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RESEARCH ARTICLE

New records of soil-inhabiting mesostigmatic mites (Acari: Mesostigmata) in Turkey

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ASBTRACT: This paper reports on four species, in three genera within two families (Ameroseiidae, Digamasellidae) of soil-inhabiting mesostigmatic mites in Turkey: *Ameroseius lidiae* Bregetova; *Ameroseius sculptilis* Berlese; *Kleemannia nova* Nasr and Abou-Awad and *Dendrolaelaspis lobatus* (Shcherbak and Chelebiev). The important diagnostic characters of each species are reviewed to facilitate species delimitation. The genus *Dendrolaelaspis* Lindquist is reported for the first time from Turkey.

Keywords: Taxonomy, first record, Parasitiformes, Gamasina, Monogynaspida, Ascoidea, Dendrolaelapinae, Palaearctic realm.

Zoobank: https://zoobank.org/58871FD7-628F-44F4-9A80-38879511504C

INTRODUCTION

Mesostigmata is a large and a cosmopolitan order of mites that includes approximately 11,500 valid species, which is about 20% of all known mite species (Beaulieu et al., 2011). The representatives of this order are characterized by an unusually diverse variety of lifestyles and habitats, but the majority of species are free-living predators. Mesostigmatic mites are found in soil, litter, rotting wood, compost, manure, carrion, nests, house dust and similar detritus-based niches. They are also associated with plants and fungi (Lindquist et al., 2009).

The mite family Ameroseiidae is presently classified in the superfamily Ascoidea of the order Mesostigmata. The most recent taxonomic work on the family was by Mašán (2017), who comprehensively revised the generic concepts and morphological attributes of this family. The family, which includes about 138 described species sorted into 12 genera (Mašán, 2017), comprises free-living mites that dwell in the soil, litter, organic matter, stored food, or dust, but most species are fungivorous (Flechtmann, 1985; Moustafa and El-Hady, 2006), which, based on the few species studied (Moustafa and El-Hady, 2006), can be biological control agents for management of various soil-borne plant pathogenic fungi (e. g., *Rhizoctonia solani* Kühn). This fact points to ameroseiids may playing an important role in the balance of the soil ecosystem.

The family Digamasellidae is well known as a group of predatory mites generally found in soil and litter, as well as in manure and compost. The family comprises about 277 nominal species placed into 12 genera that are recorded worldwide (Shcherbak, 1980; Castilho, 2012; Faraji et al., 2021). Many members of family are found in decaying wood, bracket fungi, and the galleries of bark beetles (Hirschmann, 1960; McGraw and Farrier, 1969; Shcherbak, 1980; Hirschmann and Wiśniewski, 1982a,; Karg, 1993). The classification of the digamasellids is unstable as a result of continued confusion about the definition and status of some of its genera. Different concepts of genera and subgenera have been used by different authors (e.g., Lindquist, 1975; Evans and Till, 1979; Shcherbak, 1980; Hirschmann and Wiśniewski, 1982a, 1982b; Karg, 1993). We herein follow Lindquist (1975) and subsequent authors (e.g. Castilho et al., 2012) who classified Digamasellidae into relatively few genera.

Free-living mesostigmatic mites in Turkey have been reported by various authors (see Erman et al., 2007; Çakmak et al., 2011). Nevertheless, the families Ameroseiidae and Digamasellidae remain poorly studied and before the present study, only eight and four species of Ameroseiidae and Digamasellidae had been reported from Turkey, respectively (Erman et al., 2007; Çakmak et al., 2011; Qayyoum et al., 2016; Khalili-Moghadam and Saboori, 2021). In this paper, we add to that of the Turkish fauna by reporting four species in three genera from these two families.

MATERIALS AND METHODS

Soil samples were collected from various localities at Turkey, in searching for edaphic mites. Mites were extracted from soil using Berlese-Tullgren funnels, then cleared in lactic acid solution and mounted in Hoyer's medium (Walter and Krantz, 2009). Microphotographs were taken with an AxioCam 506 camera (Carl Zeiss, Germany) equipped with differential interference contrast (DIC). Most images were captured in stacks (with the focal depth manually controlled). Selected images were combined using Helicon Focus 7.6.4 Pro (Helicon Soft Ltd., 2000). The nomenclature used for the dorsal idiosomal chaetotaxy follows that of Lindquist and Evans (1965), the notations for leg and palp setae follow those of Evans (1963a, b), and other anatomical structures mostly follow Evans and Till (1979).

