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A new species of *Paraxiopsis* de Man, 1905 (Decapoda: Axiidea: Axiidae) from Safaga (Red Sea) with notes on its burrows

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Abstract

During an actuopalaeontological study, numerous resin casts were made in the Bay of Safaga (Red Sea, Egypt). This yielded, among others, two burrow replicas of a species of the axiid genus *Paraxiopsis* de Man, 1905 from coral carpets in 26 and 28 m water depth, respectively. In addition, one specimen was captured while digging up one cast, a second was entombed in the other resin cast. A new species is described based on the captured specimen. It is most similar to *P. austrinus* Sakai, 2004, but differs in the armature of the carapace carinae and cheliped. The burrows, with up to 20 surface openings, have an irregular shape and cross-sections, no wall lining, and reach to a sediment depth of 18 cm.

Key words: Axiidea, Axiidae, *Paraxiopsis*, Red Sea, burrow

Introduction

During an actuopalaeontological study in the northern Bay of Safaga (Red Sea, Egypt) between 1984 and 1992, burrows were investigated in different habitats from the intertidal to a water depth of 36 m (Pervesler, 1990). This study revealed more than 30 resin casts of crustaceans, bivalves and enteropneusts. A few of these burrows could be unequivocally attributed to its producer when specimens had been entombed in the resin or could be captured nearby. These included the intertidal callianassid shrimp *Paratrypaea bouvieri* (Nobili, 1904), whose burrows have been described by Dworschak & Pervesler (1988) and the alpheid shrimp *Alpheus migrans* Lewinsohn & Holthuis, 1978 from depths between 34 and 36 m (Dworschak & Pervesler 2002). Further, two casts were retrieved from coral carpets with sand patches between 26 and 28 m, one of which had trapped the inhabitant, and yielded one specimen of an axiid shrimp while digging up the other one. The specimen represents an undescribed species of *Paraxiopsis* de Man, 1905. The present paper provides a description of the new species and notes on its burrows.

Material and Methods

The Bay of Safaga is situated on the east coast of Egypt (26°37'–26°52'N, 33°56'–34°E). The two burrow casts were made at the following stations: 1) on 31 October 1986 at B5 (M1960/ 26 m water depth), 36°49'30"N 33°57'30"E, coral carpet with sand patches, the sediment consisting of 6.8 % gravel, 89.27 % sand, 3.93 % silt, 0 % clay, with poor

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sorting, and 2) in July 1987 at D4 (725/ 28 m water depth), 26°49'40"N 33°58'00"E, in a sand groove in coral carpet with sediment consisting of 10.16% gravel, 87.05% sand, 2.79% silt, 0% clay and poor sorting; for details of sampling locations, topography, bottom facies, and sediments, see PILLER & PERVESLER (1989) and PILLER & MANSOUR (1990). Investigations were carried out using scuba. Burrow casts were made in situ using an epoxy resin (Araldit GY 257 with hardeners HY830 and HY 850, 25 : 7 : 8 parts by weight) based on the method outlined by PERVESLER & DWORSCHAK (1985). Before casting, surface openings were photographed using a Nikonos IV with 35 mm lens.

One shrimp was captured while digging up the cast; it was fixed in buffered seawater-formaldehyde and later transferred to 70% ethanol. The second specimen was trapped in the resin. The material is deposited in the Naturhistorisches Museum Wien (NHMW).

Sliding calipers (±0.1 mm) and a tape rule (±1 mm) were used to measure for each cast mean diameters and lengths of segments, horizontal extension and total depth, and distance between openings.

Drawings were made using a camera lucida mounted on a stereomicroscope, digitised and then inked and composed in Adobe Illustrator (COLEMAN 2003).

Systematic account

Axiidea DE SAINT LAURENT, 1979

Axiidae HUXLEY, 1879

Paraxiopsis DE MAN, 1905

Axiopsis (*Paraxiopsis*) DE MAN, 1905: 597.
Paraxiopsis; –KENSLEY, 1996: 709–712; –POORE & COLLINS, 2009: 266; –SAKAI, 2011: 156–158.
Eutrichocheles; –SAKAI, 2011: 109–111 (partim). [Not *Eutrichocheles* WOOD-MASON, 1876].

