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Reappraisal and evidences of sexual dimorphism in *Tethyranina propinqua* (Ristori, 1891) (Brachyura, Raninidae) from the Pleistocene of Italy

Giovanni Pasini & Alessandro Garassino

Abstract

We report a well-preserved complete male specimen of *Tethyranina propinqua* (Ristori, 1891) (Raninidae De Haan, 1839) from the Early Pleistocene of the surrounding area of Orvieto (Terni, Umbria, central Italy). This new record allows to describe for the first time the male morphological characters of this species known to date by female specimens only, updating the anatomical description and diagnosis of this species.

Keywords: Decapoda, Crustacea, Ranininae, environment, taxonomy.

1. Introduction

Pasini & Garassino (2018: 9) assigned to *Tethyranina* all specimens previously reported as *Ranina propinqua* Ristori, 1891 "since they lack the distinctive characters for the genus, whereas the combination of the triangular rostrum with anterolateral spines respectively bifid and trifid are typical of *Tethyranina* n. gen.". The species was described based upon four females, the holotype and three additional specimens, respectively (Pasini & Garassino 2018: 9). The record of one well-preserved male specimen preserving the entire carapace, pereiopods, and pleon allows the expansion of the morphological features of this uncommon species known to date only from the Early Pleistocene of Italy (Tyrrhenian Sea area). The studied specimen allows a reappraisal of this species, highlighting its sexual dimorphism which suggest a closer morphological comparison with the fossil and extant Indo-Pacific *Ranina ranina* (Linnaeus, 1758) (Ranininae De Haan, 1839), having similar environment and behavior.

2. Geological setting

The studied specimen was collected in a small unreported private farmland, now abandoned, located in the vicinity of Orvieto (Terni, Umbria, central Italy). According to Famiani et al. (2015), this area pertains to the South Valdichiana extensional basin, enclosed by the Meso-Cenozoic reliefs of Rapolano – Mt. Cetona Ridge (westward) and of Narnese-Amerina Ridge (eastward). The basin formed in the Late Miocene to Early Pliocene and was subsequently filled by proximal marine to coastal marine deposits from Piacenzian to Calabrian age. Most deposits including all those with crustacean records belong to the Early Pleistocene "Chiani-Tevere" depositional cycle (for complete discussion see Famiani et al. 2015: 337; and related references).

The precise stratigraphic position of the studied specimen within the fossiliferous marine Piacenzian-Calabrian deposits is unknown. Therefore, we assign here the studied specimen generically to the Early Pleistocene, as the specimens collected from several localities in Umbria (central Italy) previously described by Pasini & Garassino (2018).

3. Material and methods

One three-dimensionally preserved specimen with complete carapace, pereiopods, and pleon. The specimen is partially exposed within in an isolated greyish sub nodular cemented sandy concretion, including mostly fragmented, scattered marine mollusk shells and gastropods preserved as inner molds. Due to the hardened nature of the sediment, the specimen was previously mechanically prepared by an air-engraver and later by manual preparation.

The specimen is housed in the collections of the Museo Territoriale Paleontologico dell'Astigiano (Asti, Piedmont, N Italy).

Abbreviations: *Anatomical* – lchp: cheliped palm length; lcxp: carapace length (including rostrum); ldct: dactylus length; wchp: cheliped palm width (excluding upper and lower spiny margins); wcxp: carapace width; wf: frontal margin width (excluding anterolateral spines); wpm: posterior margin width; P1–P5: pereiopods 1 to 5; s1–s6: pleonal somites 1 to 6. *Institutional* – MNHN: Musée national d'Histoire naturelle, Paris (France); MTPA: Museo Territoriale Paleontologico dell'Astigiano, Asti (Italy), MPUR: Museo Geologico Università "La Sapienza", Roma (Italy), MSNM: Museo di Storia Naturale di Milano, Milano (Italy), MUSNAF: Museo di Storia Naturale dell'Accademia dei Fisiocritici, Siena (Italy).

