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SOME HISTORICAL SPECIMENS OF FOSSIL HERMIT CRABS (CRUSTACEA, PAGUROIDEA) HOSTED AT THE MUSEUM OF NATURAL HISTORY OF FLORENCE, ITALY

Abstract - S. Dominici, A. Garassino, G. Pasini, *Some historical specimens of fossil hermit crabs (Crustacea, Paguroidea) hosted at the Museum of Natural History of Florence, Italy.*

Subject of this study are some specimens of hermit crabs belonging to Bargagli, Manzoni, and Michelotti collections, partially described by Ristori. The review of *Pagurus squamosus* Ristori, 1886 has highlighted some morphological characters typical of *Calcinus* Dana, 1851 and so the new combination *Calcinus squamosus* (Ristori, 1886) is herein proposed. *Pagurus manzonii* (Ristori, 1888) has been revised and a lectotype is herein designated. Finally, two isolated chelae from the Oligocene of Dego (Savona) have been reported for the first time, though they are left in open nomenclature within the Paguridae.

Key words - Decapoda, Anomura, systematic, Cenozoic, Italy

Riassunto - S. Dominici, A. Garassino, G. Pasini, *Alcuni esemplari storici di crostacei paguridi fossili (Crustacea, Paguroidea) conservati al Museo di Storia Naturale di Firenze.*

Oggetto di questo studio sono alcuni esemplari di crostacei paguridi fossili appartenenti alle collezioni Bargagli, Manzoni e Michelotti, in parte descritti da Ristori. La revisione di *Pagurus squamosus* Ristori, 1886 ha messo in luce alcuni caratteri morfologici tipici del genere *Calcinus* Dana, 1851 e la nuova combinazione *Calcinus squamosus* (Ristori, 1886) è qui proposta. *Pagurus manzonii* (Ristori, 1888) è stato revisionato e un lectotipo è stato qui designato. Infine, due chele isolate dell'Oligocene di Dego (Savona), non assegnate a livello generico e specifico, vengono segnalate per la prima volta nell'ambito della famiglia Paguridae.

Parole chiave - Decapoda, Anomura, sistematica, Cenozoico, Italia

Introduction

The paleontological interests of Giuseppe Ristori (1856-1905), active in Florence in the last decades of the 19th century, ranged from palaeoflora to fauna, from vertebrates to invertebrates and from the terrestrial to the marine realms. His endeavour implied a coherency, however, which lied in his participating in the collective effort by the newly established Italian Geological Society to carry out the geological survey of the young Italian Kingdom (Corsi, 2007). If he had a taxonomic group of preference, this was the crustaceans, at least judging from the number of papers dedicated to this groups (Ristori, 1886; 1888a, 1888b; 1891a; 1891b; 1892; 1896) and from the many new species he described. All of the latter were based on type material now hosted at the Museum of Natural History of the University of Florence (Delle Cave, 1981), material in part recently revised according to modern systematics (Garassino *et al.*, 2004, 2013).

The present paper undertakes the revision of the type material of three further taxa first described by Ristori: *Pagurus squamosus* Ristori, 1886, *Xantho*? *manzonii* Ristori, 1888, and *Pagurus* sp., respectively from the Pliocene of Sarteano (Siena), the Miocene of Santa Maria Villiana (Bologna), and the Oligocene of Dego (Savona). The historical background behind this small choice of fossils reveals the variety of connections that animated the early Italian geological community.

Geological and historical setting

Sarteano (SI, Tuscany) is located close to the Cetona ridge, a positive feature forming the eastern boundary of the Radicofani Basin, in southern Tuscany. This basin is filled with Pliocene deposits, including fossiliferous mudstones, sandstones, and conglomerates. The presence of clasts bored by lithodoms and a cemented sandstone ("*Amphistegina* limestone": Delle Cave, 1981) cropping out around the town suggests that Ristori's type material of *Calcinus squamosus* belongs to the allostratigraphic unit P3, dated to the Piacenzian (Pascucci *et al.*, 2006). The label associated with the fossils indicates that they were donated to the museum in 1886 by "Piero Bargagli" (Fig. 1), very likely the Sienese entomologist Pietro Bargagli (1844-1918), active in fieldwork in the Cetona region (Bargagli, 1870; Conci & Poggi, 1996).

