp.

Marramà G., Bannikov A.F., Tyler J.C., Zorzin R., Carnevale G., 2016. Controlled excavations in the Pesciara and Monte Postale sites provide new insights about the palaeoecology and taphonomy of the fish assemblages of the Eocene Bolca Konservat-Lagerstätte, Italy. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 454: 228-245.

McAllister D.E., 1968. The evolution of branchiostegals and associated opercular, gular, and hyoid bones, and the classification of teleostome fishes, living and fossil. *Bulletin of the National Museum of Canada*, 221: 1-239.

Nelson J.S., 2006. *Fishes of the World*. 4th edn. John Wiley & Sons, Hoboken, New Jersey: 601 pp.

Nelson J.S., Grande T.C., Wilson M.V.H., 2016. *Fishes of the World*. 5th edn. John Wiley & Sons, Hoboken, New Jersey: 707 pp.

Papazzoni C.A., Carnevale G., Fornaciari E., Giusberti L., Trevisani E.,2014. The Pesciara-Monte Postale *Fossil-Lagerstätte*: 1. Biostratigraphy, sedimentology and depositional model. In: Papazzoni C.A. *et al.* (Editors). The Bolca Fossil-Lagerstätten: A window into the Eocene World. *Rendiconti della Società Paleontologica Italiana,* 4: 29-36.

Rosen D.E., Patterson C., 1990. On Müller's and Cuvier's concepts of pharyngognath and labyrinth fishes and the classification of percomorph fishes, with an atlas of percomorph dorsal gill arches. *American Museum Novitates*, 2983: 1-57.

Stiassny M.L.J., Jensen J.S., 1987. Labroid interrelationships revisited: morphological complexity, key innovations, and the study of comparative diversity. *Bulletin of the Museum of Comparative Zoology*, 151: 269-319.

Tyler J.C., Bannikov A.F., 1997. Relationships of the fossil and Recent genera of rabbitfishes (Acanthuroidei: Siganidae). *Smithsonian Contributions to Paleobiology*, 84: 1-35.

Volta G.S., 1796. *Ittiolitologia Veronese del Museo Bozziano ora annesso a quello del Conte Giovambattista Gazola e di altri gabinetti di fossili veronesi*. Stamperia Giuliari, Verona, 323 pp.

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Studi e ricerche sui giacimenti terziari di Bolca, XXII - Miscellanea Paleontologica, 19 2022: 55-59

Bibliografia e citazioni di Bolca. Opere dal 1550 al 1850 (settimo contributo)

ROMANO GUERRA*, ROBERTO ZORZIN**
*(*Bologna; **Verona)*

ABSTRACT

Authors present bibliography and Bolca quotations in their works dating from 1550 to 1850. It is the seventh contribution that complements the previous and highlights the importance of this fossil deposit in the Italian and international palaeontologic history.

Key words: Bolca, bibliography, 1550-1850.

RIASSUNTO

Gli Autori presentano la bibliografia e le citazioni di Bolca in opere che vanno dal 1550 al 1850. Si tratta del settimo contributo che ulteriormente evidenzia l'importanza di questo giacimento di fossili nella storia della Paleontologia.

Parole chiave: Bolca, bibliografia, 1550-1850.

PREMESSA

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Schede
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Località
Nel costituire la bibliografia di quest'area, interamente compresa nel comune di Vestenanova in provincia di Verona, e, solo per pochi metri, anche in quello di Altissimo in provincia di Vicenza, si è tenuto conto anche dei giacimenti vicini che fanno da contorno a vicende geologiche e umane impossibili da separare. Sono, pertanto, state incluse le seguenti località:

- Bolca;
- Vegroni;
- Pesciara;
- Monte Spilecco;
- Monte Postale (Comune di Altissimo, Provincia di Vicenza);
- Monte Purga di Bolca;
- Monte Colle;
- Cascate Stanghellini.

Sono presenti schede che non hanno valenza naturalistica.

Altre citazioni
Sono incluse citazioni che, anche se non riguardano direttamente le località sopra indicate, sono comunque riferibili alla medesima area e alle sue caratteristiche e precisamente:

- Pesci fossili del Veronese anche nelle sue variazioni;
- Ligniti di Monte Purga;
- Basalti colonnari di Monte Purga.

Cronologia
L'elenco segue l'ordine cronologico. Al termine viene fornito l'elenco alfabetico degli autori e l'anno di riferimento.

Pagine
Il solo numero si riferisce al totale delle pagine del libro. Quando il numero è preceduto dalla sigla bc si riferisce a una pagina contenente la citazione. Ne viene indicata solo una per ogni opera interessata. Per il resto ci si attiene alle norme internazionali sulla bibliografia.

Abbreviazioni

Sono utilizzate le seguenti abbreviazioni:

- Per.: Periodico, giornale, mensile, ecc.;
- Rec.: Recensione seguita dell'autore citato;
- Tomo: vale anche per volume, libro o parole simili;
- S.E.: senza editore;
- S.L.: senza località;
- S.D.T.: senza dati tipografici;
- S.N.: senza numerazione.

Divisione

In relazione alla vastità dell'argomento, la bibliografia avrà la seguente suddivisione:

- Opere dal 1550 al 1850;
- Opere dal 1851 al 1900;
- Opere dal 1901 al 1950;
- Opere dal 1951 al 2000;
- Opere dal 1901 al 2020.

Ogni settore sarà poi seguito dall'aggiornamento dei precedenti.

Collaborazione

Gli autori sono certi che l'elenco è incompleto e ringraziano anticipatamente coloro che segnaleranno opere mancanti o eventuali errori di testo. Per quanto riguarda le opere mancanti, si prega di comunicare agli autori tramite copia del frontespizio e le pagine interessate, aggiungendo il numero totale delle pagine del tomo.

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Bibliografia 1550-1850
(Settimo contributo)

1744

Dalla Corte G. *Dell'istorie della città di Verona*. Venezia, Camporese A, Savioli A., Tomo II, pp. 386.

1767

Davila M. *Catalogue systematique et raisonnè des curiosités de la nature et de l'art, qui composent le cabinet de M.D.* Parigi, Braisson, Tomo III, pp. 290.

Stengel S.L. *De structura exteriore globi terraquei, et quomodo corpora marina, alique peterificata in montes, terraeque strata pervenint dissertatio*. Heidelberg, Haener J.J., pp. 110.

1770

Giornale d'Italia. S.D.T., Per. (26 maggio 1770), Rec. (Targioni Tozzetti), pp. 377-384.

1781

Feldmann eredi. *Catalogue du cabinet des curiosités consistant en mineraux, petrifications, pierres, bois, platines polies, coquilles S.D.T. & autres pieces trés rares de fou docteur en medicine & physicien Bernhard Feldmann*. S.D.T., pp. 261.

1786

De la Lande M. *Voyage en Italie*. Parigi, Veuve Desaint, Tomo IX, pp. 615.

1788

The critical review: or annals of literature. Londra, Hamilton A., Tomo LXV, Rec. (Johnson, Piotti), pp. 474.

1789

Strange J. *Abhandlung von den säulenartigen Gebuergen und andern vulkanischen Naturererschreibungen in venetianischen Gebiete*. Heidelberg, Pfähler, pp. 161.

1792

Chamot J.A. de. *Vervol op M. Noël Chomel algemeen huishoudelyk-, natuur-, zedekundig-en konstwoordenboek*. Amsterdam, Yntema J., Tomo VIII, pp. 5285-6000.

1794

Amoretti C. *Sopra il cangiamento di clima avvenuto in Italia, e specialmente in Lombardia*. Milano, Marelli G. In "Opuscoli scelti sulle scienze e sulle arti", Tomo XIX, pp. 405-419.

Widenmann J.F.W. *Handelbuch des oryktognostischen Theils der Mineralogie*. Lipsia, Grusius S.L., pp. 1040.

1795

Boerio G. *Comuni giurisdizioni e vicariati della provincia veronese col formolario dei titoli ai pubblici rappresentanti giusdicenti e vicarj della provincia stessa*. Verona, Carattoni D., pp. bc26.

1799

Buffon, Sonnini. *Histoire naturelle, générale et particuliere par Leclerc de B.* Parigi, Dufart F., Tomo VIII, Rec. Ferber), pp. 474.

Gatterer C.W.J. *Allgemeines Repertorium der mineralogischen und salzwerkwissenschaftlichen Literatur*. Gieffen, Heper G.F., Tomo II, Rec. (Ittiolitologia), pp. 371.