Remarks. The new species is assigned to genus *Paraxiopsis* because of the 1) triangular rostrum, longer than eyestalks, significantly depressed below level of carapace, 2) absence of a postcervical carina, 3) small bifid scaphocerite, 4) third to fifth pleopods without appendix interna, 5) second male pleopod without appendix interna, with appendix masculina, and 6) absence of pleurobranchs (KENSLEY 1996, POORE & COLLINS 2009).

***Paraxiopsis tomentosus* sp.n.** (Figs 1a, 2, 3)

Material examined. Holotype male (32/12.1, right first pereopod, left third and fifth pereopods missing, dissected) NHMW 25920, Red Sea, Safaga, sta. D4 (725/ 28 m)[26°49'40"N 33°58'00"E], depression inside coral carpet, P. Pervesler coll. July 1987

Diagnosis. Carapace smooth, with tomentum of short and longer setae. Gastric region of carapace bordered by lateral carina with one large anterior and four to five small posterior spines, submedian carina with a row of seven to eight spines, and median

Fig. 1: *Paraxiopsis tomentosus* sp.n. a, holotype male (32/12.1) NHMW 25920, habitus; b, sediment surface with burrow openings, Red Sea, Safaga (stn D4, 28 m water depth), plate of cast NHMW 25921 in lower left corner (photograph: P. Pervesler). Scale bar is 10 mm (a), 10 cm (b).