Santa Maria Villiana (BO, Emilia-Romagna) is a small village on the northern flank of the northern Apen-

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nines Mounts in Emilia-Romagna. In its surroundings, marls of the Pantano Formation crop out, dated to the upper Burdigalian-Langhian, deposited in an outer shelf, possibly upper slope setting and rich with fossils, including rare crustaceans and abundant echinoderms (Borghi, 2020; Rondelli, 2022). The type material of *Pagurus manzonii* was collected and donated in 1888 (Fig. 2) by the paleontologist Angelo Manzoni (1842-1892) from Lugo, between Ravenna and Bologna, among the most clever and productive early Italian geologists (Tabanelli, 1989). In conflict with other members of the Geological Society for scientific reasons, Manzoni donated his paleontological collection to the Florence museum (Dominici, 2011a; 2011b; 2011c).

Dego (SV, Liguria) is a small village well known for its paleontological heritage. In its outskirts, Oligocene deposits of the Molare Formation, part of the so-called "Tertiary Piedmont Basin" (TPB), crop out (Ghibaudo *et al.*, 2014). The succession of the Dego area includes fossiliferous sandstones that cover an interval from late Rupelian to middle Chattian (Briguglio *et al.*, 2021; Bonci *et al.*, 2021). The type material of *Pagurus* sp. was collected and donated by Giovanni Michelotti (1814-1898), possibly the most important Italian invertebrate paleontologist of the first half of the 19th century, after the death of Giambattista Brocchi in 1826, and owner of an extremely rich paleontological collection donated in 1880 to the Geological Museum of Rome (Sacco, 1898), now lost. Fortunately, Michelotti had made an earlier large donation of fossils to the Museum of Natural History in Florence, following an appeal by Igino Cocchi (1827-1913), director of the museum and head of the Geological Committee founded in 1867 (before Rome was elected Capital of the Kingdom: Corsi, 2007; Dominici & Cioppi, 2018). The date on the label associated with *Pagurus* sp. refers to that year, 1865 (Fig. 3). Since Ristori clearly states that the Dego specimen belonged to the Michelotti collection in Rome (Ristori, 1889: 408), if the similarity between IGF 105066 and Ristori's illustration is not a coincidence, then it is plausible that the specimen actually never returned to Rome. This hypothesis is corroborated by the fact that Michelotti was no longer carrying out active research at that time (Sacco, 1898).

Material

Four isolated chelae of hermit crabs, preserved three-dimensionally, assigned to *Calcinus squamosus* (Ristori, 1886) n. comb. (one specimen) and *Pagurus manzonii* (Ristori, 1888) (one specimen). Two chelae from Dego are left in open nomenclature.

The specimens are housed in the Museo di Geologia e Paleontologia dell'Università di Firenze (the acronym "IGF" stands for "Istituto Geologico di Firenze").

Anatomical abbreviations - ld: dactylus length; lpr: propodus length (including index); hpr: propodus height; wpr: propodus width.

Systematic palaeontology

Infraorder Anomura MacLeay, 1838
Superfamily Paguroidea Latreille, 1802
Family Diogenidae Ortmann, 1892
Genus *Calcinus* Dana, 1851
Type species: *Calcinus tibicen* (Herbst, 1791), by original designation.
Included fossil species: *Calcinus agnoensis* Beschin, De Angeli, Checchi & Zarantonello, 2005.

Figure 1. A, B) *Calcinus squamosus* (Ristori, 1886) n. comb., original labels; *Calcinus squamosus* (Ristori, 1886) n. comb., holotype in dorsal (C), outer (D), inner (E) and ventral (F) view.

Calcinus squamosus (Ristori, 1886) n. comb.

