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Review of Mediterranean members of the *Aphaenogaster cecconii* group (Hymenoptera: Formicidae), with description of four new species

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Abstract

A group of six Mediterranean species related to *Aphaenogaster cecconii* Emery is reviewed. Four new species are described: *A. equestris* (SW Turkey), *A. jolantae* (Greece, Rhodes), *A. lykiaensis* (SW Turkey) and *A. olympica* (Greece, Karpathos). *Aphaenogaster cecconii* Emery and *A. phillipsi* Wheeler & Mann are redescribed. Detailed measurements and some observations on the location of nests and activity of workers are given.

Key words: Formicidae, *Aphaenogaster*, new species, Mediterranean Basin

Introduction

Aphaenogaster Mayr, 1853 is a moderately large genus with 181 valid nominal species and 44 valid nominal subspecies distributed worldwide, with most forms found in the Northern Hemisphere. In Europe and the Mediterranean area (including the Near East), 81 species have been recorded so far. There are two centers of biodiversity in this area: one in the northwestern part of North Africa and the other in the eastern part of the Mediterranean Basin. The most species-rich are faunas of Morocco (23), Greece (21), Italy (19), Algeria (18), Turkey (17), Spain (13), Transcaucasian countries (9), Croatia and Israel (8), Tunisia (7), France (6), Macedonia (6), and Bulgaria (4) (Arakelian 1994, Cagniant 1996, Bračko 2006, Bolton et al. 2007, Gratiashvili & Barjadze 2008, Casevitz-Weulersse & Galkowski 2009, Ionescu-Hirsch 2010, Lapeva-Gjonova et al. 2010, Borowiec & Salata 2012, 2013, Kiran & Karaman 2012, Boer 2013, Bračko et al. 2014). In other countries three or fewer species have been recorded (Bolton et al. 2007, Borowiec 2014).

The European and Mediterranean species of *Aphaenogaster* had been historically classified in three subgenera: (1) *Aphaenogaster* s. str. with species characterized by black body, strong sculpture of the whole surface of head and thorax with dull background, and more or less striated gaster; (2) *Attomyrma* Emery1915 with species of stout to moderately elongate, usually yellow or brown, occasionally black body, and usually fine microsculpture of head and thorax with at most partly smooth top of head and pronotum (except *A. epirotes*, *A. obsidiana*, and *A. subcostata* with strongly sculptured head but partly shiny background), and gaster without striation; and (3) *Deromyrma* Forel, 1913 (= *Ischnomyrmex* auct. not Mayr, 1863) with species of very elongate body and head and thorax mostly without distinct microsculpture, appearing shiny. Due to the fact that some species have morphology transitional between subgenera, in a recent catalogue (Bolton 2003, Bolton et al. 2007) the subgenera *Attomyrma* and *Deromyrma* were treated as synonyms of *Aphaenogaster.* However, certain species-groups can still be separated on morphological grounds (Schulz 1994, Boer 2013).

The most distinct is the *Aphaenogaster cecconii* group, which includes five described species: *A. cecconii* Emery, 1894, endemic to Crete; *A. phillipsi* Wheeler & Mann, 1916, recorded from Jordan and Israel; *A. rhaphidiiceps* (Mayr, 1877), from Kazakhstan; and *A. takahashii* Wheeler, 1930 and *A. wangtian* Terayama, 2009, from Taiwan. All species were previously placed in the subgenus *Deromyrma*. The group was characterized in Schulz (1994) by extremely elongate body, head and thorax mostly without distinct sculpture, long legs and antennae, the head elongate and strongly narrowed posteriorly, with the occiput forming a narrow neck with flared

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collar. Our recently collected material from the Mediterranean region shows that species of the *A. cecconii* group have a variety of head shapes, from oval to distinctly constricted posteriorly; only three species in the group have the head with a distinct narrow neck and the occiput margined by a sharp collar. To accommodate the new species included in this review, the definition of *A. cecconii* group should be modified as follows:

- body surface with indistinct microsculpture, shiny across extensive areas;
- body coloration from yellow to black;
- head oval and with a sharp basal carina, or
- head strongly narrowed posteriorly to a neck with a flared collar;
- antennal scapes elongate, reaching beyond the posterior margin of the head by at least 1/3 their length;
- basal and mid antennal segments distinctly longer than wide;
- mesosoma narrow and elongate.

Our observations of *Aphaenogaster cecconii* on Crete show that this species has a tendency to cavernicolous life. Nests are built in rock crevices, usually in natural caverns or caves, but these ants can also utilize human constructions such as ancient tombs, ruins, or interiors of concrete culverts under roads. Foragers avoid sun, usually staying near the entrance to the nest in shady and humid places. The workers of this species have a distinctive way of moving: slow and often performing swinging movements back and forth on their long legs (reminiscent of the movements of chameleons). Their affinity for a microhabitat rarely explored by myrmecologists probably accounts for the fact that these ants have been rarely collected and are known from few specimens. This led us to an extensive survey of ants in similar environments in other regions of the eastern Mediterranean and we discovered four new species of this group with similar habitat preferences. The biology of *A. phillipsi* is not known except the fact that it was collected at a bait (Wheeler & Mann 1916), but the type locality of Petra suggests that it was collected in a rocky habitat with natural and artificial caverns.

Below, we redescribe the two previously known Mediterranean species of the *Aphaenogaster cecconii* group and described four new species, two from Dodecanese archipelago (one from Rhodes and another one from Karpathos) and two from southwestern Turkey.

Material and methods

Specimens were compared using standard methods of comparative morphology. Photos were taken using a Nikon SMZ 1500 stereomicroscope, Nikon D5200 photo camera and Helicon Focus software.

All given label data are in their original spelling; a vertical bar (|) separates data on different rows and double vertical bar (||) separates labels. Additional information about the labels or explanatory notes are given in square brackets.

Examined specimens are housed in the following collections:

BMNH	Natural History Museum, London, UK;
CASC	California Academy of Sciences, San Francisco, California, USA.;
DBET	Department of Biodiversity and Evolutionary Taxonomy, University of Wrocław, Poland;
MCSNG	Museo Civico di Storia Naturale, Genova, Italy;
MCZ	Museum of Comparative Zoology, Cambridge, USA.;
MLBC	coll. Marek L. Borowiec, University of California, Davis, USA;
SMNG	Görlitz Senckenberg Museum für Naturkunde, Görlitz, Germany;
SSC	coll. Sebastian Salata, Wrocław, Poland.

Measurements and Indices:

Measurements.

HL—head length; measured in straight line from mid-point of anterior clypeal margin to mid-point of occipital margin; in full face view;

TL—tempora length; measured from the posterior margin of the eye to the posteromedian margin of head;
GL—gena length; measured from the anterior margin of the eye to the anteriormost projection of the clypeal margin;
HW—head width; width of head at anterior margin of eyes in full-face view;
NW—neck width; for species with narrowly constricted neck, width of neck at narrowest part;
CW—clypeus width; width of the posterior extension of the clypeus measured at the midpoint of the antennal sockets;
FLW—frontal lobes width; maximum width between external borders of the frontal lobes;
EL—eye length; measured along the maximum diameter of eye;
EW—eye width; measured along the maximum width of eye perpendicular to EL;
SL—scape length; maximum straight-line length of scape;
PNW—pronotum width; maximum width of pronotum in dorsal view;
ML—mesosoma length; measured as diagonal length from the anterior end of the neck shield to the posterior margin of the propodeal lobe;
SDL—spiracle to declivity length; minimum distance from the center of the propodeal spiracle to the propodeal declivity;
PSL—propodeal spine length; measured from the center of the propodeal spiracle to the top of the propodeal spine in lateral view;
DPST—distance between outer margins of propodeal spines measured at the tips;
DPSB—distance between outer margins of spines measured at the base;
PH—petiole height; maximum height of petiole in dorsal view;
PL—petiole length; maximum length of petiole in dorsal view;
PW—petiole width; maximum width of petiole in dorsal view;
PPH—postpetiole height; maximum height of postpetiole in dorsal view;
PPL—postpetiole length; maximum length of postpetiole in dorsal view;
PPW—postpetiole width; maximum width of postpetiole in dorsal view;
HTL—hind tibia length; maximum length of hind tibia.
Example of measurements: 1.617 ± 0.135 (1.073-1.717) = The average measurement ± standard deviation (range of variation).

Indices
CI—cephalic index: HW/HL x 100;
TGI—tempora/gena index; TL/GL x 100;
CL—clypeus index; CW/HW x 100;
FLI—frontal lobes index; CW/FLW x100;
SI1—scape index 1; SL/HL x 100;
SI2—scape index 2; SL/HW x 100;
MI—mesosoma index; ML/PNW x 100;
SPI1– propodeal spines index 1; PSL/HW x 100;
SPI2—propodeal spines index 2; PSL/SDL x 100;
PI1—petiole index 1; PL/PH x 100;
PI2—petiole index 2; PL/HW x 100;PI1—postpetiole index 1; PPL/PPH x 100;
PPI2—postpetiole index 2; PPL/HW x 100;
PSI—postpetiole/spine index; PPH/DPSB x 100;
HTI—hind tibia index; HTL/HW x 100.
All lengths are in mm.

Key to the Mediterranean species of *Aphaenogaster cecconii* group

1. Head strongly narrowed posteriad, with a narrow neck margined by a high and sharp collar (Figs. 21–23). . . . . 2.
–. Head elongately oval, gradually narrowed posteriad, without narrow neck, with occiput margined by a low, sharp carina (Figs. 24–26) . . . . . 4.