4. Systematic palaeontology

Infraorder Brachyura Latreille, 1802

Section Raninoida Ahyong, Lai, Sharkey, Colgan & Ng, 2007

Superfamily Raninoidea De Haan, 1839

Family Raninidae De Haan, 1839

Subfamily Ranininae De Haan, 1839

Genus *Tethyranina* Pasini & Garassino, 2018

Type species: *Ranina propinqua* Ristori, 1891.

Included fossil species: *Tethyranina propinqua* (Ristori, 1891).

Tethyranina propinqua (Ristori, 1891)
Figs. 1A, B, 2A–E, 3A, B

*1891 *Ranina propinqua*. – Ristori, pp. 11–14, pl. 1, figs. 4–7 (illustrated as mirrored).
2018 *Tethyranina propinqua*. – Pasini & Garassino, p. 9, fig. 4A, B [*cum synonymy*].
2019 *Tethyranina propinqua*. – De Angeli et al., p. 56, pl. 14, figs. 3, 4.

Type material: Holotype, MPUR i.543, from the Early Pleistocene of Città della Pieve (Perugia, Umbria, central Italy).

Additional material: MUSNAF 7075 and MSNM i28012 from the Early Pleistocene of Fabro Scalo and Orzalume-Cottano (Terni, Umbria, central Italy), respectively; MSNM i27876, from the Late Pleistocene of Trumbacà (Reggio Calabria, Calabria, southern Italy); MTPA 13468 (male), from the Early Pleistocene of the surrounding of Orvieto (Terni, Umbria, central Italy) (lchp: 26 mm; lcxp: 55 mm; ldct: 20 mm; wchp: 18 mm; wcxp: 45 mm; wf: 35 mm; wpm: 18 mm).

Stratigraphic range: Pasini & Garassino (2015: 50, Fig. 1A) briefly reported one incomplete frog crab (left anterolateral margin only) from the 'Pliocene sands' of Rapolano (Siena, Tuscany) tentatively assigned to *Ranina* as *Ranina* sp. However, the specimen cannot belong to *Ranina* Lamarck, 1801 due to the first anterolateral spine bifid and second trifid, diagnostic characters of *Tethyranina* Pasini & Garassino, 2018. Unfortunately, the specimen is very poorly preserved, lacking other characters useful to allow a closer precise assignment. The specimen represents the sole report known to date from Tuscany and it could be the oldest report of *Tethyranina* postdating to the Pliocene its presence in the Tyrrhenian Sea area. Since we are unable to confirm the systematic assignment of *Ranina* sp. to *Tethyranina*, the stratigraphic range of this genus is formally restricted to the Early to Late Pleistocene of Italy.

Remark: Pasini & Garassino (2018: 8) provided a diagnosis of *Tethyranina propinqua* based upon female specimens only. The additional peculiar features preserved in the studied male specimen allows an updated diagnosis including also the gender dimorphic characters.

Emended diagnosis [mainly based on MTPA 13468 (male) and MPUR i.543 and MUSNAF 7075 (females)]: Carapace subovate, wider anteriorly, narrowing posteriorly; wide, straight fronto-orbital margin in male (*vs* convex in female); dorsal surface with triangular spiny tubercles uniformly arranged; short pointed triangular rostrum downturned distally (*vs* narrower, longer in female); triangular inner-orbital spines; flat, subtriangular supraorbital spines, directed forward; bifid, rimmed extra-orbital spines with rimmed inner pointed straight tip longer than the other having an outer convex margin; convex, short anterolateral margins with two wide, strong spines; elongate, bifid first anterolateral spine with rimmed margins, pointed frontally (*vs* reduced, oblique to the middle longitudinal axis in female); wide, trifid second anterolateral spine with rimmed margins, pointed distal tips curved frontally (*vs* shorter second anterolateral spine with reduced pointed distal tips curved frontally in female); wide P1 with large chela (*vs* less developed and strong in female); triangular pleon with s1 wider than others in male (*vs* broader, rounded pleon with s1 narrower than others in female).

