

First record of *Carebara oertzeni* Forel (Hymenoptera: Formicidae) from the European part of Turkey with worker description

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Received: 15.04.2016

Accepted/Published Online: 31.01.2017

Final Version: 17.07.2017

Abstract: *Carebara oertzeni* Forel is recorded from the European part of Turkey for the first time based on queens, a male, and workers. The hitherto unknown worker caste of *C. oertzeni* is recorded and described for the first time. Our queen and male specimens have some differences from the typical *C. oertzeni* specimens. The differences are the sculpture on the anterior half of head, on the pronotum, and the area between the metanotal teeth, larger head measurements and some body ratios in queen; head measurements, 4-toothed mandibles, scape measurements, ratio of scape and 2nd funicular segment, and hair density on head dorsum in male. Moreover, some biological notes for the species are given.

Key words: Palearctic region, alpha taxonomy, Formicidae, *Carebara oertzeni*, worker description, Turkey

1. Introduction

The ant genus *Carebara* was described by Westwood (Westwood, 1840) and is characterized by the combination of the following characters: polymorphic, dimorphic, or secondarily monomorphic ants; the masticatory margin of mandibles armed with 3 to 7 teeth; anterior clypeal margin usually with 4 median setae; antennae 8–11 segmented, with a distinct 2-segmented club; eyes present, reduced or absent; palp formula 2,2 or 1,2 (Fernández, 2004; Fischer et al., 2014).

Several taxonomic studies performed on the genus (Ettershank, 1966; Fernández, 2004, 2010; Fischer et al., 2014) have enhanced our systematic knowledge of the genus and synonymized the following genera under *Carebara*: *Aeromyrma* Forel, *Afroxyidris* Belshaw & Bolton, *Aneleus* Emery, *Crateropsis* Patrizi, *Erebomyrma* Wheeler, *Hendecatella* Wheeler, *Idrisella* Santschi, *Lecanomyrma* Forel, *Neoblepharidatta* Sheela & Narendran, *Nimbamyрма* Bernard, *Oligomyrmex* Mayr, *Paedalgus* Forel, *Parvimyрма* Eguchi & Bui, *Solenops* Karawajew, *Spelaomyrmex* Wheeler, *Sporocleptes* Arnold, and *Pheidologeton* Mayr.

The genus *Carebara* is widespread, especially in the tropics and subtropics, and is currently represented by 204 species and 25 subspecies (Bolton, 2014). It contains one of the smallest (*C. minuta* Fernández) and one of the largest (*C. aberrans* Santschi) ant species in the world (Fischer et al., 2014). Many members of the genus have cryptic habits; most species have a very small body size

and live subterranean or closely related with rotten wood. Some species seem to have lestobiotic habits, nesting near or in the nests of other ant and/or termite species (Ettershank, 1966; Aldawood et al., 2011). On the other hand, several marauder ant species with group-foraging and mass-raiding habits are present in the genus, due to the synonymization of the genus *Pheidologeton* under *Carebara* (Fischer et al., 2014). Overall, however, ecological and biological notes on the genus are scarce and insufficient, except for a few keystone taxa (e.g., former *Pheidologeton* species).

The genus *Carebara* is represented in the Mediterranean region by 1 species, *Carebara oertzeni* Forel, which has been described from Greece, and a subspecies, *C. oertzeni* subsp. *aeolia* Forel from İzmir in Turkey (Forel, 1886, 1911); it has not been recorded either from Turkey or from any other locality in the region for over 100 years. Recently, Borowiec has declared *C. oertzeni* subsp. *aeolia* to be a junior synonym of *C. oertzeni* without examining the type specimens in his monograph (Borowiec, 2014). This statement is only a preliminary assessment, and therefore we do not follow Borowiec's statement in this study; thus, the genus is represented in the Mediterranean region by 1 species and 1 subspecies.

