

## Bark beetle associated trematurid mites (Acari: Uropodina: Trematuridae) from Asian Russia with description of a new species

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### Abstract

A new *Oodinychus* Berlese, 1917 species, *O. scolytana* **sp. nov.**, was discovered and described from the galleries of bark beetles *Polygraphus proximus* Blandford from two different parts of Asian Russia. New associations are given for the trematurid mites and bark beetle species. Three bark beetle associated species from the *Trichouropoda ovalis*-group are moved into the genus *Oodinychus* as *O. hirsuta* (Hirschmann, 1972) **comb. nov.**, *O. rafalski* (Wiśniewski & Hirschmann, 1984) **comb. nov.** and *O. wilkinsoni* (Hirschmann & Wiśniewski, 1986) **comb. nov.** Also, *Oodinychus egypticus* Abo-Shnaf, El-Bishlawy & Allam, 2018 is transferred to the genus *Nenteria* Oudemans, 1915.

**Key words:** Mesostigmata, systematics, association with bark beetles, Scolytinae, Eastern Palaearctic

### Introduction

The mite association with bark beetles (Coleoptera: Curculionidae: Scolytinae) is an intensively studied aspect of acarology. Until today numerous reports have been presented about this topic world-wide (e.g. Moser et al. 2010; Penttinen et al. 2013; Khaustov et al. 2016, 2018, 2018; Lieutier et al. 2016; Wirth et al. 2016; Zach et al. 2016; Vissa et al. 2019).

Uropodina is a specific group within the bark beetle associated mites; several species occur in the galleries, but numerous others were usually collected as phoretic deutonymphs on the body of the beetles. Trematuridae is a distinct family within the Uropodina with numerous unique character states, like the shape of the corniculi, tritosternum, chelicerae, presence of pedofossae and sculptural pattern on the body (Kontschán 2019). Until today, more than 100 trematurid species have been described from different regions of the world (Wiśniewski & Hirschmann 1993). The majority of these species occur in soil, moss and leaf litter, but some species live in association with several beetle groups, like bark beetles. We have very few information about the biology of the trematurids, maybe these species feed on fungus.

Our present paper contains the first records of the bark beetle associated Uropodina from the Asian part of Russia.

### Material and Methods

The galleries of bark beetles were cut by axe or knife with pieces of the barks in the forests and placed into plastic boxes, then the samples transported to the laboratory and all mites collected from the galleries under stereomicroscope Discovery V8.

The specimens investigated in this study were cleared in lactic acid, the drawings made with the aid of a camera lucida on a Leica 1000 compound microscope, the photo taken with Huawei P30 Lite mobile attached to the microscope. All specimens of the new species are preserved in ethanol and deposited in the Hungarian Natural History Museum (HNHM), Budapest, Hungary; Natural History Museum, Geneva (NHMG), Switzerland and Tyumen State University (TSU), Russia. Abbreviations: *st* = sternal setae, *h* = hypostomal setae, *ad* = adanal setae, *lf* = lyriform fissure, *p* = pore, *s* = spine-like organ. The measurements and the scales in the figures are given in micrometers ( $\mu\text{m}$ ).

## Results

List of the found species

### ***Trichouropoda polytricha* (Vitzthum, 1923)**

*Uropoda polytricha* Vitzthum, 1923, p. 149, Figures 48, 49.

*Uropoda polytricha*: Vitzthum 1926.

*Pseudouropoda polytricha*: Vitzthum 1943.

*Trichouropoda polytricha*: Hirschmann & Zirngiebl-Nicol 1961, Moser & Bogenschütz 1984, Moser *et al.* 1989; Karg 1989, Takov *et al.* 2009; Kršlak *et al.* 2010; Feketeová 2011; Gwiazdowicz *et al.* 2011; Gwiazdowicz & Gutowski 2012; Vrabec *et al.* 2012, Chaires-Grijalva *et al.* 2013, Fernández *et al.* 2013, Knee *et al.* 2013, Penttinen *et al.* 2013, Čejka & Holuša 2014, Khaustov *et al.* 2016, Khaustov *et al.* 2018.

#### *Material examined*

One female: Russia, Altai, 51° 47' 33.3", 87° 18' 30.6"; 494 masl., 21 July 2017, from the galleries of *Ips sexdentatus* Boerner, under the bark of *Pinus silvestris* Linnaeus, coll. A.A. Khaustov.

