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A new pycnogonid species from Türkiye: *Anoplodactylus gullukensis* n. sp. (Pycnogonida, Phoxichilidiidae), with an identification key to the Turkish species of the genus

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Abstract: A new species of pycnogonid collected from the shallow waters of the Güllük Gulf (Aegean Sea), *Anoplodactylus gullukensis* n. sp., is described and illustrated. Description of taxonomic characters of this species are given and differences from related species are indicated. An identification key for *Anoplodactylus* species known from Türkiye is provided.

Key words: Sea spiders, Phoxichilidiidae, *Anoplodactylus*, *A. gullukensis*, Aegean Sea, Türkiye

1. Introduction

Anoplodactylus Wilson, 1878, as a cosmopolitan genus of Pycnogonida, is represented by around 150 species worldwide (Arango and Krapp, 2007). To date, eight *Anoplodactylus* species have been recorded from Türkiye: *A. petiolatus* (Kroyer, 1844) (by Demir, 1952; Băcescu, 1959; Stock, 1962; Arnaud, 1976), *A. pygmaeus* (Hodge, 1864) (by Demir, 1952; Stock, 1962; Arnaud, 1976; Krapp et al., 2008; Çınar et al., 2008; Koçak and Alan, 2013), *A. stocki* Băcescu, 1958 (by Băcescu, 1959), *A. virescens* (Hodge, 1864) (by Arnaud, 1976), *A. digitatus* (Böhm, 1879) (by Koçak, 2014), *A. californicus* Hall, 1912 (by Stock, 1962 under the name *A. portus*), *A.* cf. *angulatus* (a juvenile specimen by Krapp et al., 2008), and *A. nanus* Krapp, Koçak & Katağan, 2008 (by Krapp et al., 2008). Among the studies carried out on the existence of *Anoplodactylus* species in Türkiye, Demir (1952) is the pioneering study, including the identification of *A. petiolatus* and *A. pygmaeus* (as *A. exiguus*) from Sea of Marmara. Of these reported *Anoplodactylus* species from Türkiye, *A. nanus* was described as a new species by Krapp et al. (2008) from the Aegean Sea. In addition, Koçak et al. (2010) reported three pycnogonid specimens as *A. angulatus* (Dohrn, 1881) from the Güllük Gulf (Aegean Sea), but the specimens have recently been reexamined and identified herein as *A. gullukensis* n. sp.

2. Materials and methods

The specimens were collected in the Güllük Gulf (Aegean Sea, Türkiye, Figure 1) in 1990 using a 20 × 20 cm metal frame covered with a bag made of a plankton net from *Cystoseira mediterranea* facies. The specimens were fixed in 5% formaldehyde, later rinsed with fresh water, and preserved in 70% ethanol. The specimens were examined and dissected under a stereomicroscope, and slide mounts were examined under a compound microscope. Drawings were made with the aid of a drawing tube mounted on an Olympus CX31 compound microscope. Measurements were done using an ocular micrometer. The specimens were deposited in the Museum of the Faculty of Fisheries, Ege University, İzmir (ESFM).

3. Results

Family PHOXICHILIDIIDAE Sars, 1891

Genus *Anoplodactylus* Wilson, 1878

Anoplodactylus gullukensis n. sp. (Figures 2–7)

Material examined: (1) One male holotype (ESFM-PYC/1990-1) from Güllük Gulf, 37°15′12″N, 27°37′04″E, collected by Dr. A. Sukatar on 11.09.1990 at depths ranging from 0 to 1 m in brown algae, *Cystoseira mediterranea* Sauvageau. (2) One female paratype (ESFM-PYC/1990-2) with the same data as the holotype. (3) One immature female paratype (ESFM-PYC/1990-2) with the same data as the holotype.

Diagnosis: An *Anoplodactylus* species with angular proboscis tip, ventral median suture in ventral view between ventral proboscis antimeres. Trunk without tubercles or setae, no segmentation suture between segments 3 and 4. Immovable finger of cheliphore with 4 spines-like teeth and two spiniform setae on the inner side.

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Figure 1. Map of the sampling area (star) where *Anoplodactylus gullukensis* n. sp. was found.