In the rest of the western Palearctic region apart from the Mediterranean region, the genus was recorded for the first time by Collingwood and van Harten (2001). They described *Carebara arabica* Collingwood & Van Harten

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(as *Oligomyrmex arabicus*) from Al Kawd, near Abyan, Republic of Yemen. Aldawood et al. (2011) described *C. abuhurayri* Sharaf and Aldawood from Al Bahah, Al Mukhwah, Zei Ein Archaeological Village, Saudi Arabia. In the sequel, Sharaf & Aldawood (2013) synonymized *C. abuhurayri* under *C. arabica* and described *C. fayrouzae* Sharaf from Al Qatif, El Naft, Eastern Province, Saudi Arabia. According to the most recent studies from the borders of the Palearctic region (Masseti and Bruner, 2009), there are recorded localities of *C. arabica* in the African region. Consequently, only 3 *Carebara* taxa (*C. oertzeni*, *C. fayrouzae*, and *C. oertzeni* subsp. *aeolia*) are known from the western Palearctic region.

In the present paper, we recorded *C. oertzeni* from the European part of Turkey based on queens, a male, and workers. Moreover, the hitherto unknown worker caste of the species is described for the first time, and some biological notes are given.

2. Materials and methods

The specimens were collected via aspirator in the field. The taxonomic studies were performed using an Olympus SZ51 stereomicroscope. The materials are deposited in the collection of the Biology Department of Trakya University, Edirne, Turkey.

Digital images were prepared using a Nikon D70s DSLR camera with 3× and 8× microscope objectives and Combine-Z (2008) free software. SEM photography was performed using a Zeiss EVO LS 10 Scanning Electron Microscope at EHT = 20 kV. The images were cleaned up with Adobe Photoshop CS2.

For morphological characters, we followed Fernández (2004, 2010), and Fischer et al. (2014). For calculation of morphometrics, we followed Seifert (2008).

Abbreviations of morphometrics: CL: Head length, from anterior point of median lobe of clypeus to midpoint of posterior head margin; CW: Head width, maximum width of the head; CS: Cephalic size, arithmetic mean of CL and CW; EL: Eye length, maximum length of compound eye; EW: Eye width, maximum diameter of compound eye; EYE: Eye size, arithmetic mean of EL and EW; SL: Scape length, excluding basal condyle; CNW: Clypeal notch width, the width of clypeal notch in frontal view; ML: Mesosoma length, diagonal length of mesosoma laterally from anteriodorsal margin of mesosoma to posterior margin of lobe of metapleura; MH: Mesosoma height, from upper level of mesonotum to lower margin of mesopleura; SCL: Scutum length, maximum length of scutum in dorsal view; SCW: Scutum width, maximum width of scutum in dorsal view; HTL: Hind tibia length, maximum length of hind tibia in profile; PNW: Pronotum width, maximum pronotal width from dorsal view; PL: Petiole length, maximum petiole length

from profile view; PH: Petiole height, maximum petiole height in profile; PW: Petiole width, maximum petiole width in dorsal view; PPL: Postpetiole length, maximum postpetiole length in profile view; PPH: Postpetiole height, maximum postpetiole height in profile; PPW: Postpetiole width, maximum postpetiole width in dorsal view; ESW: Distance between propodeal spine tips in dorsal view.

3. Results

Carebara oertzeni Forel, 1886

Material: Turkey, Edirne, Yildirim district (41°41'00"N, 26°31'38"E), 53 m a.s.l., 01.vi.2007, 07/0001, 5 workers, 3 queens, 1 male, leg. C. Karaman.