#### *Remarks*

This species was known from the Holarctic and collected from the galleries of bark beetles, like Scolytidae (Wiśniewski & Hirschmann 1993), *Ips typographus* (Linnaeus) (Moser & Bogenschütz 1984; Moser *et al.* 1989; Takov *et al.* 2009; Feketeová 2011; Gwiazdowicz *et al.* 2011; Gwiazdowicz & Gutowski 2012; Vrabec *et al.* 2012; Fernández *et al.* 2013; Knee *et al.* 2013; Penttinen *et al.* 2013; Čejka & Holuša 2014; Khaustov *et al.* 2018), *Ips sexdentatus* Boerner (Fernández *et al.* 2013), *Hylastes cunicularius* Erichson (Kršlak *et al.* 2010), *Dryocoetes autographus* Ratzeburg, *Ips amitinus* Eichhof, *I. cembrae* (Heer), *I. hauseri* (Reitter), *I. pilifrons utahensis* Wood, *I. woodi* Thatcher, *I. montanus* Eichhof, *I. perturbatus* (Eichhof), *I. hunteri* Swaine, *I. borealis* Swaine, *Pityogenes chalcographus* Linnaeus (Khaustov *et al.* 2016; Knee *et al.* 2013), and *Dendroctonus rhizophagus* Thomas & Bright (Chaires-Grijalva *et al.* 2013).

### ***Trichouropoda structura* Hirschmann & Zirngiebl-Nicol, 1961**

*Trichouropoda structura* Hirschmann & Zirngiebl-Nicol 1961, pp. 2 and 33, Figures 1: 22 and 7d.

*Trichouropoda structura*: Hirschmann & Wiśniewski 1987, Karg 1989, Kielczewski & Wiśniewski 1983, Khaustov *et al.* 2018.

#### *Material examined*

One female, one male, seven deutonymphs: Russia, Sakhalin Island, 46° 51' 92.2", 142° 52' 42.7"; 302 masl., 14 August 2017, from the galleries of *Ips subelognatus* Motschulsky under the bark of *Larix curilensis* Mayr, coll. A.A. Khaustov. Two females: Russia, Altai, 51° 57' 14.9", 84° 51'

50.2"; 738 masl., 23 July 2017, from the galleries of *Polygraphus proximus* Branford, under the bark of *Abies sibirica* Willson, coll. A.A. Khaustov.

#### Remarks

This species is known from the galleries of bark beetles, like Scolytidae in Wiśniewski & Hirschmann (1993), *Pityogenes chalcographus* Linnaeus (Kielczewski & Wiśniewski 1983) and *Ips typographus* (Linnaeus) (Khaustov *et al.* 2018).

#### ***Oodinychus scolytana* sp. nov.**

(Figures 1–31)

#### Diagnosis

Setae *jl* longer than other dorsal setae and marginally serrate. Two pairs of serrate setae situated on caudal area of dorsal shield, and other two pairs of marginally serrate setae on caudal part of marginal shield. Genital shield of female bearing 4–8 oval pits, and some oval pits situated between metapodal lines. Setae *st2* Y-shaped in males.

#### Type material

*Holotype*. Female: Altai, 623 masl., in the galleries of *Polygraphus proximus* Blandford, under the bark of *Abies sibirica* Willson, 52° 00' 13.4", 86° 33' 04.9", 21 July 2017, coll. A.A. Khaustov. (NHMG). Paratypes. Six females and two males: collection date same as in holotype (two females and one male in HNHM and four females and one male in TSU). Other paratypes. Five females and six males: Altai, 738 masl., in the galleries of *Polygraphus proximus* Blandford, under the bark of *Abies sibirica* Willson, 51° 57' 14.9", 84° 51' 50.2", 21 July 2017, coll. A.A. Khaustov. (two females and two males in NHMG, one female and two males in HNHM, two females and two males in TSU).