2. Head and thorax black, brown or partly reddish brown (Figs. 1–2, 7–8) . . . . . 3.
–. Head and thorax uniformly yellow (Figs. 11, 12). Egypt, Jordan and Israel . . . . . *phillipsi* Wheeler & Mann
3. Sides of frons with distinct microreticulation and longitudinal rugae. Head and thorax black or dark brown, first abdominal tergite dark brown to black, at base with large whitish or grey patch (Figs. 1, 2). Crete . . . . . *cecconii* Emery
–. Sides of frons with diffused microreticulation and at most with rudiments of rugae. Head and thorax brown or yellowish brown, first abdominal tergite uniformly brown (Figs. 7, 8). SW Turkey . . . . . *lykiaensis* **sp. nov.**
4. Head rusty-yellow, frons with brownish triangular patch of diffused borders, thorax, antennae and legs rusty-yellow, first gastral tergite rusty-yellow at base and brownish posteriorly (Figs. 3, 4, 18). SW Turkey . . . . . *equestris* **sp. nov.**
–. Head, thorax, antennae and legs brown to almost black, first abdominal tergite uniformly dark brown (Figs. 5–6, 9–10, 17, 19). Dodecanese . . . . . 5.
5. Scape shorter (SL: 1.457–1.763, mean 1.686 ± 0.085), head less narrowed posteriorly (HW/NW 1.869–2.119 mean 1.977 ± 0.074). Surface of head with less distinct microsculpture, especially anterior to eyes and around antennal scrobes; occipital part of head with micoreticulation absent or rudimentary (Fig. 24). Base of first abdominal tergite without longitudinal grooves or they are very short, without distinct microreticulation between grooves (Fig. 13). Body color pale brown (Fig. 5, 6). Rhodes . . . . . *jolantae* **sp. nov.**
–. Scape longer (SL: 1.672–1.880, mean 1.752 ± 0.049), head more distinctly narrowed posteriorly (HW/NW 2.132–2.436, mean 2.289 ± 0.082). Surface of head with more distinct microsculpture, especially micoreticulation is well developed anterior to eyes, around antennal scrobes and on occipital part of head (Fig. 25). Base of first abdominal tergite with long longitudinal grooves and distinct microreticulation between grooves (Fig. 14). Body color dark brown (Fig. 9, 10). Karpathos . . . . . *olympica* **sp. nov.**

Review of species

Aphaenogaster cecconii Emery, 1894

Aphaenogaster (*Ischnomyrmex*) *cecconii* Emery, 1894: 7, fig.
Aphaenogaster (*Deromyrma*) *cecconii*: Emery, 1915: 71.

Type material.: Holotype worker: Aphaenogaster | (Ischnomyrmex) | Cecconii | Emery || Creta (Cecconi) | Kisamo || MUSEO GENOVA | coll. C. Emery | (dono 1925) || TYPUS || HOLOTYPUS | Aphaenogaster | (Ischnom.) Cecconii | C. Emery, 1894 || ANTWEB | CASENT | 0904184 (MCSNG) (AntWeb image examined, http://www.antweb.org//specimenImages.do?name=casent0904184&project=allantwebants. Accessed 7 August 2014).

Other material examined. 18 workers—GR Crete, Kourna Lake | S Georgioupoli | 35.32°N 24.28°E 3.v.2007 | L. Borowiec & M.L. Borowiec (MLBC); 4 workers—GREECE, NW Crete | Kourna Lake S of Georgio- | upoli, 35.32° N/24.28° E, | 3 V 2007 L. & M.L. Borowiec (DBET); 8 workers—GR Crete, Khóra Sfakíon | 35.20°N 24.14°E 1.v.2007 | L. Borowiec & M.L. Borowiec (MLBC); 13 workers—GREECE, W Crete, 160 m | Diktamos Gorge n. Stilos | 35°26' N/24°06' E | 4 V 2011, L. Borowiec (DBET); 1 worker—GREECE, W Crete, 320 m | Therisso Gorge S of | Chania, 35°26' N/23°59' E | 1 V 2011, L. Borowiec (DBET); 1 worker—GREECE, W Crete, 186 m | Ancient Aptera E of Chania | 35°20' N/24°07' E | 4 V 2011, L. Borowiec (DBET); 3 workers—GREECE, Crete, Rethymno Pr. | Plakias, urban area | 35°11.514 N/24°23.643E | 5 V 2013, 4 m | S. Salata (SSC); 2 workers—GREECE, Crete, Rethymno Pr. | Plakias, Akrotiri Kakomouri | 35°10.801 N/24°24.028 E | 5 V 2013, 28 m | S. Salata (SSC); 1 worker—GREECE, Crete, Rethymno Pr. | Koutarliotiko Gorge | 35°11.549 N/24°27.826 E | 6 V 2013, 158 m | L. Borowiec (DBET); 1 worker—GREECE, Crete, Rethymno Pr. | Koutarliotiko Gorge | 35°11.549 N/24°27.826 E | 6 V 2013, 158 m | S. Salata (SSC); 2 workers—GREECE, Crete, Rethymno Pr. | Preveli Beach | 35°10.398 N/24°28.023E | 7 V 2013, 10 m | S. Salata (SSC); 2 workers—GREECE, Crete, Chania Pr. | Imbros Gorge | 35°12.684 N/24°10.104 E | 8 V 2013, 234 m | L. Borowiec (DBET); 2 workers—GREECE, Crete, Chania Pr. | Imbros Gorge | 35°12.684 N/24°10.104 E | 8 V 2013, 234 m | S. Salata (SSC); 1 worker—GREECE, Crete, Rethymno Pr. | Kallikratiano Gorge | 35°12.807 N/24°13.838E | 8 V 2013, 441 m | S. Salata (SSC); 1 worker—GREECE, Crete, Rethymno Pr. | Chromonastiri | 35°20.250 N/24°30.236E | 10 V 2013, 262 m | S. Salata (SSC); 3 workers—GREECE, Crete, Rethymno Pr. | Antonios Spilia Gorge | 35°15.245 N/24°34.220E | 11 V 2013, 342 m | S. Salata (SSC); 2 workers—GREECE, Crete, Rethymno Pr. | Xirocambos | 35°06' N/24°33' E | 12 V 2013, 24 m | L. Borowiec (DBET); 1 worker—GREECE, Crete, Rethymno Pr. | n. Argioupolis | 35°17.583 N/24°20.588 E | 13 V 2013, 197 m | L. Borowiec (DBET); 2 workers—GREECE, Crete, Rethymno Pr. | n. Argioupolis | 35°17.583 N/24°20.588 E | 13 V 2013, 197 m | S. Salata (SSC); 5 workers—GREECE, Crete, Rethymno Pr. | Fourfouras | 35°13.285 N/24°43.243 E | 14 V 2013, 578 m | S. Salata (SSC).

FIGURES 1–2. *Aphaenogaster cecconii* Emery. **1**, Worker dorsal. **2**, Worker lateral (scale bar = 1 mm).

Redescription. Measurements: Workers (n=23): HL: 1.617 ± 0.135 (1.073–1.717); TL: 0.833 ± 0.08 (0.513–0.905); GL: 0.559 ± 0.06 (0.346—0.625); NW: 0.339 ± 0.04 (0.19–0.38); HW: 0.924 ± 0.096 (0.587–1.022); CW: 0.174 ± 0.018 (0.112–0.201); FLW: 0.331 ± 0.019 (0.279–0.363); SL: 2.314 ± 0.2 (1.579–2.452); EL: 0..260 ± 0.025 (0.179–0.291); EW: 0.203 ± 0.017 (0.145–0.226); ML: 2.433 ± 0.217 (1.587–2.618); PSL: 0.261 ± 0.036 (0.145–0.302); SDL: 0.221 ± 0.029 (0.123–0.259); HTL: 2.207 ± 0.222 (1.395–2.513); PL: 0.638 ± 0.048 (0.525–0.693); PPL: 0.449 ± 0.027 (0.369–0.492); PH: 0.367 ± 0.02 (0.313–0.421); PPH: 0.309 ± 0.0219.8 (0.254–0.346); PNW: 0.695 ± 0.0769.8 (0.425–0.754); DPSB: 0.219 ±

0.031 (0.117–0.268); DPST: 0.241 ± 0.032 (0.134–0.268); PW: 0.238 ± 0.027 (0.139–0.268); PPW: 0.3 ± 0.032 (0.179–0.346); CI: 57.2 ± 2.2 (50.1–60.2); CL: 18.9 ± 1.5 (16.4–22.9); FLI: 53.4 ± 3.4 (47.1–60); SI1: 143.2 ± 4.2 (128.8–148.7); SI2: 251.3 ± 12.1 (235.5–291.8); PI1: 173.9 ± 11.7 (151.7–197.1); PI2: 68.6 ± 3.4 (63–75.4); PPI1: 145.8 ± 8.5 (126.9–162.9); PPI2: 32.9 ± 1.8 (30.1–37); SPI1: 28.4 ± 1.9 (24.3–32.1); SPI2: 118.3 ± 7.9 (105.7–135.4); HTI: 239.6 ± 13.6 (221.1–280.5); MI: 350.7 ± 10.95 (327.2–373.4); PSI: 138 ± 7.7 (123.3–153.6) ; TGI: 149.18 ± 6.1 (139.7–163.7).

Head and thorax dark brown to black. Abdomen black, first tergite in anterior 1/3 length with whitish to yellow-whitish spot. Legs dark brown only tarsi yellowish to yellowish-brown, often trochanters, knee and apices of tibiae paler colored, yellowish-brown. Antennae yellowish, scapes with slightly infuscate apex (Figs. 1, 2).

Head posterior to eyes with straight sides or only slightly rounded, strongly narrowed posteriad, at base forming narrow neck margined by sharp, high collar (Fig. 21). Anterior margin of clypeus shallowly emarginated. Eyes small, 0.33 times as long as length of tempora. Scapes elongate and slim, 2.33 times as long as width of head, at base 0.73 times as wide as in apex, gradually widened, straight, only apex slightly bent down with shallow preapical constriction. Funicle elongate and thin, 1.27–1.30 times as long as scape, first segment elongate, 3.3 times as long as wide on apex, 0.94 times as long as second segment, length ratio of segments 100:107:107:103:100:100:107:127:123:120:173, apical segments 1.5 times as wide as basal segments (Fig. 15). Surface of scape with very fine microsculpture, shiny, covered with long and sparse semierect setae.

