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FURTHER DATA ON THE EXTINCT ANT GENUS *EOCENOMYRMA* (HYMENOPTERA, FORMICIDAE)

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Further Data on the Extinct Ant Genus *Eocenomyrma* (Hymenoptera, Formicidae). Radchenko, A. G., Dlussky, G. M. —*Eocenomyrma ukrainica* sp. n. and *E. breviscapa* sp. n., two new ant species of the extinct genus *Eocenomyrma* Dlussky et Radchenko, are described from the Rovno amber (Late Eocene, Priabonian, 34–38 Ma). *E. ukrainica* (described based on the male and gyne) differs from the previously known species of this genus by the shorter propodeal spines and by the sculpture of the head and mesosoma. *E. breviscapa* is described based on the single worker and differs from all known *Eocenomyrma* species by the punctated head, mesosoma and waist, by another shape of the petiole, by the shorter propodeal spines, and by the distinctly shorter antennal scape. Additional data on the record of *E. rugosostriata* (Mayr) and *E. orthospina* Dlussky et Radchenko is provided. A key for the identification of six known *Eocenomyrma* species is compiled. The character of the forewing venation of the male and gyne of *E. ukrainica* supports our idea about relation of this genus and the genus *Temnothorax* Mayr, and placing *Eocenomyrma* to the tribe Formicoxenini.

Key words: ants, Formicidae, Myrmicinae, new species, *Eocenomyrma ukrainica*, *E. breviscapa*, Late Eocene, Europe, palaeontology, taxonomy.

Introduction

Dlussky and Radchenko (2006) originally included four extinct species from the Late Eocene European ambers (Priabonian, 34–38 Ma) to the genus *Eocenomyrma*: *E. rugosostriata* (Mayr, 1868) from the Baltic and Bitterfeld (= Saxonian) ambers, *E. orthospina* Dlussky et Radchenko, 2006, and *E. elegantula* Dlussky et Radchenko, 2006 from the Baltic amber and *E. electrina* Dlussky et Radchenko, 2006 from the Scandinavian (= Danish) amber.

Recently, while studying the Late Eocene European ambers, we recognized two new species of this genus from the Rovno amber (Ukraine), and additionally found one worker of *E. rugosostriata* in the Baltic amber, and two workers of *E. orthospina* in the Baltic and Rovno ambers.

Here, we described two new species, *E. ukrainica* sp. n. and *E. breviscapa* sp. n. from the Rovno amber, provide additional data to the newly recorded species, and compile a key for the identification of six known species of this genus.

Material and methods

Totally we examined six specimens in six pieces of amber: the holotype (male) and paratype (gyne) of *E. ukrainica* sp. n., the holotype (worker) of *E. breviscapa* sp. n. are deposited in the collection of I. I. Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine, Kyiv (SIZK); one worker of *E. rugosostriata* is deposited in the personal collection of Carsten Gröhn, Glinde, Germany (CGC), and two workers of *E. orthospina* are deposited in the SIZK (Rovno specimen) and CGC (Baltic one).

The figures are based on original drawings of the specimens and photographs made using an Olympus Camedia C-3030 digital camera fitted to an Olympus SZX9 microscope in conjunction with the computer program CorelDraw 8.

Not all features of the examined specimens were properly visible and measurable, hence we measured only visible details (accurate to 0.01 mm), particularly:

HL — maximum length of the head in dorsal view, measured in a straight line from the most anterior point of clypeus to the mid-point of occipital margin;

HW — maximum width of the head in dorsal view behind (above) the eyes;

FW — minimum width of the frons between frontal lobes;

FLW — maximum distance between outer margins of the frontal lobes;
 SL — maximum straight-line length of the scape from its apex to the articulation with condylar bulb;
 OL — maximum diameter of the eye;
 ML — diagonal length of the mesosoma (seen in profile) from the anterior end of the neck shield to the posterior margin of the propodeal lobes (workers) or from the anterior-upper margin of pronotum to the posterior margin of propodeal lobes (male and gyne)
 MH — height of mesosoma, measured from the upper level of scutum perpendicularly to the level of lower margin of mesopleuron (male and gyne);
 PnW — maximum width of the pronotum from above (workers);
 ScW — maximum width of the scutum from above (male and gyne);
 PL — maximum length of the petiole, measured from the posterodorsal margin of petiole to the articulation with propodeum;
 PW — maximum width of the petiole from above;
 PH — maximum height of the petiole in profile, measured from the uppermost point of the petiolar node perpendicularly to the imaginary line between the tip of subpetiolar process and posteroventral points of petiole;
 PPL — maximum length of the postpetiole between its visible anterior and posterior margins;
 PPW — maximum width of the postpetiole in dorsal view;
 PPH — maximal height of the postpetiole in profile;
 HTL — maximum length of the hind tibia;
 ESL — maximum length of the propodeal spine in profile, measured along the spine from its tip to the deepest point of the propodeal constriction at the base of the spine;
 ESD — distance between the tips of the propodeal spine in dorsal view.
 Approximate total length is calculated as the sum of HL + ML + PL + PPL + length of the gaster.
 In this paper we do not abbreviate the various indices, simply using relations of various measurements (e. g. HL/HW instead of CI) what may be more convenient for readers.

Results

Description of the new species

Eocenomyrma ukrainica sp. n.

Material examined. Holotype, male, SIZK K-3076, and paratype, gyne, SIZK K-27012, both from Klesov, Rovno amber, Late Eocene.