#### Description

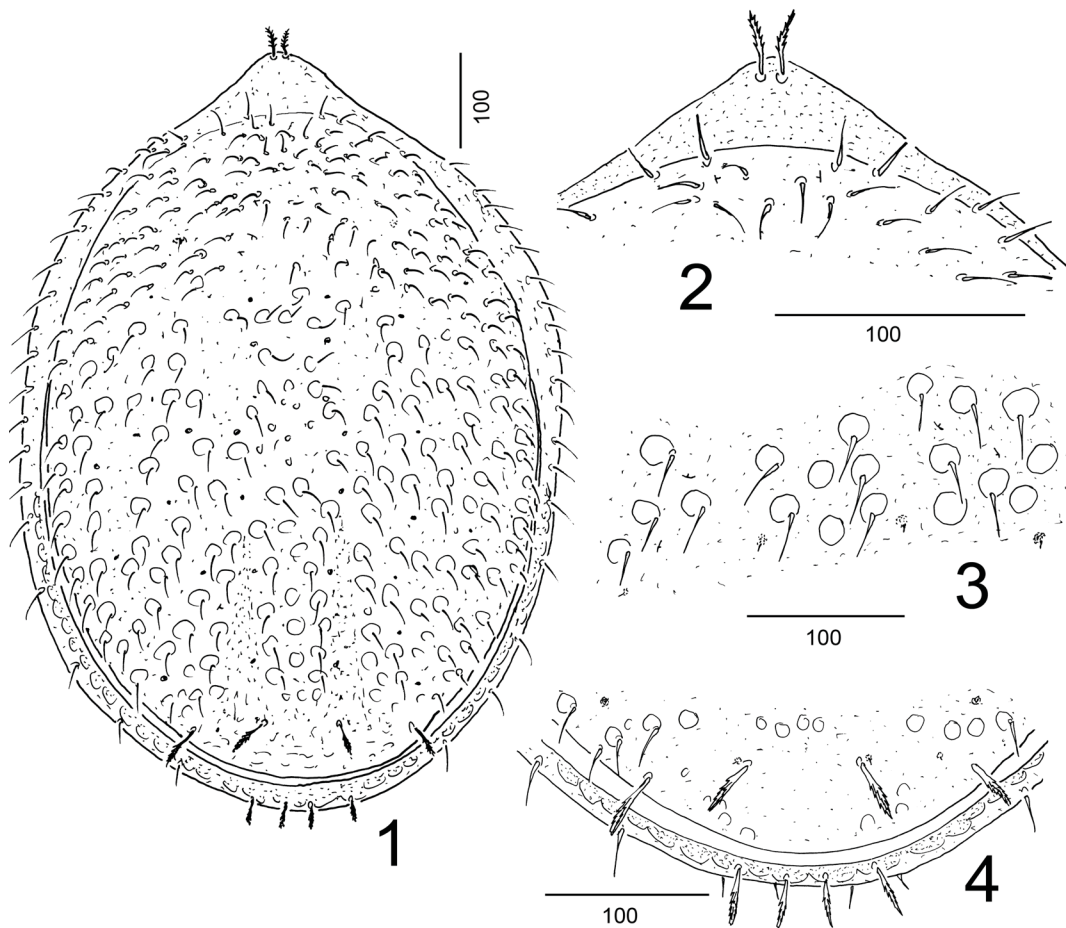
##### **Female** (n=12)

Length of idiosoma 810–835, width at level of coxae IV 550–580. Idiosoma oval-shaped, posterior margin rounded, color reddish-brown, whole idiosoma strongly sclerotized.

