

A new *Prosopistoma* (Ephemeroptera, Prosopistomatidae) species from Turkey, with ecological notes

NİLGÜN KAZANCI¹* AND GENCER TÜRKMEN¹

¹Hacettepe University, Faculty of Science, Department of Biology, Ankara, Turkey

[*Corresponding author: nilgunkazanci@gmail.com]

(Published Online: 10/04/2018)

ABSTRACT

1. In this paper, a new *Prosopistoma* species was described based on larvae from Aras River (Kars, Turkey).
2. Important distinguishing characters were illustrated (head, antenna, mouthparts, leg, gills) and photographed (general view of body, sternal plate, surface of carapace, surface of sternal plate).
3. In addition, the new species were compared to the other five West-Palaeartic *Prosopistoma* species (*P. pennigerum*, *P. oronti*, *P. orhanelicum*, *P. helenae* and *P. alaini*) in detail.
4. Moreover, some ecological information was also given.
5. A key for the West-Palaeartic *Prosopistoma* species was provided.

KEYWORDS: Aquatic insect, Ephemeroptera, mayfly, new species, Turkey.

Türkiye’den yeni bir *Prosopistoma* (Ephemeroptera, Prosopistomatidae) türü, ekolojik notlarla birlikte

NİLGÜN KAZANCI^{1*} VE GENCER TÜRKMEN¹

¹Hacettepe Üniversitesi, Fen Fakültesi, Biyoloji Bölümü, Ankara, Türkiye

[*İletişim: Nilgün Kazancı, nilgunkazanci@gmail.com]

(Online Baskı: 10/04/2018)

ÖZ

1. Bu yayında, Aras Nehri’nden (Kars, Türkiye) larvalara dayalı yeni bir *Prosopistoma* türü tanımlanmıştır.
2. Önemli ayırım karakterleri (baş, anten, ağız parçaları, bacak ve solungaçlar) çizilmiş ve fotoğrafları (genel vücut görünümü, sternal plaka, karapaksın yüzeyi, sternal plakanın yüzeyi) çekilmiştir.
3. Ayrıca Batı-Palaeartik’te bulunan diğer beş *Prosopistoma* (*P. pennigerum*, *P. oronti*, *P. orhanelicum*, *P. helenae* ve *P. alaini*) türü ile detaylı bir şekilde karşılaştırılması yapılmıştır.
4. Ek olarak, yeni türe ait bazı ekolojik bilgiler de verilmiştir.
5. Batı-Palaeartik *Prosopistoma* türleri için bir teşhis anahtarı oluşturulmuştur..

ANAHTAR KELİMELER: Ephemeroptera, mayıs sineği, sucul böcek, Türkiye, yeni tür.

INTRODUCTION

Prosopistomatidae contains 27 species throughout the World, but is absent in the Nearctic (replaced by its sister family Baetiscidae (Barber-James et al. 2008)) and the Neotropics (Schletterer et al. 2016). Prosopistomatidae is represented by fourteen species in the Oriental area, five species in the Palaearctic area, six species in the Afrotropical area and two species in the Australian area (Barber-James et al. 2008, 2018, Barber-James 2009, Schletterer et al. 2016, Ephemeroptera of the World 2018). In the West-Palaearctic area, there were five Prosopistomatidae species, *Prosopistoma pennigerum* (Müller 1785), *Prosopistoma oronti* Alouf 1977, *Prosopistoma orhanelicum* Dalkiran 2009, *Prosopistoma helenae* Bojkova and Soldan 2015 and *Prosopistoma alaini* Bojkova and Soldan 2015 (Bojkova and Soldan 2015). Up to now, only two *Prosopistoma* species have been known from Turkey. Koch (1985) recorded *P. pennigerum* (as *P. foliaceum*) from Diyarbakır (Turkey) in 1985. Dalkiran (2009) described *P. orhanelicum* from Orhaneli, Bursa (Turkey) as a new species in 2009. The new species which is described in this paper is the third *Prosopistoma* species for Turkish mayfly fauna. The collection sites of these three *Prosopistoma* species in Turkey are given in Figure 1.



Figure 1. The collection sites of *P. turcica* sp. n., *P. pennigerum* and *P. orhanelicum* in Turkey.