Schultes I.A. *Über Reisen im Vaterlande zur Aufnahme der vaterlaendischen Vaturgeschichte an die adeliche Jugend*. Vienna, S.E., pp. 83.

1801

Socquet J.M. *Essai sur le calorique*. Parigi, Desray, pp. 473.

1806

Italienische Miscellen. Tübingen, Cotta J.G., Tomo V, Rec. (Fortis), pp. 192.

1807

Wilson J. *A history of mountains, geografical and mineralogical*. Londra, Nicol, Whithe, Tomo I, pp. 176.

Annales du museum d'histoire naturelle. Parigi, Tourneisen fils, Tomo IX, pp. 500.

1809

Piranesi, Blanvillain J.F.C. *Le Pariséum, ou tableu actuel de Paris*. Parigi, Piranesi, Leblanc, pp. 412.

1810

Cobres J.P.E. von. *Kurze Uebersicht der naturhistorischen Bibliotek und des Naturen-Kabinet*. Ausburg, Königreiche Baiern, pp. 23.

1813

Cicognara L. *Storia della scultura dal suo risorgimento in Italia sino al secolo di Napoleone per servire di continuazione alle opere di Winckelmann e di d'Agincourt*. Venezia, Ricotti, Tomo I, pp. 486.

1814

Itinéraire d'Italie ou la description des voyages par les routes plus fréquentées. Milano, Vallardi P.J., pp. 258.

1816

Pollinius C. *Horti et provinciae veronensis plantae novae vel minus cognites*. Ticino, Galeati P., eredi, Tomo I, pp. 39.

1817

Schouw J.F. *En excursion til monte Bolca og Campo di Fontana i det veronesiske landskab*. Copenhagen, Kiøpping P.D. In "Molbech C., Atene et Maanedsfkift", giugno-settembre 1817, pp. 220-216.

Scortegagna F.O. *De singulari ichthyolitho epistola F.O.S. medici leoniceni ad virum clarissimus co: Arnaldum Arnaldi I Tornieri*. Padova, Seminario, pp. 77.

1819

Almanacco per l'anno bisestile 1820 contenente le più interessanti notizie cronologico-statistiche della città di Padova e suo territorio. Padova, Penada, Tomo III, pp. 151.

1820

Buffon, Lacépéde *Le opere di B. nuovamente ordinate ed arricchite della sua vita e di un ragguaglio dei progressi della storia naturale dal MDCCL in poi dal conte di L.* Venezia, Apollo, Tomo XXXVIII, pp. 567.

Buffon, Lacépéde *Le opere di B. nuovamente ordinate ed arricchite della sua vita e di un ragguaglio dei progressi*. Venezia, Apollo, Tomo XXXIX, pp. 708.

1822

Gazzetta di Milano. S.D.T., Per. (25 novembre 1822), pp. 1877-1894.

Der Wanderer. S.D.T., Per. (25 settembre 1822), pp. 4.

1823

Almanacco di Venezia per l'anno 1823. S.L., Graziosi. pp. 196.

1824

Itinéraire classique d'Italie. Parigi, Langlois H., pp. 336.

1825

Blumenbach G.F. *Manuale di storia naturale*. Lugano, Vanelli G, Co., Tomo III, pp. 368.

1827

Delafosse, Raspail, Lesson. *Bulletin des sciences naturelles et de géologie*. Parigi, Bureau de bulletin, Tomo XII, pp. 408.

1828

Valentin L. *Voyage en Italie fait en l'année 1820*. Parigi, Gabon, Co., pp. 399.

1831

Baldwin E. *Annals of Yale college, in New Hawen, Connecticut from its foundation, to the year 1831*. New Haven, Howe H., pp. 324.

1832

Mèmoires du museum d'histoire naturelle. Parigi, Belin A., Tomo XXXIX. Rec. (Faujas S. Fond), pp. 370.

1833

Ghirelli L. *Il diluvio universale provato con la storia naturale*. Roma, S.E., pp. 38.

Dell'itinerario d'Italia e sue più notabili curiosità d'ogni specie. Ancona, Sartorj A., Tomo I, pp. 302.

Saturday magazine. Londra, Parker, Per. (gennaio 1833, supplemento), pp. 33-40.

The reasury of knowledge and library of reference. New York, Conner, Cooke, Tomi IV, V, VI, pp. 412.

1835

Bloch. *Storia naturale de' pesci di B. colle figure disegnate al naturale, opera classificata per ordini, generi e specie giusta il sistema di Linnéo*. Firenze, Battelli V. e figli, Tomo V, pp. 636.

Piscatorial reminescences and gleanings by an old angler and bibliopolist. Londra, Pickering W., pp. 246.

1836

Bailly de Merlieux M.C., Jullien M.A. *Mémorial encyclopedique et progressif des connaissances humaines*. Parigi, Direzione, Tomo VI, pp. 752.

1837

Vallardi G. *Itinerario d'Italia o sia descrizione dei viaggi per le strade più frequentate sì per posta che altrimenti*. Milano, Vallardi P.G., pp. 369.

Die Natur ihre Wunder und Geheimnisse, oder die Bridgewatwe-Bücher. Stoccarda, Neff P. Tomo V, pp. 406.

Foglio di Verona. S.D.T., Per. (24 dicembre 1837), pp. 343-346.

1838

Cuvier G. *Dubbii apposti al sistema delle grandi età geologiche e al conforme discorso*. Napoli, De Serafino R. Co., pp. 131.

1839

Agassiz L. *Enumération des poissons fossiles d'Italie*. Bologna, Marsili J. In "Nuovi Annali delle scienze naturali", Anno II, Tomo IV, pp. 325-332.

Mantel G. *Die Phänomene der Geologie*. Bonn, Cohen, Tomo I, pp. 371.

1841

Tonini C. *Manuale della chimica tecnologica*. S.L., Antonelli. In "Memorie dell'Accademia dell'Agricoltura Scienze e Lettere di Verona", Tomo XXVII, pp. 665.

1842

Cantù I. *Sulla quarta riunione degli scienziati italiani in Padova. Lettera di I.C. membro di quel congresso al fratello Cesare*. Milano, Pirola L., pp. 16.

Donaldson J. *A treatise on mansures, their nature, preparation, and application*. Londra, Baldwin R., pp. 416.

1844

Stato personale del clero della città e diocesi di Verona per l'anno bisestile 1844. Verona, Libanti P., pp. 96.

1845

Bellinger Brodie P. *A history of the fossil insects in the secondary rocks of England*. Londra, Van Voorst J., pp. 130.

1846

Ganz G. *Biografie di illustri veronesi. Girolamo Fracastoro*. Verona, Libanti P., Per. (Foglio di Verona), (2 gennaio 1846), Parte II, pp. 33-36.

1847

Coghlan F. *Hand-book for European tourist through Belgium, Holland, the Rhine, Germany, Switzerland, Italy and France*. Londra, Hughes H., pp. 879.

Nardo G.D. *Biografia scientifica del fu Stefano a Renier clodiense*. Venezia, Antonelli G., pp. 56.

1848

Giebel *Fauna der Vorwelt mit steter Berückfichtigung der lebenden Thiere*. Lipsia, Brockhaus F.U., Tomo I, pp. 467.

Ladoucette J.C.F. *Histoire topographie, antiquités usage, dialectes des Hautes-Alpes*. Parigi, Gide, Co., pp. 806.

Dizionario della scienze naturali nel quale si tratta metodicamente dei differenti esseri della natura considerati o in loro stessi, secondo lo stato attuale delle nostre cognizioni, … Firenze, Battelli V., Co., Tomo XIX, pp. 921.

1849

Humbolt A. de. *Cosmos essai d'une description physique du monde*. Milano, Turati C., Tomo II, pp. 459.

1850

Catalogue des livres de géologie, botanique, zoologie, médicine, anatomie, physiologie, physique, littérature, histoire, français et etranger, composant la bibliothéque de fu M.H.D. de Blainville. Parigi, Labitte H. Rec. (Scortegagna), pp. 148.