Description: *Carapace* – Elongate, subovate carapace longer than wide, wider anteriorly, narrowing posteriorly (Fig. 1A) (*vs* curved, convex in female – Fig. 1B); pointed rostrum, with triangular short distal tip downturned (*vs* narrower, longer in female); straight orbitofrontal margin with three spines bounded by two open fissures; short, curved inner-orbital spines; subtriangular supra-orbital spines; bifid extra-orbital spines longer than rostrum, marked by narrow fissure behind inner and outer tips; extra-orbital spines with rounded external margin and inner longer spine directed forward (extra-orbital spines more developed and longer in male than in female); short, convex anterolateral margins with a bifid first spine and trifid second spine (Fig. 2A) (*vs* bifid first anterolateral spine shorter, weakly projected frontally, creating a more rounded, convex anterior frontal margin in female – Fig. 2B); trifid second anterolateral spine directed forward with a long anteriorly pointed first tip (Fig. 2A) (*vs* less wide and shorter in female – Fig. 2B); granulated posterolateral margins converging to narrow posterior margin; almost straight, granulated posterior margin, finely rimmed; dorsal carapace ornamentation usually with spiny, flattened, and triangular tubercles, directed forward sometimes paired, mostly assembled at level of postfrontal margin or rounded and small at level of extra-orbital spines (female seem to have big spiny tubercles more uniformly arranged); frontal region with sparse rounded small tubercles; dorsal regions and grooves indistinct. *Thoracic appendages* – P1, P4 and P5 left pereiopods well preserved; large, subrectangular P1 merus and P1 carpus with flattened inner margin and convex outer margin; outer margin of P1 merus with transverse parallel serrate lines; one blunt spine directed upward on the upper margin of P1 merus; flattened P1 carpus shorter than P1 merus with parallel transverse striae on outer margin and at least one pointed spine distally; stout, wide P1 homochelous with large chela in male (Fig. 2C) (*vs* less wide palm and slender dactylus in female – Fig. 2D); large P1 chela with elongate, flat, and subrectangular palm; outer surface with transverse interrupted serrate lines and tubercles; upper margin of P1 palm with two median and distal spines, the second longer; deep, concave submedian rounded notch to accommodate upper marginal tubercle P1 carpus; lower margin of P1 chela with a row of five triangular, flat spines directed forward; subtriangular, pointed P1 index with transverse granulations; upper margin of P1 dactylus with a row of spinules or teeth; long, curved, and pointed P1 dactylus downturned; occlusal margins of P1 dactylus and index with at least