Promesonotum 2.4 times as long as wide, gently, regularly convex in profile or with very shallow cleft between pronotum and mesonotum. Propodeum elongate, 1.45 times as long as wide, propodeal spines short, needle-like, runs obliquely upwards (Fig. 2). Petiole elongate with long peduncle, its anterior face deeply concave, node angulate in profile. Posterior face straight in anterior 3/4 length, then shallowly concave. Ventral margin of petiole straight, without spine or distinct angulation (Fig. 2). In dorsal view, petiole almost parallel sided before petiolar node, then gently widened. Postpetiole in profile regularly rounded. In dorsal view postpetiole 1.68 times as long as wide, regularly widened from base to apex, apical half with gently rounded sides (Fig. 1).

Mandibles elongate, with outer edges straight, dorsal surface with distinct striation and several setose punctures, shiny, inner margin with one larger and 5–6 smaller teeth. Clypeus on whole surface with longitudinal rugae, interspaces microreticulate but more or less shiny. Frontal carinae short, not extending to the line connecting anterior margin of eyes, subparallel, interantennal area deeply impressed, microreticulate, without or with short, indistinct, 1–2 rugae, frontal triangle with thin longitudinal rugae, microreticulate but shiny between rugosities. Frons only on sides with thin longitudinal rugae, in central part with distinct microsculpture but shiny. Area between eyes distinctly microreticulate but appears shiny, microreticulation gradually diffused from front to back, gena, tempora and base of head with indistinct sculpture, on neck forming transverse striation, shiny. Pronotum with microreticulation diffused on top and distinct on sides . Top of pronotum shiny, sides from slightly dull to slightly shiny, with two rows of 4+2 setae. Mesonotum on whole surface microreticulate and partly microgranulate, sides with several transverse rugae, propodeum with slightly granulate sculpture, microreticulate, below spiracles with indistinct oblique rugae, top in anterior part with fine transverse wrinkles but surface of both mesonotum and propodeum appears slightly shiny (Fig. 2). Top of mesosoma in anterior part with 8–14 setae, in posterior part with only 2 setae, propodeum anteriorly with few very short setae and posteriorly with a pair of short setae, as long as or slightly shorter than propodeal spines. Base of petiole and postpetiole on entire surface microreticulate but without wrinkles, nodes smooth and shiny, covered with several sparse, long setae. Gaster on pale basal spot of first tergite more or less microreticulate, other parts shiny, without microreticulation, tergites with sparse, long, erect setae from as long as to 1.5 times as long as propodeal spines.

Legs very long, hind femora 1.2 times as long as thorax, hind tibiae 0.8 times as long as hind femora, hind tarsi 1.1 times as long as hind femora. Dorsal surface of femora with short, sparse, adherent pubescence, inner margin with row of sparse, long, setae, tibiae on whole surface covered with short, adherent to semierect pubescence, only inner margins with row or slightly longer and more erect setae (Fig. 2).

Biology. *Aphaenogaster cecconii* is a common species in Crete. The nest entrances are found in small caverns, at entries to large caves, cracks in rock walls of northern exposure, inside large porous limestone rocks in shady places of mountain streams, in ancient tombs, and in walls of ruins and other man-made structures. The ants forage in an area 70–100 cm around the entrance to the nest. In three cases we observed single workers crawling over large rocks in streams, likely transported there by the current after heavy rains. The workers bring small plant seeds or pieces of stalks to the nest, but also small fragments of dead insects. When disturbed, the ants retreat swiftly into

the nest entrance, remain immobile, or fall from the rock wall or stone onto the ground. We have not conducted any night observations so it is hard for us to say whether the species is more active at night. During the day we did not see any peaks of high activity. Even during the heat of the day their habitats are shaded and workers forage in the area around the nest.

Distribution. Endemic to Crete.

Discussion. *Aphaenogaster cecconii* is the species with the most elongated body, constricted neck base and head sides straight posterior to the eyes. It is also the darkest-colored species, mostly dark brown to black and only the first gastral tergite has a pale, whitish to whitish-yellow spot. The only other Mediterranean species that is dark colored and possesses a distinct neck constriction, *A. lykiaensis* **sp. nov.**, differs in the body being brown to partly rusty brown, the first gastral tergite uniformly brown, the head constriction broader, and the sides of the head posterior to the eyes slightly bulging. The third dark species, *A. jolantae* **sp. nov.**, distinctly differs in having an elongately-oval head without a pronounced neck constriction, and the first gastral tergite is uniformly dark brown.

Aphaenogaster equestris sp. nov.

Etymology. Named after the equestrian relief in the cavern of ancient Termessos where the nest of this new species was located.

Type material. Holotype worker: TURKEY, Antalya Prov. | ancient Termessos | 1018 m, 36°58'N/30°27'E | 3 VII 2010, L. Borowiec (BMNH); 13 paratype workers: the same data as holotype (DBET, SMNG, CASC, MLBC).

Description. Measurements: Workers (n=14): HW: 1.43 ± 0.039 (1.500–1.350); TL: 0.688 ± 0.02 (0.659–0.748); GL: 0.535 ± 0.03 (0.48–0.581); HW: 0.934 ± 0.032 (0.894–0.981); CW: 0.167 ± 0.008 (0.161–0.188); FLW: 0.319 ± 0.015 (0.291–0.341); SL: 1.889 ± 0.051 (1.804–1.978); EL: 0.249 ± 0.012 (0.235–0.277); EW: 0.199 ± 0.009 (0.182–0.212); ML: 2.092 ± 0.67 (1.935–2.184); PSL: 0.252 ± 0.022 (0.215–0.285); SDL: 0.189 ± 0.012 (0.168–0.201); HTL: 1.754 ± 0.048 (1.682–1.855); PL: 0.597 ± 0.027 (0.556–0.642); PPL: 0.406 ± 0.018 (0.380–0.447); PH: 0.368 ± 0.014 (0.359–0.391); PPH: 0.302 ± 0.014 (0.279–0.318); PNW: 0.682 ± 0.029 (0.648–0.754) ; DPSB: 0.242 ± 0.033 (0.198–0.307); DPST: 0.253 ± 0.017 (0.240–0.279); PW: 0.236 ± 0.012 (0.212–0.257); PPW: 0.307 ± 0.024 (0.286–0.346); CI: 65.1 ± 1.5 (62.7–67.2); CL: 18.1 ± 1.2 (15.9–20.1); FLI: 52.5 ± 3.6 (45.7–62.3); SI1: 132.2 ± 2.8 (125.8–137.2); SI2: 203 ± 6.6 (193.3–217.9); PI1: 160.2 ± 5.3 (150–170.1); PI2: 64 ± 2.4 (59.8–68.4); PPI1: 137.6 ± 9.4 (122–150); PPI2: 32.1 ± 1.1 (30.8–33.9); SPI1: 27.2 ± 1.7 (24.2–29.7); SPI2: 134.2 ± 4.2 (128–141.8); HTI: 188.7 ± 3.3 (185–195.1); MI: 310.9 ± 6.2 (296.4–320.4); PSI: 122.3 ± 14.1 (89.6–135.4); TGI: 128.9 ± 8.0 (116.5–140.9).

Head rusty yellow, frons with triangular brownish spot of diffused borders (Fig. 14). Thorax rusty yellow. Abdomen mostly brown, first tergite in anterior 1/3 length with rusty yellow spot. Legs and antennae rusty yellow (Figs. 3, 4).

Head elongate-oval, posterior to eyes moderately narrowed posteriad, at base without narrow neck, base margined by sharp carina, head width/base width ratio 2.2, tempora length/genae length ratio 1.45 (Fig. 26). Anterior margin of clypeus distinctly emarginate. Eyes small, 0.37 times as long as length of tempora. Scapes elongate and slim, 1.83 times as long as width of head, at base 0.67 times as wide as in apex, gradually widened, straight, only apex slightly bent down with shallow preapical constriction. Funicle elongate and thin, 1.30–1.33 times as long as scape, first segment elongate, 3.1 times as long as wide on apex, 1.25 times as long as second segment, length ratio of segments 100:80:96:96:104:100:104:136:136:128:200, apical segments 1.63 times as wide as basal segments (Fig. 18). Surface of scape with fine microsculpture, shiny, covered with moderately long and sparse setae, in basal half of scape adherent and in apical half semierect.

Promesonotum twice as long as wide, gently, regularly convex in profile. Propodeum elongate, 1.26 times as long as wide, propodeal spines short, needle-like, runs obliquely upwards (Fig. 4). Petiole elongate with long peduncle, its anterior face deeply concave, node subangulate in profile. Posterior face almost straight. Ventral margin of petiole straight, without spine or distinct angulation (Fig. 4). In dorsal view, petiole almost parallel sided anterior to petiolar node, then gently widened. Postpetiole in profile regularly rounded. In dorsal view postpetiole 1.37 times as long as wide, regularly widened from base to apex, apical half with gently rounded sides (Fig. 3).

Mandibles elongate, with outer edges straight, dorsal surface with distinct striation and several setose punctures, shiny, inner margin with two larger and 3–4 smaller teeth. Clypeus in the middle with fine longitudinal rugae, interspaces more or less microreticulate but shiny. Frontal carinae short, not extending to the line connecting

FIGURES 3–4. *Aphaenogaster equestris* **sp. nov. 3**, Worker dorsal. **4**, Worker lateral (scale bar = 1 mm).

anterior margin of eyes, subparallel, interantennal area deeply impressed, shiny, without rugae or with short median carina, frontal triangle with thin longitudinal rugae, microreticulate but shiny between rugosities. Frons on sides with thin longitudinal rugae, in central part mostly only microreticulate or with 1–2 thin longitudinal rugae, surface of frons appears slightly opaque. Gena, tempora and base of head with microreticulation gradually diffused from frons to basal carina, basal part of head appears shiny. Pronotum in top shiny with diffused microreticulation and two rows of 4+2 setae, on sides with distinct microreticulation and surface from slightly dull to slightly shiny. Mesonotum on whole surface microreticulate and partly microgranulate, sides with few oblique rugae especially close to posterior corners, propodeum with slightly granulate sculpture, microreticulate, below spiracles with 1–3 longitudinal rugae, top in anterior part with fine transverse wrinkles but surface of both mesonotum and propodeum appears more or less shiny (Fig. 3). Top of mesosoma in anterior part with 5–6 setae, in posterior part with only 2 setae, propodeum with a pair of short setae, as long as or slightly shorter than propodeal spines. Base of petiole and postpetiole distinctly microreticulate but without wrinkles, nodes with diffused microreticulation, shiny, covered

with several sparse, long setae. Gaster shiny, only close to postpetiole with diffused, indistinct microreticulation, tergites with sparse, long, erect setae from as long as to 1.5 times as long as propodeal spines.