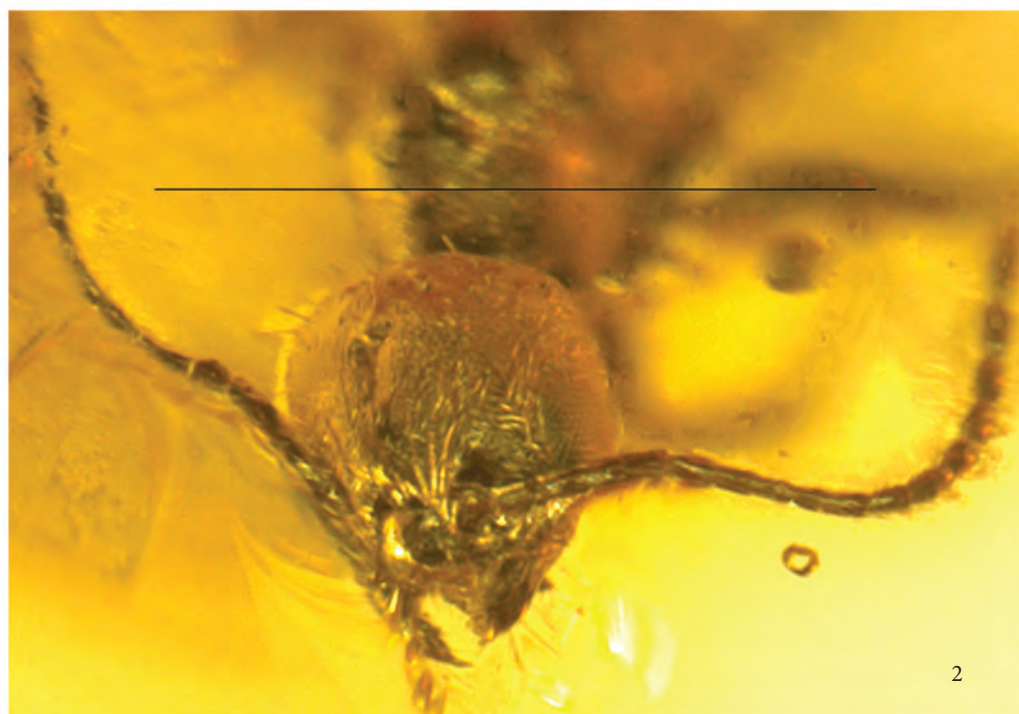
Etymology. Named after Ukraine, country where the type material of this species was found.

Male (figs 1–4). Total length: ca. 2.45 mm. Head distinctly longer than width, with convex sides, moderately rounded occipital corners and quite strongly convex occipital margin. Clypeus convex (seen in profile), with two not coarse lateral carinae, its anterior margin shallowly and widely concave. Eyes not very big, their maximal diameter about 3 times smaller than length of head, situated distinctly in front of midlength of sides of head, so that temples longer than maximum diameter of eye. Ocelli well developed though not big. Antennae 13-segmented, with not well defined 3-segmented club, scape of moderate length, far not reaching occipital margin, subequal to total length of 1st to 5th funicular segments. Mandibles elongate-triangular, with distinct masticatory margin, which is with four small acute teeth. Palp formula 4, 3.

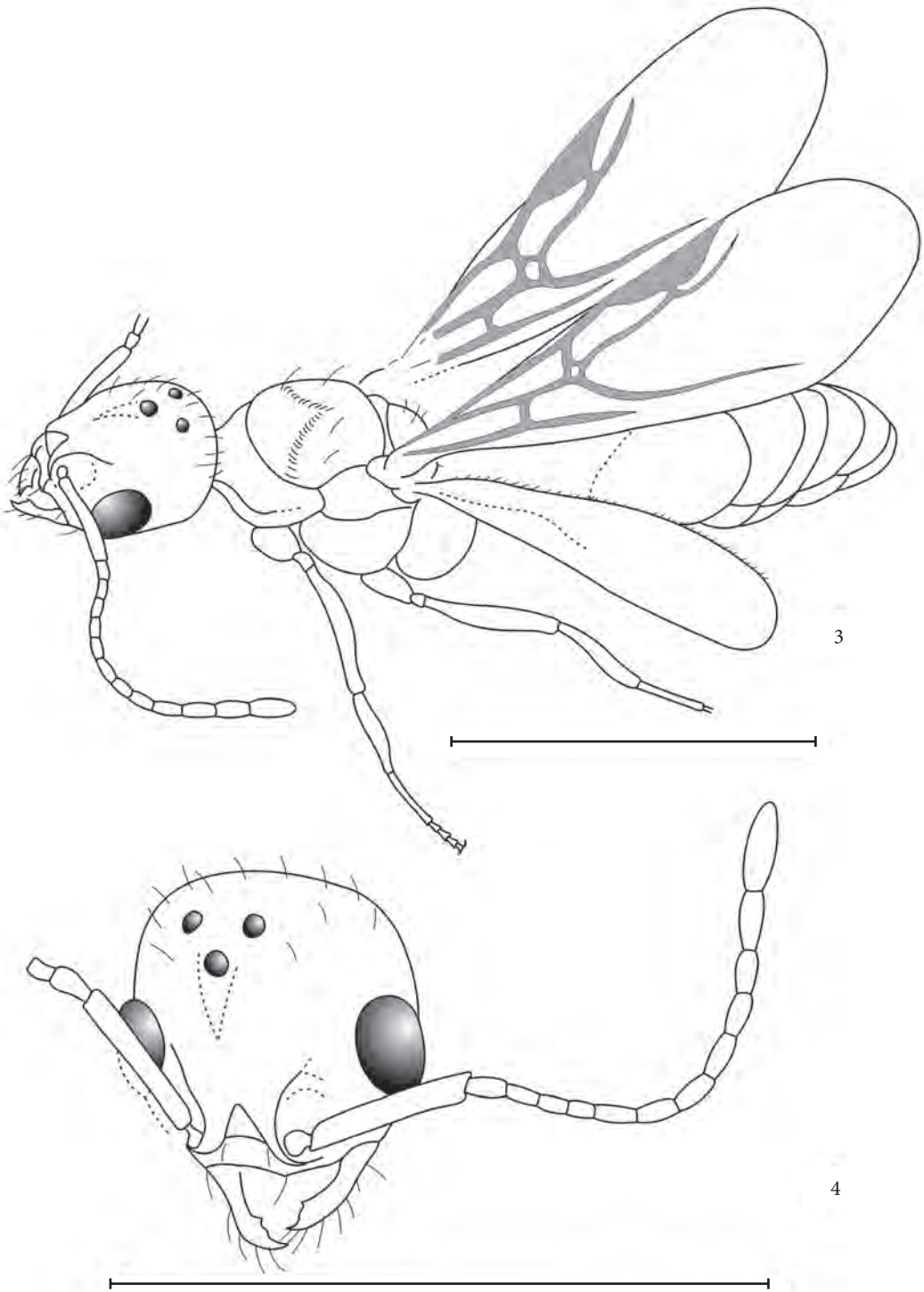
Mesosoma relatively long, scutum not strongly convex, Mayrian furrows well developed. Propodeum with distinct short acute teeth, its dorsal surface subequal to posterior one. Petiole and postpetiole barely visible, but petiole seems with quite short peduncle and high node with rounded dorsum; postpetiole higher than length, with rounded dorsum. Middle and hind tibiae without spurs, pretarsal claws simple.