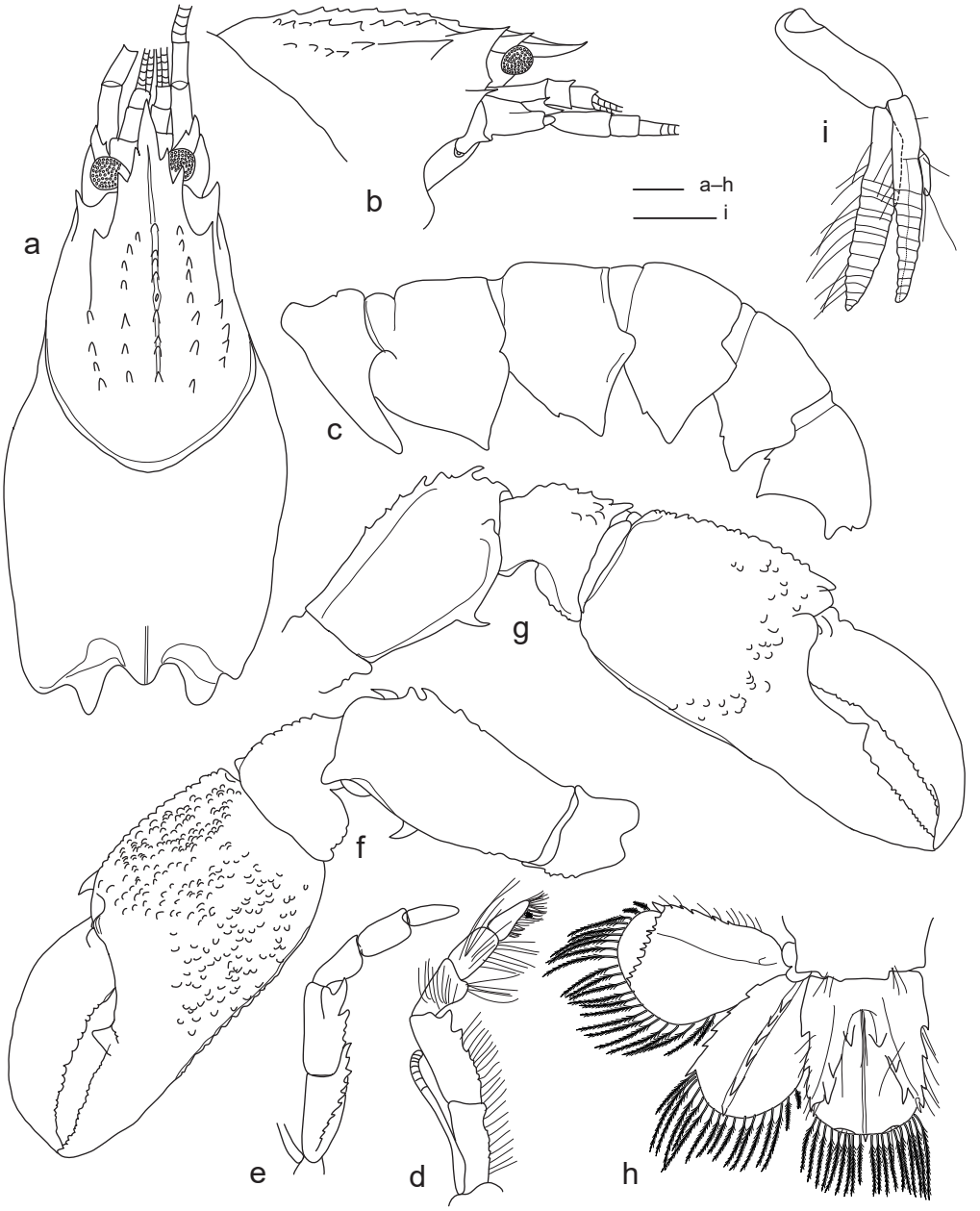

Fig. 2: *Paraxiopsis tomentosus* sp.n., holotype male NHMW 25920. a, carapace dorsal view; b, front, lateral view; c, pleon, lateral view; d, right third maxilliped, lateral view; left third maxilliped, mesial view; f, first left pereopod, lateral view; g, same, mesial view; telson and left uropod; i, left second pleopod. Setation omitted except in d, h and i. Scale bar is 1 mm.

carina with eight blunt teeth. Rostrum triangular, acuminate at tip, with two lateral spines proximally. Third maxilliped with ischium bearing four small spines on lower border, and merus with five spines. First pereopod massive, merus with five spines on upper and one strong spine on lower border. Male first pleopod absent.

Description of male holotype. Tomentum of pilose short and long setae over carapace and pleon, especially dense on cheliped and third maxilliped (Fig. 1a). Gastric region of carapace convex posterior to rostrum; with one large anterior and four to five small posterior spines; submedian carina with row of seven to eight spines; median carina with eight blunt teeth, with central protuberance, extending backward to cervical groove; anterolateral margin with large tooth. Rostrum triangular, acuminate, with two lateral spines proximally, continuous laterally with lateral carina of carapace (Fig. 2a, b). Cervical groove distinct. Posterior thoracic region with short median carina.

Relative lengths of first to sixth pleomeres dorsally 1.0; 1.3; 1.3; 1.5; 1.3 and 1.5 (Fig. 2c). First pleuron narrow, unarmed ventrally; pleuron 2 broadened, triangular; third to fifth pleura triangular, each with denticle at anteroventral angle.

Telson 1.2 times as long as broad, with three medial spines in paired diagonal lines; lateral margins with four spines, a movable spine at posterolateral angle, posterior margin rounded, with median spine (Fig. 2h).

Eyestalk cylindrical, shorter than rostrum; cornea pigmented. Antennular peduncle shorter than antennal peduncle; article 1 longer than articles 2 and 3 combined; articles 2 and 3 short, subequal. Antennal peduncle article 1 with spine distoventrally; article 2 with short distodorsal tooth, scaphocerite with spine on mesial margin; article 3 with distoventral spine; article 4 as long as article 2, and twice as long as article 5 (Fig. 2b).

Mouthparts similar to those of other species of the family, without specific characters (see POORE & COLLINS 2009). Third maxilliped (Fig. 2d, e) with basis bearing small distal spine on lower border; ischium with four teeth, crista dentata with ten triangular teeth; merus with six teeth, gradually increasing distally in size; carpus half as long as merus; propodus as long as carpus and longer than dactylus. Exopod flagellate at distal 1/3, reaching to 2/3 length of endopod merus.

