



Records of brachyuran crabs from the Pliocene (Piacenzian) of Reggio Emilia (Emilia Romagna, N Italy)

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Abstract

Four species of brachyuran crabs are recorded from the Pliocene (Piacenzian) clays of the Apennine Mountains, all collected in natural gullies around the Castellarano and Monticelli di Quattro Castella, Reggio Emilia (Emilia Romagna, N Italy). These species are already known in the fossil record of Italy, and are assigned to *Calappa granulata* (Linnaeus, 1758) (Calappidae De Haan, 1833); *Chlinocephalus demissifrons* Ristori, 1886 (Euryplacidae Stimpson, 1871); *Goneplax rhomboides* (Linnaeus, 1758) (Goneplacidae MacLeay, 1838); *Monodaeus bortolottii* Delle Cave, 1988 (Xanthidae MacLeay, 1838). *Chlinocephalus demissifrons* and *Monodaeus bortolottii* are reported for the first time from Emilia Romagna.

Keywords: Crustacea, Decapoda, Brachyura, Pliocene, Emilia Romagna, N Italy.

Resumen

Se reportan cuatro especies de cangrejos braquiuros del Plioceno (Piacenziano) de las Montañas Apeninas, todas recolectadas en drenajes naturales alrededor de Castellarano y Monticelli di Quattro Castella, Reggio Emilia (Emilia Romagna, N Italia). Estas especies se conocen en el registro fósil de Italia, y son asignadas a *Calappa granulata* (Linnaeus, 1758) (Calappidae De Haan, 1833); *Chlinocephalus demissifrons* (Ristori, 1886) (Euryplacidae Stimpson, 1871); *Goneplax rhomboides* (Linnaeus, 1758) (Goneplacidae MacLeay, 1838); y *Monodaeus bortolottii* (Delle Cave, 1988) (Xanthidae MacLeay, 1838). *Chlinocephalus demissifrons* y *Monodaeus bortolottii* se reportan por vez primera para Emilia Romagna, N de Italia.

Palabras Clave: Crustacea, Decapoda, Brachyura, Plioceno, Emilia Romagna, Italia.

1. Introduction and geological setting

Many authors have reported decapod crustaceans from the Pliocene and Pleistocene of Emilia Romagna (Ristori, 1886; Vinassa de Regny, 1897; Tettoni, 1923; Beschin and Santi, 1997; Garassino and Fornaciari, 2000; Garassino and De Angeli, 2004; Garassino *et al.*, 2010; De Angeli *et al.*, 2011). The specimens have been discovered in two different localities along the Apennine Reggiano Mountains around Castellarano and Monticelli di Quattro Castella,

both located in Reggio Emilia Province (Emilia Romagna, N Italy) (Figure 1).

1.1. Castellarano

Eight specimens (MSNM i27756, i27757, i27761, i27762, i27763, i27764, i27765, i27766) were collected from Castellarano (44°31'00"N, 10°44'00"E), around 20 km southern of Reggio Emilia, where light blue clays crop out in an old quarry today abandoned. No detailed stratigraphic



Figure 1. Geographical map of Emilia Romagna with the fossiliferous localities: 1) Castellarano, 2) Monticelli di Quattro Castella. (after Pasini and Garassino, 2010).

data are available for this deposit, which belongs to the “Argille di Lugagnano” Formation (Cita *et al.*, 2006). The lower circalittoral to epibathyal mollusk assemblage, however, is generally comparable, with some differences, to an assemblage from the near Campore outcrop (Parma, Emilia Romagna) from the Pliocene (Piacenzian) (Ceregato *et al.*, 2007). Bertolaso and Garilli (2009: 15) suggested “an Early to Middle Pliocene age could be prudentially assigned” to the Castellarano deposit. Based on these data, we ascribe the specimens to the Piacenzian (Pliocene). An unidentified *in situ* paguroid and *Retropluma craverii* (Crema, 1895) (Retroplumidae Gill, 1894) were recently reported from Castellarano by Pasini and Garassino (2010) and De Angeli *et al.* (2011).