RESULTS

Family Ameroseiidae Evans

Genus *Ameroseius* Berlese

Ameroseius Berlese, 1904: 258.

Type species: *Seius echinatus* Koch, 1839 (= *Acarus corbicula* Sowerby, 1806), by original designation.

Diagnosis. The diagnosis of *Ameroseius* used here is based on that of Mašán (2017).

Ameroseius lidiae Bregetova

(Figure 1)

Ameroseius lidiae Bregetova, 1977: 161.

Ameroseius lidiae — Kazemi and Rajaei, 2013: 65; Khalili-Moghadam and Saboori, 2014: 675; Khalili-Moghadam and Saboori, 2021: 410.

Ameroseius (*Ameroseius*) *lidiae* — Hajizadeh et al., 2013: 150.

More information about the synonyms of this species are available in Mašán (2017: 51).

Specimens examined. Two females; 36°20'01.9"N, 34°00'03.3"E, Sökün, Silifke, Mersin, Turkey; 20 January 2015; coll. K. Yalçın; soil-litter in commercial strawberry field. One female; 37°18'33"N, 34°45'48"E, Akçatekir, Pozantı, Adana, Turkey; 3 February 2015; coll. I. Doker; moss in *Pinus* sp. Forest. One female; 36°19'29.4"N, 34°03'16.0"E, Arkum, Silifke, Mersin, Turkey; 23 February 2015; coll. K. Yalçın; soil-litter in commercial strawberry field.

Remarks. *Ameroseius lidiae* was described from Ukraine and Tajikistan (holotype: Ukraine, estuary of Dnieper River; paratype: Tajikistan hollow of willow tree) (see Bregetova, 1977). The description provided by Bregetova (1977) lack some of the most important details and do not provide enough information for accurate and consistent species identification. Recently, the species fully redescribed by Khalili-Moghadam and Saboori (2014). The species has also been recorded from China, Hungary, Iran, Kazakhstan, Moldavia, Russia, Saudi Arabia, Slovakia, Spain, Syria, Uzbekistan (Khalili-Moghadam and Saboori, 2021) and it is now recorded in Turkey for the first time, from soil-litter. Morphological characters of our specimens agree very well with the redescription given by Khalili-Moghadam and Saboori (2014), also with supplementary information presented by Mašán (2017). *Ameroseius lidiae* is easily recognized by the dorsal shield entirely reticulated and with 29 pairs of somewhat slender setae (Fig. 1A), seta *j1* is about two times as wide as *j2* (Figs 1A, 1C), the tip of setae *j6* and *J2* extended at most to the midpoint of the distance between the base of *j6-J2* and *J2-J4*, respectively, and *J4* obviously not reaching posterior margin of dorsal shield (Fig. 1A); sternal shield almost smooth (or faintly reticulated), except some irregular lines anteriorly (Figs 1B, 1D), bearing two pairs of smooth setae, setae *st3* located on two small plates adjacent to posterior margin of sternal shield and *st4* on soft cuticle near hyaline flap of genital shield (Figs 1B, 1D); genital shield reticulate, with nearly parallel margins (Figs 1B, 1D), anal shield suboval, with delicate reticulation on surface and bearing only three circum-anal setae (Figs 1B, 1E); six pairs of opisthogastric setae present (Figs 1B, 1E), metapodal platelets small, elongate and narrow (Fig. 1B); deutosternal groove with seven rows of 1– 2 denticles, the denticles of 5th and 6th rows not discernible (Fig. 1F); cheliceral digits terminally with no hyaline appendages, fixed cheliceral digit with an apical tooth and three robust teeth and movable digit with one small subapical tooth (Fig. 1G).

Ameroseius sculptilis Berlese

(Figure 2)

Ameroseius sculptilis Berlese, 1916: 47.

Ameroseius sculptilis — Khalili-Moghadam and Saboori, 2021: 412.