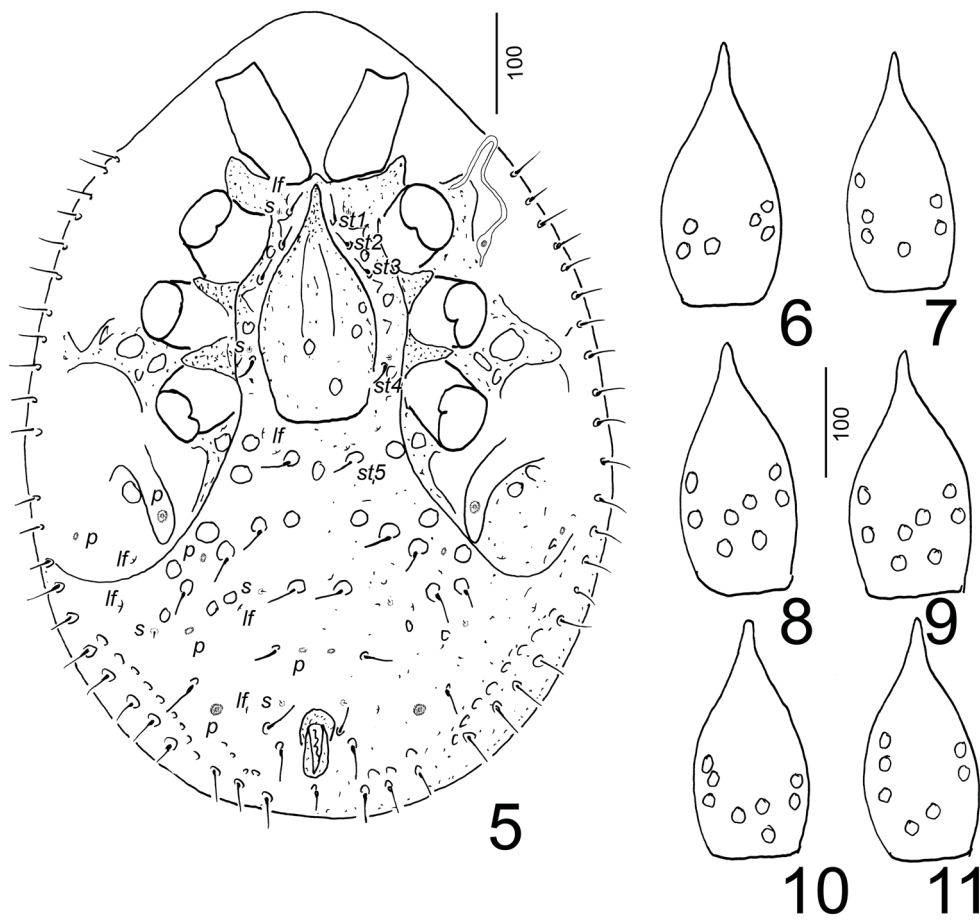
*Dorsal idiosoma* (Figure 1). Marginal and dorsal shields completely separated. Surface of marginal shield smooth in anterior region and scalloped on caudal part. Majority of setae on marginal shield smooth and needle-like (*ca* 22–25 long), except two pairs of serrate setae (*ca* 30–35 long) on posterior area. Dorsal shield oval-shaped, neutrichous, bearing smooth and needle-like setae (*ca* 22–26 long). Setae *jl* longer (*ca* 27–29 long) than other dorsal setae and marginally serrate (Figure 2). Setae on posterior part of dorsal shield associated with oval pits (25×30) (Figure 3), setae on anterior area without oval pits. Two pairs of marginally serrate setae (*ca* 35–40 long) visible on caudal area of dorsal shield (Figure 4). Four pairs of lyrifissures and numerous spine-like organs placed on dorsal shield.

*Ventral idiosoma* (Figure 5). Sternal setae (*st1*–*st5*) short (*ca* 20–26 long), smooth and needle-like. Setae *st1* situated at level of anterior margin of coxae II, *st2* at mid-level of coxae II, *st3* at posterior level of coxae II, *st4* at anterior level of coxae IV, *st5* close to basal margin of genital shield and associated with oval pits. Surface of sternal shield with some oval pits. One pair of lyriform fissures situated near *st1*, two pairs close to *st5*, two additional pairs close to anterior and posterior areas of the metapodal lines, and other two pairs anterior to anal opening. Numerous other sensory organs situated on ventral idiosoma. Spine-like organs visible close to *st1* and *st4*, posterior to metapodal line and anterior to anal opening. Pore-like organs situated anterior to and anterolaterad

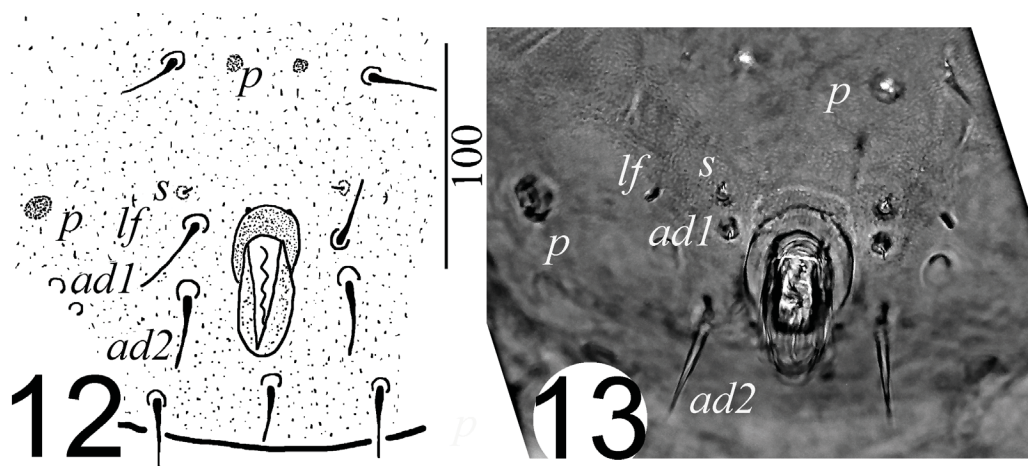
anal opening, one pair situated anterior and one pair posterior to metapodal line, and one pair on pedofossae IV. Ventral shield with 5–6 pairs of needle-like setae (*ca* 28–32 long), associated with oval pits and two pairs of needle like setae (*ca* 30–34 long), without oval pits anterior to anal opening, with 12–13 smooth and needle-like setae on margin of ventral shield and 13–15 needle-like setae (*ca* 30–33 long) on margins of the ventral idiosoma anterior to metapodal line. Ventral region of opisthogastric surface covered by some oval pits anterior and lateral to anal opening. Anal opening longer than wide (2.2:1), with two pairs of smooth and needle-like adanal setae (*ca* 32–34 long), and one smooth and needle-like postanal seta (*ca* 19–23 long) (Figures 12–13). Pore-like structures situated close to short ventral setae and posterior to pedofossae IV. Metapodal line present. Genital shield *ca* 240–250 long and *ca* 115–120 wide, situated between coxae II–IV, with peaked anterior margin and shield surface with some oval pits. Number of pits very variable in different paratypes (Figures 6–11). Prestigmatid part of peritremes long, with two bends, poststigmatid part short and straight (Figure 14), stigmata situated between coxae II and III. Pedofossae deep and with smooth surface, separated furrows for tarsi IV present with pores. Tritosternum with narrow base, tritosternal lacinia marginally serrate and apically divided into one short and two long spine-like branches (Figure 15).