1886 *Pagurus squamosus* Ristori, p. 125, pl. 3, figs. 3-5.
1909 *Pagurus squamosus* (Ristori); Lőrenthey, p. 223.
1929 *Pagurus squamosus* (Ristori); Glaessner, p. 287.
1950 *Pagurus squamosus* (Ristori); Comaschi Caria, p. 326.
1956 *Pagurus squamosus* (Ristori); Comaschi Caria, p. 288.
1981 *Pagurus squamosus* (Ristori); Delle Cave, p. 44.
1929 *Pagurus*? (*Calcinus*?) *squamosus* Ristori; Glaessner, p. 228.
1981 *Pagurus squamosus* Ristori; Delle Cave, p. 44.
2006 *Pagurus squamosus* Ristori; De Angeli & Garassino, p. 27.
2014 *Pagurus squamosus* Ristori; Pasini, Garassino & De Angeli *in* Baldanza *et al.*, p. 270, figs. 4 E-F.

Type material - Holotype, IGF 860E.

Type locality - Sarteano (Siena, Tuscany, central Italy).

Type age - Pliocene (Piacenzian).

Measurements - IGF 180E - ld: 6 mm; lpr: 16 mm; hpr: 10.5 mm; wpr: 8 mm.

Note - The author did not provide a diagnosis for the studied species, limited to a general description and discussion. We provide herein the diagnosis for this species.

Diagnosis - Wide right propodus palm higher than long, subrhomboidal in transverse section; rimmed upper margin almost straight; very convex inferior margin forming a forward scaly profile; outer surface inflated longitudinally in the middle part, tapering to the upper and lower margin with more rounded inner margins; surfaces ornated by flattened coarse irregular scaled tubercles, inner proximal surface nearly smooth; carpo-propodial articulation strongly diagonal to the inner palm surface; strong short dactylus rounded dorsally ornated as the palm, as long as the fixed finger; straight horizontal occlusal margin.

Description - As for the diagnosis (see also Ristori, 1886: 125).

Discussion - Ristori (1886) reported *Pagurus squamosus* from the Pliocene of Sarteano (Siena) based upon a single loose complete right chela as look at the mirror and upside down (Ristori, 1886: pl. 3, figs. 3, 4). Moreover, Ristori (1886: 126) pointed out that the species has "*mayor affinities with the living* Pagurus elegans" now considered synonym of *Calcinus elegans* (H. Milne Edwards, 1836). Indeed, later Glaessner (1929: 288) cited this specimen as *Pagurus*? (*Calcinus*?) *squamosus* Ristori, 1886 in dubitative way, questioning its generic assignment. Indeed, Pasini, Garassino & De Angeli *in* Baldanza *et al.* (2014) already pointed out that "*the holotype of* P. squamosus *does not show the typical characters of* Pagurus *and it needs to be revised and re-assigned to another genus*". The representatives of *Calcinus* Dana, 1851 are characterized by having wide chelae, more or less ornate palm, with strongly convex lower margin, stout dactylus, and strong diagonal carpo-propodial articulation, morphological characters shared with the studied specimen. Therefore the new combination *Calcinus squamosus* (Ristori, 1886) is herein proposed.
Calcinus is poorly reported in the fossil record. De Angeli & Garassino (2006: 25) listed *Calcinus agnoensis* Beschin, De Angeli, Checchi & Zarantonello, 2005 from the Eocene of Veneto (N. Italy), and two specimens generically ascribed to *Calcinus* sp. by Ristori (1891: 24) from the Pliocene of Lazio (central Italy), now lost.
Calcinus squamosus (Ristori, 1886) n. comb. is the second species formally reported to date in the fossil record.

Family Paguridae, Latreille, 1802
Genus *Pagurus* Fabricius, 1775
Type species: *Cancer bernhardus*, Linnaeus, 1758, by original designation.
Included fossil species: See Schweitzer *et al.* (2010), Beschin *et al.* (2012), De Angeli & Caporiondo (2017).