Description

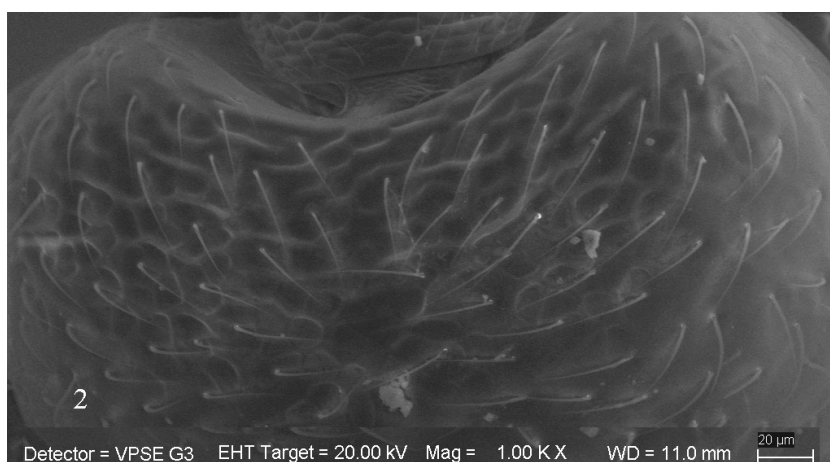
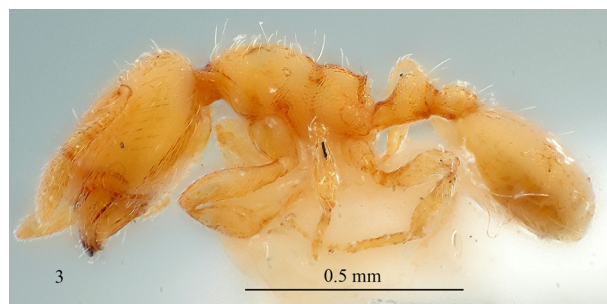
Workers (n: 5). CL: 0.40–0.43 (0.42), CW: 0.33–0.36 (0.35), SL: 0.24–0.26 (0.25), CNW: 0.08–0.10 (0.09), PNW: 0.21–0.23 (0.22), ML: 0.43–0.46 (0.44), MH: 0.21–0.25 (0.23), PL: 0.12–0.14 (0.13), PW: 0.086–0.093 (0.088), PPW: 0.09–0.10 (0.095), PPL: 0.09 (0.09), PH: 0.11–0.12 (0.12), PPH: 0.08–0.09 (0.084), HTL: 0.21–0.23 (0.22), ESW: 0.08–0.10 (0.09), CS: 0.36–0.40 (0.39), SL/CS: 0.64–0.66 (0.64), CNW/CS: 0.21–0.25 (0.23), ML/CS: 1.13–1.19 (1.15), MH/CS: 0.56–0.63 (0.60), HTL/CS: 0.57–0.58 (0.57), PNW/CS: 0.54–0.58 (0.57), PL/CS: 0.33–0.35 (0.34), PW/CS: 0.22–0.24 (0.23), PH/CS: 0.29–0.32 (0.30), PPL/CS: 0.22–0.24 (0.23), PPW/CS: 0.24–0.25 (0.25), PPH/CS: 0.21–0.22 (0.22), ESW/CS: 0.22–0.25 (0.23).

Worker (Figures 1–4): Head longer than wide, sides of head convex, posterior head margin slightly concave medially, corners almost emarginated; frontal lobes expanded over antennal scrobe, frontal carinae short; anterior margin of clypeus medially concave, clypeus narrow and shiny; eyes very small, with only 1 ommatidium and positioned slightly above level of frontal carinae; mandible shape regularly triangular, without sculpture and shiny, masticatory margin with 5 brownish teeth (Figure 1); scape short, distinctly shorter than head width, when laid back from their insertions fail to reach posterior margin of head, antennae 9-segmented; anterolateral sides of head longitudinally striated, cephalic dorsum slightly punctate and striated medially (Figure 2).

Promesonotal suture absent; metanotal groove distinct (Figure 3), dorsum of propodeum convex, posterior corners with a wide-based, blunt, subtriangular spine; promesonotum without sculpture and shiny, only confined lower parts and all propodeum punctated.

Petiole as wide as postpetiole, petiole almost as high as wide, postpetiole as high as long; petiole punctate except its apex, petiole and postpetiole apex without sculpture. Anterior margin of first gaster tergite emarginated in dorsal view and whole gaster shiny (Figure 4).