Ameroseius (*Ameroseius*) *sculptilis* — Hajizadeh et al., 2013: 150.

More information about the synonyms of this species are available in Mašán (2017: 51).

Specimens examined. Three females; Gölbaşı, Adıyaman, Turkey; 29 May 2014; coll. I. Döker and C. Kazak; unknown plant belongs to family Asteraceae. One female; Kuluşağı, Malatya, Turkey; 30 May 2014; coll. I. Döker and C. Kazak; *Anchusa* sp. (Boraginaceae).

Remarks. *Ameroseius sculptilis* was described from Italy (Berlese, 1916) where it was found in moss. The description of this species is brief and both the description and illustrations lack many important details. Bregetova (1977) considered that *Ameroseius pulcher* Westerboer (in Westerboer and Bernhard, 1963) is a junior synonym of *A. sculptilis*. However, Bregetova (1977) did not provide any explanation for this decision, nor did she provide the details of the examined specimens. *Ameroseius pulcher* was described from Germany (Westerboer and Bernhard, 1963) where it was found in rotting grass. Recently, Mašán (2017) has confirmed this synonymy by examination of type series of both species, we here follow Mašán (2017). *Ameroseius sculptilis* has also been recorded from Bulgaria, Iran, Japan, Norway, Russia, Slovakia (Khalili-Moghadam and Saboori, 2021) and it is now recorded in Turkey for the first time, from soil-litter. Morphological characters of our specimens agree very well with the supplementary information presented by Mašán (2017) for this species. *Ameroseius sculptilis* is easily recognized by the dorsal shield strongly reticulated, between *j6* and *J2* with subtriangular sculptural pattern (Fig. 2A), and with 29 pairs of mostly serrated setae, seta *j1* thickened (Fig. 2C), most *j–J* setae not reaching the base of the subsequent seta in the series (Fig. 2A), sternal shield almost smooth (or faintly reticulated), except some irregular longitudinal lines laterally (Figs 2B, 2D), bearing two pairs of smooth setae, setae *st3* located on two small