Elenco degli autori con anni di pubblicazione

Amoretti C.: 1794
Agassiz L.: 1839
Bailly de Merlieux M.C., Jullien M.A.: 1836
Baldwin E.: 1831
Bellinger Brodie P.: 1845
Bloch: 1835
Blumenbach G.F.: 1825
Boerio G.: 1795
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Buffon, Sonnini: 1799
Cantù I.: 1842
Chamot J.A. de: 1792
Cicognara L.: 1813
Cobres J.P.E. von: 1810
Coghlan F.: 1847
Cuvier G.: 1838
Dalla Corte G.: 1744
Davila M.: 1767
De la Lande M.: 1786
Delafosse, Raspail, Lesson: 1827
Donaldson J.: 1842
Feldmann eredi: 1781
Ganz G.: 1846
Gatterer C.W.J.: 1799
Ghirelli L.: 1833
Giebel: 1848
Humbolt A. de: 1849
Ladoucette J.C.F.: 1848
Mantel G.: 1839
Nardo G.D.: 1847
Piranesi, Blanvillain J.F.C.: 1809
Pollinius C.: 1816
Schouw J.F.: 1817
Schultes I.A.: 1799
Scortegagna F.O.: 1817
Socquet J.M.: 1801
Stengel S.L.: 1767
Strange J.: 1789
Tonini C.: 1841
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Studi e ricerche sui giacimenti terziari di Bolca, XXII - Miscellanea Paleontologica, 19 2022: 61-66

Bibliografia e citazioni di Bolca. Opere dal 1851 al 1900 (sesto contributo)

ROMANO GUERRA*, ROBERTO ZORZIN**
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Pagine
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Abbreviazioni

Sono utilizzate le seguenti abbreviazioni:

- Per.: Periodico, giornale, mensile, ecc.;
- Rec.: Recensione seguita dell'autore citato;
- Tomo: vale anche per volume, libro o parole simili;
- S.E.: senza editore;
- S.L.: senza località;
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Divisione

In relazione alla vastità dell'argomento, la bibliografia avrà la seguente suddivisione:

- Opere dal 1550 al 1850;
- Opere dal 1851 al 1900;
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- Opere dal 1951 al 2000;
- Opere dal 2001 al 2020.

Ogni settore sarà poi seguito dall'aggiornamento dei precedenti.

Collaborazione

Gli autori sono certi che l'elenco è incompleto e ringraziano anticipatamente coloro che segnaleranno opere mancanti o eventuali errori di testo. Per quanto riguarda le opere mancanti, si prega di comunicare agli autori tramite copia del frontespizio e le pagine interessate, aggiungendo il numero totale delle pagine del tomo.

Negli aggiornamenti saranno citate tutte le persone che contribuiranno a integrare/migliorare questo elenco e i precedenti.

BIBLIOGRAFIA 1851-1900
(SESTO CONTRIBUTO)

1853

HUMBOLT A. VON, BOMPLAND A. *Personal narrative of travels to the equinoctial regions of America during the years 1799-1804*. Londra, Bohn H.G., Tomo III, pp. 442.

MASSALONGO A. *Catalogo ragionato dei rettili fino ad ora conosciuti nella provincia veronese*. Venezia, Antonelli. In "Memorie dell'Accademia d'Agricoltura Scienze e Lettere di Verona", Tomo XXIX, pp. 383-434.

1857

DE BETTA E. *Erpetologia delle provincie venete e del Tirolo meridionale*. S.L., Vicentini, Franchini. In "Memorie dell'Accademia dell'Agricoltura Scienze e Lettere di Verona", Tomo XXXV, pp. 365.

FRANCESCHI A. *A G. Batt. Dott. Bidasio-Imberti per senno e integrità rispettabile per paterne sollecitudini esimio nel fausto giorno delle nozze della sua Ilda diletta A.F. in argomento di antica osservanza…* Treviso, Andreola-Medesin, pp. 11.

GAUDIN C.T., STROZZI C. *Mémoire sur quelques gisements des feuilles fossiles de la Toscane*. Zurigo, Zurcher et Furrer, pp. 47.

MASSALONGO A.B. *Sulla flora fossile di Sinigallia. Lettere del D.A.M. al chiariss. Sig. Giuseppe Scarabelli*. Verona, Merlo A., pp. 32.

Reivas dell'Ibis. *Brevi notizie storico-statistiche sul monte Bolca*. Milano, Civelli G. e C. In "Notizie scientifico-letterarie-artistiche dell'Ibis", Anno I, pp. 21-25.

Reivas dell'Ibis. *Reliquie della flora cretacea della provincia veronese*. Milano, Civelli G. e C. In "Notizie scientifico-letterarie-artistiche dell'Ibis", Anno I, pp. 153-154.

Reivas dell'Ibis. *Cenni sulla costituzione geognostica del monte Pastello nella provincia veronese*. Milano, Civelli G. e C. In "Notizie scientifico-letterarie-artistiche dell'Ibis", Anno I, pp. 355-356.

Reivas dell'Ibis. *I gessi della provincia veronese –Nuova scoperta di piante fossili nella provincia veronese – Nuove cave di ligniti della provincia di Verona*. Milano, Civelli G. e C. In "Notizie scientifico-letterarie-artistiche dell'Ibis", Anno I, pp. 88-90.

Reivas dell'Ibis. *Brevi notizie storico-statistiche sul monte Bolca*. Milano, Civelli G. e C. In "Notizie scientifico-letterarie-artistiche dell'Ibis", Anno I, pp. 21-25.

1858

Il berico. S.D.T. Per. (18 luglio 1858) pp. 8.

1859

TORNABENE F. *Flora fossile dell'Etna*. Catania, Accademia Gioenia, pp. 147.

1860

MOLIN R. *De rajidis tribus bolcanis*. Vienna, S.E., pp. 7.

WINKLER T.C. *Description de quelques nouvelles espéces de poissons fossiles du calcaire lithographique de Solenhofen*. S.D.T., pp. 94.

1861

Milne Edwards A. *Note sur les crustacés fossiles*. Parigi, Société. In "Bulletin de la Société géologique de France", Tomo XVIII, pp. 656-662.

1862

D'Archiac A. *Cours de paléontologfie stratigraphique professé au museum d'histoire naturelle*. Parigi, Savy, Tomo III, pp. 491.

1865

Adunanza del giorno 26 novembre 1865. Venezia, Segreteria. In "Atti del I.R. Istituto Veneto di Scienze, Lettere ed Arti", novembre 1865-ottobre 1866, pp. 1300.

1866

Supplemento mensile al consultore amministrativo. Verona, Civelli G. e C., Per. (29 gennajo 1866), pp. 8.

1867

Boccardo G. *La terra prima dell'origine della specie umana*. Milano, Redazione. In "L'universo illustrato", Per. (27 ottobre 1867), pp. 67-68.

1868

Ball J. *A guide to the eastern Alps*. Londra, Longmans, Green and Co., pp. 639.

1870

Burgmeister H. *Histoire de la création exposé scientifique des phases de dévelopement du globe terrestre et de ses habitans*. Parigi, Savy, pp. 689.

1873

Ball J. *South Tyrol and Venetian or Dolomite Alps*. Londra, Longmans, Green and Co., pp. 529.

Zambusi del Lago F. *Racconti della nonna, storia di Verona dalla sua origine fino all'anno 1873*. Verona, Minerva, pp. 438.

1874

Bassani F. *Annotazioni sui pesci fossili del calcare eocene di m. Bolca*. Padova, Prosperini P. In "Atti della Società veneto-trentina di Scienze naturali", Tomo III, pp. 169-191.

De Zigno A. *Annotazioni paleontologiche, pesci fossili nuovi del calcare eoceno dei monti Bolca e Postale*. Venezia, Segreteria, pp. 14.

Lasaulx A. von *Sopra le rocce eruttive del Vicentino*. Roma, Barbera. In "Bollettino del R. Comitato Geologico Italiano", Tomo V, pp. 16-51.

Schimper W. P. *Traité de paléontologie végétale ou la flore du monde primitif dans ses rapport avec les formations géologiques et la flore du monde actuel*. Parigi, Bailliere J.B. e figli, Tomo III, pp. 896.

Nature, a weekly illustrated journal of science. Londra, Macmillan & Co., Tomo X, pp. 534.

1875

Bittner A. *Die Brachyuren der vicentinische Tertiärgebirges*. Vienna, K.&K. Hof, pp. 46.

Krauss J. *Börsenblatt für den deutschen Buchhandel und die mit ihm verwandten Geschäftszweige*. Lipsia, Redazione, Annata XLI, Parte IV, pp. 156.

Perini O. *Storia di Verona dal 1790 al 1822*. Verona, Noris C., Tomo III, pp. 588.

1877

Bassani F. *Ittiodontoliti del Veneto*. Padova, Prosperini P., pp. 38.

1878

De Zigno A. *Aggiunte alla ittiologia dell'epoca eocena*. Venezia, Segreteria, pp. 13.

Strafforello G., Treves E. *Dizionario universale di geografia, storia e biografia*. Milano, Treves, pp. 2240.