Right first pereopod missing, left cheliped massive (Fig. 2f, g). Coxa with tubercles mesially, ischium bearing four low tubercles on lower margin; merus about two times as long as high, lower border with three low tubercles proximally and one large curved spine at 2/3 length, upper border with six spines increasing in size distally; carpus 0.5 length of merus, lower border with four tubercles, upper border with several tubercles proximally and one large tooth distally; chela about three times as long as carpus; palm slightly longer than high, lower border smooth in proximal and distal thirds, serrated in middle 1/3, upper border serrated and with strong distal spine, lateral face densely tuberculated, mesial face with few tubercles posterior to articulation with dactylus; fixed finger slightly shorter than palm, cutting edge with large triangular tooth proximally, serrated distally; dactylus as long as palm, curved, cutting edge serrated.

Second pereopod (Fig. 3a, b) coxa with low tubercles mesially, ischium with low tubercles on upper and lower border; merus with low teeth on proximal 2/3 of upper border, lower border with low teeth on proximal half, one triangular tooth at 1/2 length

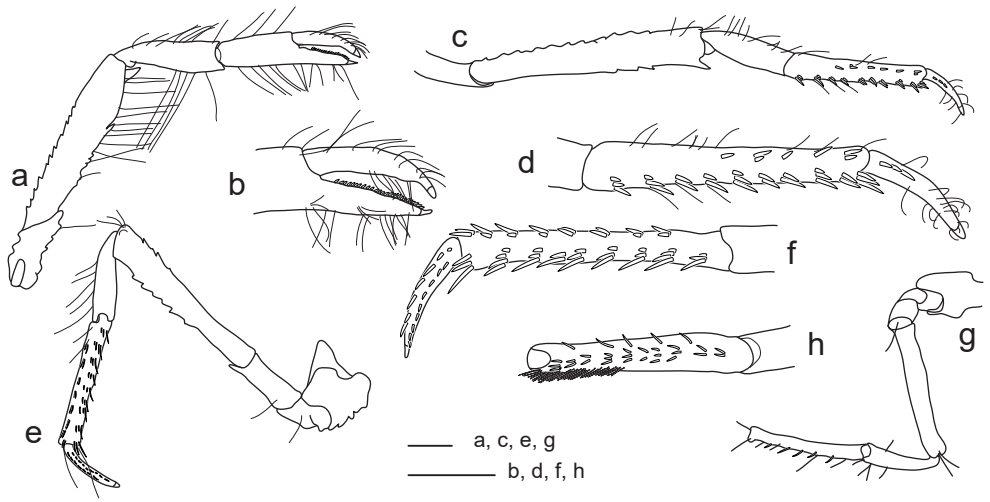

Fig. 3: *Paraxiopsis tomentosus* sp.n., holotype male NHMW 25920. a, left second pereopod, mesial view; b, same, detail of fingers; c, third right pereopod, lateral view; d, same, detail of distal articles; e, left fourth pereopod, lateral view; f, same, detail of distal articles; g, right fifth pereopod, mesial view; h, same, detail of distal articles, lateral view. Scale bar is 1 mm.

and one strong spine distally; carpus half as long as merus, unarmed; chela 1.5 times as long as carpus, fixed finger shorter than palm, with corneous spines on cutting edge; dactylus shorter than palm, unarmed on cutting edge.

Third pereopod (Fig. 3c, d) simple, gonopore present on mesial surface; coxa with tubercles, basis and ischium unarmed; merus elongate, upper border serrated, lower border with three low teeth on distal half and one strong distal spine; carpus 0.4 length of merus, unarmed; propodus twice as long as carpus, with ten transverse rows of spiniform setae on lower border, proximal two, fifth and eights and distal rows represented by three, other rows with two spiniform setae, upper lateral with five groups of one or two spiniform setae; dactylus half as long as propodus, with three lateral spiniform setae in proximal half, tip corneous.