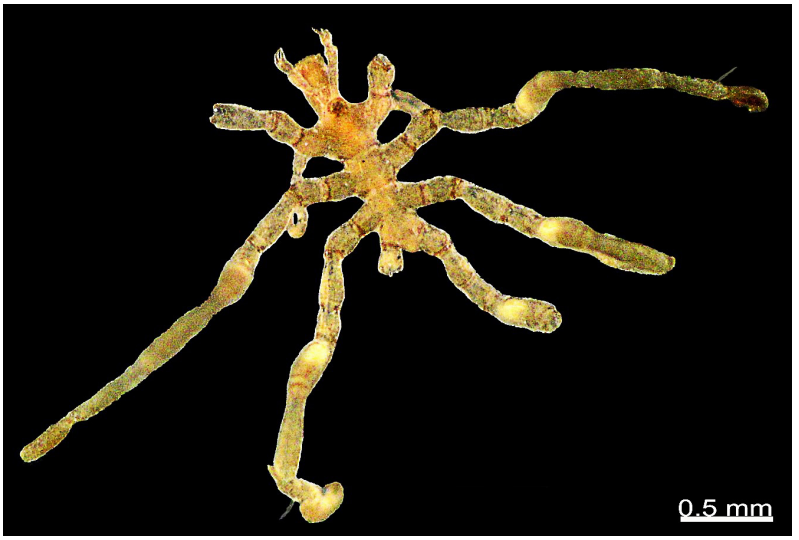

Figure 2. *Anoplodactylus gullukensis* n. sp., holotype male. Dorsal view.

Oviger six-articled. Two cement gland pores without any protruding ducts on the dorsal face of each femur; all leg articles armed with few short setae, propodal sole without cutting lamina, heel bearing two robust spines and one to two slender spines; absence of genital spurs on coxae 2 of leg3 and 4; main claw long-about as long as sole, auxiliary claws minute.

Holotype description: Habitus small size. First trunk segment largest in width and length, without tubercles or setae. Segmentation sutures present between trunk segments 1 and 2, as well as between 2 and 3; no suture between segments 3 and 4 (Figures 2 and 3A).

Neck short. Ocular tubercule dome shaped, low and wide, not apical cone, close to anterior edge of cephalon, lateral sense organs inconspicuous (this term is sometimes used instead of lateral papilla, e.g., Lehmann et al., 2017, Brenneis, 2022), four eyes well pigmented (Figure 3A).

Abdomen short, longer than ocular tubercule, almost erect, with three short distal setae, its distal margin is slightly longer than the end of the fourth lateral process (Figure 3A).