Società toscana di scienze naturali, adunata del 7 luglio 1878. Roma, Barbera. In "Bollettino del R. Comitato Geologico d'Italia", Anno IX, pp. 332-341.

1879

Lioy P. *Balene sui nostri monti*. Milano, Treves F.lli. Per. (L'illustrazione italiana), (9 febbraio 1879), pp. 81-86.

Nicholson H.A. *A manual of palaeontology for the use of students*. Edinburgh and London, Blackwood W. and sons, Tomo II, pp. 531.

Seguenza G. *Le formazioni teziarie nella provincia di Reggio Calabria*. Roma, Salviucci. In "Reale Accademia dei Lincei", Anno CCLXXVII, pp. 446.

1880

Bassani F. *Appunti su alcuni pesci fossili d'Austria e di Wurtenberg*. Padova, Prosperini P., pp. 38.

Bassani F. *Contribuzione alla fauna ittiolitica del Carso presso Comen in Istria*. Padova, Prosperini P., pp. 15.

Bassani F. *Note paleontologiche*. Padova, Prosperini P. pp. 16.

Bittner A. *Beiträge zur kenntniss alttertiärer echiniden Fauna der Südalpen*. Vienna, Holder A. In “Beiträgen zur Paläontologie Oesterreich-Ungarns”, pp. 93.

Humbolt A. von *Briefe A.V.H. an seinen Bruder Wilhelm, Heraugegeben von der Familie v.H. in Ottmachau*. Stoccarda, Cotta J.G., LXXXVIII, pp. 228.

Sauvage M.H.-E. *Étude sur las poissons des faluns de Bratagne*. Chalon sur Saone, Dejussieu J., pp. 43.

Sauvage M.H.-E. *Nouvelles recherches sur les poissons fossiles découverts par m. Alby a Licata, en Sicile*. Parigi, Masson G., pp. 50.

Viviani G.F. *Il fondo cartografico dell’accademia di agricoltura scienze e lettere di Verona (e altri disegni dell’archivio accademico)*. Verona, S.E. In “Atti e memorie dell’Accademia di Agricoltura, Scienze e Lettere di Verona”, Tomo XXXII, pp. 151-239.

Bollettino del r. comitato geologico italiano. Roma, Barbera. Tomo IX. Rec. (De Zigno), pp. 590.

1881

Van Beneden M.P,-J. *Sur un poisson fossile nouveau des environs de Bruxelles*. Bruxelles, Hayez F. In “Bulletins de l’Académie royale de Belgique”, Serie III, Tomo I, n. 2, pp. 13.

1882

Goiran A. *Prodromus florae veronensis (continuazione)*. Firenze, Pellas G. In “Giornale botanico italiano”, Tomo XIV, pp. 75-97.

Nicolis E. *Note illustrative della carta geologica della provincia di Verona*. Roma, Tipografia Nazionale. In “Bollettino del R. Comitato Geologico Italiano d’Italia”, Tomo XIII, pp. 221-230.

Relazione annuale dell’ispettore capo al comitato geologico sul lavoro della carta geologica (1881-1882). Roma, Tipografia Nazionale. In “Bollettino del R. Comitato Geologico d’Italia”, Anno XIII, pp. 2-28.

1883

Cantù C. *Storia universale*. Torino, Unione Tip. Ed. Torinese, Tomo I, pp. 559.

Annali di agricoltura 1883 relazione sul servizio minerario nel 1881. Roma, Botta eredi, pp. 427.

1884

(Gozzadini G.) *Maria Teresa di Serego-Allighieri Gozzadini*. Bologna, Zanichelli N., pp. 694.

1886

Hoernes R. *Manuel de paléontologie*. Parigi, Savy., pp. 741.

1887

Davis J.W.D. *The fossil fishes of the chalk of mount Lebanon, in Syria*. Dublino, R. Dublin Society. In “The scientific transactions of the Royal Dublin Society”, Tomo III, Serie II, pp. 457-636.

Woodward S. *Note in the affinities of the so-called “torpedo” (Cyclobatis, Egerton) from the cretaceous of mount Lebanon*. Hertford, Astin S. e figli. In “Geoelogical magazine”, Decade III, Tomo IV, N. 18, pp. 3.

1888

Toni F. *Della collezione geologica, paleontologica e paletnologica da lui raccolta*. Foligno, Scariglia P., pp. 156.

1889

Newton E.F. *Description of a new species of Clupea (C. vectensis) from Oligocene strata in the isle of Wight*. Londra, Geological Society. In “Quarterly journal of the Geological Society”, pp. 112-117.

Nicholson H.A. *A manual of palaeontology for the use of students with a general introductions on the principles of palaeontology*. Edinburgh, Blackwood W. e figli, Tomo II, pp. 889-1624.

1890

Buzzati A. *Bibliografia bellunese*. Venezia, Merlo L., Rec. (Catullo), pp. 939.

Zittel K.A., Schimper W.P., Schenk A. *Handbuch der Palaeontologie*. Monaco, Oldenburg R., Tomo II, pp. 958.

1890

Steinmann G. *Elemente der Palaeontologie*. Lipsia, Engelmann W., Tomo II, pp. 337-848.

1893

Massalongo C. *Le galle nella flora italica (Entomocecidii)*. Verona, Franchini G. In “Memorie dell’Accademia d’Agricoltura Arti e Commercio di Verona”, Tomo LXIX, Serie III, pp. 227-525.

1893

Vinassa de Regny P.F. *I molluschi dei terreni terziari delle Alpi venete*. Pisa, Nistri T. e Co. In “Processi verbali della Società Toscana di Scienze Naturali”, Adunata del 7 maggio 1893, pp. 7.

Bollettino del r. comitato geologico d'Italia. Roma, Tipografia Nazionale, Tomo XXIV, Rec. (Oppenheim), pp. 405.

Bollettino del r. comitato geologico d'Italia. Roma, Tipografia Nazionale, Tomo XXIV, Rec. (Negri), pp. 405.

1894

Vinassa de Regny P.F. *Un'escursione nelle Alpi venete*. Pisa, S.E. In "Processi verbali della Società Toscana di Scienze Naturali", Adunata del 21 gennaio 1894, pp. 9.

Bollettino del r. comitato geologico d'Italia. Roma, Tipografia Nazionale, Tomo XXV, Rec. (Vinassa de Regny), pp. 9.

1895

Cocco L. *Studi sui denti di plagiostomi con note paleontologiche*. S.D.T. In "Atti e resoconti dell'Accademia delle Scienze, Lettere ed Arti dei Zelanti e P.P. dello studio di Acireale, Tomo VII, pp. 25.

Bernard F. *Éléments de paleontologie*. Padova, Bailliere J.B. e figli, pp. 1168.

Vinassa de Regny P.F. *Prospetto della fauna del monte Postale e di s. Giovanni d'Ilarione*. Pisa, Nistri T. e Co., pp. 8.

Zittel K.A. *Grundzüge der Palaeontologie (Palaeozoologie)*. Monaco, Oldenburg R., pp. 971.

1896

Vinassa de Regny P.F. *Synopsis dei molluschi terziari delle Alpi venete*. Pisa, Nistri T. e Co. In "Palaeontographia italica", Tomo II, Parte III, Roncà, pp. 149-184.

1899

Bassani F. *La ittiofauna del calcare eocenico di Gassino in Piemonte*. Napoli, R. Accademia Scienze, pp. 41.