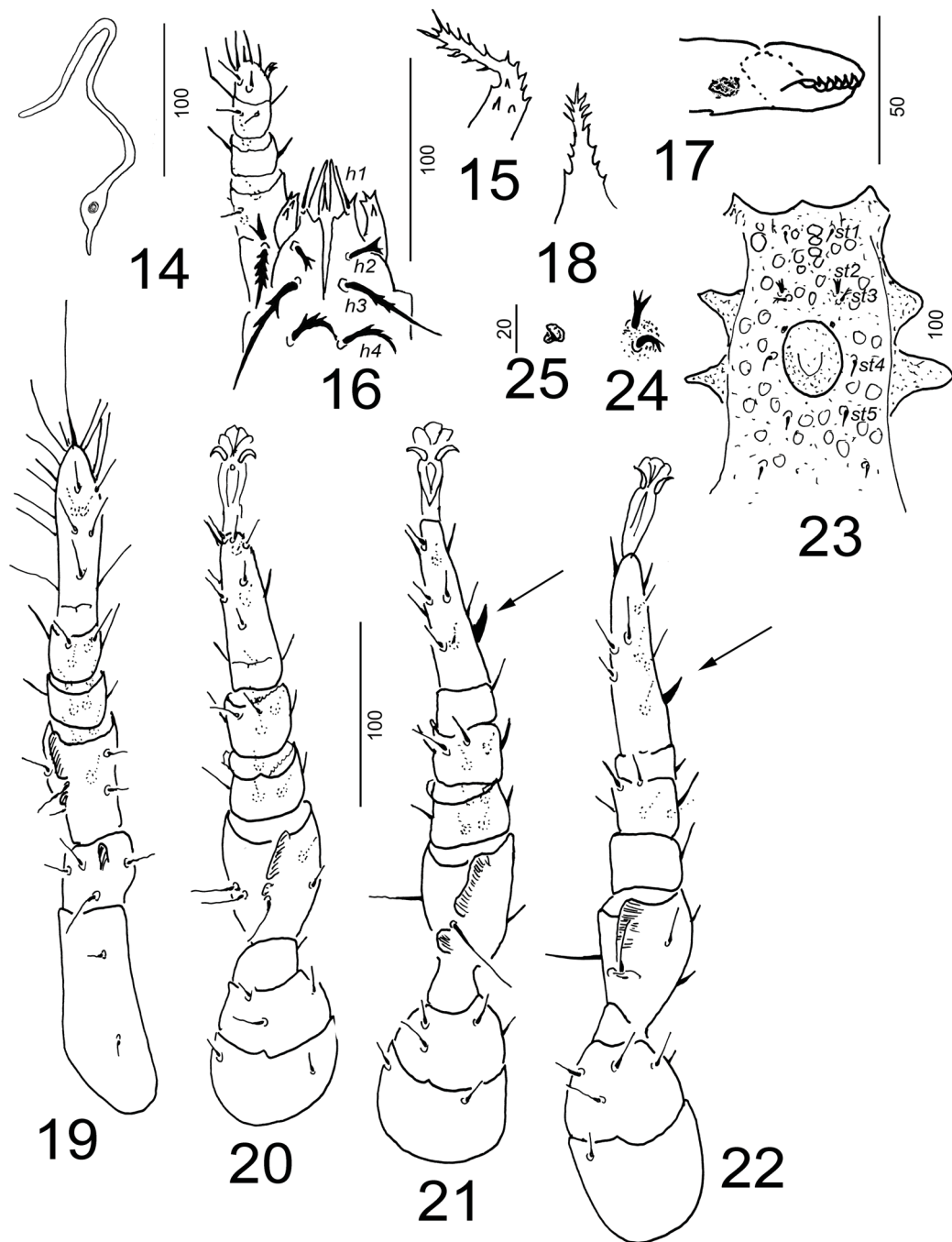
**FIGURES 1–4.** *Oodinychus scolytana* sp. nov., female, holotype. 1. Dorsal view of idiosoma; 2. Apical part of idiosoma; 3. Sculptural pattern and dorsal setae; 4. Caudal part of dorsal idiosoma.