Fourth pereopod (Fig. 3e, f) simple, coxa with low teeth mesially; ischium unarmed; merus with four teeth on upper and six teeth on lower border; carpus about half as long as merus, unarmed; propodus twice as long as carpus, with six spiniform setae along lateral midline, and with nine transverse rows consisting of two to four spiniform setae on lower lateral surface; dactylus about half times as long as propodus, with rows of seven and nine spiniform setae on lateral face, and corneous tip.

Fifth Pereopod (Fig. 3g, h) coxa, basis and ischium unarmed; merus 4.5 times as long as ischium; carpus 0.5 of length of merus; propodus 1.6 times length of carpus, with 6 spiniform setae on lower border, with nine transverse rows consisting of one to three spiniform setae on lateral face and dense short setae distally; dactylus missing.

Epipods on third maxilliped to fourth pereopod, podobranchs (rudimentary) on third maxilliped to third pereopod, arthrobranchs on third maxilliped to fourth pereopod.

First pleopod absent. Second pleopod (Fig. 2i) with appendix masculina, without appendix interna: third to fifth pleopods without appendices internae.

Uropodal exopod rounded on distal margin, anterior margin with five teeth distally, and an articulated tooth at anterodistal angle; dorsal surface with one low longitudinal carina; transverse denticulate suture present. Uropodal endopod as long as telson, anterior margin with five lateral teeth including distal one at anterodistal angle; dorsal surface carinate with row of six teeth medially (Fig. 2h).

Etymology. From the Latin adjective *tomentosus*, covered with setae (hair).

Remarks. Of the 17 species of *Paraxiopsis*, the new species most resembles *Paraxiopsis austrinus* (SAKAI, 1994) from Australia and Papua New Guinea, figured by POORE & COLLINS (2009) and diagnosed most recently by POORE (2018). Both share: 1) having a tomentum of setae over the body and most appendages; 2) general appearance of the rostrum and carinae; and 3) shape and armature of the telson and uropods.

The new species differs from *P. austrinus* by 1) much stronger rostral spines (vs small spines), 2) teeth on median carina (vs unarmed), 3) a more massive first pereopod (vs slender first pereopod), 3) a single spine on lower border first pereopod merus (vs 4 spines), and 4) a pleon with acute second to sixth pleura (vs truncate).

The only species of *Paraxiopsis* from the western Indian Ocean is the widespread *P. brocki* (DE MAN, 1888) but this has a smooth carapace.

Paraxiopsis granulimana KENSLEY, 1996 from the Gulf of Mexico has one massive first pereopod (the pair is smaller), also a prominent meral tooth and tuberculate palm. It differs from the new species in lacking a prominent tooth on the fixed finger and having a smooth median carina.

The burrows

On the sediment surface, the openings of the burrow of *P. tomentosus* sp.n. are characterised by numerous simple holes in a density of around 60 per m^2 (Fig. 1b). The burrows consist of interconnected short vertical or oblique shafts and tunnels with irregular cross-sections. Pieces of rubble and shells are attached to the resin all over. The burrow wall is not lined, allowing the resin to penetrate into the interstices of the gravelly sand.

The cast from station B5 (NHMW 25922, Fig. 4a, b) has 9 surface openings, reaches a total depth of 18 cm with a horizontal extension of 41x19 cm and an estimated total length of 180 cm. Burrow diameters at openings range from 9x11 to 17x14 mm, at 5 cm from 20x15 to 33x29 mm, and tunnels from 22x25 to 17x37 mm with chambers 45x80 mm wide. An ovigerous female is entombed in this cast (Fig. 4c).

The cast from station D4 (NHMW 25921, Fig. 4d, e) has about 20 surface openings, reaches to a depth of 17 cm with a horizontal extension of 34x44 cm and an estimated total length of 200 cm. Burrow diameters at openings range from 15 to 20 mm, reach 24 mm in 5 cm depth and in horizontal passages 40x60 mm. The holotype male (Fig. 1b) was captured while digging out this cast.