1.2. Monticelli di Quattro Castella

Monticelli di Quattro Castella (44°38'00"N, 10°28'00"E), western Reggio Emilia, is located among the last hills of the Apennine Mountains toward the Pianura Padana (Lombardy). Five specimens (MSNM i27758, i27759, i27760, i27766, i27767) and six loose dactyli, were collected from some small blocks of blue clays detached by natural erosion along a gully, located in front of an old, disused quarry (Cava Moja). The scarce macrofauna assemblage includes mainly small mollusks and some irregular echinoids (*Schizaster* sp.) preserved as internal moulds. Lacking detailed stratigraphic data for this locality, the only geo-paleontological reports useful are those related to the study of the nearby Cava Moja (Marasti and Raffi, 1977; Monegatti and Raffi, 2001) where the malacofauna assemblage includes also deep-water forms referred to as Piacenzian (lowermost Pliocene) assemblage (Bertolaso pers. comm., 2009). Pasini and Garassino (2012) reported from this locality two cirrolanid isopods (*Palaega* sp. and *Palaega steatopigia* Pasini and Garassino, 2012), referred

to the Piacenzian and suspected to indicate deep-water deposits. We ascribe the specimens to the Piacenzian (Pliocene), based on these data.

2. Material

The specimens are preserved as three-dimensional moulds in small blocks of blue clays, in dorsal or ventral views, partially articulated, slightly compressed, and mostly lacking the dorsal epicuticle. Some incomplete chelipeds and one carapace were collected loose in the naturally washed sediments. The specimens have been assigned to *Calappa granulata* (Linnaeus, 1758) (Calappidae De Haan, 1833) (1 specimen), *Chlinocephalus demissifrons* Ristori, 1886 (Euryplacidae Stimpson, 1871) (1 specimen); *Goneplax rhomboides* (Linnaeus, 1758) (4 specimen) (Goneplacidae MacLeay, 1838); *Monodaeus bortolottii* Delle Cave, 1988 (Xanthidae MacLeay, 1838) (5 specimen). Moreover one specimen is assigned to an indeterminate Goneplacinae (Goneplacidae MacLeay, 1838). Some loose dactyli not reported here could be assigned to unidentified carcinids. The specimens are deposited in the Palaeontological Collections of the Museo di Storia Naturale di Milano (MSNM). The systematic arrangement used in this paper follows the recent classifications proposed by Castro (2007), Ng *et al.* (2008) and Schweitzer *et al.* (2010).

2.1. Abbreviations

lcxp: length of carapace; ld: length of dactylus; wcxp: width of carapace.

3. Systematic Paleontology

Section Eubrachyura de Saint Laurent, 1980
 Superfamily Calappoidea De Haan, 1833
 Family Calappidae De Haan, 1833
 Genus *Calappa* Weber, 1795

Type species: *Cancer granulatus* Linnaeus, 1758, subsequent designation by Latreille (1810).

Included fossil species: see Schweitzer *et al.* (2010).

Calappa granulata (Linnaeus, 1758)

Cancer granulatus Linnaeus, 1758: 627.

Cancer granulatus – Linnaeus, 1767: 533.

Calappa granulata – Garassino and De Angeli, 2004: 38, fig. 4 (1-3). — Garassino *et al.*, 2004: 264, fig. 7 a-c. — De Angeli and Garassino, 2006: 40. — Ng *et al.*, 2008: 48. — De Angeli *et al.*, 2009: 176, 177, 195, 196, fig. 8a, b. — Schweitzer *et al.*, 2010: 82. — Garassino *et al.*, 2012: 51. — Garassino and Pasini, 2013: 330, 331. — Baldanza *et al.*, 2013: 344.

Stratigraphic range: Piacenzian (Pliocene - Recent).

Locality: Monticelli di Quattro Castella (Reggio Emilia).

Material and measurements: one complete right dactylus in lateral view (MSNM i27767 - ld: 10 mm).

Discussion: Although the specimen appears incomplete, the general shape of the curved dactylus, with a typical strong posterior outer lateral tooth, shows morphological affinities with *Calappa granulata* (Linnaeus, 1758). This species was reported from the Pliocene of Candelo, Masserano, Cossato, and S. Pietro (Piedmont) (Garassino *et al.*, 2004; Garassino and Pasini, 2013); Arda River (Emilia Romagna) (Garassino and De Angeli, 2004); Orciano, Presciano, and Terre Rosse (Tuscany) (Ristori, 1891a; De Angeli *et al.*, 2009); and Altavilla (Sicily) (Gemmellaro, 1914); from the Early Pleistocene of Poggio i Sodi (Tuscany) (Baldanza *et al.*, 2013). This is the first record for this species from Reggio Emilia Province.

Superfamily Goneplacoidea MacLeay, 1838
Family Euryplacidae Stimpson, 1871
Genus *Chlinocephalus* Ristori, 1886

Type species: *Chlinocephalus demissifrons* Ristori, 1886, by monotypy.