Forewing venation rather peculiar: veins are very coarse, closed cell 1r+2r long and marrow, and closed cell mcu extremely small (especially on left wing). Except for those, general character of venation similar to that of gyne (see below).

Head dorsum finely but densely punctated, frons laterally with fine longitudinal rugulae, narrow central band on frons between frontal triangle and anterior ocellus, as



Figs 1–2. *Eocenomyrma ukrainica* sp. n., photos of holotype male: 1 — body in dorsal view; 2 — head in dorsal view. Scale bar 1 mm.



Figs 3–4. *Eocenomyrma ukrainica* sp. n., line drawings of holotype male made based on photos: 1 — body in dorsal view; 2 — head in dorsal view (sculpture omitted). Scale bar 1 mm.

well as frontal triangle and central part of clypeus, smooth and shiny; mandibles with fine longitudinal rugulosity, appear shiny. Pronotum with very fine transversal striae, anterior part of scutum between Mayrian furrows with fine superficial microstriation, its remainder part and scutellum smooth and shiny. Mesopleura and sides of propodeum with somewhat coarser longitudinal rugulosity. Gaster smooth and shiny.

Whole body with not abundant, rather short suberect hairs; scape and legs with sparse decumbent pilosity.

Measurements (in mm): HL 0.53, HW 0.45, SL 0.27, OL 0.19, ML 0.75, MH 0.43, HTL 0.40, total length ca. 2.45.

Indices: HL/HW 1.18, SL/HL 0.50, SL/HW 0.59, OL/HL 0.35, ML/MH 1.75.

G y n e (figs 5, 6). Total length ca. 3 mm. Head width is not properly measurable, but head seems elongate, with almost straight sides, rounded occipital corners and slightly convex occipital margin. Eyes of moderate size, situated in front of midlength of sides of head, length of genae subequal to maximum diameter of eye. Ocelli rather small. Antennae 12-segmented, with 3-segmented club, first funicular segment ca. twice longer than width, 2nd to 8th segments somewhat longer than width; scape relatively short, not reaching occipital margin. Clypeus with two lateral carinae, anterior clypeal margin shallowly and widely concave. Mandibles obscured in the specimen.

Mesosoma relatively short, less than 1.5 times longer than height, scutum slightly convex, does not overlap pronotum. Propodeum with quite long thin, not widened at base acute spines, its dorsal surface somewhat shorter than posterior one, propodeal lobes angulated at apices, but not sharply pointed. Petiole long and quite low, with long peduncle, ca. 1.8 times longer than height, its anterior surface distinctly concave, petiolar node with very narrowly rounded dorsum, almost cuneiform. Postpetiole subdlobular. Spur on middle tibia obscured, but hind tibiae with small simple spur.

Forewing with closed cells 1r+2r and mcu, cell 3r open posteriorly, cell rm absent; cell 1r+2r very long, ca. twice longer than width. Vein section 1RS slightly inclined posteriorly. Cell mcu trapezoid (not pentagonal), far not reaching



Fig. 5. *Eocenomyrma ukrainica* sp. n., photo of paratype gyne, body in lateral view. Scale bar 1 mm.

distally level of pterostigmal base. Cross-vein cu-a merging with vein section 1M+Cu far proximally than cell mcu (vein section 2M+Cu much longer than cross-vein cu-a).

Head dorsum with not coarse but dense longitudinal, slightly sinuous rugosity, reticulation developed on sides of head and on occipital region. Pronotum with five transversal rugae, scutum and scutellum with finer, dense longitudinal rugae, mesopleura and sides of propodeum with coarser longitudinal, slightly sinuous rugae. Petiole densely and quite coarsely punctated, postpetiole with less coarse punctation.

Whole body with not abundant straight erect to suberect hairs; scape and legs with short subdecumbent pilosity.

Measurements (in mm): HL 0.65, SL 0.43, OL 0.13, ML 0.75, MH 0.51, ScW 0.45, PL 0.32, PH 0.18, PPL 0.19, PPH 0.19, HTL 0.40, ESL 0.11, total length ca. 3.00.