Legs very long, hind femora 1.1 times as long as thorax, hind tibiae 0.8 times as long as hind femora, hind tarsi 1.2 times as long as hind femora. Dorsal surface of femora with short, sparse, adherent pubescence, inner margin with row of sparse, long, setae, tibiae on whole surface covered with short, adherent to semierect pubescence, only inner margins with row of slightly longer and more erect setae (Fig. 4).

Biology. The type nest was located in a rock crevice at a height of about 50 cm, in a deep cave two meters from the entrance. This cave is famous for its ancient equestrian relief and the nest was located under the relief. Workers were active on the wall between the nest entrance and the entrance to cave; three workers were collected on a large limestone rock adjacent to the cave entrance.

Distribution. Southwestern Turkey, Antalya Province.

Discussion. Both *Aphaenogaster equestris* **sp. nov.** and *A. phillipsi* are colored mostly yellow to rusty yellow, but the latter differs in head strongly narrowed posteriad with distinct narrow neck margined by a sharp collar. In addition, *A. phillipsi* has the head without a dark spot, and microsculpture more diffused and thus surface appearing more shiny. See also discussion under *A. jolantae*.

Aphaenogaster jolantae sp. nov.

Etymology. Dedicated to Jolanta Świetojańska, associate and participant in all myrmecological trips of the senior author and a well-known Polish entomologist.

Type material. Holotype worker: GREECE, Rhodes | Epta Piges 92 m, W of | Kolymbia, 36°15'N/28°06'E | 4 VII 2008, L. Borowiec || Collection L. Borowiec | Formicidae | LBC-GR00109 (BMNH); 23 paratype workers: the same data as holotype (DBET, SMNG, CASC, MLBC); 4 paratype workers: GREECE, Rhodes | Apollona, 36°15'N/27°55'E |10 VII 2008, 287 m | L. Borowiec || Collection L. Borowiec | Formicidae | LBC-GR00163 (DBET).

Description. Measurements: Workers (n=11): HL: 1.342 ± 0.078 (1.117–1.420) ; HW: 0.888 ± 0.093 (0.704–1.016); TL: 0.621 ± 0.04 (0.536–0.693); GL: 0.482 ± 0.03 (0.425–0.52); NW: 0.482 ± 0.031 (0.441–0.536); CW: 0.173 ± 0.019 (0.131–0.201); FLW: 0.307 ± 0.027 (0.257–0.346); SL: 1.686 ± 0.085 (1.457–1.763); EL: 0.246 ± 0.012 (0.218–0.257); EW: 0.186 ± 0.016 (0.145–0.201); ML: 1.928 ± 0.118 (1.605–2.092); PSL: 0.241 ± 0.027 (0.179–0.279); SDL: 0.197 ± 0.017 (0.168–0.235); HTL: 1.529 ± 0.096 (1.280–1.661); PL: 0.538 ± 0.040 (0.487–0.575); PPL: 0.377 ± 0.03 (0.324–0.419); PH: 0.32 ± 0.029 (0.279–0.357); PPH: 0.306 ± 0.028 (0.251–0.351); PNW: 0.658 ± 0.043 (0.553–0.704) ; DPSB: 0.223 ± 0.025 (0.167–0.246); DPST: 0.246 ± 0.038 (0.207–0.313); PW: 0.232 ± 0.018 (0.187–0.251); PPW: 0.287 ± 0.024 (0.234–0.335); CI: 66.1 ± 5.1 (52–71.8); CL: 19.5 ± 1.9 (17.8–24.4); FLI: 56.4 ± 6.1 (50–72.8); SI1: 125.7 ± 2.7 (122.3–130.4); F2: 191.6 ± 19.6 (171–246); PI1: 167.9 ± 16.9 (149.6–204.3); PI2: 61.5 ± 7.1 (53.4–77); PPI1: 123.3 ± 7.5 (109.7–133.9); PPI2: 35.7 ± 3.4 (33.1–43.6); SPI1: 27.3 ± 3.3 (24.6–34.9); SPI2: 122.2 ± 7.6 (106.5–129.5); HTI: 173.5 ± 16.1 (158.9–217.6) MI: 293.4 ± 11.1 (271.2–312.1); PSI: 142.4 ± 12.4 (127.2–162.2); TGI: 129.1 ± 9.4 (115.4–144.4).

Head, thorax and abdomen pale brown, first abdominal tergite without paler basal spot. Legs mostly brown only tarsi yellowish to yellowish-brown, often trochanters, knee and apices of tibiae paler colored, yellowish-brown. Antennal scapes brown, pedicle yellowish brown (Figs. 5, 6).

Head posterior to eyes gently, regularly convex, without constriction at base, basal margin margined by sharp carina (Fig. 24). Anterior margin of clypeus shallowly emarginate. Eyes small, 0.41 times as long as length of tempora. Scapes elongate and slim, 1.68 times as long as width of head, at base 0.58 times as wide as in apex, gradually widened, mostly straight, only apex slightly bent down without preapical constriction. Funicle elongate and thin, 1.38–1.40 times as long as scape, first segment elongate, 2.8 times as long as wide on apex, 1.29 times as long as second segment, length ratio of segments 100:77:95:95:95:91:95:127:118:127:200, apical segments 1.75 times as wide as basal segments (Fig. 17). Surface of scape finely microreticulate but shiny, covered with short and sparse adherent setae and only at apex of scape pubescence slightly raised from the ground.

Promesonotum 1.77 times as long as wide, pronotum gently, regularly convex in profile without cleft between pronotum and mesonotum. Propodeum elongate, 1.29 times as long as wide, propodeal spines short, needle-like, runs obliquely upwards (Fig. 6). Petiole elongate with long peduncle, its anterior face deeply concave, node from

subangulate to rounded in profile. Posterior face straight in anterior 3/4 length then shallowly concave. Ventral margin of petiole straight, without spine or distinct angulation (Fig. 6). In dorsal view, petiole almost parallel sided anterior to petiolar node, then gently widened. Postpetiole in profile regularly rounded. In dorsal view postpetiole 1.33 times as long as wide, regularly widened from base to apex, apical half with gently rounded sides (Fig. 5).

FIGURES 5–6. *Aphaenogaster jolantae* **sp. nov. 5**, Worker dorsal. **6**, Worker lateral (scale bar = 1 mm).

Mandibles elongate, with outer edges straight, dorsal surface with distinct striation and several setose punctures, shiny, inner margin with one larger and 6–7 smaller teeth. Clypeus on whole surface with fine longitudinal rugae, interspaces microreticulate but shiny. Frontal carinae short, not extending to the line connecting

anterior margin of eyes, subparallel, interantennal area deeply impressed, shiny, with only one median, fine carina, frontal triangle with very thin longitudinal rugae appearing as striation, microreticulate but shiny. Frons only on sides with thin longitudinal rugae, in central part with distinct microsculpture but shiny. Area between eyes distinctly microreticulate but appears shiny, microreticulation gradually diffused from front to back, gena, tempora and base of head with indistinct sculpture, on vertex microreticulation mostly diffused and surface shiny. Pronotum with microreticulation diffused on top, distinct on sides . Top of pronotum shiny, sides more or less shiny, with rows of 4+1+2 setae. Mesonotum on whole surface microreticulate and partly microgranulate, sides microgranulate without rugae or only with 2–3 short, transverse rugae, propodeum at top microreticulate, on sides with slightly granulate sculpture, below spiracles with few fine longitudinal rugae, top in anterior part with fine transverse wrinkles but surface of both mesonotum and propodeum appears slightly shiny (Fig. 5). Top of mesosoma in anterior part with 6 setae, in posterior part with only 2 setae, propodeum anteriorly with a pair of short setae, as long as or slightly shorter than propodeal spines. Base of petiole and postpetiole microreticulate but without wrinkles, nodes smooth and shiny, covered with several sparse, long setae. Gaster shiny, first tergite at base without longitudinal grooves and without distinct microreticulation (Fig. 13), tergites with sparse, long, erect setae from as long as to 1.5 times as long as propodeal spines.

Legs very long, hind femora 1.04 times as long as thorax, hind tibiae 0.77 times as long as hind femora, hind tarsi 1.23 times as long as hind femora. Dorsal surface of femora with short, sparse, adherent pubescence, inner margin with row of sparse, moderately long, setae, tibiae on whole surface covered with very short, adherent pubescence, only inner, apical margins with row or slightly longer and semierect setae (Fig. 6).

Biology. A nest of this species was located in a crevice inside a shallow cavern, near the middle of a 3 m high wall of a gorge on the famous tourist route Epta Piges (Seven Springs). Workers were foraging on the inner wall of the cavern at a distance of 1 m from the entrance to the nest. A couple of the foragers were carrying remains of moths collected from a nearby spider web. More workers were found in a hollow trunk of a huge *Platanus orientalis* tree. A large entrance to the hollow tree was located about 70 cm above the ground and led to a hollow trunk that could accommodate two standing people standing. The interior walls of the tree were charred; the entrance to the nest was probably on the roof of the hollow, where a few foraging workers were collected.

Distribution. Greece, Dodecanese, Rhodes island.

Discussion. *Aphaenogaster jolantae* **sp. nov.**, *Aphaenogaster olympica* **sp. nov.** and *Aphaenogaster equestris* **sp. nov.** are together easily distinguished from the other three species of the *A. cecconii* group by the head lacking a narrowed neck with flared collar. *Aphaenogaster equestris* differs in having the body mostly rusty-yellow and the sculpture of the head stronger, with the head surface partly dull. *Aphaenogaster olympica* is very similar and differs in subtle morphometric and sculptural characters described in the key.

Aphaenogaster lykiaensis sp. nov.