Included fossil species: *Chlinocephalus demissifrons* Ristori, 1886.

Remarks: Schweitzer *et al.* (2010) erroneously reported two species as belonging to this genus, *C. demissifrons* Ristori, 1886, and *C. subovalis* (Ristori, 1886). Indeed Ristori (1886) described the new genus *Chlinocephalus*, with only the type species *C. demissifrons*; any species, named *subovalis* is reported in the text. The genus is therefore monotypic, as correctly reported by Karasawa and Kato (2003).

Chlinocephalus demissifrons Ristori, 1886
Figure 2

Chlinocephalus demissifrons Ristori, 1886: 101, Pl. 2 (figs. 5-6).

Chlinocephalus demissifrons – Glaessner, 1929: 113. — Glaessner, 1969: R517. — Karasawa and Kato, 2003: 139, Tab. 5. — Garassino *et al.*, 2004: 275-278, figs. 15, 16. — De Angeli and Garassino, 2006: 64. — De Angeli *et al.*, 2009: 195. — Schweitzer *et al.*, 2010: 133. — Garassino *et al.*, 2012: 52.

Stratigraphic range: Piacenzian (Pliocene).

Locality: Castellarano (Reggio Emilia).

Material and measurements: one complete carapace in dorsal view, partially compressed, preserving the right cheliped and incomplete walking legs (MSNM i27756 - lcxp: 23 mm; wcxp: 25 mm; ld = 9 mm).

Discussion: The specimen reflects the main morphological characters of *Chlinocephalus demissifrons* Ristori, 1886, as follows: suboval, convex, smooth

carapace, slightly wider than long; well-developed fronto-orbital region, wide straight front, with a weak median incision and deep wide orbits; two sharp pointed spines on anterolateral margins; convex posterolateral margin; wide, straight posterior margin; dorsal region not distinct, with two transverse ridges, marking a dorsal depression on the carapace among them; suboval, wide cardiac region; well-developed P1 with elongate merus; subcylindrical carpus with a strong spine on inner distal margin; robust chelae with elongate curved dactylus. *Chlinocephalus demissifrons* was already reported from the Pliocene of Fornaci (Savona, Liguria, NW Italy) (Ristori, 1886) and Biella (Piedmont, NW Italy) (Garassino *et al.*, 2004). Moreover, Garassino *et al.* (2004) pointed out that the specimen assigned by Ristori (1891a) to *Titanocarcinus sculptus* Ristori, 1891, from the Pliocene of Mucigliani (Siena, Tuscany) could be a juvenile stage of *C. demissifrons*. The specimen represents the first report for the species from Emilia Romagna and the second report along the southern paleo-Adriatic Gulf.

Family Goneplacidae MacLeay, 1838
Subfamily Goneplacinae MacLeay, 1838
Genus *Goneplax* Leach, 1814

Type species: *Ocypoda bispinosa* Lamarck, 1801, by original designation.

Fossil species: *G. gulderi* Bachmayer, 1953; *G. rhomboides* (Linnaeus, 1758).

Remarks: Karasawa and Kato (2003, Table 6) and Schweitzer *et al.* (2010) provided check lists of the fossil species of *Goneplax*. At present, *G. craverii* Crema, 1895, is assigned to *Retropluma* (De Angeli *et al.*, 2011). Müller (1993) pointed out that *G. formosa* Ristori, 1886, and *G. meneghinii* Ristori, 1886, from the Pliocene of Rapolano (Siena, Tuscany) must be considered as junior synonyms of *G. rhomboides* (Linnaeus, 1758). Moreover, Müller (1993), comparing the main characters of the holotypes of *G. sacci* Crema, 1895 (*G. saccoi* [sic] in Karasawa and Kato, 2003, and Schweitzer *et al.*, 2010) and *G. gulderi* Bachmayer, 1953, from the Miocene of Austria, pointed out the similarity of the fronto-orbital margin between the two species, different from *G. rhomboides* for the presence of two well-marked transverse ridges on the dorsal surface of carapace and for the front as wide as the orbits. The loss of the holotype of *G. sacci* questions the systematic validity of this species that should be considered as *nomen dubium* (for discussion, see Garassino *et al.*, 2013). Finally, *G. arenicola* has been assigned to a new genus inside the Goneplacinae (Garassino *et al.*, 2013). So based on the above-mentioned observations, we recognize only two valid fossil species of *Goneplax* (Garassino *et al.*, 2013).