Elenco degli autori con anni di pubblicazione

(Gozzadini G.): 1884
Ball J.: 1873, 1868
Bassani F.: 1874, 1877, 1880, 1880, 1880, 1899
Bernard F.: 1895
Bittner A.: 1875, 1880
Boccardo G.: 1867
Burgmeister H.: 1870
Buzzati A.: 1890
Cantù C.: 1883
Cocco L.: 1895
Davis J.W.D.: 1887
D'Archiac A.: 1862
De Betta E.: 1857
De Zigno A.: 1874, 1878
Franceschi A.: 1857
Gaudin C.T., Strozzi C.: 1857
Goiran A.: 1882
Hoernes R.: 1886
Humbolt A. von: 1853, 1880
Krauss J.: 1875
Lasaulx A. von: 1874
Lioy P.: 1879
Massalongo A.: 1853
Massalongo A.B.: 1857
Massalongo C.: 1893
Milne Edwards A.: 1861
Molin R.: 1860
Newton E.F.: 1889
Nicholson H.A.: 1879, 1889
Nicolis E.: 1882
Perini O.: 1875
Reivas dell'Ibis: 1857, 1857, 1857, 1857
Sauvage M.H.-E.: 1880, 1880
Schimper W.Ph.: 1874
Seguenza G.: 1879
Steinmann G.: 1890
Strafforello G., Treves E.: 1878
Toni F.: 1888
Tornabene F.: 1859
Van Beneden M.P.J: 1881
Vinassa de Regny P.F.: 1893, 1894, 1895, 1896
Viviani G.F.: 1880
Winkler T.C.: 1860
Woodward S.: 1887
Zambusi del Lago F.: 1873
Zittel K.A.: 1895
Zittel K.A., Schimper W.P., Schenk A.: 1890

Ringraziamenti

Gli autori ringraziano in modo particolare: Stefano Scala della Biblioteca del Museo di Storia Naturale di Verona per la ricerca di molte opere. Si ringraziano, inoltre: Laura Guerra per la paziente revisione dei testi, Alessandro Guerra per il supporto informatico, Mirco Travaglini per il supporto in numerose biblioteche di Bologna, il personale della Biblioteca dell'Archiginnasio di Bologna per la gentilezza nella ricerca di numerosi volumi, il personale della Biblioteca d'Arte e Storia di San

Giorgio in Poggiale di Bologna per la gentilezza nella consultazione di numerosissime opere, il personale della Biblioteca Universitaria di Bologna per la gentilezza nella ricerca di molte opere e, infine, Renzo Robbi, Girolamo Lo Russo e Annarita Volpi di Piacenza, Tiziano Stradoni di Verona, Claudio Sensi di Assisi, Adria Faraone di Castiglion del Lago (PG) e Claudio Busi di Bologna. Si ringraziano, infine, i server Wikipedia, Google e BNF per i numerosi supporti in rete.

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Studi e ricerche sui giacimenti terziari di Bolca, XXII - Miscellanea Paleontologica, 19 2022: 67-68

Bibliografia e citazioni di Bolca. Opere dal 1901 al 1950 (quarto contributo)

ROMANO GUERRA*, ROBERTO ZORZIN**
*(*Bologna, **Verona)*

ABSTRACT

Authors present bibliography and Bolca quotations in their works dating from 1901 to 1950. It is the fourth contribution that complements the previous and highlights the importance of this fossil deposit in the Italian and international palaeontologic history.

Key words: Bolca, bibliography, 1901-1950.

RIASSUNTO

Gli Autori presentano la bibliografia e le citazioni di Bolca in opere che vanno dal 1901 al 1950. Si tratta del quarto contributo che evidenzia l'importanza di questo giacimento di fossili nella storia della Paleontologia.

Parole chiave: Bolca, bibliografia, 1901-1950.

PREMESSA

La pubblicazione dei precedenti contributi non ha interrotto il paziente lavoro di documentazione che ha permesso di integrare i dati bibliografici già pubblicati con nuove informazioni.

Per facilitare il lettore duplichiamo i principali appunti che illustrano i criteri con cui sono state redatte le schede.

Schede
Le schede si riferiscono solo a opere materialmente consultate e inserite nello schedario. Sono presenti solo opere a stampa.

Località
Nel costituire la bibliografia di quest'area, interamente compresa nel comune di Vestenanova in provincia di Verona, e, solo per pochi metri, anche in quello di Altissimo in provincia di Vicenza, si è tenuto conto anche dei giacimenti vicini che fanno da contorno a vicende geologiche e umane impossibili da separare. Sono, pertanto, state incluse le seguenti località:

- Bolca;
- Vegroni;
- Pesciara;
- Monte Spilecco;
- Monte Postale (Comune di Altissimo, Provincia di Vicenza);
- Monte Purga di Bolca;
- Monte Colle;
- Cascate Stanghellini.

Sono presenti schede che non hanno valenza naturalistica.

Altre citazioni
Sono incluse citazioni che, anche se non riguardano direttamente le località sopra indicate, sono comunque riferibili alla medesima area e alle sue caratteristiche e precisamente:

- Pesci fossili del Veronese anche nelle sue variazioni;
- Ligniti di Monte Purga;
- Basalti colonnari di Monte Purga.

Cronologia
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BIBLIOGRAFIA 1901-1950 (QUARTO CONTRIBUTO)

1910

ROCCATI A. *Elementi di geologia e geografia fisica ad uso dei licei e degli istituti*. Torino, Unione Tip. Editrice Torino, pp. 294.

1929

Catalogo delle collezioni di minerali, di rocce, di fossili, di oggetti etnologici, ecc. formanti il museo di scienze naturali già costituito dal c.te Toni Francesco di Spoleto. Spoleto, Tipografia dell'Umbria, pp. 246.

1939

Catalogo della mostra in onore di Lazzaro Spallanzani. Pavia, Biblioteca universitaria, pp. 42.

S.D.

STEGAGNO G. *Bolca e il suo territorio cenni di storia geologica*. Verona, Tipografia Cooperativa. In "Bollettino mensile del CAI, Sezione di Verona", Anno III, N. 3, pp. 15.

ELENCO DEGLI AUTORI CON ANNI DI PUBBLICAZIONE

Roccati A.: 1910
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Gli autori ringraziano in modo particolare: Stefano Scala della Biblioteca del Museo di Storia Naturale di Verona per la ricerca di molte opere. Si ringraziano, inoltre: Laura Guerra per la paziente revisione dei testi, Alessandro Guerra per il supporto informatico, Mirco Travaglini per il supporto in numerose biblioteche di Bologna, il personale della Biblioteca dell'Archiginnasio di Bologna per la gentilezza nella ricerca di numerosi volumi, il personale della Biblioteca d'Arte e Storia di San Giorgio in Poggiale di Bologna per la gentilezza nella consultazione di numerosissime opere, il personale della Biblioteca Universitaria di Bologna per la gentilezza nella ricerca di molte opere e, infine, Renzo Robbi, Girolamo Lo Russo e Annarita Volpi di Piacenza, Tiziano Stradoni di Verona, Claudio Sensi di Assisi, Adria Faraone di Castiglion del Lago (PG) e Claudio Busi di Bologna. Si ringraziano, infine, i server Wikipedia, Google e BNF per i numerosi supporti in rete.

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Studi e ricerche sui giacimenti terziari di Bolca, XXII - Miscellanea Paleontologica, 19 2022: 69-72

Bibliografia e citazioni di Bolca. Opere dal 1951 al 2000 (terzo contributo)

ROMANO GUERRA*, ROBERTO ZORZIN**
*(*Bologna, **Verona)*

ABSTRACT

Authors present bibliography and Bolca quotations in their works dating from 1951 to 2000. It is the third contribution that complements the previous and highlights the importance of this fossil deposit in the Italian and international palaeontologic history.

Key words: Bolca, bibliography, 1951-2000.

RIASSUNTO

Gli Autori presentano la bibliografia e le citazioni di Bolca in opere che vanno dal 1951 al 2000. Si tratta del terzo contributo che evidenzia l'importanza di questo giacimento di fossili nella storia della Paleontologia.

Parole chiave: Bolca, bibliografia, 1951-2000.

PREMESSA

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- Pesciara;
- Monte Spilecco;
- Monte Postale (Comune di Altissimo, Provincia di Vicenza);
- Monte Purga di Bolca;
- Monte Colle;
- Cascate Stanghellini.

Sono presenti schede che non hanno valenza naturalistica.

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Negli aggiornamenti saranno citate tutte le persone che contribuiranno a integrare/migliorare questo elenco e i precedenti.

BIBLIOGRAFIA 1951-2000 (TERZO CONTRIBUTO)

1956

BERTIN L. *La terre notre planéte*. Parigi, Larousse, pp. 404.

1959

CASTELLARIN A. *Sull'età delle vulcaniti veronesi*. Bologna, Museo Geologico. In "Giornale di Geologia", Serie 2, Tomo XXVII. Rec. (Malaroda), pp. 15-26.

1962

PICCOLI G. *Recenti ricerche geologiche sulle manifestazioni vulcaniche cretaceo-cenozoiche delle Venezie*. Roma, Libreria dello Stato. In "Bollettino del Servizio Geologico d'Italia", Tomo LXXXII, pp. 79-108.

1966

MANTESE G. *Storia di Valdagno*. Valdagno, Comune, pp. 746.

1972

(MENIN A.) *La valle del Chiampo. Brevi note di paleontologia e di paletnologia. Il nuovo museo preparato dai frati francescani della Pieve*. Chiampo, Collegio Serafico Missionario, pp. 40.

1976

FISHER J.C., GAYRARD V.Y. *Fossils of all ages*. New York, Grosset, Dunlap, pp. 199.