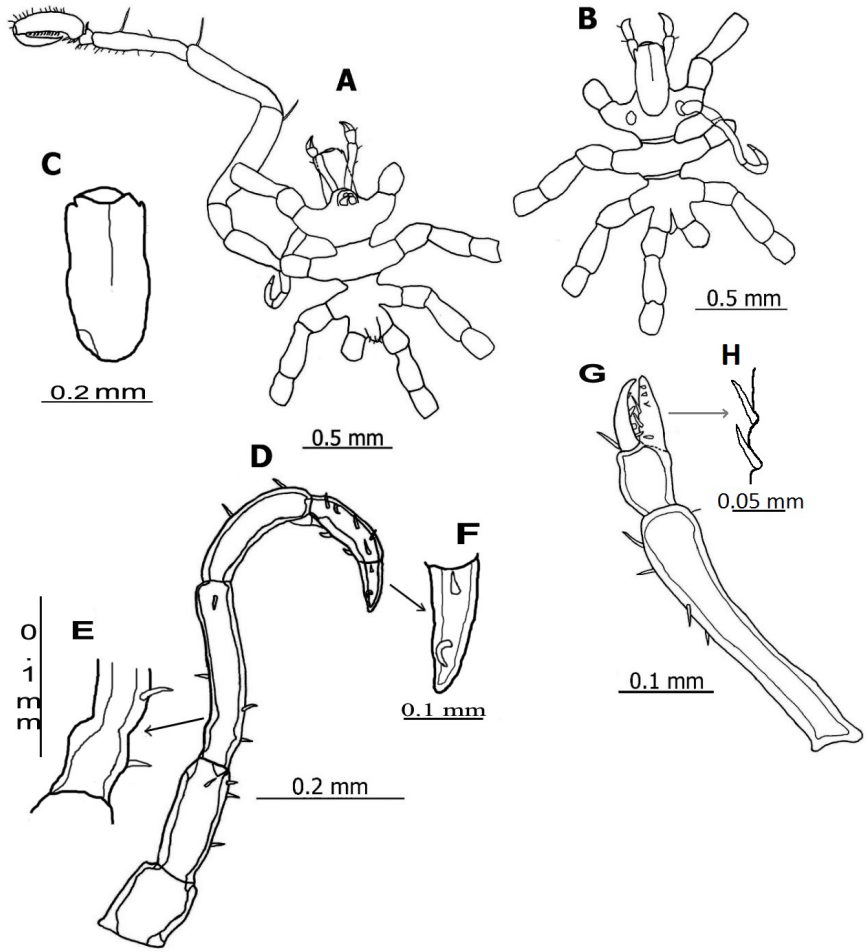

Figure 3. *Anoplodactylus gullukensis* n. sp., holotype male. A. Trunk, dorsal view with left leg 2. B. Trunk, ventral view. C. Proboscis, ventral view. D. Right oviger. E. Pseudo-articulation in article 3 of right oviger. F. Article 6 of right oviger. G. Left cheliphore. H. Two spiniform setae on the inner side of immovable finger of cheliphore.

Proboscis cylindrical, slender, somewhat bulging ventrally in lateral view, with two slightly swoollen in about medially, slightly constricted near distal end, about half length of trunk, slightly longer than the length of segments 2 and 3 combined but shorter than segments 1 and 2 combined, in ventral view tip with two protruding angular projections of ventral antimeres (like *Anoplodactylus angulatus*), long median suture apparent in ventral view between ventral antimeres (Figures 3B and 3C).

Oviger of six articles, article 3 longest, article 4 second longest, article 6 triangular with two short setae (one of them well curved), article 5 about half length of article 3, article 1 glabrous, a trace of such a pseudo-articulation in the article 3 (as in *A. sandromagni* Krapp, 1996), article 2 and 3 with four setae, article 4 with two lateral setae, article 6 about half length of article 5, article 5 with two curved spines and five setae -one of them well curved- (Figures 3D-3F).

Cheliphore with a long and slender scape, distally increasing in diameter, overhanging proboscis, slightly curved, sparsely setose. Scape slightly longer than proboscis. Chela shorter than scape. Palm as long as fingers. Fingers subequal, immovable finger almost straight and with 4 spine-like teeth and two spiniform setae on the inner side, movable finger recurved, slightly shorter than immovable finger and with 4 spines-like teeth (the more distal spine reduced to a denticulation) and armed with a spiniform seta on the outer side (Figures 3G and 3H).

Legs comparatively short, all leg articles armed with few short setae, femur longest, coxa 1 shortest, coxa 2 expanded in diameter distally, mostly so at about half length and slightly longer than coxa 3 (Figures 4A and 4B). Coxae 2 on legs 3 and 4 without genital spur, only genital pores ventrally on coxae 2 of the legs (Figure 4A). Tibia 1 slightly longer than tibia 2, and femur slightly longer than tibia 1, the usual subterminal robust setae present near the