Etymology. Named after ancient Lykia region (Greek: Λυκία) in the southwestern part of Mediterranean Turkey. The type locality is located in the heart of this ancient land.

Type material. Holotype worker: TURKEY, Antalya Prov. | road Kemer-Somakseğri | 319 m, 36°35'N/ 30°28'E | 1 VII 2010, L. Borowiec (BMNH); 21 paratype workers: the same data as holotype (DBET, SMNG, CASC, MLBC).

Description. Measurements: Workers (n=22): HL: 1.530 ± 0.063 (1.626–1.36); HW: 0.912 ± 0.053 (0.765–1.005); TL: 0.743 ± 0.04; GL: 0.511 ± 0.04 (0.424–0.57); NW: 0.365 ± 0.04 (0.308–0.458); CW: 0.19 ± 0.014 (0.156–0.218); FLW: 0.318 ± 0.02 (0.268–0.358); SL: 2.166.9 ± 0.067 (2.000–2.303); EL: 0.254 ± 0.016 (0.218–0.285); EW: 0.204 ± 0.013 (0.162–0.223); ML: 2.263.7 ± 0.091 (2.126–2.447); PSL: 0.268 ± 0.021 (0.236–0.307); SDL: 0.201 ± 0.017 (0.190–0.235); HTL: 2.190 ± 0.096 (1.980–2.368); PL: 0.606 ± 0.047 (0.514–0.698); PPL: 0.433 ± 0.019 (0.402–0.469); PH: 0.376 ± 0.024 (0.335–0.424); PPH: 0.329 ± 0.018 (0.291–0.372); PNW: 0.688 ± 0.043 (0.573–0.788) ; DPSB: 0.227 ± 0.021 (0.179–0.279); DPST: 0.251 ± 0.023 (0.201–0.302); PW: 0.238 ± 0.023 (0.179–0.307); PPW: 0.33 ± 0.025 (0.257–0.285); CI: 59.6 ± 1.3 (56.3–61.8); CL: 20.6 ± 1.2 (17.5–22.3); FLI: 59 ± 3 (51.7–64.2); SI1: 141.7 ± 3.6 (135.5–147.4); SI2: 238.1 ± 9.5 (221.4–261.4); PI1: 161.1 ± 10.7 (130.8–181.8); PI2: 66.3 ± 3.8 (54.1–72.5); PPI1: 132.5 ± 7.1 (116.2–142.8); PPI2: 35.5 ± 0.9 (33.9–37); SPI1: 29.1 ± 1.2 (26.9–31.9); SPI2: 132.3 ± 8.5 (120–155.8); HTI: 241.2 ± 8.7

(226–258.8); MI: 329.8 ± 13.2 (295.2–353.6); PSI: 142.3 ± 6.8 (130.6–159.7); TGI: 145.8 ± 8.5 (120.5–168.6). Head and thorax pale brown, pronotum often yellowish brown. Petiole and postpetiole yellowish brown with darker top. Abdomen brown, first tergite without basal spot, only extreme margins of tergites yellowish-brown. Legs yellowish-brown, tarsi paler colored, yellowish. Antennae rusty yellow (Figs. 7, 8).

FIGURES 7–8. *Aphaenogaster lykiaensis* **sp. nov. 7**, Worker dorsal. **8**, Worker lateral (scale bar = 1 mm).

Head posterior to eyes slightly rounded then with straight sides strongly narrowed posteriad, at base forming narrow neck margined by sharp, high collar (Fig. 22). Anterior margin of clypeus moderately deeply emarginate. Eyes small, 0.35 times as long as length of tempora. Scapes elongate and slim, 2.17 times as long as width of head, at base 0.73 times as wide as in apex, gradually widened, straight, only apex slightly bent down without preapical constriction. Funicle elongate and thin, 1.27–1.30 times as long as scape, first segment elongate, 2.9 times as long as wide on apex, 1.24 times as long as second segment, length ratio of segments 100:81:100:104:104:104:108:130:127:123:196, apical segments 1.5 times as wide as basal segments (Fig. 16). Surface of scape with fine microsculpture but shiny, covered with long and sparse, in basal half adherent, apically semierect setae.

Promesonotum 2.1 times as long as wide, gently, regularly convex in profile. Propodeum elongate, 1.4 times as long as wide, propodeal spines short, needle-like, runs obliquely upwards (Fig. 8). Petiole elongate with long peduncle, its anterior face deeply concave, node subangulate to rounded in profile. Posterior face shallowly concave. Ventral margin of petiole straight, without spine or distinct angulation (Fig. 8). In dorsal view petiole almost parallel sided anterior to petiolar node, then gently widening. Postpetiole in profile with short basal peduncle, node regularly rounded. In dorsal view postpetiole 1.57 times as long as wide, regularly widened from base to apex, apical half with gently rounded sides (Fig. 7).

Mandibles elongate, with outer edges straight, dorsal surface with distinct striation and several setose punctures, shiny, inner margin with one larger and 6–7 smaller teeth. Clypeus in basal part with fine longitudinal rugae, interspaces microreticulate but more or less shiny. Frontal carinae short, not extending to the line connecting anterior margin of eyes, subparallel, interantennal area deeply impressed, microreticulate, without rugae or with short median carina, frontal triangle microreticulate, without rugae or with 1–3 thin rugae, interspaces shiny. Frons mostly without longitudinal rugae, only area close antennal scrobes with few short rugosities, surface with diffused microsculpture, shiny. Area between eyes, gena, tempora and base of head with diffused microsculpture, glossy. Pronotum mostly glossy, only along bases with slightly irregular sculpture, top of pronotum with two to three rows of 4+2+(2) setae. Mesonotum on whole surface microreticulate and microgranulate, without rugae or with rudiments of transverse fine rugae, propodeum with slightly granulate sculpture, microreticulate, below spiracles without or with rudiments of longitudinal rugae, top in anterior part with fine transverse wrinkles but surface of both mesonotum and propodeum appears shiny (Fig. 7). Top of mesosoma in anterior part with 6–8 setae, in posterior part with only 2 setae, propodeum anteriorly with a pair of short setae and posteriorly with a pair of short setae, shorter than propodeal spines. Whole surface of petiole and postpetiole with diffused microreticulation, shiny, covered with several sparse, long setae. Gaster on whole surface shiny, only close to postpetiole with diffused microreticulation, tergites with sparse, long, erect setae from as long as to 1.5 times as long as propodeal spines.

Legs very long, hind femora 1.25 times as long as thorax, hind tibiae 0.8 times as long as hind femora, hind tarsi as long as hind femora. Dorsal surface of femora with very short, sparse, adherent pubescence, inner margin with row of sparse, long, setae, tibiae on in basal half covered with very short, adherent pubescence, in apical half with short semierect setae (Fig. 8).

Biological data. The nest entrance was located in a gap in a concrete culvert 2 m across, by a road, at the height of about 1.70 m above the ground. Foraging workers were observed mainly within 1 m from the entrance to the nest, but two workers were caught 2 m from the nest, low above the ground in a tight dark place.

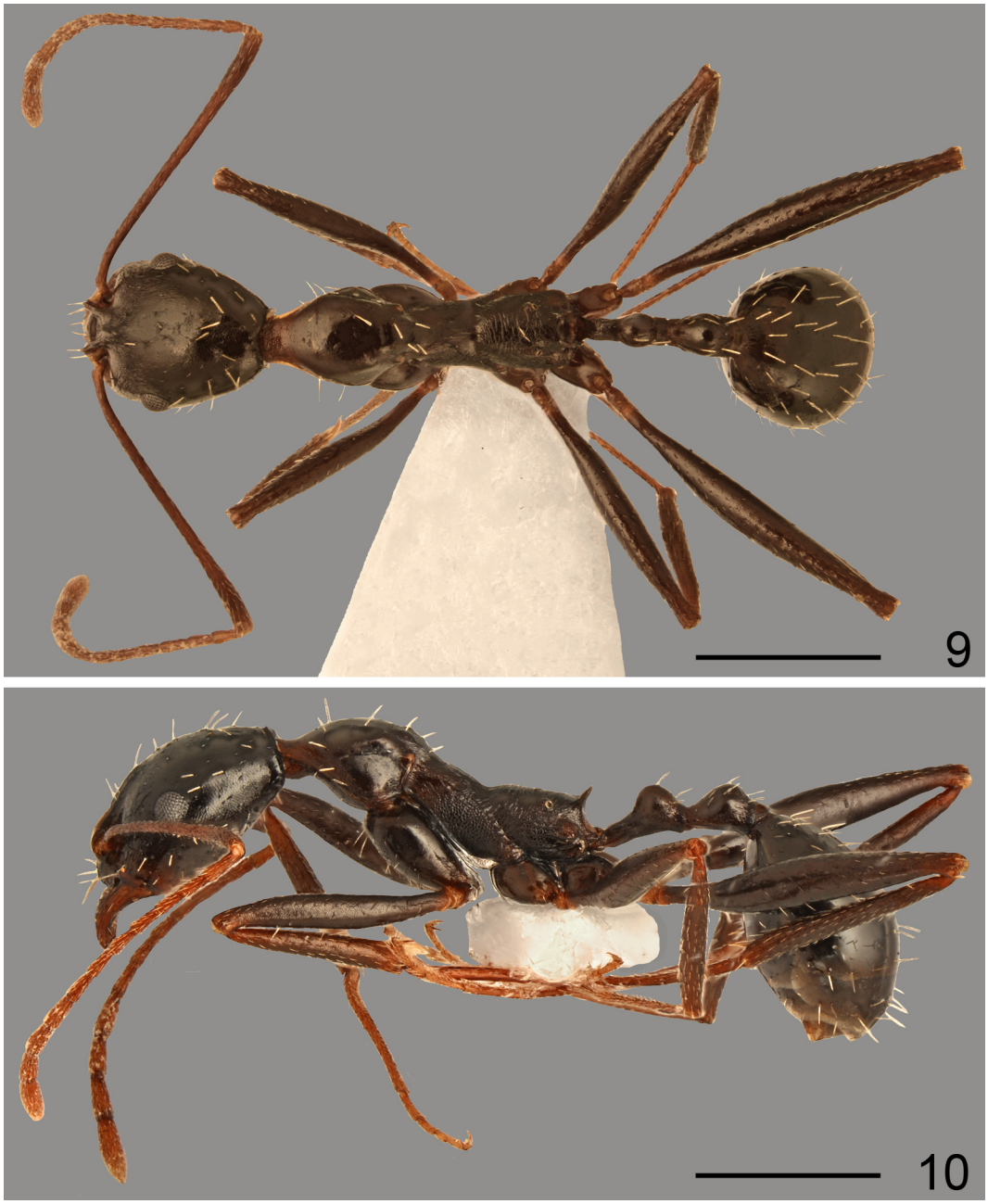
Distribution. Southwestern Turkey, Antalya Province.