1977

OLIVIERI D. *Toponomastica veneta*. S.L., Seppia, pp. 191.

1978

LISKE T. *Bolca ist einem reiseabstecher Wert*. Heidelberg, Vereinigund der Freunde. In "Der Aufschluss", Anno XXIX, pp. 131-135.

1980

ROITER F. *Verona e terre scaligere*. Udine, Magnus, pp. 140.

1985

BIANCO P., MAINARDI F., TREVISAN L. *Grande dizionario enciclopedico*. Torino, Unione Tip. Editrice Torino, Tomo III, pp. 964.

1989

CAPPELLINI V., BOROLI P., LOCATELLI S., BONACCINI W., ALTRI. *Enciclopedia geografica de Agostini*. Novara, Istituto Geografico De Agostini, pp. 1296.

1991

CHOAT J.H., BELLWOOD D.R. *Reef fishes: their history and evolution*. In: Sale P.F., The Ecology of fishes on Coral Reefs, chapter 3, Academic Press, pp. 39-66.

1992

LAMMERER B. *Itinerari geologici nel Trentino-Alto Adige*. Lana (BZ), Tappeiner, pp. 223.

1993

Graesse J.G.T. *Trésor de livres rares et précieux*. Ginevra, Slatkine Reprints. Rec. (Volta), pp. 523.

1995

Lazzari C. *Il giacimento di Bolca tra il cinquecento e il settecento*. Firenze, Olschki L.S. In "Bibliografia italiana di storia della scienza", Tomo XIV-XV, pp. 474.

Moretti l., Cappelletti V., Beccari M., Costantini L., altri. *La piccola Treccani dizionario enciclopedico*. Roma, Istituto Enciclopedia Treccani, Tomo III, pp. 1032.

1996

Landini W., Sorbini L. *Ecological and trophic relationships of eocene monte Bolca (Pesciara) fish fauna*. Modena, Mucchi. In "Autecology of selected fossil organisms: archievements and problem", pp. 120.

1997

Tartaro G., Mazzini M. *Il museo paleontologico di Montevarchi*. Montepulciano (SI), Le Balze, pp. 68.

Levi-Montalcini R., Cappelletti v., Agrimi M., Alleva E., altri. *Dizionario biografico degli italiani*. Roma, Istituto Enciclopedia Treccani, Rec. (Fortis), pp. 829.

1998

Bellwood D.R. *What are reef fishes? – Comment on the report by D.R. Robertson: Do coral-reef fish faunas have a distinctive taxonomic structure? (Coral Reefs 17:179-186)*. Discussion, Coral Reefs, 17: 187-189.

(Guderzo M.) *Il museo civico di Bassano del Grappa*. Milano, Electa, pp. 142.

1999

Fratta A. *I musei scientifici dell'università di Napoli Federico II*. Napoli, Federiciana Editrice Universitaria, pp. 320.

2000

Papazzoni C.A. *The early Eocene (early-late Cuisian) of Bolca*. Ferrara, Università. In: Bassi D. (ed.), Field trip guide book. Shallow water benthic communities at the Middle-Upper Eocene boundary. Annali dell'Università di Ferrara, Scienze della Terra, supplement, pp. 61-62.

Papazzoni C.A., Less G. *Stop 2. the type "Spileccian"*. Ferrara, Università. In: Bassi D. (ed.). Field trip guide book. Shallow water benthic communities at the Middle-Upper Eocene boundary. Annali dell'Università di Ferrara, Scienze della Terra, supplement, pp. 64-65.

S.D., Arbocco G., Capocaccia L., Cortesogno L., Elena M.V., Poggi R. *Museo civico di storia naturale di Genova "Giacomo Doria". Guida alla visita*. Genova, SAGEP, pp. 120.

Elenco degli autori con anni di pubblicazione

(Guderzo M.): 1998
(Menin A.): 1972
Bertin L.: 1956
Bianco P., Mainardi F., Trevisan L.: 1985
Cappellini V., Boroli P., Locatelli S., Bonaccini W., altri: 1989
Castellarin A.: 1959
Fisher J.C., Gayrard V.Y.: 1976
Fratta A.: 1999
Graesse J.G.T.: 1993
Lammerer B.: 1992
Landini W., Sorbini L.: 1996
Lazzari C.: 1995
Levi-Montalcini R., Cappelletti v., Agrimi M., Alleva E., altri: 1997
Liske T.: 1978
Mantese G.: 1966
Moretti l., Cappelletti V., Beccari M., Costantini L., altri: 1995
Olivieri D.: 1977
Papazzoni C.A.: 2000
Papazzoni C.A., Less G.: 2000
Piccoli G.: 1962
Roiter F.: 1980
Tartaro G., Mazzini M.: 1997

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Studi e ricerche sui giacimenti terziari di Bolca, XXII - Miscellanea Paleontologica, 19 2022: 73-78

Bibliografia e citazioni di Bolca. Opere dal 2001 al 2020 (secondo contributo)

ROMANO GUERRA*, ROBERTO ZORZIN**
*(*Bologna, **Verona)*

ABSTRACT

Authors present bibliography and Bolca quotations in their works dating from 2001 to 2020. It is the second contribution that complements the previous and highlights the importance of this fossil deposit in the Italian and international palaeontologic history.

Key words: Bolca, bibliography, 2001-2020.

RIASSUNTO

Gli Autori presentano la bibliografia e le citazioni di Bolca in opere che vanno dal 2001 al 2020. Si tratta del secondo contributo di questo periodo che evidenzia l'importanza di questo giacimento di fossili nella storia della Paleontologia.

Parole chiave: Bolca, bibliografia, 2001-2020.

PREMESSA

La pubblicazione dei precedenti contributi non ha interrotto il paziente lavoro di documentazione che ha permesso di integrare i dati bibliografici già pubblicati con ulteriori schede. Riteniamo che col presente contributo i titoli di questa bibliografia abbiano superato il numero di 5.000. Su indicazione del Comitato di Redazione, a partire dal 2021 la pubblicazione dei futuri dati bibliografici recuperati avrà una cadenza biennale e l'ultimo periodo delle opere raccolte sarà dal 2001 al 2020 anziché al 2019.

Pur consci che molto è stato fatto, siamo convinti che l'opera sia ancor lontana dalla conclusione, anzi, come ben sanno coloro che si applicano alla ricerca bibliografica, questa impresa non avrà fine e ancora ci sarà da approfondire. I lettori possono esser certi che il nostro impegno non verrà meno. Ci affidiamo anche alla loro collaborazione, particolarmente in questo momento in cui i giacimenti dell'Eocene marino della Val d'Alpone e di alcuni comuni limitrofi sono intenti a ottenere il riconoscimento come Patrimonio dell'Umanità da parte dell'UNESCO.

Quando abbiamo dato inizio a questo lavoro non avremmo mai immaginato che una modesta località fossilifera dei Lessini Nord-orientali avesse accumulato nei secoli tanta risonanza; avevamo pensato che il traguardo dei tremila titoli sarebbe stato il massimo delle soddisfazioni. Siamo andati ben oltre anche perché abbiamo captato una richiesta quasi giornaliera di tutto o parte di questo lavoro. Ci si permetta di dire che ne siamo orgogliosi. Riteniamo che il capitale geo-paleontologico della più importante località del contesto, e parliamo di Bolca, valga da sola il titolo, e intendiamo misurarlo col lavoro bibliografico che ci siamo imposti, ma, conoscendo oltre che la carta anche i fossili, siamo sicuri che in Bolca la natura ha posto quanto di meglio ha espresso in Paleontologia. Lasciamo agli scienziati questo giudizio, ma considerando le dimensioni del giacimento è opportuno dire che in nessuna parte del mondo tanta poca roccia ha dato tanto in quantità, qualità e unicità di fossili. Questa consapevolezza, suffragata dalla presenza in tanti musei e collezioni di materiale bolcense, sarà la spinta a ricercare ulteriormente nuove angolazioni per valorizzare il contesto e dare un ulteriore contributo alla conoscenza della straordinaria geologia italiana e mondiale.

Per facilitare il lettore duplichiamo i principali appunti che illustrano i criteri con cui sono state redatte le schede.

Schede

Le schede si riferiscono solo a opere materialmente consultate e inserite nello schedario. Sono presenti solo opere a stampa.