Indices: SL/HL 0.65, OL/HL 0.20, PL/HL 0.49, PL/PH 1.79, PPL/HL 0.29, PPL/PPH 1.00, ESL/HL 0.17, ML/MH 1.47.

Workers unknown.

Comparative diagnosis. We may compare only gyne of *E. ukrainica* with the workers of other species because males of other species are unknown. Gyne of *E. ukrainica* well differs from *E. breviscapa* sp. n. by the another sculpture (not punctated) of the head, mesosoma and waist; it differs from *E. elegantula* Dlussky et Radchenko by the mostly

longitudinally rugulose sculpture on the head and mesosoma instead the fine and dense reticulation in the latter species; from *E. electrina* Dlussky et Radchenko it differs by the distinctly longer petiole (PL/PH 1.79 vs. 1.27), by the much shorter, straight propodeal spines (ESL/HL 0.17 vs. 0.33), by the sculpture of the mesosoma (mostly longitudinally rugose vs. completely coarsely reticulated in the latter species). Similarly to the preceding species, *E. ukrainica* differs from *E. orthospina* Dlussky et Radchenko by the shorter propodeal spines (ESL/HL 0.17 vs. > 0.35) and by the similar pattern of the mesosomal sculpture. At last, by the body sculpture *E. ukrainica* the most resembles *E. rugosostriata* (Mayr), but differs from it by the distinctly shorter and straight propodeal spines (ESL/HL 0.17 vs. > 0.30).

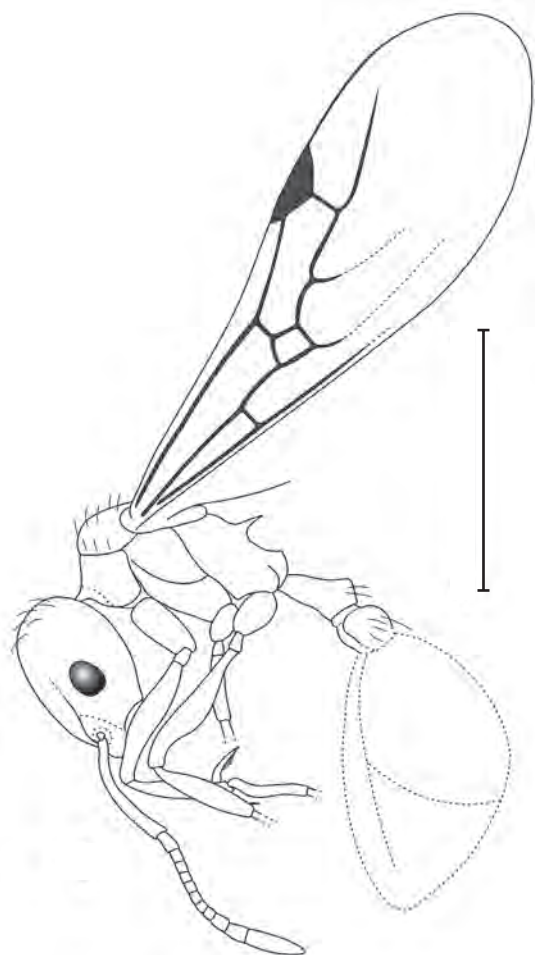


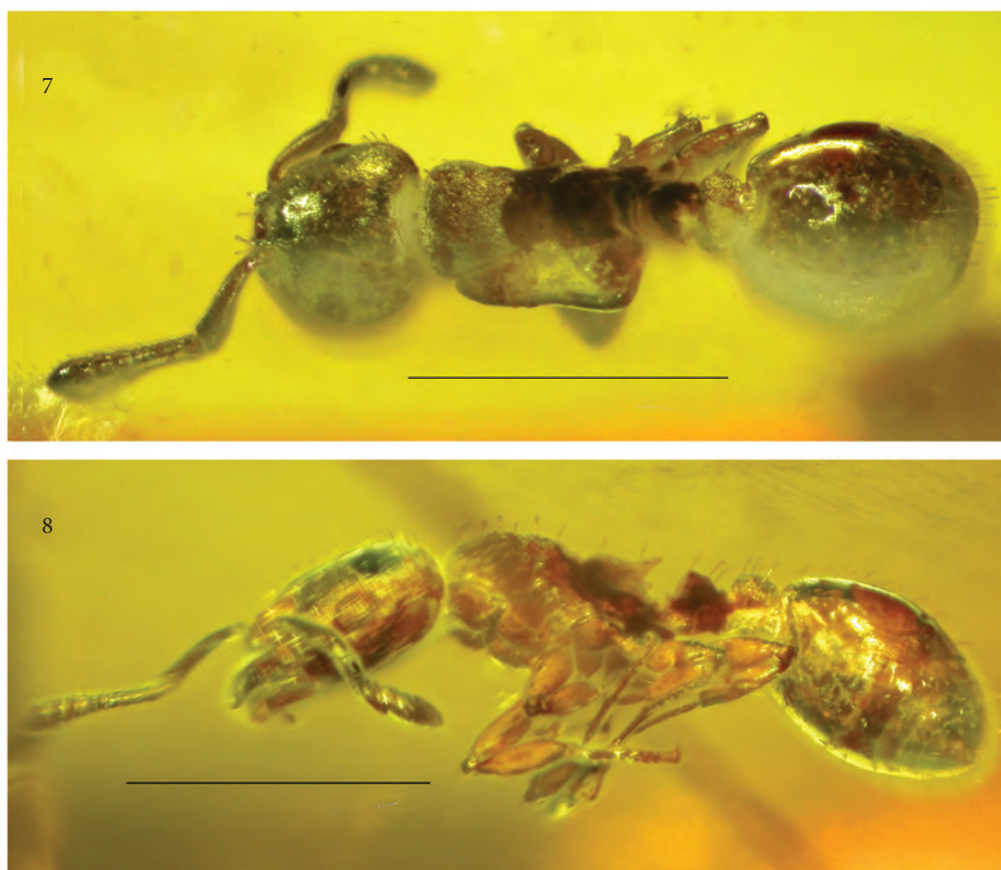
Fig. 6. *Eocenomyrma ukrainica* sp. n., line drawing of paratype gyne made based on photo, body in lateral view (sculpture omitted). Scale bar 1 mm.