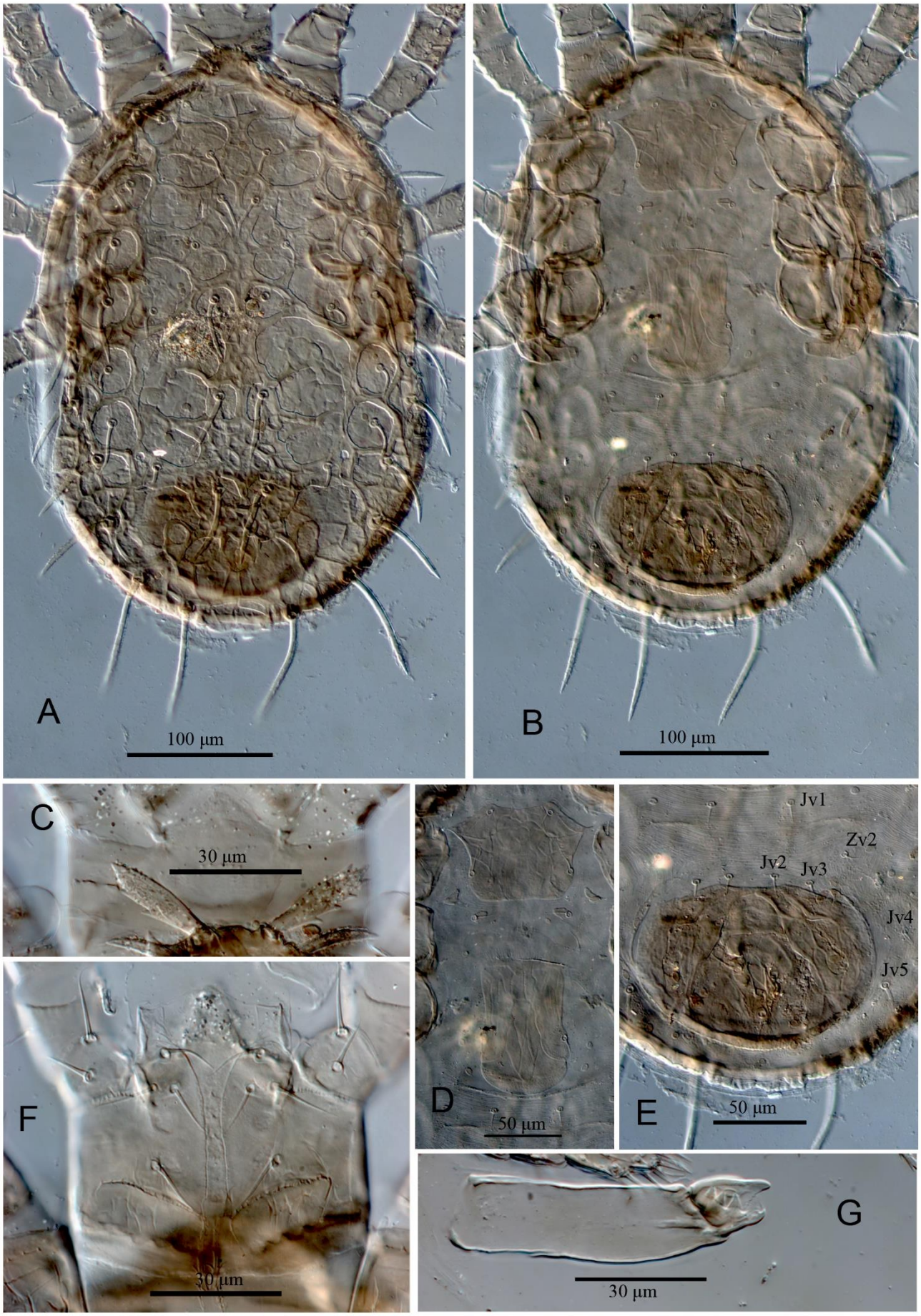

Figure 1. DIC micrographs of *Ameroseius lidiae* Bregetova, 1977, adult female. **A.** Idiosoma in dorsal view, **B.** Idiosoma in ventral view, **C.** Vertical setae *j1* enlarged, **D.** Sternal and genital shields, **E.** Anal shield, **F.** Subcapitulum, **G.** Chelicera.