Località

Nel costituire la bibliografia di quest'area, interamente compresa nel comune di Vestenanova in provincia di Verona, e, solo per pochi metri, anche in quello di Altissimo in provincia di Vicenza, si è tenuto conto anche dei giacimenti vicini che fanno da contorno a vicende geologiche e umane impossibili da separare. Sono, pertanto, state incluse le seguenti località:

- Bolca;
- Vegroni;
- Pesciara;
- Monte Spilecco;
- Monte Postale (Comune di Altissimo, Provincia di Vicenza);
- Monte Purga di Bolca;
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Bibliografia 2001-2020
(Secondo contributo)

2004

Martínez-Delclòs, X., Briggs, D.E.G., Peñalver, E. *Taphonomy of insects in carbonates and amber.* Palaeogeography, Palaeoclimatology, Palaeoecology, 2003: 19-64.

Simili R. *Il teatro della natura di Ulisse Aldrovandi.* Bologna, Compositori, pp. 143.

2005

Bosellini A. *Storia geologica d'Italia. Gli ultimi 200 milioni d'anni.* Bologna, Zanichelli, pp. 183.

2006

Baruzzi M. *Una vita da scienziato. Carte e libri di Giuseppe Scarabelli nella Biblioteca comunale di Imola.* Imola, Biblioteca comunale, pp. 488.

2007

(Alessandrini A., Ceregato A.) *Natura picta Ulisse Aldrovandi.* Bologna, Compositori, pp. 670.

2008

Dalla Vecchia F.M. *Vertebrati fossili del Friuli – 450 milioni di anni di evoluzione*. Udine, Comune, pp. 303.

De Angeli A., & Garassino G. *Pseudosquilla lessinea n. sp. (Crustacea, Stomatopoda, Pseudosquillidae) and Scyllarides bolcensis n. sp. (Crustacea, Decapoda, Scyllaridae) from lower Eocene (Ypresian) of Monte Postale (Altissimo, Vicenza, NE Italy).* Atti della Società Italiana di Scienze Naturali e del Museo civico di Storia Naturale di Milano, 149 (II): 167-178.

Doyen S. *Les poissons fossiles du "monte" Bolca (Italie)*. Revigny, SARL. In "Minéraux & fossils". n. 367, pp. 35-42.

Gioppi E. *Museo di storia naturale di Firenze. Geologia e paleontologia*. S.D.T., pp. 16.

Lebron P. *La bourse de Munich 2007*. Revigny, SARL. In "Minéraux & fossils". n. 367, pp. 20-30.

2009

Damarco P. *Museo paleontologico "Giulio Maini". Paleontologia e geologia*. Ovada (AL), Comune. pp. 27

Dolin L., Pacaud J.M. *Les Cypraeoidea et Velutinoidea (Mollusca, Caenogastropoda) du Lutétien inférieur du Vicentin et du Véronais (nord-est de l'Italie)*. Revue de Paléobiologie, Geneve, 28 (2), pp. 277-314.

Doyen S. *Le monte Bolca (Italie) une lagune pétrifiée à l'Éocene*. Revigny, SARL. In "Minéraux & fossils", n. 367, pp. 44-53.

(Fanti F.) *I dinosauri italiani e altri vertebrati fossili nel nostro paese. Guida fotografica alla mostra. Museo geologico Giovanni Capellini, 5 settembre 2009-11 gennaio 2010*. Bologna, Museo geologico, pp. 56.

2010

Goatley C., Bellwood D.R., Bellwood O. *Fishes on coral reefs: changing roles over the past 240 million years*. Paleobiology, 36 (3), pp. 415-427.

2011

Gugole G. *Val d'Alpone una terra da scoprire*. S.L., Comitato per il turismo, pp. 53.

Zanini M. *Le piante di Francesco Calzolari*. S.L., WBA Monograf, pp. 644.

2012

Calzolari L. *Duecentocinquant'anni "a pescar fossili"*. Milano, Club Alpino Italiano. In "Montagne 360°", febbraio 2012, pp. 25-31.

2014

Bellwood D.R., Goatley C.H.R., Brandl S.J., Bellwood O. *Fifty million years of herbivory on coral reefs: fossils, fish and functional innovations*. Proceedings of the Royal Society B, Biological Sciences, pp. 8.

2015

Friedman M., Beckett H.T., Close R.A. & Johanson Z. *The English Chalk and London Clay: two remarkable British bony fish Lagerstätten*. In: Johanson, Z., Barrett, P. M., Richter, M. & Smith, M. (eds.), *Arthur Smith Woodward: His Life and Influence on Modern Vertebrate Palaeontology*. Geological Society, Special Publication. Doi.org/10.1144/SP430.18.

2016

Dal Lago A. *Le collezioni naturalistiche ottocentesche del museo civico di Vicenza*. Vicenza, Museo naturalistico archeologico. In "Natura vicentina", n. 20, pp. 57-76.

Miola A., Mariotti Lippi M., Mercuri A.M., Fiorentino G., Kustatscher E. *Materiali e metodi in Paleobotanica e Archeobotanica*. In: Kustatscher E., Roghi G., Bertini A. & Miola A (eds.), La storia delle piante fossili in Italia, Museo di Scienze Naturali dell'Alto Adige, 9, pp. 38-55.

2018

Baraldi F. *Il pensiero geologico nelle dissertazioni inedite degli accademici mantovani del XVIII secolo*. Mantova, Accademia Nazionale Virgiliana. In "Atti e memorie", Tomo LXXXV, supplemento, pp. 258.

La biodiversità della val d'Alpone candidata al patrimonio dell'umanità. S.L., Rumor. In "L'Alta Valle informa", dicembre 2018, pp. 6.

2019

Brombin V., Bonadiman C., Jourdan F., Roghi G., Coltorti M., Webb L.E., Callegaro S., Bellieni G., De Vecchi P., Sedea R., Marzoli A. *Intraplate magmatism at a convergent plate boundary: the case of the Cenozoic northern Adria magmatism*. Elsevier, Earth-Science Reviews, https://doi.org/10.1016/j.earscirev.2019.03.016, 192, pp. 355-378.

Marramà G., Carnevale G., Giusberti L., Naylor G.J.P., Kriwet J. *A bizarre Eocene dasyatoid batomorph (Elasmobranchii, Myliobatiformes) from the Bolca Lagerstätte (Italy) reveals a new, extinct body plan for stingrays*. Scientific Reports, 9: 14087, https://doi.org/10.1038/s41598-019-50544-y.

2020

Bannikov A.F., Zorzin R. *Stefanichtys mariannae, a new genus and species of percoid fish (Perciformes s.l.) from Eocene of Bolca in northen Italy.* Verona, Comune. In “Studi e ricerche sui giacimenti terziari di Bolca”, Miscellanea paleontologica, n. 17, pp. 15-26.

Bannikov A.F., Zorzin R. *A new genus and species of percomorph fish “stem pleuronectiform” from the Eocene of Bolca in northern Italy.* Verona, Comune. In “Studi e ricerche sui giacimenti terziari di Bolca”, Miscellanea paleontologica, n. 17, pp. 5-14.

(Baruzzi M.) *Lettere di Giuseppe Scarabelli ad Abramo Massalongo.* Imola, Biblioteca comunale, pp. 270.

Bosellini F.R., Stolarski J., Papazzoni C.A., Vescogni A. *Exceptional developement of dissepimental coenostenum in the new Eocene scleractinian coral genus Nancygyra (Ypresian, Monte Postale, N.E. Italy).* Modena, Mucchi. In “Bollettino della Società Paleontologica Italiana”, n. 59, pp. 291-298.

Busulini A., Zorzin R., Beschin C., Tessier G. *Lophoranina maxima Beschin, Busulini, De Angeli & Tessier, 2004 (Brachyura, Raninidae) from Lower Eocene laminites of the “Pesciara di Bolca” (Verona, northeast Italy).* In “Geologija”, n. 63, pp. 111-120.

Capobianco A., Beckett H.T., Steurbaut E., Gingerich P.D., Carnevale G., Friedman M. *Large-bodied sabre-toothed anchovies reveal unanticipated ecological diversityin early Palaeogene teleosts.* In “Royal Society open Science”, n. 7, pp. 192-260.

Carnevale G. *I fossili di Bolca, icone della paleontologia italiana.* In “Geologicamente, Società Geologica Italiana”, n. 2, pp. 38-47.

Carnevale G., Pietsch T.W., Bonde N., Leal M.E.C., Marramà G. *†Neilpeartia ceratoi, gen. et sp. nov., a new frogfish from the Eocene of Bolca, Italy.* In “Journal of Vertebrate Palaeontology”, DOI:10.1080/02724634.2020.1778711.

Crame J.A. *Early Cenozoic evolution of the latitudinal diversity gradient.* In “Eart-Science Reviews, https://doi.org/10.1016/j.earscirev. 2020.103090, pp. 10.