Eocenomyrma breviscapa sp. n.

Material examined. Holotype, worker, SIZK K-5518, Klesov, Rovno amber, Late Eocene.

Etymology. From the Latin words “*brevis*” — short, and “*scapus*” — scape, meaning that the antennal scape is short.

Worker (figs 7–11). Total length ca. 2.4 mm. Head short, 1.07 times longer than width, with convex sides, rounded occipital corners and convex

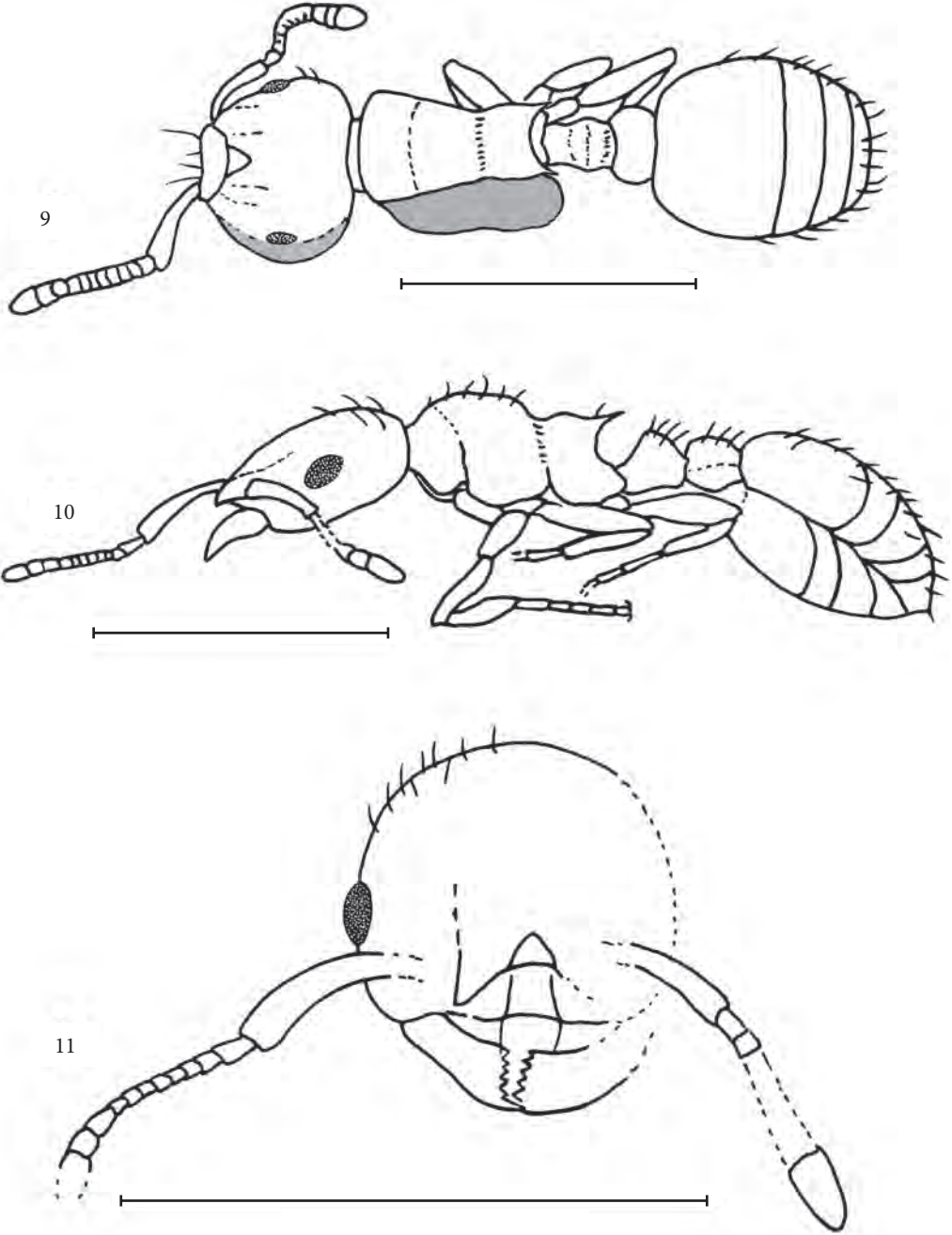


Figs 7–8. *Eocenomyrma breviscapa* sp. n., photos of holotype worker: 7 — body in dorsal view; 8 — body in lateral view. Scale bar 1 mm.