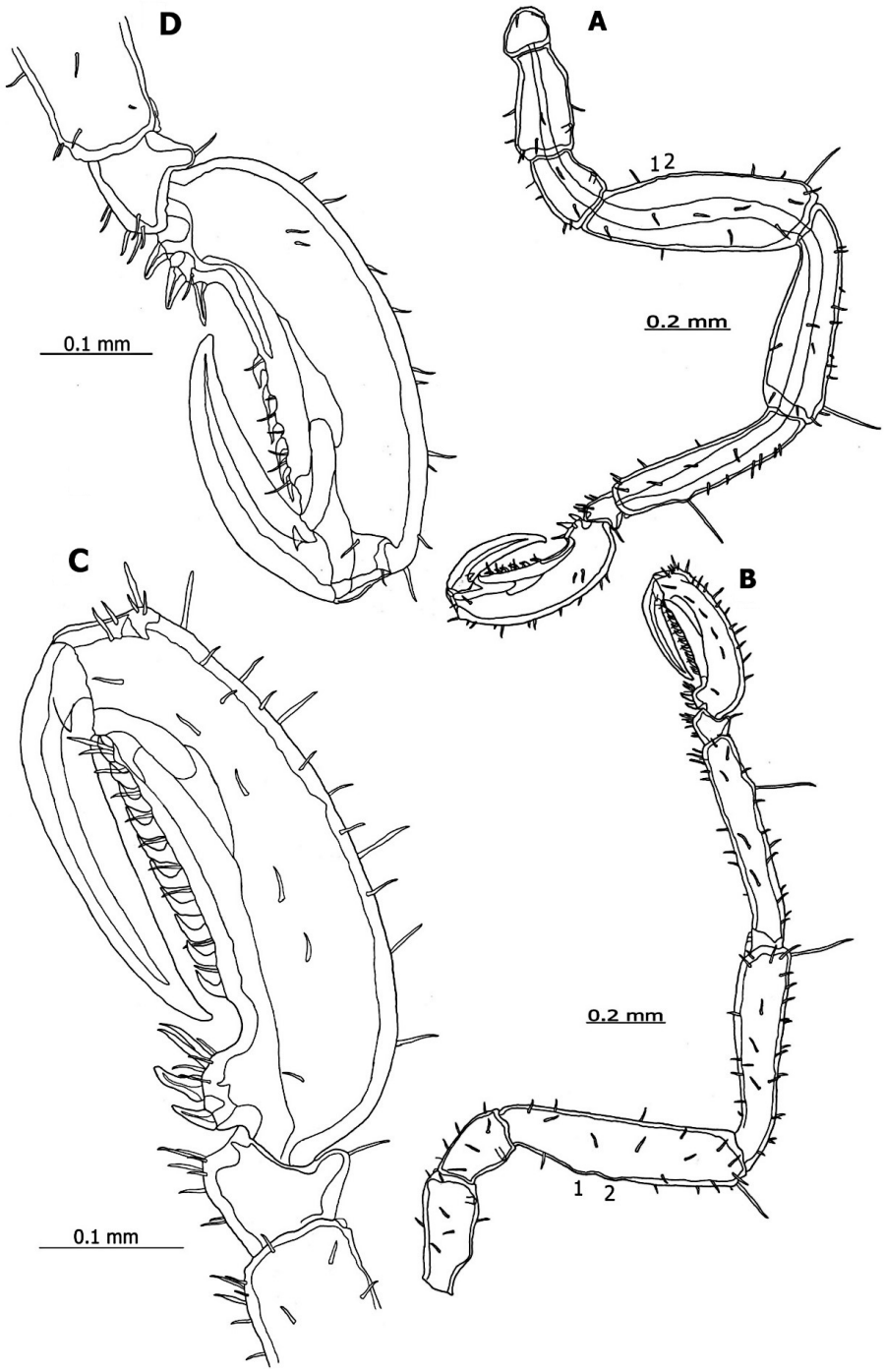

Figure 4. *Anoplodactylus gullukensis* n. sp., holotype male. A. Left leg 4. B. Left leg 2. C. Propodus and tarsus of left leg 2. D. Propodus and tarsus of left leg 4.

end of femur and both of tibia (Figures 4A and 4B). Tarsus short, bearing 6–7 setae ventrally and one seta dorsally. Propodus about as long as tibia 2, curved. Heel distinct, bearing two robust spines and one to two slender spines. Sole almost straight, armed with a row of characteristically curved robust spines with about six to ten, no trace of cutting lamina. Main claw robust, about as long as sole, slightly curved distally. Auxiliary claws minute (less than half length of proximal main claw diameter) (Figures 4C and 4D).Two cement gland pores without any protruding ducts on the dorsal face of each femur (Figures 4A and 4B, Figures 5A and 5B).