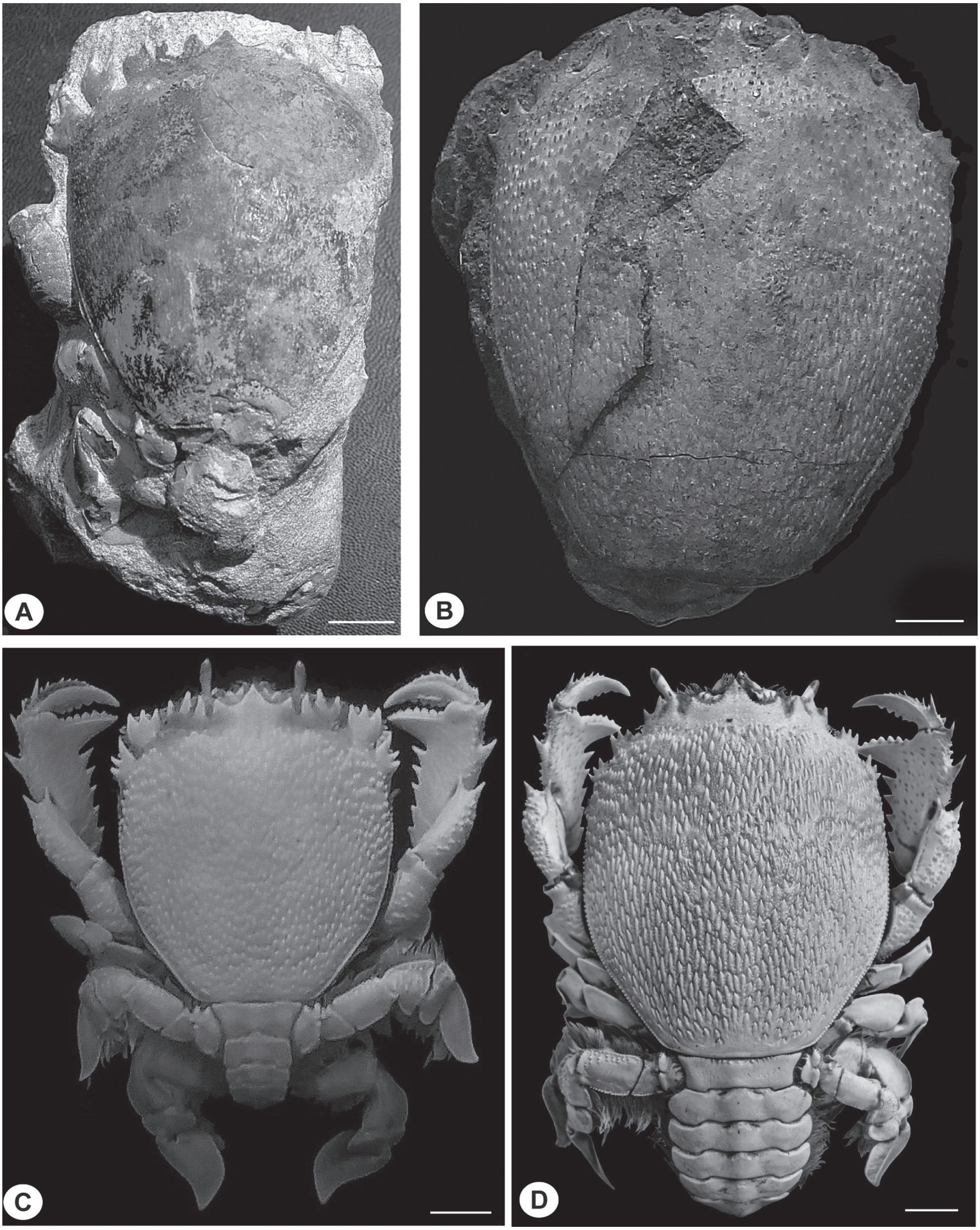

Fig. 1. A – *Tethyranina propinqua* (Ristori, 1891), MTPA 13468 (male), dorsal view. Scale bar equals 11 mm. **B** – *Tethyranina propinqua* (Ristori, 1891), MPUR i.543, holotype (female), dorsal view. Scale bar equals 10 mm. **C** – *Ranina ranina* (Linnaeus, 1758), MNHN-IU-2016-2018, extant male (Indo-Pacific). Scale bar equals 25 mm. **D** – *Ranina ranina* (Linnaeus, 1758), MSNM Cr 2442, extant female (Indo-Pacific). Scale bar equals 10 mm. Photographs: J. Luque (1C), M. Macrì (1B), G. Pasini (1D), R. Sigismondo (1A).