Head with decumbent, long pubescence, hairs as long as the distance between them or slightly longer; anterior



Figures 1–4. *Carebara oertzeni* Forel, worker; 1 - head, in full face view; 2 - SEM photo of head, dorsofrontal view; 3 - body in profile; 4 - body in dorsal view.

clypeal margin with 4 apical long setae, on lateral edges of clypeus under antennal scrobe with 2 pairs of long erect hairs; posterior head corners with a pair of long, subdecumbent hairs, sides of head, under the posterior head corners with 1 pair of long, erect hairs; scape with decumbent pubescence, flagellar segments with dense subdecumbent pubescence.

Promesonotum with subdecumbent long pubescence and 4–5 pairs of long, erect hairs; propodeal dorsum with 1 pair of long, erect hairs; dorsum of petiole and postpetiole with subdecumbent, long pubescence and 1 pair of long, erect hairs, lateral sides of petiole with 1 pair

of erect hairs; gaster with long, subdecumbent pubescence, and sparse erect hairs. Femora and tibiae with sparse, long, subdecumbent pubescence.

Whole body yellow, only mandibular teeth slightly darker.

Queen (n: 3). CL: 0.78–0.80 (0.80), CW: 0.72 (0.72), SL: 0.44–0.46 (0.45), CNW: 0.14–0.15 (0.14), FLW: 0.31 (0.31), EYE: 0.21–0.22 (0.21), ML: 1.44 (1.44), MW: 0.80–0.83 (0.82), PL: 0.42–0.47 (0.44), PW: 0.25–0.27 (0.26), PH: 0.30–0.31 (0.31), PPL: 0.28–0.30 (0.29), PPW: 0.30–0.32 (0.31), PPH: 0.24–0.30 (0.27), HTL: 0.53–0.54 (0.54), ESW: 0.28–0.30 (0.29), SCL: 1.10–1.11 (1.11), SCW: 0.64–

0.65 (0.65), CS: 0.75–0.76 (0.76), SL/CS: 0.59–0.61 (0.60), CNW/CS: 0.18–0.20 (0.19), ML/CS: 1.89–1.92 (1.90), MH/CS: 1.07–1.09 (1.08), HTL/CS: 0.70–0.72 (0.71), SCL/SCW: 1.70–1.73 (1.71), SCL/CS: 1.45–1.48 (1.46), SCW/CS: 0.85–0.86 (0.85), PL/CS: 0.55–0.63 (0.59), PW/CS: 0.33–0.36 (0.35), PH/CS: 0.40–0.41 (0.40), PPL/CS: 0.37–0.40 (0.39), PPW/CS: 0.39–0.43 (0.41), PPH/CS: 0.32–0.39 (0.35), ESW/CS: 0.37–0.40 (0.38), EYE/CS: 0.28–0.29 (0.28).

Queen (Figures 5 and 6): Head distinctly longer than wide, sides almost straight and slightly narrowed below eyes; posterior margin of head broadly concave, with rounded margins; anterior clypeal margin concave (Figure 5); eye length almost one-third of CW and covered with short, sparse, erect hairs; mandibles triangular, with 5–6 teeth; scape short, slightly longer than half of head length, just past median ocellus, antennae with 9-segmented, anterior part of head to posterior margin of eye longitudinally striated, striation slightly surpassing posterior margin of eye and not reaching median ocellus; center of clypeus and frontal triangle without sculpture and shiny; mandibles indistinctly longitudinally striated in profile.

Posterior edge of pronotum broadly concave medially in profile view; scutum raised above pronotum; prescutum with a slight depression between scutum and scutellum; propodeal spines broad and blunt; very feeble, short transverse striae at junction of pronotum, anepisternum, and katapisternum in profile; transverse striations on metapleuron, declivity of propodeum rugulose, rest of mesosoma unsculptured and shiny (Figure 6).