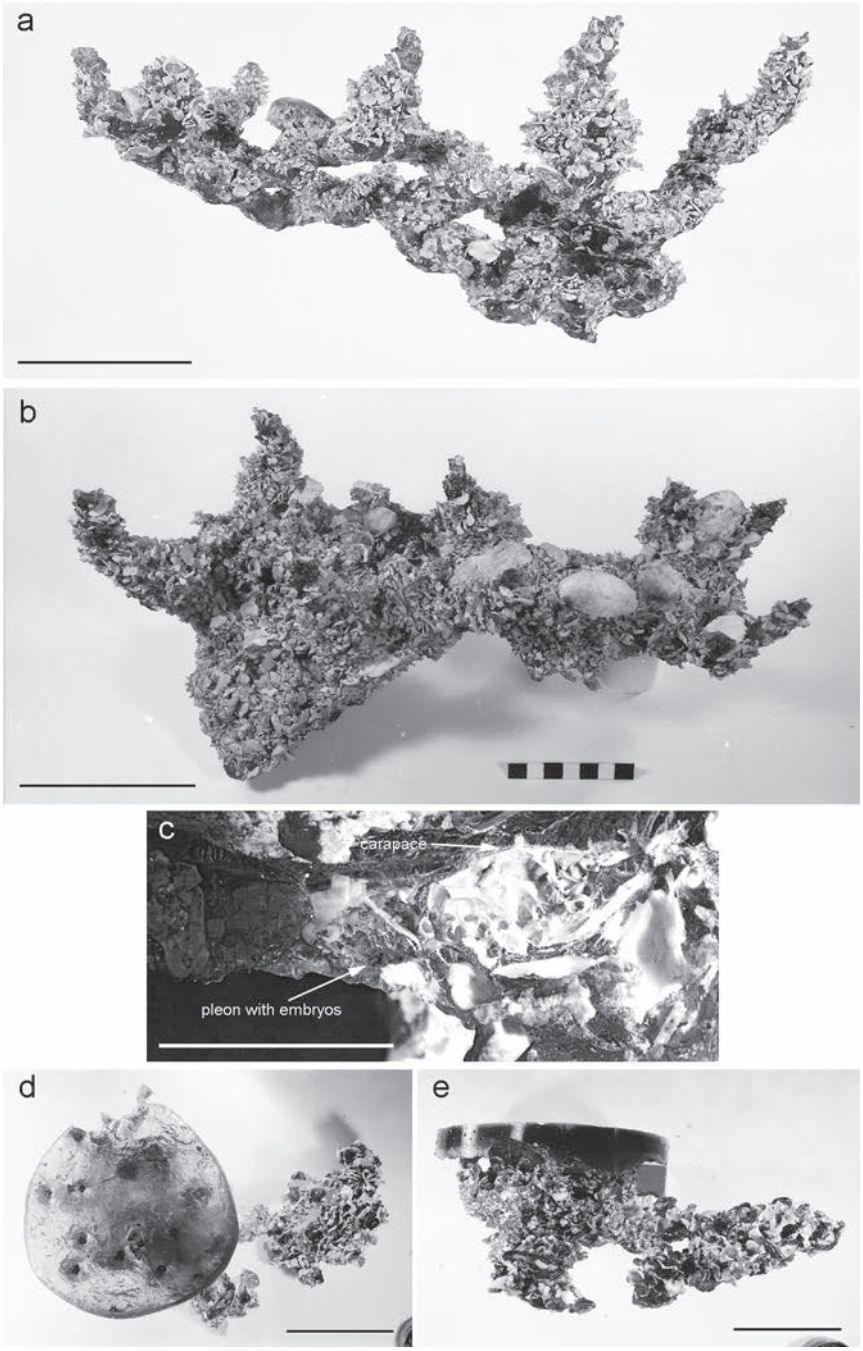

Fig. 4: *Paraxiopsis tomentosus* sp.n. a, b, resin cast of burrow (stn B5, 28 m water depth) in side and plan view, respectively; c, entombed ovigerous female in cast B5; e, f, resin cast of burrow (stn D4, 26 m water depth) in plan and side view, respectively. Scale bar is 10 cm (a, b, e, f), 10 mm (c).

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