Goneplax rhomboides (Linnaeus, 1758)
Figure 3

Cancer rhomboides Linnaeus, 1758: 626.

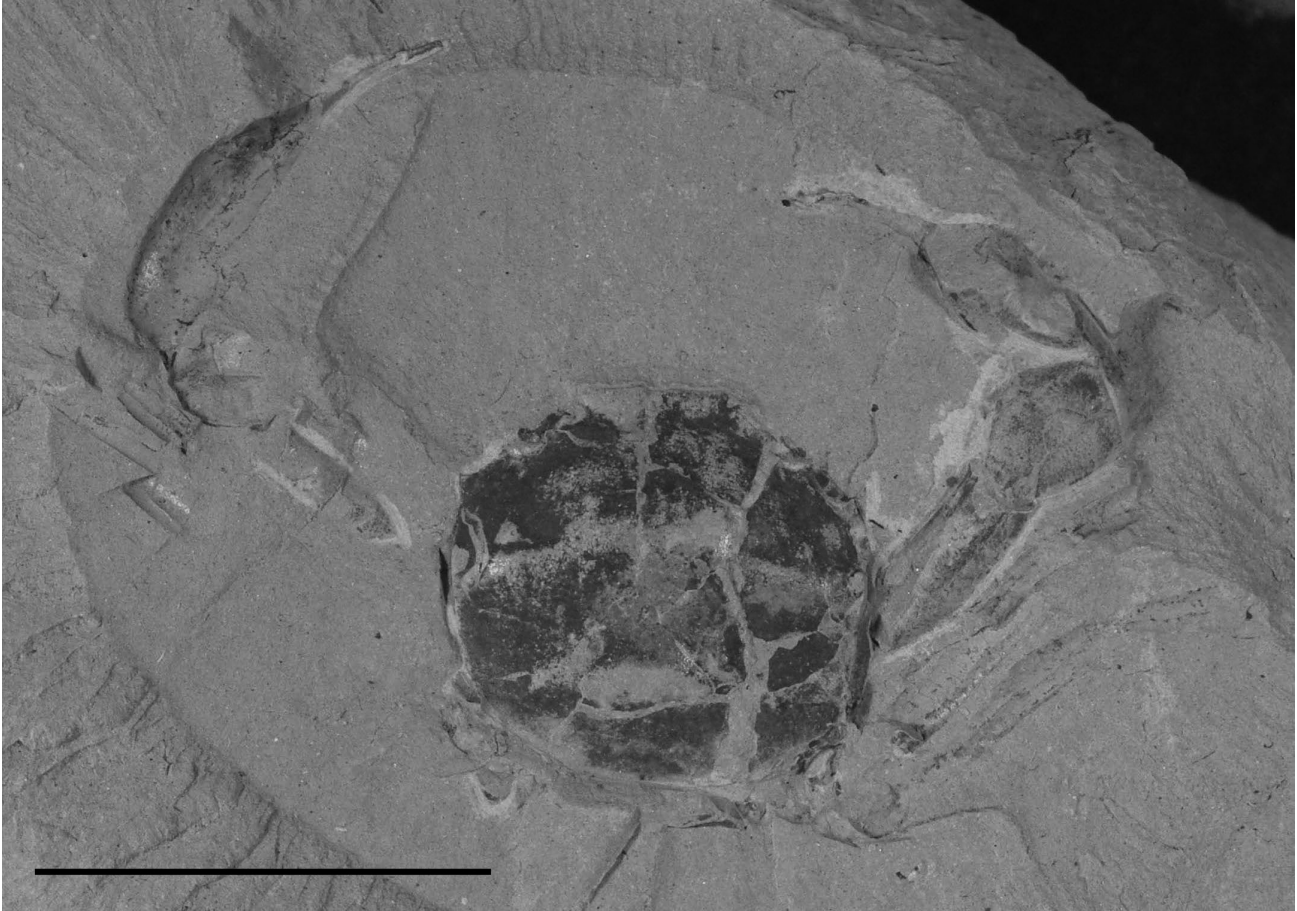


Figure 2. *Chlinocephalus demissifrons* Ristori, 1886, MSNM i22756. Scale bar = 25 mm.

Goneplax angulata Leach, 1814: 430.

Goneplax impressa Desmarest, 1817: 504, 505.

Goneplax rhomboides [sic] – Glaessner, 1929: 199. — Vía Boada, 1933: 226.