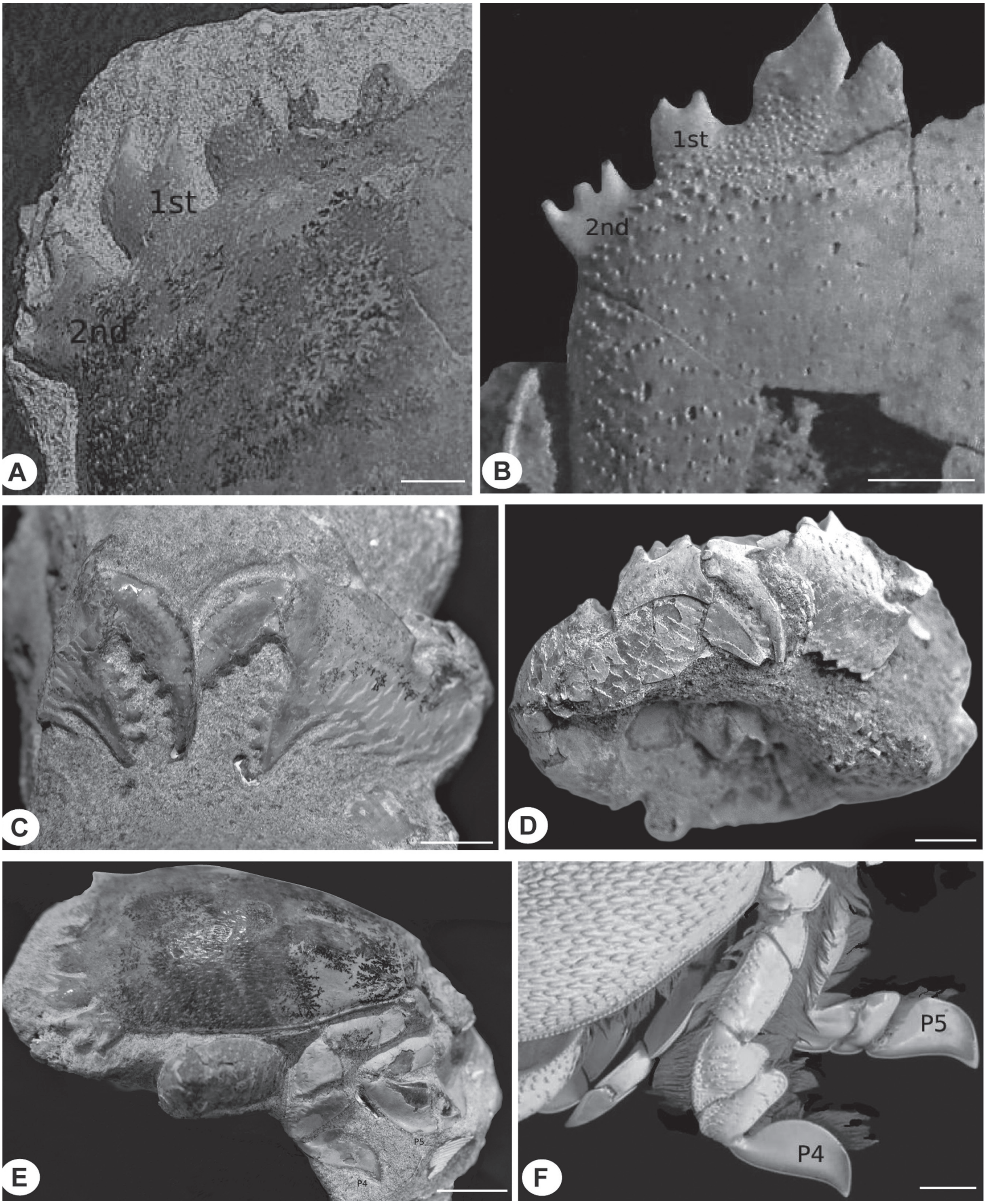

Fig. 2. A – *Tethyranina propinqua* (Ristori, 1891), MTPA 13468 (male), close-up view of the left anterolateral margin with 1st and 2nd spines. Scale bar equals 43 mm. **B** – *Tethyranina propinqua* (Ristori, 1891), MUSNAF 7075 (female), close-up view of the left anterolateral margin with 1st and 2nd spines. Scale bar equals 5 mm. **C** – *Tethyranina propinqua* (Ristori, 1891), MTPA 13468 (male), left and right P1. Scale bar equals 6.6 mm. **D** – *Tethyranina propinqua* (Ristori, 1891), MUSNAF 7075 (female), left and right P1. Scale bar equals 10 mm. **E** – *Tethyranina propinqua* (Ristori 1891), MPTA 13468 (male), left P4, P5. Scale bar equals 9 mm. **F** – *Ranina ranina* (Linnaeus, 1758) MNHN-IU-2016-2018, extant male (Indo-Pacific), left P4, P5. Scale bar equals 10 mm. Photographs: J. Luque (2F), G. Manganelli (2B, 2D), R. Sigismondo (2A, 2C, 2E).