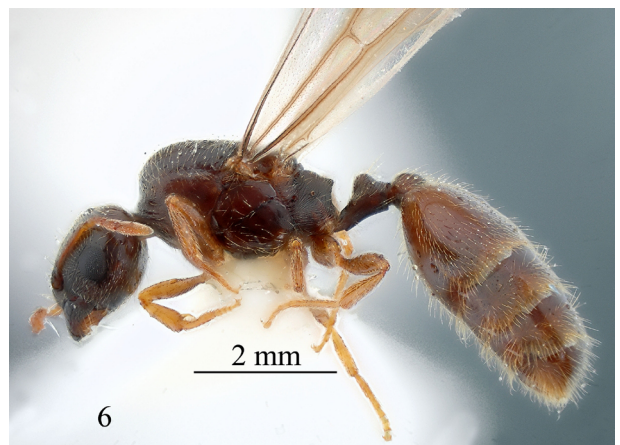
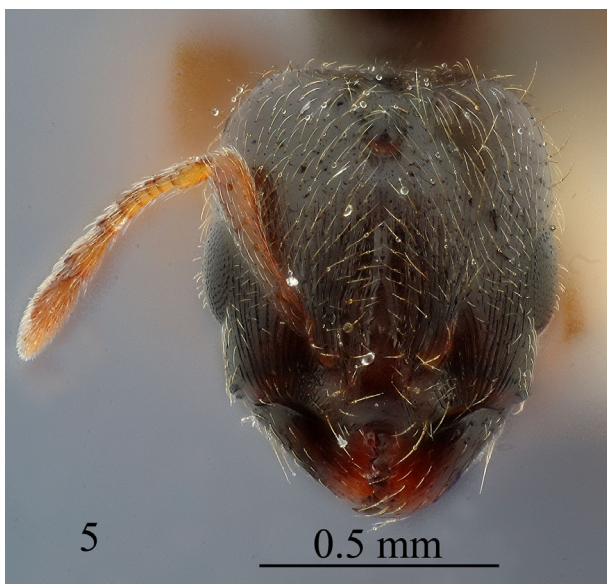
Petiole long, anterior and posterior faces concave, almost triangular in profile, its apex broadly and smoothly

rounded; postpetiole as long as wide, node broadly rounded in profile; petiole punctate except at its apex; postpetiole indistinctly reticulate, node glabrous. Gastral tergites shagreened except shiny first tergite.

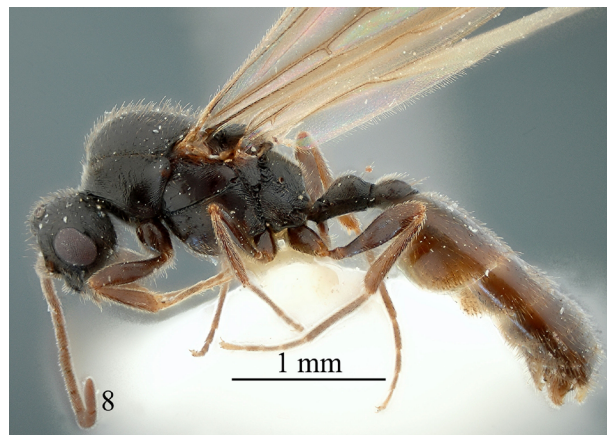
Head dark brown; mandibles mainly concolorous with head, only masticatory surface reddish; antennae yellowish red; mesosoma except propodeum reddish brown; propodeum and petiole dark brown and postpetiole reddish brown; gaster yellowish brown; legs yellowish red.

Male (n: 1). CL: 0.64, CW: 0.63, SL: 0.16, FLW: 0.17, EYE: 0.26, ML: 1.50, MW: 0.89, PL: 0.42, PW: 0.24, PH: 0.30, PPL: 0.30, PPW: 0.24, PPH: 0.25, HTL: 0.68, ESW: 0.19, SCL: 1.14, SCW: 0.65, CS: 0.64, SL/CS: 0.25, ML/CS: 2.37, MH/CS: 1.40, HTL/CS: 1.07, SCL/SCW: 1.74, SCL/CS: 1.79, SCW/CS: 1.03, PL/CS: 0.66, PW/CS: 0.37, PH/CS: 0.47, PPL/CS: 0.47, PPW/CS: 0.37, PPH/CS: 0.39, ESW/CS: 0.29, EYE/CS: 0.40.