De Angeli A., Garassino G. *A new xanthid crab,* Neoliomera zovoensis *sp. nov. (Decapoda, Brachyura), from the Lower Eocene beds of Zovo (Vestenanova, Verona, northeast Italy).* Geologija 63/1, pp. 67-72.

Forsey G.F. *Seagrass and cuttlefish – an historic association.* In “Palaeontologia Elettronica”, 22.3.79, https://doi.org/10.26879/881.

Fraaije R.H.B., Beschin C., Busulini A., Tessier G., Jagt J.W.M., Bakel B.W.M. *Joecalcinus, a new hermit crab genus from the Eocene of northern Italy: the second Cenozoic representative of the extant family Calcinidae (Decapoda, Anomura).* N. Jb. Geol. Paleont. Abh., 296/1-2: 101-105.

Georgalis G.L., Zaboli D., Garcia A.P., Pillola G.L., Delfino M. *The occurrence of Eocenochelus (Testudines, Pleurodira) from Sardinia supports palaeogeographic recostruction of the proximity of the Island to continental western Europe during the Eocene.* In “Rivista Italiana di Paleontologia e Stratigrafia”, 126 (3), pp. 833-846.

Guerra R., Guerra L. *Abramo Massalongo e Bolca.* Verona, Comune. In “Studi e ricerche sui giacimenti terziari di Bolca”, Miscellanea paleontologica, n. 17, pp. 39-185.

Guerra R., Zorzin R. *Bibliografia e citazioni di Bolca. Opere dal 1550 al 1850 (sesto contributo).* Verona, Comune. In “Studi e ricerche sui giacimenti terziari di Bolca”, Miscellanea paleontologica, n. 17, pp. 187-191.

Guerra R., Zorzin R. *Bibliografia e citazioni di Bolca. Opere dal 1851 al 1900 (quinto contributo).* Verona, Comune. In “Studi e ricerche sui giacimenti terziari di Bolca”, Miscellanea paleontologica, n. 17, pp. 193-199.

Guerra R., Zorzin R. *Bibliografia e citazioni di Bolca. Opere dal 1901 al 1950 (terzo contributo).* Verona, Comune. In “Studi e ricerche sui giacimenti terziari di Bolca”, Miscellanea paleontologica, n. 17, pp. 201-203.

Guerra R., Zorzin R. *Bibliografia e citazioni di Bolca. Opere dal 1951 al 2000 (secondo contributo).* Verona, Comune. In “Studi e ricerche sui giacimenti terziari di Bolca”, Miscellanea paleontologica, n. 17, pp. 205-209.

Guerra R., Zorzin R. *Bibliografia e citazioni di Bolca. Opere dal 2001 al 2019 (primo contributo).* Verona, Comune. In “Studi e ricerche sui giacimenti terziari di Bolca”, Miscellanea paleontologica, n. 17, pp. 211-238.

Gut C., Vukić J., Šanda R., Moritz T., Reichenbacher B. *Identification of past and present gobies: distinguishing Gobius and Pomatoschistus (Teleostei: Gobioidei) species using characters of otoliths, meristics and body morphometry.* Contribution to zoology, pp. 42.

Larocca Conte G., Trevisani E., Guaschi P., Fanti F. *New specimen of the rare requiem shark Eogaleus bolcensis from the Bolca Lagerstätte, Italy.* In “Acta Polonica”, 65 (X), pp. 14.

Marammà G., Bannikof A.F., Carnevale G. *An Eocene scorpionfish from Monte Postale (Bolca Lagerstätte,northeastern Italy).* Modena, Mucchi. In "Bollettino della Società Paleontologica Italiana", doi: 10.4435/BSPI.2020.09.

Marramà G., Carnevale G., Naylor G.J.P., Varese M., Giusberti L., Kriwet J. *Anatomy, taxonomy and phylogeny of the Eocene guitarfishes from the Bolca Lagerstätten, Italy, provide new insights into relationships of the Rhinopristiformes (Elasmobranchii: Batomorphii).* In "Zoological Journal of the Linnean Society", 2020, XX, pp. 1-21.

Marramà G., Carnevale G., Naylor G.J.P., Kriwet J. *Skeletal anatomy, phylogenetic relationships, and palaecology of the Eocene urolophid stingray Arechia crassicaudata (Blainville, 1818) from Monte Postale (Bolca Lagerstätte, Italy).* In "Journal of Vertebrate Palaeontology", DOI: 10.1080/02724634.2020.1803339.

M.G. *Scavi a Bolca, spunta rombo indiano.* Verona, L'Arena. Per. "L'Arena", 25 febbraio 2020, p. 8.

Piccini S. *Angels from the past.* Torreano (UD), SP. Stefano Piccini R.N., pp. 105.

Romano M. *I fossili una storia italiana.* Roma, Società geologica italiana, pp. 304.

Stradoni T. *Archeologia della natura: Kant, Fortis, Stoppani e i pesci di Bolca.* Verona, Comune. In "Studi e ricerche sui giacimenti terziari di Bolca", Miscellanea paleontologica, n. 17 pp. 27-38.

Young G.A., Hagadorn J.W. *Evolving preservation and facies distribution of fossil jellyfish: a slowly closing taphonomic window.* Modena, Mucchi. In "Bollettino della Società Paleontologica Italiana". n. 59 (3), pp. 185-203.

Zanotti S., Zorzin R. *The fossils of the Pesciara Lagerstätte (Bolca, Northeastern Italy): a statistical analysis.* 2nd Palaeontological Virtual Congress, May 2020, Poster.

Elenco degli autori con anni di pubblicazione

(Alessandrini A., Ceregato A.): 2007
(Baruzzi M.): 2020
(Fanti F.): 2009
Bannikov A.F., Zorzin R.: 2020
Baraldi F.: 2018
Baruzzi M.: 2006
Bellwood D.R., Goatley C.H.R., Brandt S.J., Bellwood O.: 2014
Bosellini A.: 2005
Bosellini F.R., Stolarski J., Papazzoni C.A., Vescogni A.: 2020
Brombin V., Bonadiman C., Jourdan F., Roghi G., Coltorti M., Webb L.E., Callegaro S., Bellieni G., De Vecchi P., Sedea R., Marzoli A.: 2019
Busulini A., Zorzin R., Beschin C., Tessier G.: 2020
Calzolari L.: 2012
Capobianco A., Beckett H.T., Steurbaut E., Gingerich P.D., Carnevale G., Friedman M.: 2020
Carnevale G.: 2020
Carnevale G., Pietsch T.W., Bonde N., Leal M.E.C., Marramà G.: 2020
Crame J.A.: 2020
Dal Lago A.: 2016
Dalla Vecchia F.M.: 2008
Damarco P.: 2009
De Angeli A., Garassino G.: 2008
Dolin L., Pacaud J.M.: 2009
Doyen S.: 2008, 2009
Doyen S.: 2009
Forsey G.F.: 2020
Fraaije R.H.B., Beschin C., Busulini A., Tessier G., Jagt j.W.M., Bakel B.W.M.: 2020
Friedman M., Beckett H.T., Close R.A. Johanson Z.: 2015
Georgalis G.L., Zaboli D., Garcia A.P., Pillola G.L., Delfino M.: 2020
Gioppi E.: 2008
Goatley C., Bellwood D.R., Bellwood O.: 2010
Guerra R., Guerra L.: 2020
Guerra R., Zorzin R.: 2020
Gugole G.: 2011
Gut C., Vukić J., Šanda R., Moritz T., Reichenbacher B.: 2020
Larocca Conte G., Trevisani E., Guaschi P., Fanti F.: 2020
Lebron P.: 2008
M.G.: 2020
Marammà G., Bannikof A.F., Carnevale G.: 2020
Marammà G., Carnevale G., Naylor G.J.P., Kriwet J.: 2020
Marammà G., Carnevale G., Giusberti L., Naylor G.J.P., Kriwet J.: 2019
Marammà G., Carnevale G., Naylor G.J.P., Varese M., Giusberti L., Kriwet J.: 2020
Martínez-Delclòs, X., Briggs, D.E.G., Peñalver, E.: 2004
Miola A., Mariotti Lippi M., Mercuri A.M., Fiorentino G. Gustatscher E.: 2016
Piccini S.: 2020
Romano M.: 2020
Simili R.: 2004
Stradoni T.: 2020
Young G.A., Hagadorn J.W.: 2020

Zanini M.: 2011
Zanotti S., Zorzin R.: 2020

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