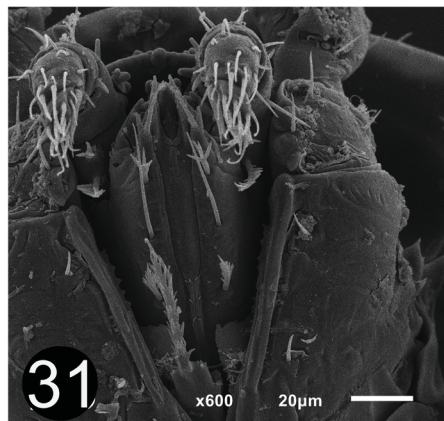
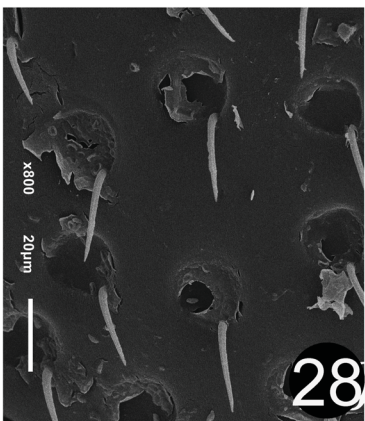
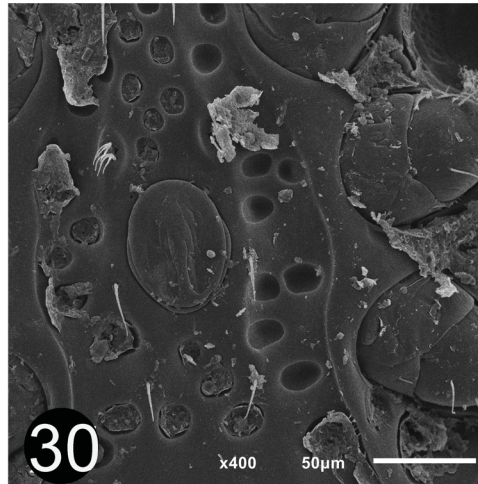
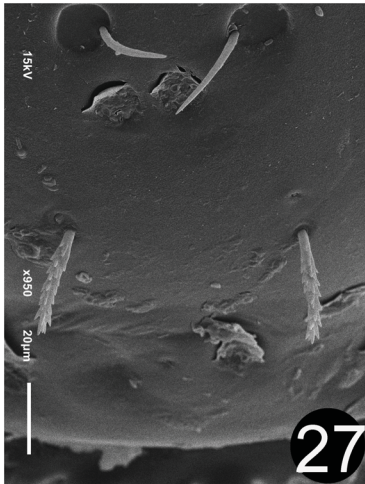
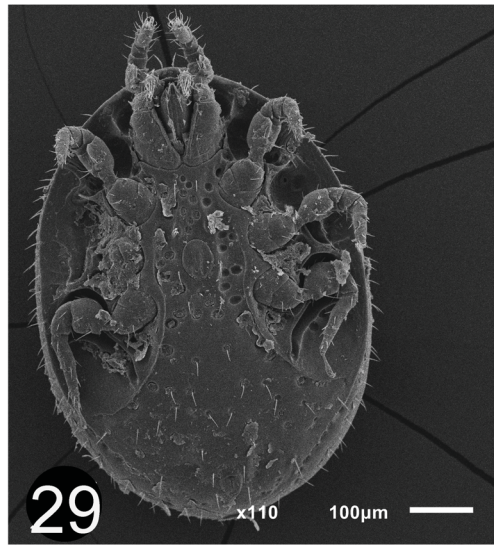
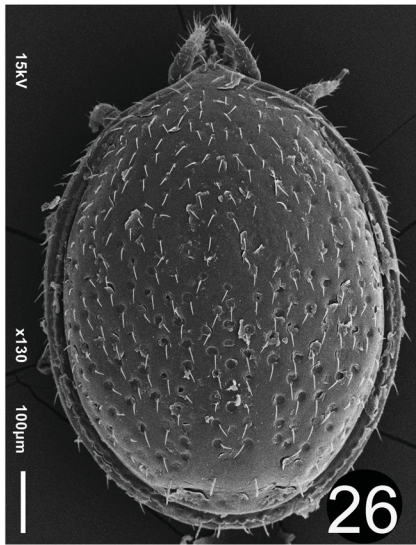
**FIGURES 5–11.** *Oodinychus scolytana* sp. nov., female, holotype; 5. Ventral view of idiosoma; 6–11. Genital shields of paratypes.