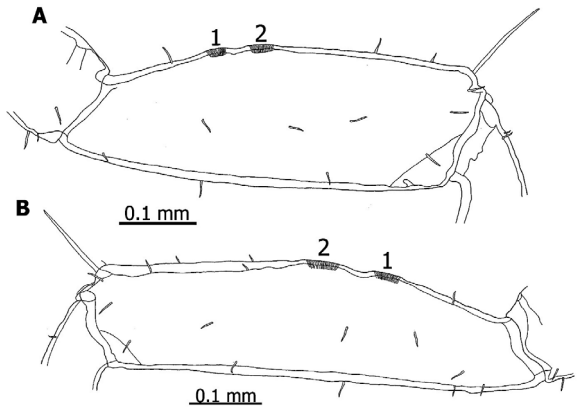

Figure 5. *Anoplodactylus gullukensis* n. sp., holotype male. A. Pores of cement gland of left leg 4. B. Pores of cement gland of left leg 2.

Figure 6. *Anoplodactylus gullukensis* n. sp., paratype female. Dorsal view.

Holotype measurements (mm):
Total length from tip of proboscis to tip of the fourth lateral process (ventral): 1.04
Trunk length from frontal margin of cephalic segment to tip of fourth lateral process: 0.85
Trunk width across first lateral process: 0.57
Proboscis length (ventral): 0.42
Abdomen length: 0.12
Cheliphore length: 0.45
Ocular length: 0.08
Oviger lengths: article 1, 0.11; article 2, 0.17; article 3, 0.26; article 4, 0.19; article 5, 0.13; article 6, 0.07
Fourth leg lengths: coxa 1, 0.15; coxa 2, 0.26; coxa 3, 0.20; femur, 0.56; tibia 1, 0.52; tibia 2, 0.49; tarsus, 0.09; propodus, 0.42; main claw, 0.27; auxiliary claw, 0.02

Female: Slightly smaller, but otherwise in close agreement with male (Figure 6). Femora swollen, with eggs in different size. Genital pores ventrally on coxae 2 of all legs, larger than those in male (Figure 7A). Main claw curved proximally. Propodal sole bearing more numerous curved robust spines (Figure 7B). Proboscis as in male, with ventrolateral angular projections at tip corners (Figure 7C).

Distribution: So far, *A. gullukensis* n. sp. is known only from the type-locality, Güllük Gulf, Aegean Sea, at a depth of 0 to 1 m.

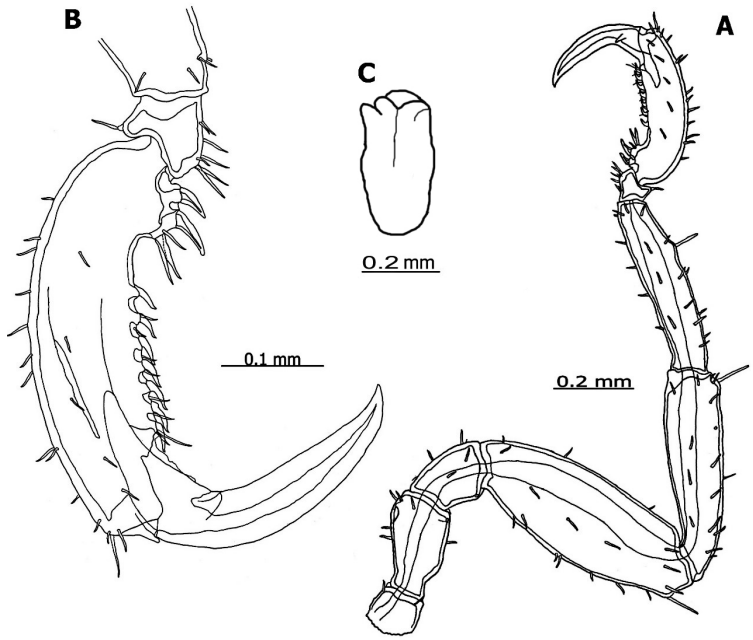

Figure 7. *Anoplodactylus gullukensis* n. sp., paratype female. A. Left leg 4. B. Propodus and tarsus of left leg 4. C. Proboscis, ventral view.

Etymology: This species is named after the geographical area (Güllük Gulf, Aegean Sea) where the type specimens were collected.