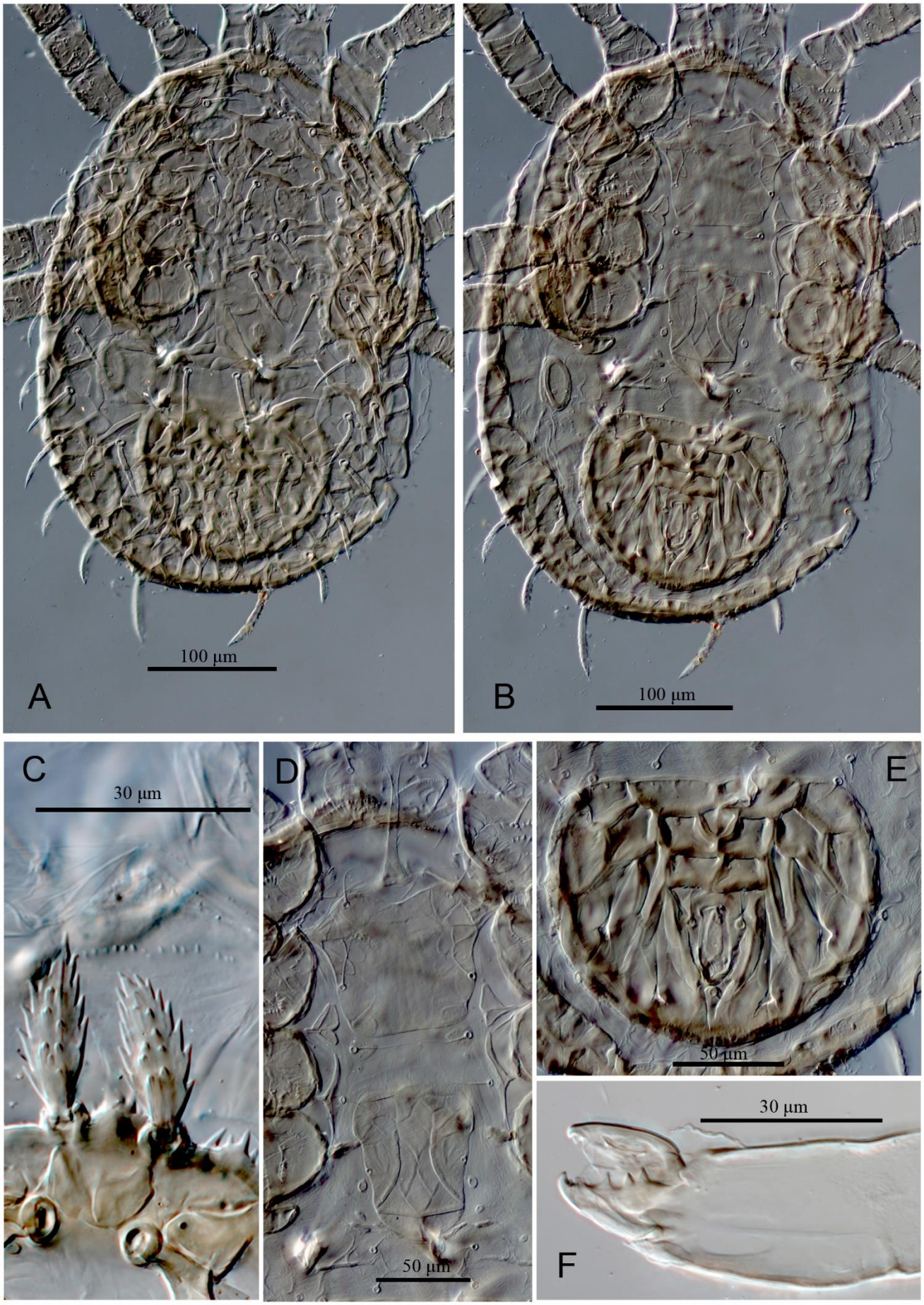

Figure 2. DIC micrographs of *Ameroseius sculptilis* Berlese, 1916, adult female: **A.** Idiosoma in dorsal view; **B.** Idiosoma in ventral view; **C.** Vertical setae *j1* enlarged; **D.** Sternal and genital shields; **E.** Anal shield; **F.** Chelicera.

plates adjacent to posterior margin of sternal shield and *st4* on soft cuticle near hyaline flap of genital shield (Figs 2B, 2D); genital shield reticulate, with nearly parallel margins (Figs 2B, 2D), anal shield subpentagonal, coarsely reticulate on surface, bearing only three circum-anal setae (Figs 2B, 2E); six pairs of opisthogastric setae present (Fig. 2B), metapodal platelets enlarged and rounded (Fig. 2B); fixed cheliceral digit with an apical tooth and three robust teeth and movable digit with one small subapical tooth (Fig. 2F).

Genus *Kleemannia* Oudemans

Kleemannia Oudemans, 1930: 135.

Type species: *Zercon pavidus* C. L. Koch, 1839, by original designation.

More information about the synonyms of this genus are available in Mašán (2017: 51).

Diagnosis. The diagnosis of *Ameroseius* used here is based on that of Mašán (2017).

***Kleemannia nova* Nasr and Abou-Awad**

(Figure 3)

Kleemannia nova Nasr and Abou-Awad, 1986: 75.

Ameroseius (*Kleemannia*) *novus* — Hajizadeh et al., 2013: 150.

Ameroseius nova — Kazemi and Rajaei, 2013: 65.

Kleemannia nova — Mašán, 2017: 90; Khalili-Moghadam and Saboori, 2021: 419.

Specimen examined. One female; 36°20'01.9"N, 34°00'03.3"E, Sökün, Silifke, Mersin, Turkey; 20 January 2015; coll. K. Yalçın; soil-litter in commercial strawberry field.