Male (Figures 7 and 8): Head longer than wide with convex lateral sides; posterior head margin and corners convex; clypeal carinae prominent, anterior clypeal margin almost straight or slightly concave (Figure 7); eyes situated nearly in front of midlength of head, with dense, short, erect pubescence; mandibles small and triangular, masticatory margin armed with 4 teeth; scape very short, as long as one-fourth of CL, 2 times longer than wide and distinctly shorter than second funicular segment, first funicular segment (0.1 mm) almost half length of second funicular segment (0.19 mm), third funicular segment (0.14 mm) distinctly shorter than second and longer than first one, antennae 13-segmented; anterior half of head longitudinally striated, posterior half irregularly striated.



Figures 5–6. *Carebara oertzeni* Forel, queen; 5 - head in full face view; 6 - body in profile.



Figures 7–8. *Carebara oertzeni* Forel, male; 7 – head in full face view; 8 – body in profile.

Scutum raised over pronotum; dorsum of scutum broadly convex; prescutum with slight depression; propodeum narrow and with blunt denticles; pronotum coarse and transversally striated and dull; scutum and scutellum longitudinally striated with median part bare and shiny; anepisternum and katapisternum feebly striated (Figure 8); metapleuron coarsely sculptured and dull, dorsum of propodeum between denticles without sculpture and shiny, distance between propodeal denticles almost equal to three-quarters of PPH; petiole and postpetiole as wide as their height; hind tibia length longer than SCW; subgenital plate V-shaped.

Head with dense and erect hairs, head dorsum behind lateral ocelli with dense, short, erect hairs, anterior half of head with sparse erect hairs; eyes with dense, short, erect pubescence; scape with short, subdecumbent pubescence; lower part of head with dense, erect hairs; pronotum, scutum, scutellum with dense, erect hairs; anepisternum and katapisternum as in queen; propodeal dorsum with dense, short, erect hairs, metapleuron with sparse, long, erect hairs; anterior face of petiole and postpetiole to midpoint of apex with short, dense, suberect pubescence and posterior face of petiole with 1 pair of long, erect hairs and postpetiole with 3 pairs of erect hairs, and lateral sides also with 3 erect hairs; femora and tibiae with short, dense, appressed pubescence; gaster with dense, subdecumbent hairs.

Head, mesosoma, and petiole black; gaster reddish brown; legs brown; scape and funicular segments brown to reddish brown except yellowish first segment; wing veins yellowish brown.

Taxonomy: In general aspect of body shape, our queens are similar to the photos of the type specimen of *C. oertzeni* (CASENT0908910), which were provided from AntWeb (antweb.org, 2011), and to its original description.

In the original description, *C. oertzeni* was characterized by strongly striated and dull middle part of head, with the striae reaching the sides of median ocelli; striated pronotum along the side; smooth and shiny area between metanotal teeth. Moreover, we measured some morphometrics of *C. oertzeni* from AntWeb photos using Adobe Photoshop CS2 software; CL: 0.69; CW: 0.65; ML: 1.43; MW: 0.83; ESW: 0.33; PW: 0.24; EL: 0.26; EW: 0.21; CS: 0.67; EYE: 0.24; ML/CS: 2.15; MW/CS: 1.25; ESW/CS: 0.48; PW/CS: 0.39; PPW/CS: 0.39; EL/CS: 0.37; EW/CS: 0.30.

Our queens are similar to the *C. oertzeni* type specimen in body size and color, but clearly distinguished from it by longitudinal striation of the anterior part of head reaching only to posterior margin of eye and sides of median ocellus never striated, smooth pronotum except feebly striated junction with anepisternum and katapisternum, rugulose striation on declivity of propodeum and between the propodeal teeth, and wider head, CW 0.72 versus 0.65; longer head, CL 0.80 versus 0.69; greater CS, 0.76 versus 0.67; smaller PW/CS, 0.35 versus 0.39; smaller ML/CS, 1.90 versus 2.15; smaller MH/CS, 1.08 versus 1.25.