Discussion. *Aphaenogaster lykiaensis* **sp. nov.**, *A. cecconii* Emery, and *A. phillipsi* Wheeler & Mann have the head strongly narrowed posteriorly to a neck with a flared collar. *Aphaenogaster phillipsi* distinctly differs in the body being almost uniformly yellow to rusty yellow. *Aphaenogaster cecconii* at first glance looks the most similar but differs in being dark brown to black with a whitish to yellow-white spot at the base of the first abdominal tergite, and with stronger sculpture on the frons.

Aphaenogaster olympica sp. nov.

Etymology. Named after its locus typicus, Olympos village.

Type material. Holotype worker: GREECE, Dodecanese | Karpathos, Olympos, 429 m | 35,72448 N/27,16972 E | 19 V 2014, S. Salata || Collection L. Borowiec | Formicidae | LBC-GR01334 (BMNH); 6 paratype workers: the same data as holotype (DBET); 4 paratype workers: GREECE Dodecanese | Karpathos, Olympos 351 m | 35°43'N 27°10'E | 19.05.2014 S. Salata (SSC); 15 paratype workers: GREECE, Dodecanese, 399 m | Karpathos, Spoa-Mesochori rd. | 35,62784 N/27,12748 E | 21 V 2014, S. Salata || Collection L. Borowiec | Formicidae | LBC-GR01335 (DBET, SMNG, CASC, MLBC); 1 paratype worker: GREECE Dodecanese | Karpathos, Spoa |—Mesochori rd., 384 m | 35°37'N 27°07'E | 21.05.2014 S. Salata (SSC); 7 paratype workers: GREECE, Dodecanese | Karpathos, Flaskia Gorge, 67 m | 35,5597 N/27,10981 E | 21 V 2014, S. Salata || Collection L. Borowiec | Formicidae | LBC-GR01336 (DBET); 2 paratype workers: GREECE Dodecanese | Karpathos, Flaskia Gorge | 23 m 35°33'N 27°06'E | 21.05.2014 S. Salata (SSC); 4 paratype workers: GREECE Dodecanese | Karpathos, Ag. Andreas | Gorge, 73 m 35°33'N | 27°11'E 23.05.2014 S. Salata (SSC).



FIGURES 9–10. *Aphaenogaster olympica* **sp. nov. 9**, Worker dorsal. **10**, Worker lateral (scale bar = 1 mm).

Description. Measurements: Workers (n=11): HL: 1.342 ± 0.078 (1.117–1.420) ; HW: 0.888 ± 0.093 (0.704–1.016); TL: 0.621 ± 0.04 (0.536–0.693); NW: 0.381 ± 0.021 (0.341–0.413); GL: 0.482 ± 0.03 (0.425–0.52); CW: 0.173 ± 0.019 (0.131–0.201); FLW: 0.307 ± 0.027 (0.257–0.346); SL: 1.686 ± 0.085 (1.457–1.763); EL: 0.246 ± 0.012 (0.218–0.257); EW: 0.186 ± 0.016 (0.145–0.201); ML: 1.928 ± 0.118 (1.605–2.092); PSL: 0.241 ± 0.027 (0.179–0.279); SDL: 0.197 ± 0.017 (0.168–0.235); HTL: 1.529 ± 0.096 (1.280–1.661); PL: 0.538 ± 0.040 (0.487–0.575); PPL: 0.377 ± 0.03 (0.324–0.419); PH: 0.32 ± 0.029 (0.279–0.357); PPH: 0.306 ± 0.028 (0.251–0.351); PNW: 0.658 ± 0.043 (0.553–0.704) ; DPSB: 0.223 ± 0.025 (0.167–0.246); DPST: 0.246 ± 0.038 (0.207–0.313); PW: 0.232 ± 0.018 (0.187–0.251); PPW: 0.287 ± 0.024 (0.234–0.335); CI: 66.1 ± 5.1 (52–71.8); CL: 19.5 ± 1.9 (17.8–24.4); FLI: 56.4 ± 6.1 (50–72.8); SI1: 125.7 ± 2.7 (122.3–130.4); F2: 191.6 ± 19.6 (171–246); PI1: 167.9 ± 16.9 (149.6–204.3); PI2: 61.5 ± 7.1 (53.4–77); PPI1: 123.3 ± 7.5 (109.7–133.9); PPI2: 35.7 ± 3.4 (33.1–43.6); SPI1: 27.3 ± 3.3 (24.6–34.9); SPI2: 122.2 ± 7.6 (106.5–129.5); HTI: 173.5 ± 16.1 (158.9–217.6) MI: 293.4 ± 11.1 (271.2–312.1); PSI: 142.4 ± 12.4 (127.2–162.2); TGI: 129.1 ± 9.4 (115.4–144.4); ; NI: 228.9 ± 8.2 (213.2–243.6).

Head, thorax and abdomen dark brown, first abdominal tergite without paler basal spot. Legs mostly brown with tarsi yellowish to yellowish-brown, often trochanters, knee and apices of tibiae paler colored, yellowish-brown. Antennal scapes brown, pedicle yellowish brown (Figs. 9, 10).

Head posterior to eyes gently, regularly convex, without constriction at base, basal margin margined by sharp carina (Fig. 25). Anterior margin of clypeus shallowly emarginate. Eyes small, 0.39 times as long as length of tempora. Scapes elongate and slim, 1.75 times as long as width of head, at base 0.56 times as wide as in apex, gradually widened, mostly straight, only apex slightly bent down without preapical constriction. Funicle elongate and thin, 1.37–1.39 times as long as scape, first segment elongate, 3.2 times as long as width at apex, 1.47 times as long as second segment, length ratio of segments 100:68:72:72:79:75:79:107:96:96:158, apical segments 1.64 times as wide as basal segments (Fig. 19). Surface of scape finely microreticulate but shiny, in basal half covered with short and sparse adherent setae, from midlength to apex pubescence gradually raised from the ground.

Promesonotum 1.88 times as long as wide, pronotum gently, regularly convex in profile without cleft between pronotum and mesonotum. Propodeum elongate, 1.39 times as long as wide, propodeal spines short, needle-like, sloping obliquely upwards (Fig. 10). Petiole elongate with long peduncle, its anterior face deeply concave, node rounded in profile. Posterior face straight in anterior 3/4 length then shallowly concave. Ventral margin of petiole straight, without spine or distinct angulation (Fig. 10). In dorsal view, petiole almost parallel sided anterior to petiolar node, then gently widened posteriorly. Postpetiole in profile regularly rounded. In dorsal view postpetiole 1.47 times as long as wide, regularly widened posteriorly, apical half with gently rounded sides (Fig. 9).

Mandibles elongate, with outer edges straight, dorsal surface with distinct striation and several setose punctures, shiny, inner margin with one larger and 6–7 smaller teeth. Clypeus on whole surface with fine longitudinal rugae, interspaces microreticulate but shiny. Frontal carinae short, not extending to the line connecting anterior margin of eyes, subparallel, interantennal area deeply impressed, shiny, without or with only one short median, fine carina, frontal triangle with very thin longitudinal rugae appearing as striation, microreticulate but shiny. Frons on sides with thin longitudinal rugae, in central part with distinct microsculpture but shiny. Area between eyes distinctly microreticulate but appears shiny, microreticulation gradually diffused from anterior to posterior; gena, tempora and vertex microreticulate, on occipital part of head microreticulation more or less diffused but visible, surface shiny. Pronotum with microreticulation diffused dorsally, distinct on sides. Dorsum of pronotum shiny, sides more or less shiny, with rows of 4+1+2 setae. Mesonotum on whole surface microreticulate and partly microgranulate, sides microgranulate with 3–4 short, transverse rugae, propodeal dorsum microreticulate, on sides with slightly granulate sculpture, below spiracles with few fine longitudinal rugae, dorsal part of propodeum in anterior part with fine transverse wrinkles but surface of both mesonotum and propodeum appears slightly shiny (Fig. 9). Mesonotum dorsally with 6 + 2 setae, propodeum anteriorly with a pair of short setae, as long as or slightly shorter than propodeal spines. Stem of petiole and postpetiole microreticulate but without wrinkles, nodes smooth and shiny, covered with several sparse, long setae. Gaster shiny**,** first tergite at base with short longitudinal grooves and with more or less distinct microreticulation (Fig. 14)**,** tergites with sparse, long, erect setae from as long as to 1.5 times as long as propodeal spines.

Legs very long, hind femora 1.1 times as long as thorax, hind tibiae 0.81 times as long as hind femora, hind tarsi 1.1 times as long as hind femora. Dorsal surface of femora with short, sparse, adherent pubescence, inner margin with row of sparse, moderately long setae, tibiae on whole surface covered with very short, adherent pubescence, only inner, apical margins with row or slightly longer and semierect setae (Fig. 10).

Biology. The habitat preferences are as in *Aphaenogaster cecconii*. The foraging workers are found in small caverns, at entries to large caves, cracks in rock walls of northern exposure, and inside large porous limestone rocks in shady parts of mountain streams.

Distribution. Greece, Dodecanese, Karpathos island.

Discussion. *Aphaenogaster olympica* **sp. nov.**, *Aphaenogaster jolantae* **sp. nov.** and *Aphaenogaster equestris* **sp. nov.** are together easily distinguished from the other three species of the *A. cecconii* group by the head lacking a narrowed neck with flared collar. *Aphaenogaster equestris* differs in having the body mostly rusty-yellow and the sculpture of the head stronger, with the head surface partly dull. *Aphaenogaster jolantae* is very similar and differs by the characters outlined in the key.