Remarks. *Kleemannia nova* was described from Egypt (Nasr and Abou-Awad, 1986) where it was found in manure and has also been recorded from Iran, Morocco, Peru (Khalili-Moghadam and Saboori, 2021) and it is now recorded in Turkey for the first time, from soil-litter. Morphological characters of our specimen agree very well with the description given by Nasr and Abou-Awad (1986), also with supplementary information presented by Mašán (2017) for this species. *Kleemannia nova* is easily recognized by the dorsal shield entirely reticulated and with 29 pairs of flattened, feather-shaped setae (*z6* present) (Fig. 3A), setae *j1* fan-shaped and marginally serrate (Figs 3A, 3E); pseudo-metasternal platelets enlarged and well developed (Figs 3B, 3C); setae *Jv2* and *Jv3* located on anteromedial surface of ventrianal shield and setae *Jv4* absent (Figs 3B, 3C); anterior margin of epistome with pointed central projection (Fig. 3E); deutosternal groove with seven rows of 1– 2 denticles, except 6th and 7th rows with 4– 5 denticles (Fig. 3D); fixed cheliceral digit with an apical tooth and four robust teeth and movable digit with one small subapical tooth (Fig. 3F).

Family Digamasellidae Evans

Genus *Dendrolaelaspis* Lindquist

Dendrolaelaps (*Dendrolaelaspis*) Lindquist, 1975: 16.

Dendrolaelaspis — Shcherbak, 1980: 175.

Dendrolaelaps (*Dendrolaelaspis*) Hirschmann and Wisniewski, 1982a: 137.

Type species: *Digamasellus angulosus* Willmann, 1936, by orıgınal designation.

Diagnosis. The concept of *Dendrolaelaspis* used here is based on that of Lindquist (1975).

***Dendrolaelaspis lobatus* (Shcherbak and Chelebiev)**

(Figure 4)

Dendrolaelaps (*Dendrolaelaspis*) *lobatus* Shcherbak and Chelebiev, 1977: 471.

Dendrolaelaspis lobatus — Shcherbak, 1980: 180; Karg and Schorlemmer,

2009: 69.

Dendrolaelaps (*Dendrolaelaspis*) *lobatus* — Hirschmann and Wisniewski, 1982a: 144.

Specimen examined. One female; 36°19'29.4"N, 34°03'16.0"E, Arkum, Silifke, Mersin, Turkey; 23 February 2015; coll. K. Yalçın; soil-litter in commercial strawberry field.

Remarks. Lindquist (1975) erected *Dendrolaelaspis* as a subgenus of *Dendrolaelaps* Halbert *sensu lato* and designated *Digamasellus angulosus* Willmann as its type species. Shcherbak (1980) raised most of the groups considered as subgenera of *Dendrolaelaps sensu lato* including *Dendrolaelaspis*, to the generic level and listing them in subfamily Dendrolaelapinae Hirschmann. The genus comprises about 19 nominal species that are recorded worldwide (Castilho, 2012). *Dendrolaelaspis lobatus* was described from Kazakhstan (Shcherbak and Chelebiev, 1977) where it was found in compost. Morphological characters of our specimen agree very well with description given by Shcherbak and Chelebiev (1977), also with supplementary information presented by Shcherbak (1980) for this species. The species has been recorded in Europe and Asia and is now recorded from Turkey for the first time from the soil-litter. *Dendrolaelaspis lobatus* is easily recognized by the shape and length of opisthonotal setae which are almost spatulate (club-shaped), except setae *J1* and Z1 needle-like, *Z4* scimitar-like, *J4* spine-like, and *J5* rod-shaped (Fig. 4A), anterior margin of the sternal shield hardly conspicuous (Fig. 4B), ventrianal shield bearing five pairs of smooth preanal setae (*Jv1–3, Zv2–2*) (Fig. 4B), post-anal seta club-shaped (Fig. 4B), hypostomal groove with five transverse rows of denticles, each row with 18–30 small denticles, posterior row extending outward from hypostomal groove (Fig. 4C); epistome triramous, central prong shorter than lateral prongs, each