Goneplax cf. *rhomboides* – Gemmellaro, 1914: 90, Pl. 1 (fig. 26).

Goneplax angulata – Heller, 1863: 103. — Nobre, 1936: 57, Pl. 21 (fig. 40). — Bouvier, 1940: 278, fig. 176, Pl. 9 (fig. 2). — Zariquiey Álvarez, 1946: 162, Pl. 18 (figs. a, b).

Gonoplax [sic] *impressa* – Desmarest, 1822: 102–104, Pl. 8 (figs. 13, 14).

Goneplax impressa – Garassino *et al.*, 2012: 46.

Gonoplax [sic] *bispinosa* – Ristori, 1891b: 20.

Stratigraphic range: Piacenzian (Pliocene - Recent).

Locality: Castellarano (Reggio Emilia).

Material and measurements: one incomplete specimen in dorsal view (MSNM i27762 – lcxp: 19 mm; wcxp: 25 mm); two incomplete compressed moulds (MSNM i27764, i27765) in ventral and dorsal view and one three-dimensional isolate carapace (MSNM i27766 – lcxp: 14 mm; wcxp: 20 mm).

Discussion: Although poorly preserved and partially compressed, the specimens show a subrectangular carapace with smooth dorsal surface, wider than long, widest at

junction between antero- and posterolateral margins; well-developed orbits; outer orbital angle with acute spine; small acute anterolateral spine; dorsal regions not distinct; elongate chelipeds and dactyli; very elongate, flat ambulatory legs. These characters and the shape and arrangement of the pleonal sternites (where observables) allow ascribing the specimens to the fossil and extant *G. rhomboides*. This species has been already reported from the Pliocene-Pleistocene of Piedmont, Emilia Romagna, Tuscany, and Lazio (Ristori, 1891b; Garassino and De Angeli, 2004; Garassino *et al.*, 2004; De Angeli *et al.*, 2009; Garassino *et al.*, 2012; Baldanza *et al.*, 2013).

Genus and sp. indet.

Figure 4

Stratigraphic range: Piacenzian (Pliocene).

Locality: Castellarano (Reggio Emilia).

Material and measurements: one incomplete carapace three-dimensionally preserved in dorsal view (MSNM i27763 – lcxp: 20 mm; wcxp: 20 mm).

Description: Subquadrate carapace, as wide as long, strongly inflated in transverse section; dorsal surface of the carapace with small pits, without clear indications of