**FIGURES 12–13.** *Oodinychus scolytana* sp. nov., female, holotype. 12. Anal region; 13. Anal region in microscopic photo.



**FIGURES 14–25.** *Oodinychus scolytana* sp. nov., female, holotype. 14. Peritreme; 15. Tritosternum; 16. Ventral view of gnathosoma and palps; 17. Chelicera; 18. Epistome; 19. Leg I in ventral view; 20. Leg II in ventral view; 21. Leg III in ventral view; 22. Leg IV in ventral view (arrows show the spine-like setae); 23. Intercoxal area of male paratype; 24. Setae *st2* and *st3*; 25. Pore-like sensory organ close to anterior margin of male genital opening.



**FIGURES 26–31.** SEM micrographs of *Oodinychus scolytana* sp. nov., male, paratype. 26. Dorsal view of idiosoma; 27. Setae on caudal area of dorsal shield; 28. Pits and setae on dorsal shield; 29. Ventral view of idiosoma; 30. Intercoxal area of male; 31. Ventral view of gnathosoma and tritosternum.

*Gnathosoma* (Figure 16). Corniculi horn-like, with three lateral teeth, internal malae smooth, narrow, shorter than corniculi. Hypostomal setae *h1* smooth and needle-like (*ca* 20–22 long), *h2* apically trifurcated (*ca* 13–16 long), *h3* (*ca* 56–62 long) and *h4* (*ca* 30–34 long) long and marginally serrate. Movable digit of chelicerae as long as fixed digit, both digits bearing numerous small teeth, internal sclerotized node present (Figure 17). Margin of epistome serrate (Figure 18). Palps bearing smooth setae, except those on palp trochanter, with a long serrate and a short bifurcated ventral seta; palp apotele bifurcate (Figure 16).

*Legs* (Figures 19–22). Length of legs: I 355–360, II 320–330, III 350–365, IV 375–380. Legs I without ambulacral claws (Figure 19), other claws on legs II–IV large. All legs with smooth and needle-like setae, except one robust dorsal seta on tarsi III–IV. Femora of legs I–IV with large lateral flaps. Legs chaetotaxy as mentioned in Evans (1972).

#### **Male (n=8)**

Length of idiosoma 800–840, width 530–580.

*Dorsal idiosoma* (Figures 26–28). As in female.

*Ventral idiosoma* (Figures 23, 29). Surface of sternal shield with numerous oval pits. Three pairs of smooth, short (*ca* 10–16 long) and needle-like and two pairs of bifurcated sternal setae present. Setae *st1* placed near to anterior margin of sternal shield, *st2* trifurcated and situated at level of posterior margin of coxae II, *st3* similar in shape and length to *st2* and situated close to *st2* (Figure 24), *st4* situated lateral to genital shield, *st5* at level of posterior margin of genital shield. One pair of lyriform fissures present close to *st1*, one pair close to *st5*. One pair of lyrifissures present close to *st1* and one pair of pores present close to anterior margin of genital shield (Figures 25, 30). Position and shape of ventral setae and ornamentation of ventral shield as in female. Genital shield oval-shaped (*ca* 76–80 long and *ca* 55–59 wide), without sculptural pattern, and situated between coxae III.

*Gnathosoma* (Figure 31). As in female, except smooth setae *h3*.

Nymphs and larvae unknown.