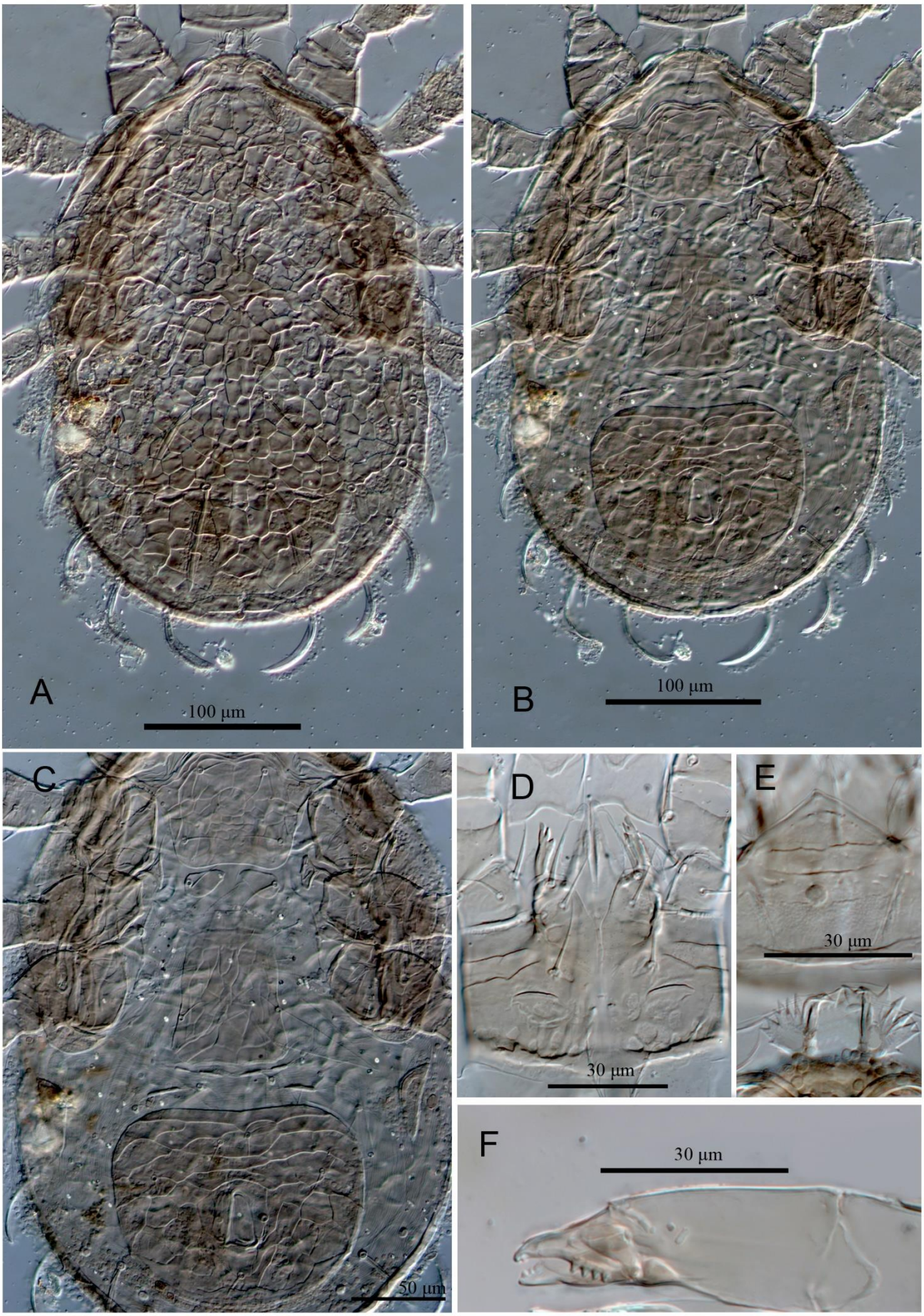

Figure 3. DIC micrographs of *Kleemannia nova* Nasr and Abou-Awad, 1986, adult female: **A.** General view dorsally; **B.** General view ventrally; **C.** Idiosoma in ventral view; **D.** Subcapitulum; **E.** Vertical setae *j1* enlarged and epistome; **F.** Chelicera.