The aim of this study is to describe a new *Prosopistoma* species from Turkey. For this purpose, description of the new species (*Prosopistoma turcica* sp. n.), was made, some photographs of the holotype were taken, and important distinguishing body parts were illustrated. *Prosopistoma turcica* sp. n. was compared to the other five West-Palaearctic *Prosopistoma* species. In addition, some habitat characteristics and ecological information were given.

MATERIAL AND METHODS

The specimens were collected by D-framed hand net (500 μ m) in Jul. 2014 with the other benthic macroinvertebrate specimens and substratum materials. These were first kept in 4% formaldehyde solution in the field. After being transported to the laboratory, benthic macroinvertebrates and *Prosopistoma* specimens were separated from the substratum materials, washed with water and then stored in 80% ethyl alcohol solution. All specimens were collected by G. Türkmen.

Head, body parts, legs and mouthparts were dissected from the specimens. After the dissection, head, carapace, sternal plate and legs were transferred into 10% potassium hydroxide (KOH) solution to macerate muscles. After the soft tissues and muscles were gone, the remaining structures were embedded on slides. Glycerin was used as mounting medium, entellan was used to closure the sides.

For examination, LEICA S8 APO stereomicroscope, LEICA DMR light microscope with DIC attachment research microscope and LEICAMZ75 stereomicroscope with drawing tube were used. The tube was used to aid in producing line drawings of structures. For taking photographs and measurements, LEICA Application Suit V3 image analysis system was used.

RESULTS

Description, Prosopistoma turcica sp. n.,

Larva; General coloration (Figures 2A, 2B) brownish-yellow to greenish-yellow, head light yellow, medial zone covering the bases of antennae and the middle ocellus light brownish with angular transversal band. Notal shield (carapace) with light marginal area (protruding area or rim), inner part of this area greenish-yellow, central area of the carapace yellow to brownish-yellow with distinct dark pattern. Posterior area of the central part of the carapace blurry greenish-yellow.

Body length (Bl) 4.14 mm without cerci, body width (Bw) 2.97 mm (ratio for body; Bw/Bl = 0.71). Carapace wider than long, carapace length (Cl) along median suture 2.63 mm, carapace strongly convex, height of carapace (Ch) 1.06 mm (ratios for carapace; Bw/Cl = 1.13 and Ch/Bw = 0.36). Posterior dorsal margin of carapace over median suture with distinct, rounded notch. Lateral protruding area (or rim) highly developed. Surface of head, carapace and sternal plate with characteristic chagrin structure (scale-like structure), protuberances indiscriminately on the surface of these body parts, mostly rounded, rarely bluntly pointed with black dots, not creating a distinct pattern or group (Figures 3A, 3B). Dorsal part of sternal plate is like an equilateral triangle (not elongated), distal tip reaching to the hind margin of 3rd abdominal sternum (Figure 4).