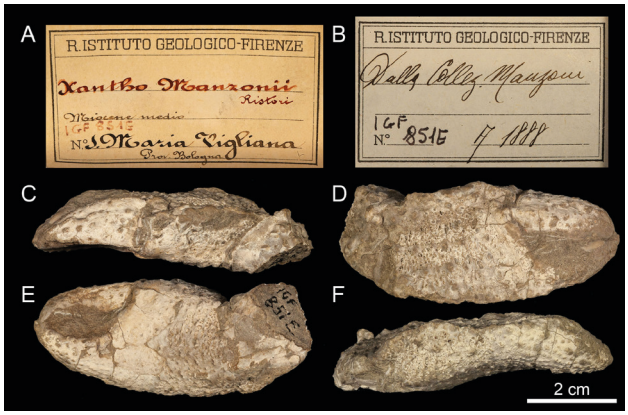

Figure 2. A, B) *Pagurus manzonii* (Ristori, 1888), original labels; *Pagurus manzonii* (Ristori, 1888), lectotype in dorsal (C), outer (D), inner (E) and ventral (F) view.

Pagurus manzonii (Ristori, 1888a)

1888a *Xantho*? *manzonii* Ristori, p. 213, pl. 4, figs. 1-4.
1895 *Xantho*? *manzonii* Ristori; Crema, p. 677.
1896 *Pagurus manzonii* (Ristori); Ristori, p. 511, pl. 12, figs. 6-8.
2006 *Pagurus manzonii* (Ristori); De Angeli & Garassino, p. 27.

Type material - Lectotype IGF 851E, herein designated.

Type locality - Santa Maria Vigliana (Bologna, Emilia-Romagna, N Italy).

Type age - Miocene.

Measurements - ld: 22 mm; lpr: 50 mm; hpr: 20 mm; wpr: *c* 22 mm.

Note - Ristori (1888a: 214) provided a short description of this species based upon four specimens coming from several localities from the Cenozoic of Italy. We provide herein the diagnosis and the updated emended description of the only traced specimen.

Diagnosis - Right strong propodus; subsquare palm with upper tuberculate carina, outer surface flattened, coarse granulated with four distinct longitudinal rims of rounded alternate tubercles, inner surface proximally ornate by irregular tubercles forming transverse short rims and by sparse rounded tubercles distally; strong tuberculate dactylus long as the index with longitudinal deep groove along the middle outer surface, downward pointed tip, straight occlusal lower margin; granulated strong fixed finger, convex lower margin with slightly curved tip directed upward; trigonal

carpus in transverse view with tuberculate surfaces; strong rounded tubercle at the upper outer margin of the carpo-propodial articulation.

Emended description - Right strong propodus slightly compressed dorsoventrally preserving complete palm and dactylus, and incomplete carpus; subsquare chela with slightly convex upper and lower margins narrowing posteriorly; upper margin bearing a tuberculate carina (as preserved); lower margin rounded transversally; flattened outer palm surface, with coarse granulations and four distinct longitudinal rims of rounded alternate tubercles; inner palm surface proximally ornate by irregular tubercles forming transverse short rims and by sparse rounded tubercles distally; strong tuberculate triangular dactylus, as long as the index, with rounded upper margin and with a longitudinal deep groove along the middle outer surface; dactylus pointed tip downward directed and straight occlusal lower margin; fixed finger strong as the dactylus, granulated with gently convex lower margin with slightly curved tip directed upward; poorly preserved carpus, subtriangular in transverse section, with tuberculate surfaces and a stronger rounded tubercle at the upper outer margin of the carpo-propodial articulation.

Note - Ristori (1888a: 214) reported the presence at the inner proximal carpo-propodial junction of "*remains of a shield or abdomen… covered by tubercles*" – as observable in the original drawning (pl. 4, fig. 4). Probably this part was successively lost during some re-preparation work.