In the original description, the male of *C. oertzeni* subsp. *aeolia* was characterized with the following characters: scape same length as second funicular segment, scape 2.5 times longer than its width, mandibles 3-toothed. Our male is differentiated from the type specimen by a shorter

scape from the second funicular segment, scape almost 2 times longer than wide, 4-toothed mandibles, and dense, short, and erect hairs on dorsum of head behind the ocelli.

However, we do not describe a new species for the present because we did not have a chance to study type material of *C. oertzeni* and *C. oertzeni* subsp. *aeolia*.

In addition, the worker caste of a *Carebara* species is described for the first time in the Mediterranean region. The worker caste of the *C. oertzeni* is characterized by broad and medially concave anterior clypeal margin, 5-toothed mandibles, 9-segmented antennae, punctated head dorsum and propodeum, presence of propodeal spines, and deep metanotal depression.

Biology: The specimens of *C. oertzeni* were collected from the outer wall of the first author's grandfather's adobe house, which is more than 55 years old. The specimens were found on the outer wall of the house; a male and queen were copulating while the specimens were collected. The baseboard of the outer wall of the house was dominated by several colonies of *Pheidole pallidula* (Nylander); several nests of *Cataglyphis nodus* (Brullé), *Formica cunicularia* Latreille, *Plagiolepis* sp., *Messor* sp. were present close to the baseboard of the house. Moreover, a colony of termites was situated in a timber on the outer wall of the house. The nest of the species could not be found. Despite multiple collecting visits to the type locality since 2007, no additional material was found. Perhaps this is due to the tiny size of workers, and the subterranean and cryptic habits of the genus.

4. Discussion

The genus *Carebara* was classified into 5 different formal species groups (*concinna*, *alperti*, *crigensis*, *escherichi*, and *polita*) according to recent studies (Fernández, 2010; Bharti and Kumar, 2013; Fischer et al., 2014). The characters peculiar to these species groups are as follows: *concinna* species group: 11- to 9-segmented antennae, dimorphic, major and minor workers present, major workers possess eyes, eyes present or absent in minor workers, propodeum armed and unarmed; *alperti* species

group: 11-segmented antennae, monomorphic, workers possess eyes, propodeum unarmed and propodeal lobes small; *crigensis* species group: 10-segmented antennae, monomorphic, mandibles with 2 teeth; *escherichi* species group: 9- to 8-segmented antennae, monomorphic, with short propodeum and narrow head; and *polita* species group: 11-segmented antennae except *C. madibai* Fischer & Azorsa with 9 segments, dimorphic, minor workers always possess eyes and propodeal spines.

C. oertzeni workers have 9-segmented antennae, eyes present with 1 ommatidium; all the obtained workers are monomorphic. These character combinations are compatible with the species groups *concinna* and *escherichi*. However, *C. oertzeni* is differentiated from the *escherichi* species group by a long propodeum and wider head. Thus, according to the possession of the character combination mentioned above, the species could be a member of the *concinna* species group. The *concinna* species group corresponds to the former genus *Oligomyrmex* for which the 2 Mediterranean ant taxa *C. oertzeni* and *C. oertzeni* subsp. *aeolia* were previously defined as members. Thus, the workers of the species are confirmed, including the species within the *concinna* species group, and they are confirmed on a factual basis without bias. However, the genus needs a worldwide revision, through which the species groups can be rearranged more accurately.

The *Carebara oertzeni* records from Edirne indicate that the subterranean ant fauna of the region and the country as a whole is poorly known. The use of different collecting methods—e.g., soil digging, leaf litter sifting, and Berlese extraction—would be efficient in collecting members of the genus *Carebara*, as well as other cryptic genera (Bestelmeyer et al., 2000).

Acknowledgments

We thank Trakya University Technology Research and Development Center (TUTAGEM) for their help with SEM photography. We also thank Volkan Aksoy (Edirne) for linguistic improvements on the early version of the manuscript.

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