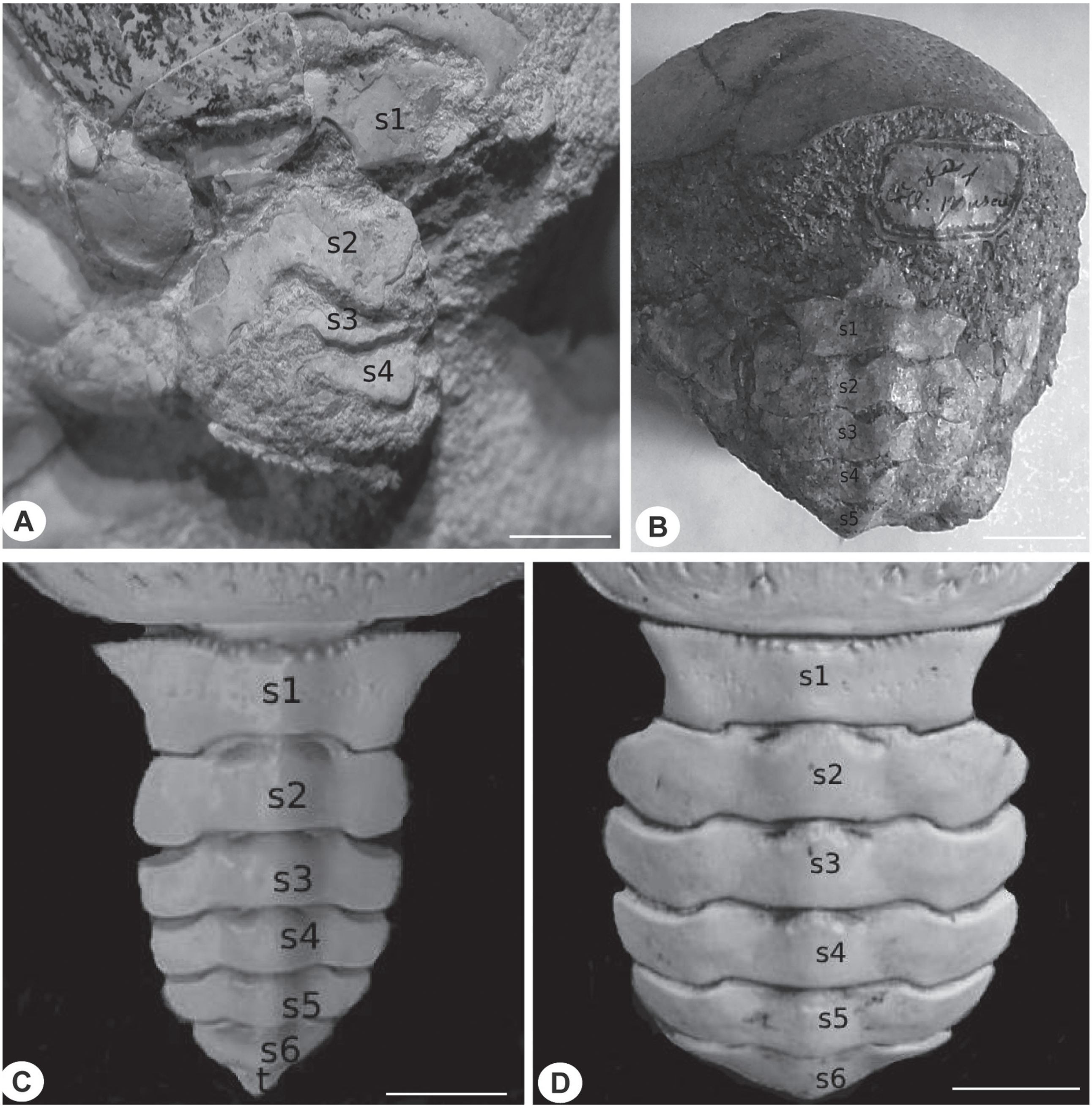

Fig. 3. A – *Tethyranina propinqua* (Ristori, 1891), MTPA 13468 (male), pleon (s1–s4). Scale bar equals 4.5 mm. **B** – *Tethyranina propinqua* (Ristori, 1891), MPUR i.543, holotype (female), pleon (s1–s5). Scale bar equals 10 mm. **C** – *Ranina ranina* (Linnaeus, 1758), MNHN-IU-2016-2018, extant male (Indo-Pacific), pleon [including telson (t)]. Scale bar equals 8.5 mm. **D** – *Ranina ranina* (Linnaeus, 1758), MSNM Cr 2442, extant female (western Indo-Pacific), pleon (s1–s6). Scale bar equals 13.5 mm. Photographs: J. Luque (3C), M. Macrì (3B), G. Pasini (3D), R. Sigismondo (3A).