Discussion - McLaughlin (2003) provided taxonomic keys for paguroids at family level, based on mainly on differences in morphology of appendages such as antennules, pleopods, maxillipeds or pereiopods not useful in fossil specimens. Therefore it is hard to assign fossil paguroids without preserved shields/carapaces and isolated fossil chelae show similarities in shape and ornamentation with a lot of convergences (R. Fraaije, pers. comm. 2020). Ristori (1888a: 213, pl. 4, figs. 1-4) reported *Xanto? manzonii*, based on four incomplete chelipeds three of which, figured in the pl. 4 (figs. 1-3) seem to be lost. Later Ristori (1896: 511) discussed once again this species, reassigning it to *Pagurus*. The description was mainly based on the best-preserved studied specimen (IGF 851E), originally figured as look at the mirror and upside down (Ristori, 1888a: pl. 4, fig. 4). The studied propodus shows generic characters shared with several representatives of the Paguridae. Indeed, nobody could choose a different systematic assignment for the studied specimen. Therefore, since the external morphological proxy characters (*sensu* Schweitzer, 2003) of the studied specimen are well defined and peculiar, we prefer to keep the original combination *Pagurus manzonii* as proposed by Ristori (1896).

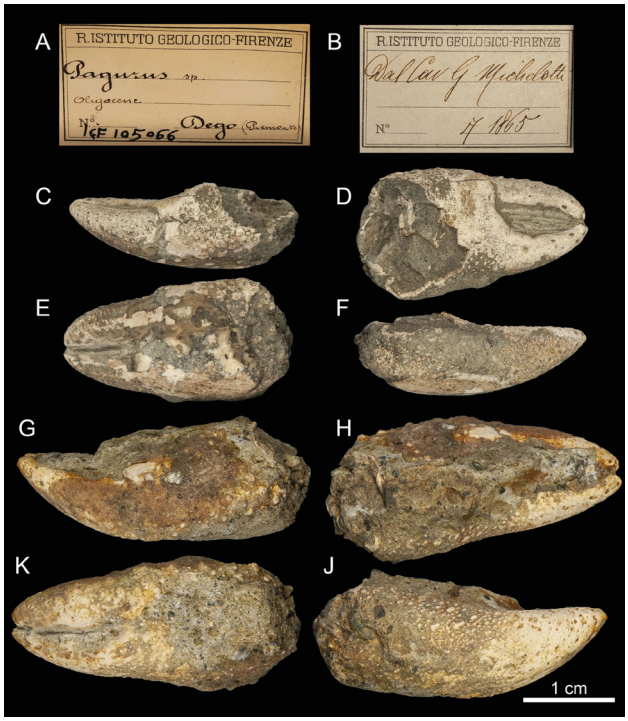

Figure 3. A, B) Paguridae, Latreille, 1802, original labels; IGF 105066 smaller specimen in dorsal (C), inner (D), outer (E) and ventral (F) view; IGF 105066 larger specimen in dorsal (G), inner (H), outer (K) and ventral (J) view.

Family Paguridae, Latreille, 1802
Genus et species indet.

1888b *Pagurus* sp. indet. Ristori, p. 408, pl. 15, fig. 16.

Material - IGF 105066 (two specimens with the same catalogue number).

Locality - Dego (Savona, Liguria, N Italy).

Type age - Oligocene.

Discussion - Based on strong morphological similarities, we identified IGF 105066 (see smaller specimen Fig. 3C-F) with one of the specimens part of the Michelotti collection and illustrated by Ristori (1888b: pl. 15, fig. 16). IGF 105066 is currently kept together with other specimens of the collection donated by Michelotti to the museum in the 1860s and, albeit Ristori describes his specimens as burrowed from Michelotti collection then in Rome, now lost, we make the case that they were never returned to the Capital and included among the rich Florentine collections reordered in the first decades of the 20th century (Cioppi & Dominici, 2011). They were collected from Michelotti in the Oligocene of Dego (then Piedmont, now in Savona province, Liguria, NW Italy). Both left incomplete chelae (31 mm and 25 mm respectively in length) are three dimensionally preserved. They appear similar in shape but unfortuna-

tely they are too washed and poorly preserved to allow a possible systematic assignment (see Pasini *et al*., 2020: 20). Therefore we prefer to leave the studied specimens in open nomenclature within the Paguridae.

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