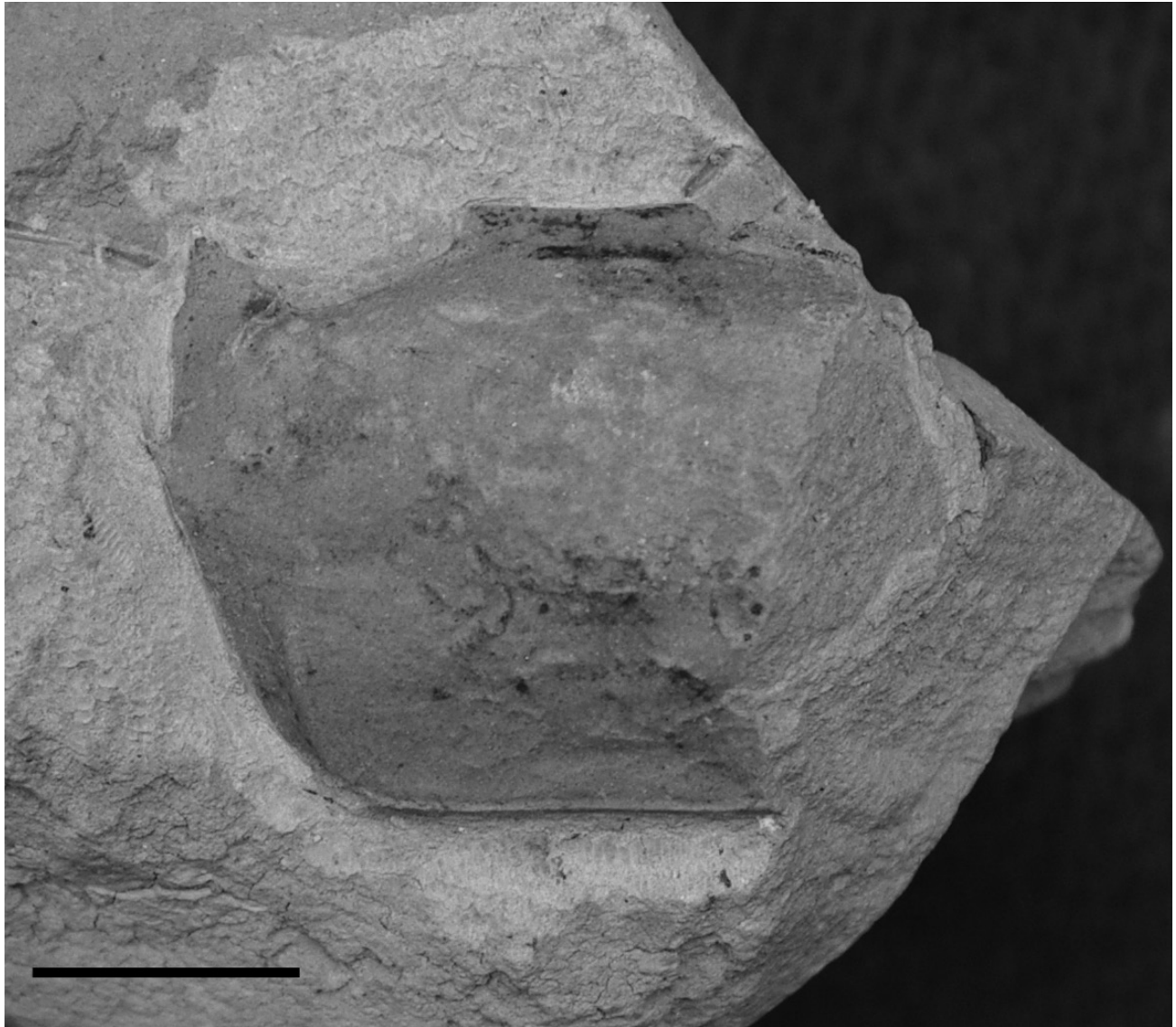


Figure 3. *Goneplax rhomboides* (Linnaeus, 1758), MSNM i27762. Scale bar = 7 mm.

regions; wide, straight front, protruding downwards, not marked by median notch; wide orbits, with supraorbital margin conspicuously sinuous; outer orbital tooth strongly projecting outwardly; straight anterolateral margin so that the fronto-orbital margin is as wide as the maximum width of carapace at junction of antero- posterolateral margins; one reduced anterolateral tooth on each side of the carapace; posterolateral margins slightly rounded; straight posterior margin.

Remarks: The family Goneplacidae, as reported by Castro (2007), has the following diagnostic characters: carapace transversely rectangular, subquadrate, or trapezoidal; front narrow to wide, typically lamellar, straight; dorsal surface smooth; varying number of anterolateral spines posterior to outer orbital angle (sometimes none but typically one or two); orbits moderately to conspicuously wide, long; fissure in supraorbital margin absent; dorsal surface of carapace

typically smooth or with slight horizontal ridges, moderately convex, without clear indication of regions. Most of these characters are present in the specimen, here assigned to Goneplacidae. The subquadrate carapace, as wide as long, excludes the belonging of the specimen to the extant and fossil *Carcinoplax* H. Milne Edwards, 1852, *Eutricoplax* Castro, 2007, *Menoplax* Castro, 2007, *Thyraplax* Castro, 2007, *Goneplax* Leach, 1814, *Goneplacoides* Castro, 2007, *Hadroplax* Castro, 2007, *Neogoneplax* Castro, 2007, *Paragoneplax* Castro, 2007, *Singhaplax* Serène and Soh, 1976, *Microgoneplax* Castro, 2007, *Ommatocarcinus* White, 1852, *Exoptheticus* Castro, 2007, and *Neommatocarcinus* Takeda and Miyake, 1969, having transversely rectangular carapace, slightly or much wider than long or subcircular carapace. The subquadrate carapace, moderately convex, without clear indication of regions is a character shared with *Pycnoplax* Castro, 2007, and *Notonyx* A. Milne-



Figure 4. Goneplacinae indet., MSNM i27763. Scale bar = 20 mm.