Aphaenogaster phillipsi Wheeler & Mann, 1916

Aphaenogaster (*Deromyrma*) *phillipsi* Wheeler & Mann, 1916: 168, fig. 1.

Type material. Syntype worker: PETRA | Palestine 1914 | W. M. Mann || Wm. M. Wheeler || M.C.Z | CoType | 1–3 | 20618 (MCZ) (Image examined, http://insects.oeb.harvard.edu/mcz/Species_record.php?id=17989). The type locality Petra is now placed in Jordan.

Other material examined. One worker: ISRAEL | Arad | 21 IV 1981 | A. FREIDBERG || Aphaenogaster | philippsi Wheeler [sic! spelling error] | J. Kugler det. 1982 || BMNH(E) | 1017816 || ANTWEB | CASENT | 0280962 || Aphaenogaster phillipsi (NHML). The same specimen is imaged on AntWeb (http://www.antweb.org/specimen/casent0280962; image by Michele Esposito; accessed 7 August 2014).

Redescription. Measurements: Worker (n = 1): HL: 1,630; HW: 0.995; TL: 0.8; GL: 0.525; CW: 0.190; FLW: 0.346: SL: 2.431; EL: 0.257; EW: 0.207; ML: 2.290; PSL: 0.234; SDL: 0.215; HTL: 2.250; PL: 0.654; PPL: 0.520; PH: 0.419; PPH: 0.369; PNW: 0.749; DPSB: 0.302; DPST: 0.285; PW: 0.268; PPW: 0.369; CI: 61; CL: 19.1; FLI: 54.9; SI1: 148.5; SI2: 243.3; PI1: 156.1; PI2: 65.7; PPI1: 140.9; PPI2: 37.1; SPI1: 23.5; SPI2: 108.8; HTI: 226.1; MI: 305.7; PSI: 122.2; TGI: 152.4.

Head and thorax yellow. Abdomen yellow, first tergite in posterior 2/3 length brown. Mandibles, antennae and legs yellow (Figs. 11, 12).

Head posterior to eyes with straight sides strongly narrowed posteriad, at base forming narrow neck margined by sharp, high collar, head width/neck width ratio 2.39, tempora length/genae length ratio 1.76 (Fig. 23). Anterior margin of clypeus straight. Eyes small, 0.41 times as long as length of tempora. Scapes elongate and slim, 2.22 times as long as width of head, at base 0.67 times as wide as in apex, gradually widened, straight, only apex slightly bent down without preapical constriction (Fig. 20). Surface of scape shiny, covered with very short and sparse adherent setae, only on apex of scape pubescence slightly raised from the ground.

Promesonotum 2.1 times as long as wide, pronotum regularly convex in profile. Propodeum elongate, 1.41 times as long as wide, propodeal spines short, spiniform, runs obliquely upwards (Fig. 12). Petiole elongate with long peduncle, its anterior face deeply concave, node rounded. Posterior face straight in anterior 3/4 length then shallowly concave. Ventral margin of petiole without spine or distinct angulation (Fig. 10). In dorsal view, petiole almost parallel sided before petiolar node, then globular. Postpetiole in profile regularly rounded. In dorsal view postpetiole 1.5 times as long as wide with regularly rounded sides (Fig. 11).

Mandibles elongate, with outer edges staright, dorsal surface with distinct striation and six setose punctures, shiny, inner margin with 8 small teeth. Clypeus only on sides with 2–3 thin oblique rugae, central part without sculpture, shiny. Frontal carinae short, not extending to the line connecting anterior margin of eyes, subparallel, interantennal area deeply impressed, smooth and shiny, frontal triangle with few, short, thin longitudinal rugae but shiny between rugosities. Frons only in dorsal part with thin longitudinal rugae, central part microreticulate but shiny. Gena, central part of head, tempora and base of head with indistinct microreticulation, shiny. Entire pronotum with diffused microreticulation, shiny, with 10 long setae. Mesonotum on top and sides slightly microgranulate, sides with few thin, oblique rugae, propodeum with slightly granulate sculpture, below spiracles with two short, thin, longitudinal rugae, top in anterior part with fine transverse wrinkles but surface of both mesonotum and propodeum appears slightly shiny (Fig. 11). Top of mesosoma and propodeum each with a pair of short setae, slightly shorter than propodeal spines. Petiole and postpetiole on almost entire surface microreticulate but without wrinkles, appearing shiny, covered with several sparse, long setae. Gaster shiny, without microreticulation, tergites with sparse, long, erect setae 1.5 times as long as propodeal spines.

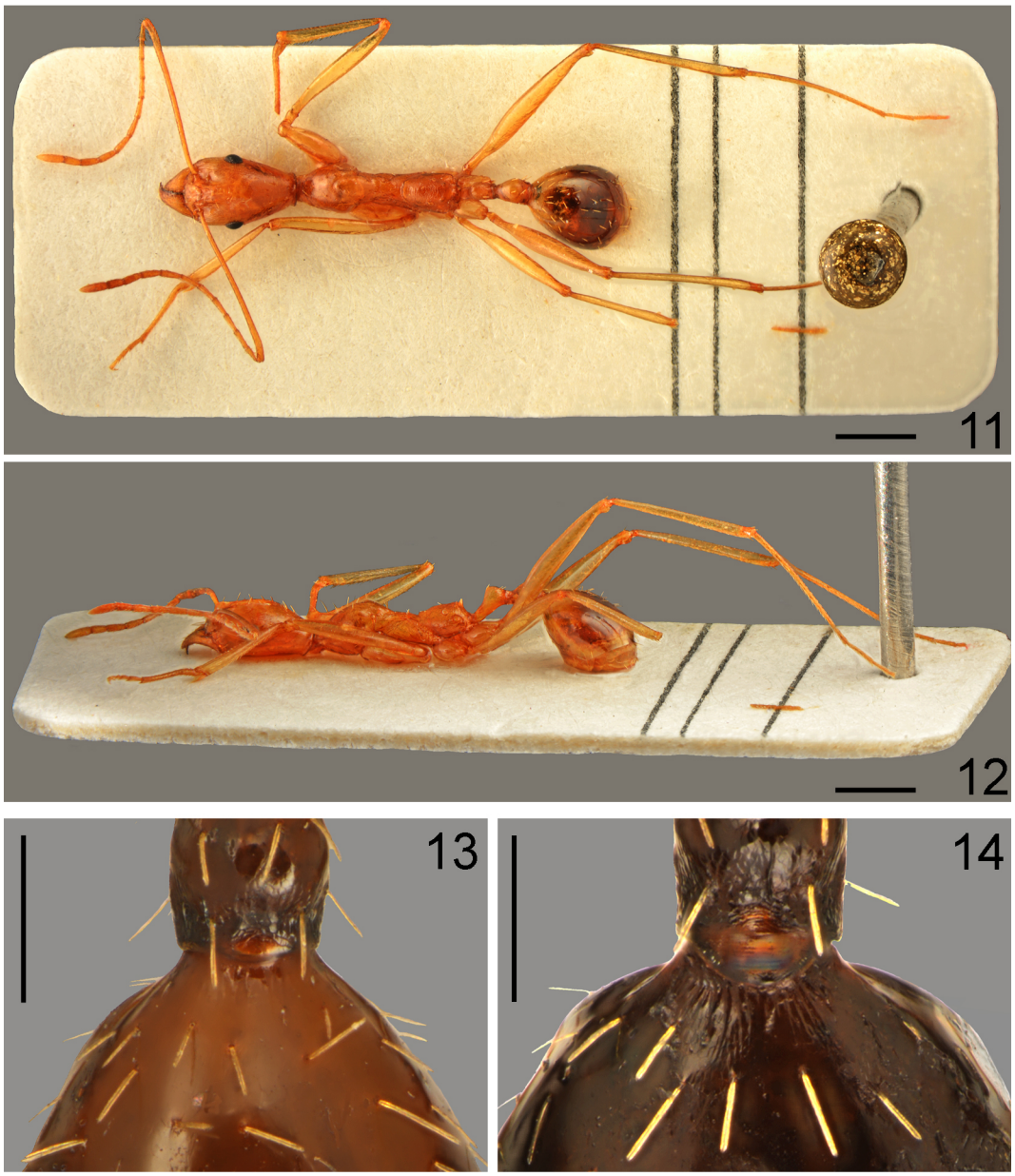
Legs very long, hind femora 1.25 times as long as thorax, hind tibiae 0.8 times as long as hind femora, hind tarsi 1.1 times as long as hind femora. Surface of legs shiny, fore tibiae only on ventral surface covered with very short and adherent pubescence, femora and mid- and hind tibiae completely without pubescence (Fig. 12).

Biological data. Nothing is known about the biology of this species.

Distribution. Jordan: Petra (type locality); Israel: Judean Hills, Judean Desert and northern Negev (Bodenheimer 1937, Kugler 1988, Vonshak & Ionescu-Hirsch 2010). Also recorded from Egypt (Kugler 1988, Mohamed et al. 2001) but according to Taylor (2010) the record was based on misidentification of *Aphaenogaster splendida* (Roger, 1859).

Discussion. *Aphaenogaster phillipsi* is easily distinguished from other species of the group by the pale, mostly yellow to partly rusty yellow body with only the first gastral tergite partly brown. *Aphaenogaster equestris* at first

glance is the most similar species, especially because of its mostly rusty yellow coloration, but differs in the head being elongately oval, without a basal constriction and a flared collar, and the frons has a triangular brown spot with diffused borders. *Aphaenogaster equestris* is more distinctly microsculptured, with parts of the thorax and head more or less opaque, while *A. phillipsi* at first glance appears completely shiny.