five triangular teeth (as preserved – occlusal teeth of P1 index stronger than those of P1 dactylus) (Fig. 2C); P2, P3 not preserved; P4 and P5 well-preserved, modified to be the swimming/digging legs, both are flattened transversally, broad with narrow paddle-like shaped dactylus with pointed tip, more elongate and leafed in P5; stout, short rectangular P4 and P5 meri; triangular, knee-shaped P4 and P5 carpi, wider in P5, with a subrectangular propodus; P4 and P5 meri, carpi, and propodi with transverse lines running from upper to lower margins (Fig. 2E). *Pleon (male)* – s1–s4 partially preserved, slightly translated; narrow, subtriangular pleon narrowing posteriorly (Fig. 3A) (*vs* broader, rounded pleon with gently convex lateral rounded bracket-shaped margins in female – Fig. 3B); subtrapezoidal s1 wider than s2–s4 (s5, s6 poorly preserved) (Fig. 3A) (*vs* subrectangular s1 narrower in female – Fig. 3B); subrectangular s2–s4 decreasing posteriorly; smooth s1–s4 with raised axial carina.

Telson, pleonal appendages, telson, and ventral parts not preserved.

5. Environmental remarks

Several morphological characters of the studied specimen plus the holotype and additional specimens, combined with the palaeoenvironmental data provided by Baldanza et al. (2014: 268) and Famiani et al. (2015: 339) could support some hypothesis about the environment and behavior of *Tethyranina propinqua* (Ristori, 1891), mainly compared with those of the most similar fossil and extant Indo-Pacific *Ranina ranina* (Linnaeus, 1758) (Figs. 1C, 1D, 2F, 3C, 3D).

The complete transversally flattened P4–P5 bearing a sub-elliptical pointed paddle-like dactylus, combined with the moderately vaulted carapace narrowing posteriorly and with dorsal spiny tubercles directed forward and uniformly arranged are functional adaptations that promote burrowing and camouflage in soft sediments, all characters fully comparable with those of the extant burrower *R. ranina* which has nocturnal habits, usually living in sublittoral soft sandy-marly bottoms. All reported specimens of *Tethyranina* were collected from shallow proximal to coastal marine soft sediments (Bizzarri & Baldanza 2009; Baldanza et al. 2014: 268; Famiani et al. 2015: 339).

6. Conclusions

The studied specimen is herein assigned to a mature male of *Tethyranina propinqua* (Ristori, 1891). This study highlighted the main morphological characters that distinguish adult male from female. In male the frontal margin is almost straight, notably well developed; wide, long anterolateral spines; and wide, robust flattened P1, whereas female shows a rounded convex frontal margin; shorter anterolateral spines; and proportionally smaller P1. The presence of a triangular rostrum plus two distinct anterolateral spines, respectively bifid and trifid in both sexes strongly supports that this combination of characters is unambiguously typical of *Tethyranina*, not shared with other genera within the Ranininae.

The morphology of male and female as well as the shape of P1 and P4–P5 are herein described and compared for the first time.

In conclusion, the studied specimen enlarges our knowledge concerning the morphology of this fossil species that appears, as reported to date, a species with a restricted palaeogeographic area. Indeed, most of the records come from the eastern paleo-Tyrrhenian Sea margins (Famiani et al. 2015; Pasini & Garassino 2018) with just a record from Calabria, southern Tyrrhenian Sea (Garassino et al. 2014). Moreover, the species has a relatively short range of time, today confidently recorded from the Early to Late Pleistocene and it probably disappeared due to the environmental changes connected to the last Quaternary glacial event (Taviani 2002; Bianchi et al. 2012).

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