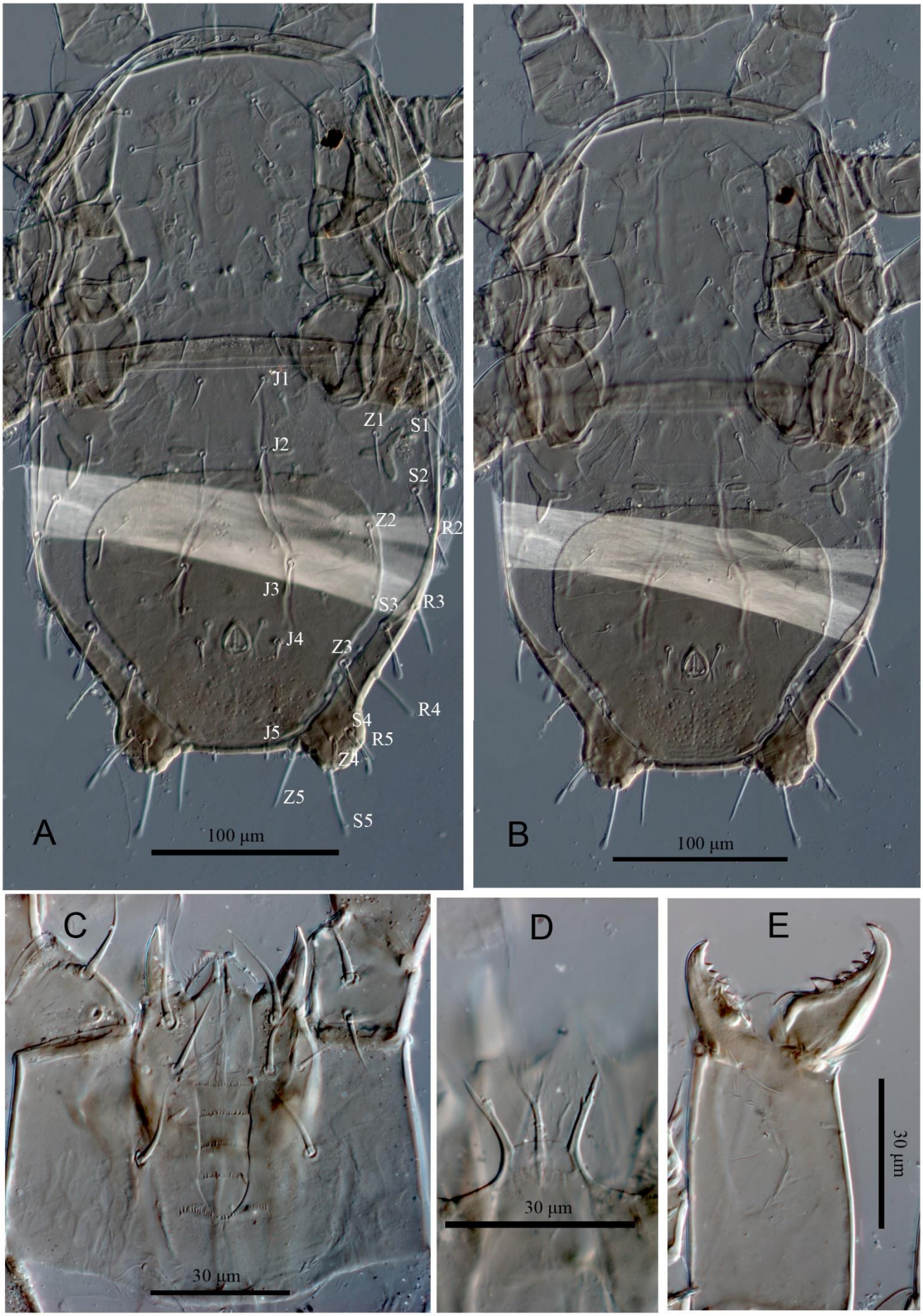

Figure 4. DIC micrographs of *Dendrolaelaspis lobatus* (Shcherbak and Chelebiev), adult female: **A.** Idiosoma in dorsal view; **B.** Idiosoma in ventral view; **C.** Subcapitulum; **D.** Epistome; **E.** Chelicera.

of these with single barb along their inner margins (Fig. 4D), fixed digit of chelicera with an offset distal tooth (gabelzhan), followed by five variously sized teeth, movable digit of chelicera with four well-spaced teeth in addition to apical hook (Fig. 4E).

Authors' contributions

Omid Joharchi: Species determination, writing – original draft. **İsmail Döker:** Species collector, writing – review & editing. **Kemal Yalçın:** Species collector. **Cengiz Kazak:** Species collector, writing – review & editing.

Statement of ethics approval

Not applicable.

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Conflict of interest

No potential conflict of interest was reported by the authors.

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