**Etymology.** The name of the new species refers to the association with bark beetles (Scolytinae).

#### **Discussion**

The genus *Oodinychus*, or the *Trichouropoda ovalis* species group in Hirschmann's Gangsystems, contains more than 50 species from all over the world (Wiśniewski & Hirschmann 1993). Currently, a new diagnosis of the genus *Oodinychus* together with the description of a new species, *Oodinychus egypticus* Abo-Shnaf, El-Bishlawy & Allam, 2018, and a key to nine species of the genus has been presented by Abo-Shnaf *et al.* (2018). The newly described species has paralacinae on the gnathosoma (see Figure 1F in Abo-Shnaf *et al.* (2018)), which is a specific character of the genus *Nenteria* Oudemans, 1915. So, this species does not belong to the genus *Oodinychus* and herein is transferred to the genus *Nenteria*, as *Nenteria egypticus* Abo-Shnaf, El-Bishlawy & Allam, 2018 **comb. nov.** Based on the latter mentioned reason, the diagnosis of the genus *Oodinychus* presented in Abo-Shnaf *et al.* (2018) is also very questionable and does not match with more than 50 described species under *Oodinychus*.

More than 20 species of genus *Oodinychus* have been reported in association with beetles, and four species were collected together with bark beetles (Wiśniewski & Hirschmann 1993; Khaustov *et al.* 2018). Three of these four species were placed in the large genus *Trichouropoda* sensu lato (Wiśniewski & Hirschmann 1993), while *Oodinychus karawaiewi* (Berlese, 1904) was previously



moved (see Wiśniewski & Hirschmann 1993). However, in our opinion based on the dorsal and ventral sculptural pattern, the shape of genital shield and the presence of the two pairs of pilose setae on caudal part of dorsal shield, these other three species need to be transferred to the genus *Oodinychus* too, as *O. hirsuta* (Hirschmann, 1972) **comb. nov.**; *O. rafalski* (Wiśniewski & Hirschmann, 1984) **comb. nov.** and *O. wilkinsoni* (Hirschmann & Wiśniewski, 1986) **comb. nov.** The most important differences between these five bark-beetles associated *Oodinychus* species are presented in Table 1.

**TABLE 1.** Distinguishing characters among the bark-beetle associated *Oodinychus* species.

	<i>O. karawaiewi</i>	<i>O. hirsuta</i>	<i>O. rafalskii</i>	<i>O. wilkinsoni</i>	<i>O. scolitana</i>
Pits on dorsal- and ventral idiosoma	irregular	oval	oval	oval	oval
Position of pits on female genital shield	several and situated on all area of genital shield	without pits	few and situated on all area of genital shield	few and situated close to basal margin	few and situated close to basal margin
Shape of female genital shield	scutiform with apical process	scutiform with apical process	scutiform with apical process	oval, with a spine like apical process	scutiform with apical process
Genital shield of male	without court	without court	without court	with court	without court
Setae <i>st3</i> in females	longer than <i>st1</i> and <i>st2</i>	longer than <i>st1</i> and <i>st2</i>	longer than <i>st1</i> and as long as <i>st2</i>	longer than <i>st1</i> and <i>st2</i>	as long as <i>st1</i> and <i>st2</i>
Setae <i>st2</i> in males	smooth	smooth	pilose	pilose	bifurcate
Setae <i>h3</i>	pilose	pilose	pilose	smooth	serrate
Surface of margin of ventral idiosoma	reticulate	reticulate	smooth	reticulate	smooth
Setae on caudal part of marginal shield	with two pairs of marginally serrate setae	with two pairs of marginally serrate setae	needle-like	with two pairs of marginally serrate setae	with two pairs of marginally serrate setae

The widely distributed species of the genus *Oodinychus*, *O. ovalis* (C.L. Koch, 1839), differs in the number and position of the oval pits on female genital shield from the new species. The whole surface of the female genital shield in *O. ovalis* is covered with numerous of pits, but the female genital shield in the new species has fewer (usually 6–8) oval pits which are scattered in 2/3 posterior region of the shield. On the other hand, reticulate sculptural pattern is presented lateral to outer margins of pedofossae on ventral idiosoma of *O. ovalis*, contrary with the new one, where this character is absent. *Oodinychus ovalis* seems to be polymorphic on molecular point of view in the studied polish specimens (although only one gene was investigated by Błoszyk *et al.* (2019)), but based on the investigated specimens occurring in several European countries, e.g. Switzerland, Slovenia, Hungary, Romania and the countries of the Balkan Peninsula, the morphological aspects of the species do not show notable intraspecific variations (Kontschán 2009, 2011, 2013, 2014)).

The new species differs from the other and non-bark-beetle associated species of *Oodinychus* (or the *Trichouropoda ovalis*-group) in the following character combination: number of pits on the female genital shield is few, reticulate sculptural pattern lateral to outer margins of pedofossae on ventral idiosoma absent and the presence of two pairs of serrate setae on caudal part of the marginal shield. These characters are not visible together in the previously described species of the genus *Oodinychus* or the *Trichouropoda ovalis*-group.

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