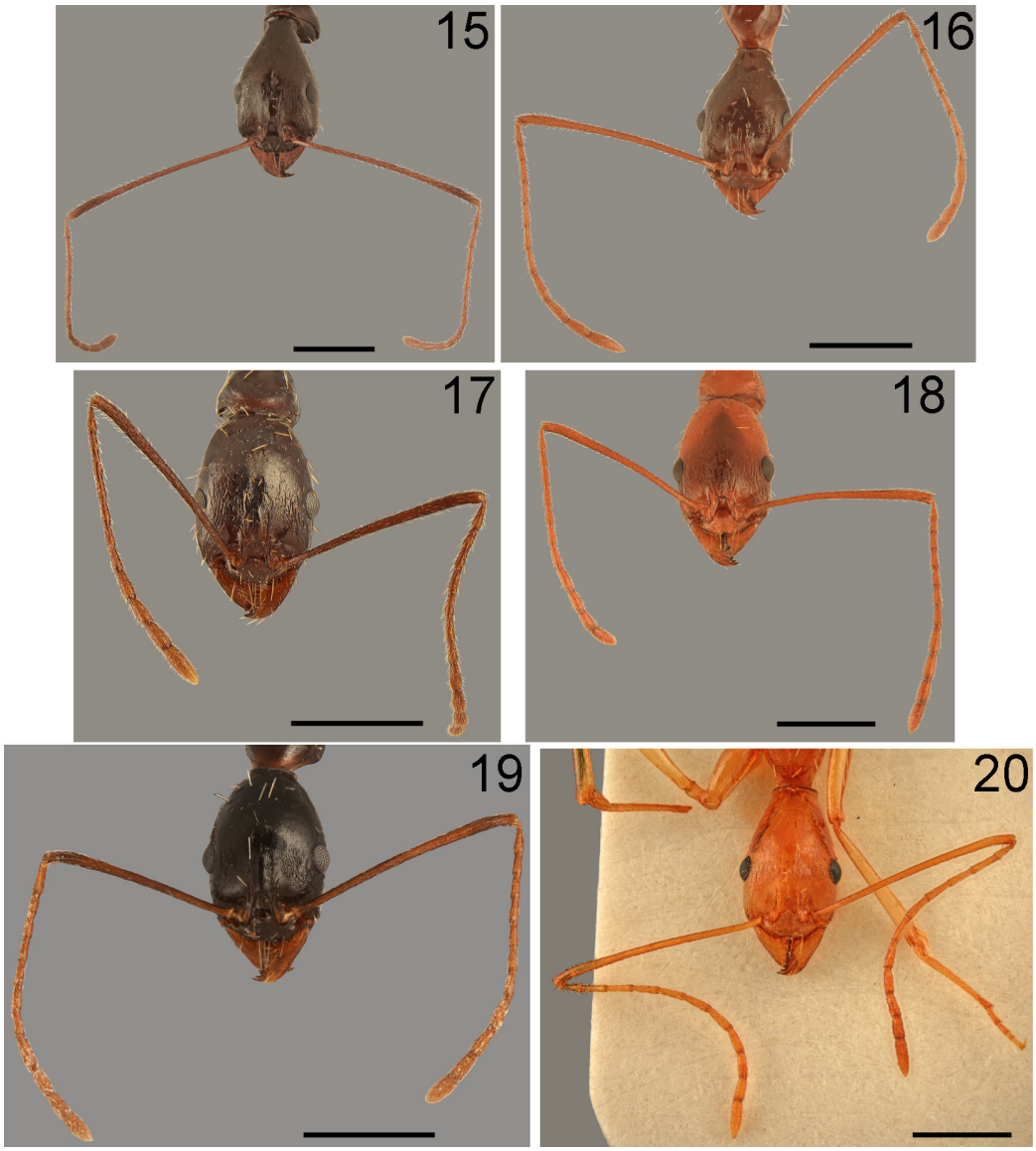


FIGURES 11–12. *Aphaenogaster phillipsi* Wheeler & Mann. **11**, Worker dorsal. **12**, Worker lateral (scale bar = 1 mm); **13–14.** Base of first abdominal sternie. **13,** *Aphaenogaster jolantae* **sp. nov. 14,** *Aphaenogaster olympica* **sp. nov.** (scale bar = 0.3 mm).

Discussion

The discovery of four new species of cavernicolous *Aphaenogaster* shows that this group of ants is more speciose than previously thought, at least in the eastern part of the Mediterranean basin, where there are many geological sites suitable for ants from the *cecconii* group. Species of this group also show that separation of the subgenus *Deromyrma* from *Aphaenogaster* is groundless, as one can see a gradual transformation of the head from the typical oval shape (characteristic for most *Aphaenogaster* species) to a strongly constricted neck with a flared collar (the diagnostic character for the subgenus *Deromyrma*). We are not sure if the characteristic elongation of the

body and appendages, preference for dark, cold and wet habitats and slow movement indicates the monophyletic origin of this group of ants or is the result of an evolutionary parallelism resulting from adaptation to cavernicolous life. A tendency towards elongation of the body and slow movement is present in another group of Mediterranean members of the genus *Aphaenogaster*, the *Aphaenogaster splendida* group (*sensu* Schulz 1994, Boer 2013), formerly placed in the subgenus *Attomyrma*. Forest-inhabiting species in this group, forming nests in the soil under stones (e.g. *A. splendida* (Roger, 1859) and *A. rugosoferruginea* Forel, 1889), are rather stout and have relatively short antennae and legs, while species forming nests in rock crevices and caves (e.g. *A. ovaticeps* (Emery, 1898) and *A. muelleriana* Wolf, 1915) have rather elongated bodies and appendages. In other geographic regions there are species with similar narrow necks. For example, *A. dejeani* Cagniant, 1982 from Morocco belongs to a group of black and strongly sculptured species that has a head shape similar to *A. lykiaensis* **sp. nov.** (Cagniant 1982). Species with narrow necks also occur in tropical countries, e.g. *A. araneoides* Emery, 1890 from Costa Rica, *A. dromedaria* (Emery, 1900) from new Guinea, *A. feae* Emery, 1889 from southeastern Asia, *A. gonacantha* Emery, 1899 from Madagascar, and *A. laevior* Emery, 1887 from Sulawesi (see AntWeb resources http://www.antweb.org/ /images.do?subfamily=myrmicinae&name=aphaenogaster&rank=genus&project=allantwebants&genCache=true). It is now known that *Aphaenogaster* is not a monophyletic genus and these forms may be only very distantly related to the Mediterranean species (Ward 2011).



FIGURES 15–20. Head and antennae. **15**, *Aphaenogaster cecconii* Emery. 1**6**, *Aphaenogaster lykiaensis* **sp. nov. 17**, *Aphaenogaster jolantae* **sp. nov. 18**, *Aphaenogaster equestris* **sp. nov. 19**, *Aphaenogaster olympica* **sp. nov. 20**, *Aphaenogaster phillipsi* Wheeler & Mann. (scale bar = 1 mm).

FIGURES 21–26. Head. **21**, *Aphaenogaster cecconii* Emery. 22, *Aphaenogaster lykiaensis* **sp. nov. 23**, *Aphaenogaster phillipsi* Wheeler & Mann. **24**, *Aphaenogaster jolantae* **sp. nov. 25**, *Aphaenogaster olympica* **sp. nov. 26**, *Aphaenogaster equestris* **sp. nov.** (scale bar = 0.5 mm).

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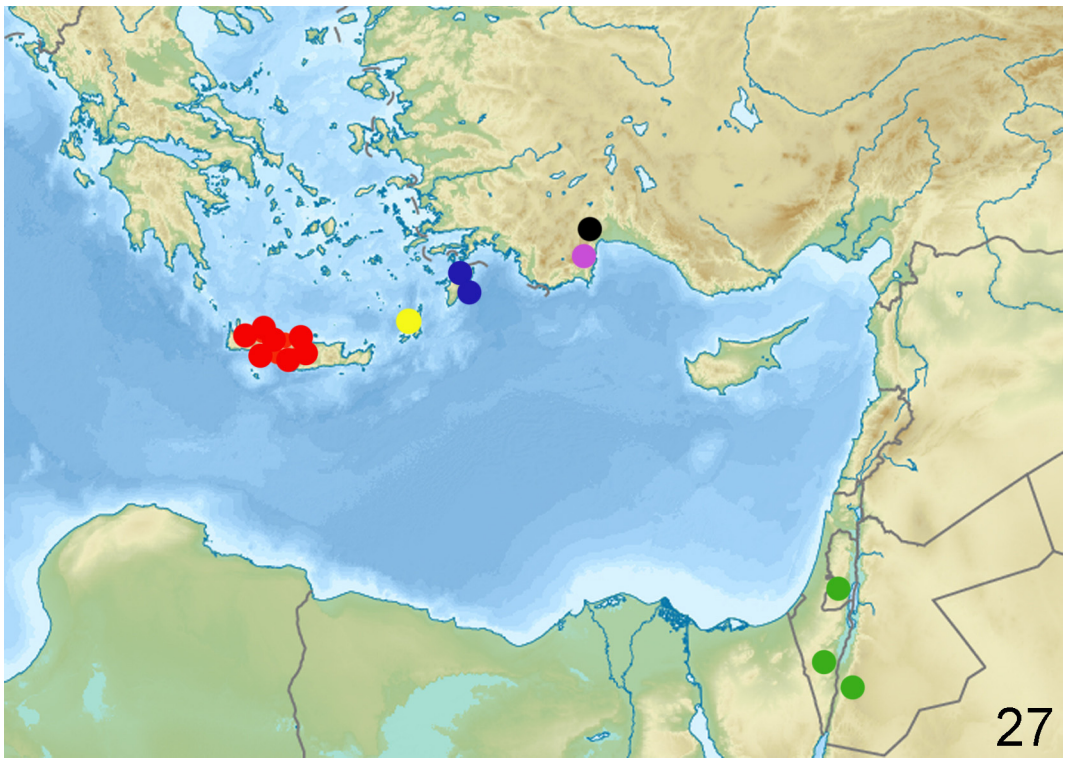

FIGURE 27. Map of distribution: *Aphaenogaster cecconii* (red circles), *Aphaenogaster equestris* (black circle), *Aphaenogaster jolantae* (navy blue circles), *Aphaenogaster olympica* (yellow circle), *Aphaenogaster lykiaensis* (violet circle), and *Aphaenogaster phillipsi* (green circles).

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