Edwards, 1873. The single anterolateral tooth on each side of carapace, however, in the specimen excludes its inclusion in *Pycnoplax* with two anterolateral teeth, or to *Notonyx* without anterolateral teeth. The Goneplacidae, as reported by Karasawa and Kato (2003) and Schweitzer *et al.* (2010), includes eight fossil genera, *Amydrocarcinus* Schweitzer, Feldmann, González-Barba and Vega, 2002; *Carcinoplax* H. Milne Edwards, 1852; *Goneplax* Leach, 1814; *Icriocarcinus* Bishop, 1988; *Kowaicarcinus* Feldmann, Schweitzer, Maxwell and Kelley, 2008; *Magyarcarcinus* Schweitzer and Karasawa, 2004; *Ommatocarcinus* White, 1852; *Psopheticus* Wood-Mason, 1892. *Carcinoplax*, *Goneplax*, and *Ommatocarcinus* are extant genera from which the specimen is excluded. *Amydrocarcinus* was described

from the Eocene Tepetate Fm. (Mexico) (Schweitzer *et al.*, 2002; Schweitzer and Karasawa, 2004), *Icriocarcinus* from the Late Cretaceous (late Campanian or early Maastrichtian) of San Diego County (California, USA) (Bishop, 1988), *Kowaicarcinus* from the Pliocene of New Zealand (Feldmann *et al.*, 2008), *Magyarcarcinus* from the Late Eocene of Hungary (Schweitzer and Karasawa, 2004). We exclude the specimen from these genera not only for geological age and paleogeographic implications, but also for its ovoid carapace, small and squared orbits, and the dorsal surface of the carapace typically smooth of *Amydrocarcinus*; the pentagonal carapace, anterolateral margins with three acute spines, and the dorsal surface of the carapace strongly ridged of *Icriocarcinus*; the hexagonal

carapace, small and ovoid orbits, and tri-lobed anterolateral margin of *Kowaicarcinus*; the circular carapace, small and ovoid orbits, the smooth dorsal surface of the carapace of *Magyarcarcinus*. Instead, *Psopheticus* from the Oligocene of Taiwan (Hu and Tao, 1996; Karasawa and Kato, 2003), and from the Late Pliocene of Japan (Karasawa, 1997) is the only genera having more close characters with the specimen. However the poorly preservation of the carapace and the lack of other comparative material, can not make possible to assign the specimen to this genus.

Superfamily Xanthoidea MacLeay, 1838

Family Xanthidae MacLeay, 1838

Subfamily Euxanthinae Alcock, 1898

Genus *Monodaeus* Guinot, 1967

Type species: *Xanto couchii* Couch, 1851, by original designation.

Included fossil species: *Monodaeus bortolottii* Delle Cave, 1988.

Remarks: Schweitzer *et al.* (2010) reported two fossil species belonging to *Monodaeus*. We point out that *Monodaeus couchii* (Couch, 1851), however, has never been reported as a fossil, being only an extant species.

Monodaeus bortolottii Delle Cave, 1988

Figure 5

Monodaeus bortolottii Delle Cave, 1988: 123-126, Pl. 1 (figs. 1, 2), Pl. 2 (figs. 1-5).

Monodaeus bortolottii – De Angeli & Garassino, 2006: 74. — De Angeli *et al.*, 2009: 185, 195, fig. 16. — Schweitzer *et al.*, 2010: 126. — Garassino *et al.*, 2012: 52. — Baldanza *et al.*, 2013: 347, 348, fig. 13.

Stratigraphic range: Piacenzian (Pliocene - late Gelasian-early Calabrian (Pleistocene).

Locality: Castellarano and Monticelli di Quattro Castella (Reggio Emilia).

Material and measurements: two incomplete carapaces (MSNM i27757, i27761 – Castellarano); three carapaces