4. Discussion

The new species belongs to *Anoplodactylus* group of species (*A. angulatus* (Dohrn, 1881), *A. robustus* (Dohrn, 1881), *A. sandromagni* Krapp,1996, *A. nanus* Krapp, Koçak & Katağan, 2008, and *A. gullukensis* n. sp.), which share the following characteristics (Krapp et al. 2008):

1. angular proboscis in ventral view
2. presence of stout yet short auxiliary claws
3. no cutting sole lamina
4. cement gland pores on dorsal surface of femur, absence of cement gland ducts, only a series of openings on outer side of femur
5. compact build, lateral processes separated by less than half their diameter
6. compact cephalon
7. ocular tubercle a very low cone at the anterior extremity of the cephalon
8. no male genital spurs on coxa 2 of legs 3 and 4.

Anoplodactylus gullukensis n. sp. resembles *A. sandromagni*, *A. nanus*, and *A. angulatus* in terms of having a ventral angular proboscis tip and an oviger with six articles. *A. gullukensis* n. sp. differs from these species in having two cement gland pores on the dorsal face of each femur (three-six cement gland pores in *A. angulatus*, cf. Dohrn, 1881 p.187 lines 17-18 pl. XII; six cement gland pores in *A. nanus*, cf. Krapp et al., 2008 p. 63 lines 18-19 Fig. 5a; three cement gland pores in *A. sandromagni*, cf. Krapp, 1996 p. 522 lines 23-24). *A. gullukensis* also differs from *A. angulatus* by the presence of one to two slender spines on the propodal heel, and two spiniform setae on the inner side of the immovable finger of the cheliphore. In addition, the distal contour of abdomen is slightly longer than distal margin of the fourth lateral processes in *A. gullukensis*, while the distal contour of abdomen is nearly reaching to half the length of the coxa 1 in *A. angulatus*. *A. gullukensis* is also distinguished from *A. angulatus* based on the presence of a well curved seta on the sixth article of the oviger and the trace of a pseudoarticulation in article three of the oviger. This new species is also distinguished from *A. sandromagni* and *A. nanus* in having a larger trunk length (about 25% longer than in *A. sandromagni* and about twice those in *A. nanus*), and two short setae on article six of the oviger, compared to none in *A. sandromagni* and *A. nanus*. Furthermore, the length of the auxiliary claw is less than half the diameter of the proximal main claw in *A. gullukensis*, whereas it is slightly larger than the diameter of the proximal main claw in *A. sandromagni* and less than a third of the diameter of the proximal main claw in *A. nanus*. This new species is also distinguished from *A. nanus* due to the presence of spine-like teeth and spiniform setae on the inner side of the immovable finger of the cheliphore and having terminal robust setae on both tibiae. In addition, *A. gullukensis* differs from *A. sandromagni* in the lack of a segmentation

suture between segments three and four, and the presence of two spiniform setae on the inner side of the immovable finger of the cheliphore.

Identification key to the Turkish species of *Anoplodactylus* (Adult male specimens)

1. Oviger with 5 articles 2
– Oviger with 6 articles 3
2. Trunk partially segmented, segmentation absent between segments 3 and 4. Propodus robust, with 2 large spines on heel. Propodal sole no lamina…… .*A. virescens*
– Trunk without segmentation. Propodus slender, with 1 large spine on heel. Propodal sole with lamina ..... *A. stocki*
3. Trunk small, less than 1 mm 4
– Trunk not small, larger than 1mm 8
4. Cement gland pore with protruding duct. Trunk with a dorsal tubercle and an apical seta. Propodal sole with long lamina. Auxiliaries claws absent ..... *A. pygmaeus*
- Cement gland pores without any protruding ducts. Trunk without ornamentation. Propodal sole no lamina. Auxiliaries claws present 5
5. Distal contour of abdomen nearly reaching to half length of the coxa 1. Slender spine absent on the propodal heel. 3-6 cement gland pores on the dorsal face of femur ... *A. angulatus*
-Distal contour of abdomen little longer than distal margin of fourth lateral processes. Propodal heel with a slender spine 6
6. Six cement gland pores on the dorsal face of femur .... *A. nanus*
-Two cement gland pores on the dorsal face of femur .... *A. gullukensis* n. sp.
8. Lateral processes ornamented only with setae .... *A. digitatus*
- Lateral processes ornamented with tubercle; with setae 9
9. Trunk not segmented. Oviger article 2 longest. Propodal sole with long lamina ..... *A. petiolatus*
-Trunk partially or completely segmented. Oviger article 3 longest. Propodal sole no lamina ..... *A. californicus*

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