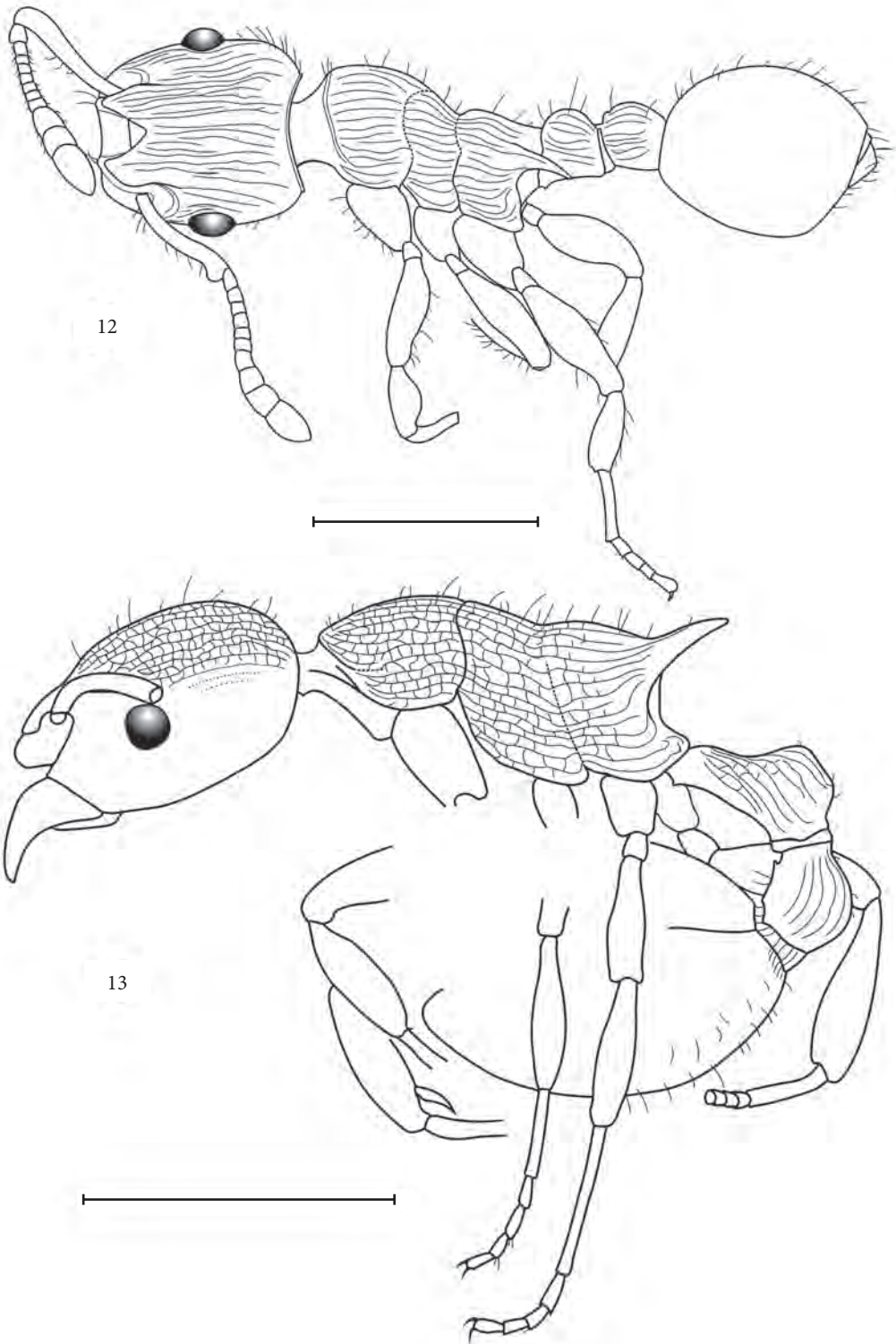
occipital margin. Eyes of moderate size, their maximum diameter 0.21 of head length, situated at midlength of lateral side of head. Antennae 12-segmented, with distinct, quite big 3-segmented club that is subequal to total length of remainder funicular segments, first funicular segment ca. 1.5 times longer than width, 2–8th segments transversal; scape very short, nearly twice shorter than head length, far not reaching occipital margin. Central part of clypeus longitudinally concave, with two lateral longitudinal carinae and well marked anterolateral corners, its anterior margin concave, with pair of long setae on anterolateral corners. Clypeus posteriorly widely inserted between frontal lobes; frontal lobes anteriorly reaching anterior clypeal margin. Palp formula 4, 3. Mandibles elongate-triangular, masticatory margin with longer apical tooth and small 5 denticles.

Mesosoma ca. 2.8 times longer than height, promesonotal suture developed, metanotal groove deep. Anterior margin of pronotum slightly convex, humeri narrowly rounded. Propodeal spines rather short, straight, widened at base and acute at apex, directed posteriorly at an angle ca. 45° (seen in profile), very slightly divergent (seen from above). Propodeal lobes rounded. Petiole with very short peduncle, quite high, only little longer than height, its anterior surface steep, very slightly concave, meets with dorsal surface of node at an acute angle, dorsal plate short and strongly declined posteriorly so that petiole seems cuneiform (seen in profile). Postpetiole wider than petiole. Middle and hind tibiae without spur.

Head dorsum, mesosoma and waist densely punctated, head dorsum additionally with longitudinal striation.