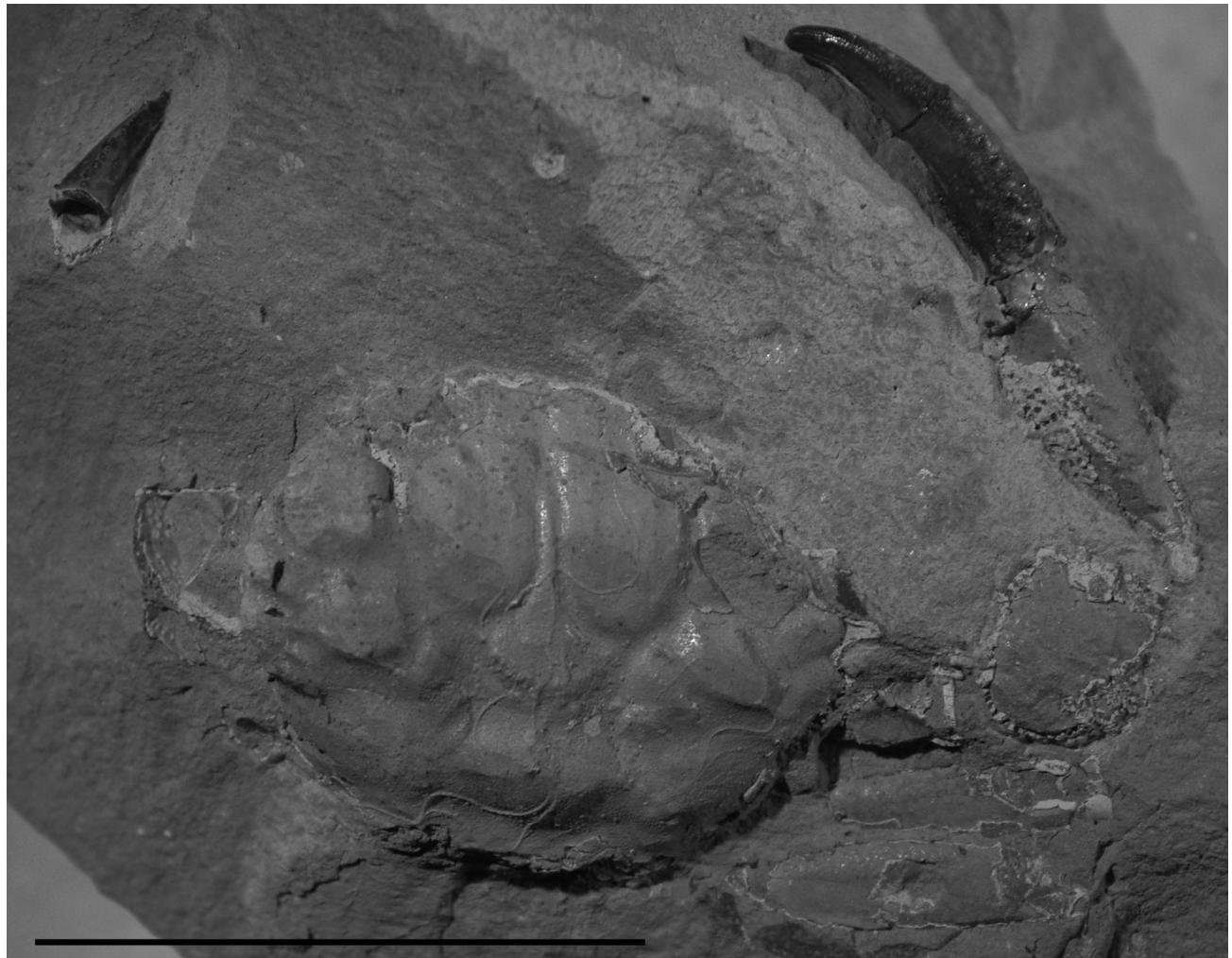


Figure 5. *Monodaeus bortolottii* Delle Cave, 1988, MSNM i27758. Scale bar = 25 mm.

preserved in dorsal view as internal moulds including part of the chelipeds (MSNM i27758 – lcxp: 20 mm; wcxp: 25 mm.; ld: 15 mm; i27759, i27760) from Monticelli di Quattro Castella.

Discussion: Although preserved as internal moulds, the specimens show morphological affinities with *Monodaeus bortolottii* Delle Cave, 1988. The suboctagonal carapace is slightly convex, wider than long; straight front margin, with a weak median incision; short, convex anterolateral margin; long, convergent posterolateral margin; posterior margin straight medially and convex on margins with a granular ridge; dorsal region well marked by grooves, with wide, raised epigastric lobes; suboval protogastric regions well marked; subpentagonal mesogastric regions with narrow, elongate anterior process between protogastric regions; cardiac region well marked by branchiocardiac grooves; small hepatic regions poorly marked; wide branchial regions well marked; subtrapezoidal palm of chelipeds, wider anteriorly with a strong pointed dactylus slightly curved downwards. A rim of pointed denticles runs dorsally on the dactyli, decreasing in size towards the smooth tip. *Monodaeus bortolottii* has been previously reported only from the Pliocene of Volterra (Delle Cave, 1988) and Grosseto (De Angeli *et al.*, 2009) in Tuscany. Finally, according to Baldanza *et al.* (2013) this species is also reported from the Early Pleistocene of Poggio i Sodi (Siena, Tuscany). This is the first record of this species from Emilia Romagna Region (N Italy).

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