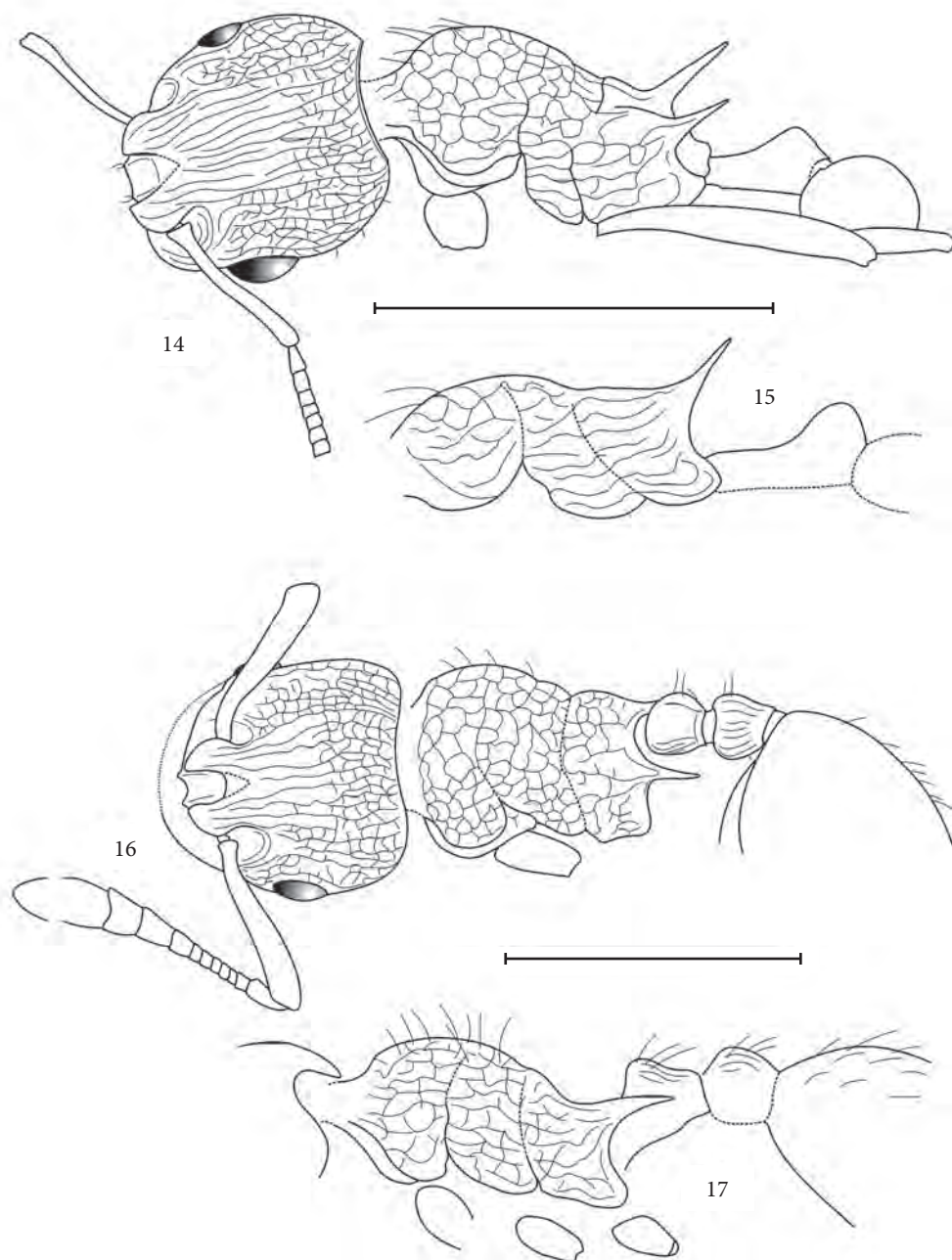
Figs 9–11. *Eocenomyrma breviscapa* sp. n., line drawings of holotype worker made based on photos: 9 — body in dorsal view; 10 — body in lateral view; 11 — head in dorsal view (sculpture omitted). Scale bar 1 mm.



Figs 12–13. Line drawings of *Eocenomyrma rugosostriata* (Mayr), neotype worker (12, body in dorso-lateral view) and *E. elegantula* Dlussky et Radchenko, holotype worker (13, body in lateral view). Scale bar 1 mm.

Body with sparse, rather short, blunt straight suberect hairs, scape and legs with decumbent pilosity.

Measurements (in mm): HL 0.62, HW 0.57, FW 0.17, FLW 0.18, SL 0.33, OL 0.13, PnW 0.36, ML 0.74, MH 0.30, PL 0.22, PW 0.23, PH 0.20, PPL 0.09, PPW 0.27, PPH 0.20, ESL 0.09, ESD 0.20, HTL 0.33, total length ca. 2.4.



Figs 14–17. Line drawings of *Eocenomyrma orthospina* Dlussky et Radchenko, holotype worker (14 — head, mesosoma and waist, dorso-lateral view; 15 — mesosoma and petiole, lateral view) and *E. eocenica* Dlussky et Radchenko, holotype worker (16 — head, mesosoma and waist, dorso-lateral view; 17 — mesosoma and petiole, lateral view). Scale bar 1 mm.

Indices: HL/HW 1.09, FW/HW 0.30, FLW/FW 1.08, SL/HL 0.52, SL/HW 0.57, OL/HL 0.21, PL/HL 0.35, PL/PH 1.13, PPL/HL 0.15, PPL/PPH 0.47, ESL/HL 0.15, ESL/HW 0.16, ESD/ESL 2.14, ML/MH 2.48.

Gynes and males unknown.

Comparative diagnosis. *E. breviscapa* well differs from all known *Eocenomyrma* species (including described here gyne of *E. ukrainica*) by the punctated head, mesosoma and waist, by the much shorter, cuneiform petiole (PL/PH 1.13 vs. > 1.25 in other species), by the shorter propodeal spines (ESL/HW 0.16 vs. > 0.30 in other species), and by the distinctly shorter scape (SL/HL 0.52 vs. > 0.58, usually > 0.60 in other species).

Newly founded material of other *Eocenomyrma* species

E. rugosostriata

Material examined. 1 worker, Baltic amber, CGC F-6738.

Measurements (in mm): HL 1.01, OL 0.22, ML 1.37, MH 0.48, PL 56, PH 0.29, PPL 0.35, PPH 0.29, ESL 0.33, HTL 0.56, total length ca. 4.30.

Indices: PL/HL 0.55, PL/PH 1.95, PPL/HL 0.35, PPL/PPH 1.23, ESL/HL 0.32, ML/MH 2.84.

E. orthospina

Material examined. Two workers:

1) Baltic amber, CGC F-6800.

Measurements (in mm): HL 0.69, HW 0.60, FW 0.27, FLW 0.31, SL 0.46, ML 0.75, PnW 0.75, PL 0.31, PW 0.23, PPL 0.21, PPW 0.30, ESD 0.27, total length ca. 3.0.

Indices: HL/HW 1.15, FW/HW 0.45, FLW/FW 1.15, SL/HL 0.67, SL/HW 0.77, PL/HL 0.45, PPL/HL 0.30.

2) Rovno amber, SIZK K-7026 (specimen damaged, without petiole, postpetiole and gaster).

Measurements (in mm): HL 0.66, HW 0.57, SL 0.52, FW 0.23, FLW 0.26, AL 0.85, PnW 0.39, ESL 0.31, ESD 0.30, HTL 0.52, total length ca. 3.5 (by analogy of ML+HL compare to other species).

Indices: HL/HW 1.16, SL/HL 0.79, SL/HW 0.91, FW/HW 0.46, FLW/FW 1.13, ESL/HL 0.47, ESL/HW 0.53.

A key for the identification of *Eocenomyrma* species

1. Head, mesosoma and waist only densely punctated, without rugosity or reticulation (fig. 7). Scape relatively very short, SL/HL 0.52, SL/HW 0.57. Petiole with very short peduncle, PL/PH 1.13, its anterior surface steep, very slightly concave, meets with dorsal surface of node at an acute angle, dorsal plate short ant strongly declined posteriorly so that petiole seems cuneiform (seen in profile) (figs 8, 10). *E. breviscapa* sp. n.
- Head, mesosoma and waist longitudinally rugose or reticulated; petiole of another shape, but in any case with much longer peduncle, PL/PH > 1.25 (figs 5, 6, 12–17) Scape distinctly longer, SL/HL > 0.58, SL/HW > 0.70. 2
- 2(1). Gyne: propodeal spines relatively short (ESL/HL 0.17), straight, slightly widened at the base; head dorsum and mesosoma mostly longitudinally rugose, coarse reticulation presents on occipital area of the head (figs 5, 6). *E. ukrainica* sp. n.
- Workers: propodeal spines longer (ESL/HL > 0.23), more widened at the base, often curved down along their length, if straight, then much longer, ESL/HL > 0.35 (figs 12–17). 3

- 3(2). Head dorsum and mesosoma with longitudinal, slightly sinuous rugosity, without reticulation (fig. 12) *E. rugosostriata* (Mayr) 4
 – Head dorsum and mesosoma at least partly with reticulation (figs 13–17)..... 4
 4(3). Whole head dorsum and mesosoma with fine reticulation; petiolar node with well developed, flattened dorsal plate (fig. 13). *E. elegantula* Dlussky et Radchenko 5
 – Frons with longitudinal, slightly sinuous rugae, remainder part of head dorsum with coarse reticulation; petiolar node with rounded dorsum, without dorsal plate (figs 14–17). 5
 5(4). Propodeal spines thin, not widened at the base, straight, directed backward and upward; petiole with very long peduncle (PL/PH > 1.90) (figs 14, 15). *E. orthospina* Dlussky et Radchenko 5
 – Propodeal spines massive, widened at the base, slightly curved down along their length, directed mainly backward; petiole with much shorter peduncle (PL/PH 1.27) (figs 16, 17). *E. electrina* Dlussky et Radchenko

Discussion

When we described *Eocenomyrma* (Dlussky and Radchenko, 2006), this genus was suggested to be most likely resembling *Temnothorax* Mayr and placed to the tribe Formicoxenini (sensu Bolton, 2003). Discovering and description of the winged male and gyne of this genus support this idea: the forewing venation in *E. ukrainica* in general has the character of the venation of *Temnothorax*. Particularly, only two closed cells present, 1r+2r and mcu, the cell 3r is open distally and the cell rm is absent. Additionally, the cell 1r+2r is long, the vein section 1RS slightly inclined posteriorly, the cell mcu trapezoid (not pentagonal), far not reaching distally level of the pterostigmal base, and the cross-vein cu-a merging with the vein section 1M+Cu far proximally than the cell mcu (the vein section 2M+Cu much longer than the cross-vein cu-a).

The primary diagnosis of the genus *Eocenomyrma* (Dlussky and Radchenko, 2006) was based on the workers alone, and now we may add some more characters of the male: the antennal scape of moderate length (SL/HL 0.50, SL/HW 0.59), the forewing with the closed cells 1r+2r and mcu, the cell 3r is open distally, the cell rm is absent.

Nevertheless, *Eocenomyrma* well differs from *Temnothorax* by the clypeal shape: its median portion concave transversally, with the distinctly marked anterolateral corners, delineated by the two lateral longitudinal carinae, and its anterior margin shallowly concave, with the pairs of long setae situate on the anterolateral clypeal corners. In contrary, the median portion of clypeus in *Temnothorax* is convex or somewhat flattened, but never with the lateral longitudinal carinae and marked anterolateral corners, the anterior clypeal margin is rounded or somewhat prominent, occasionally with the small median notch. Anyway, we may confirm our previous suggestion that *Eocenomyrma* most probably did not arise from the any extant Formicoxenini genera, but has common ancestor with them, including *Temnothorax*.

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