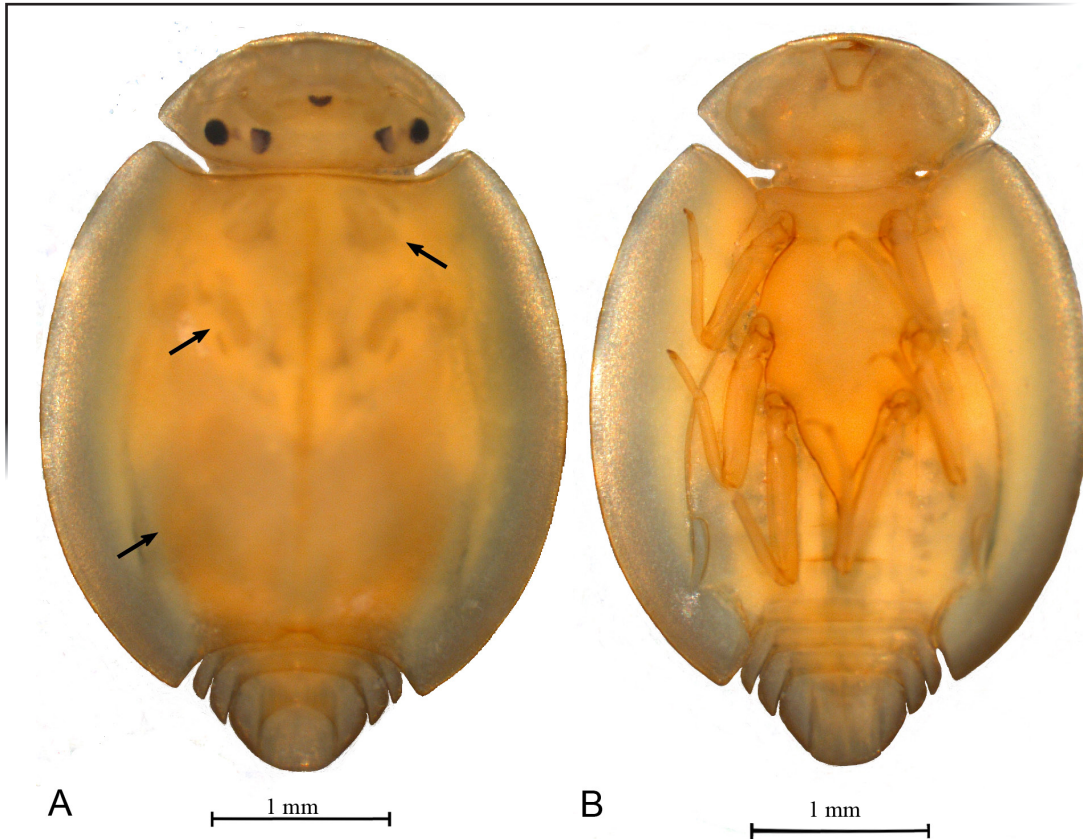


Figure 2. *Prosopistoma turcica*. sp. n.; mature larva (Holotype). **A.** dorsal view. **B.** ventral view.

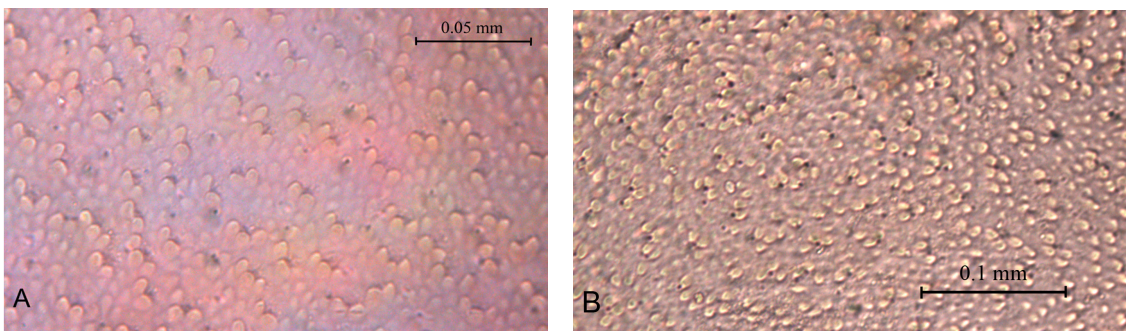


Figure 3. **A.** surface of carapace (Holotype). **B.** surface of sternal plate (Holotype).

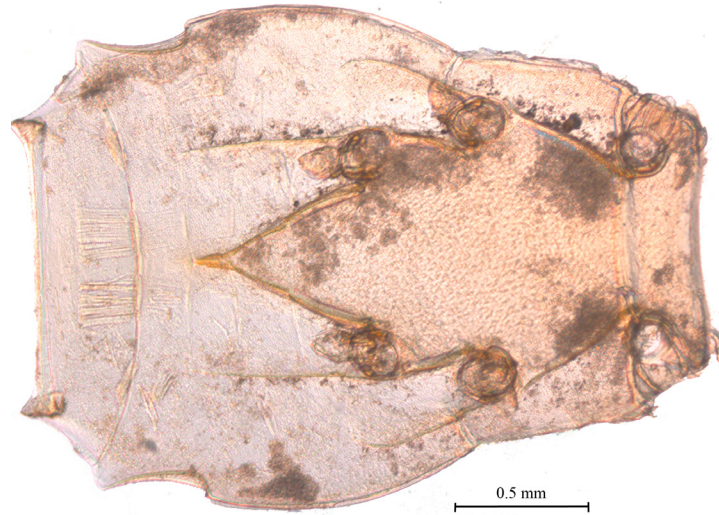


Figure 4. Sternal plate (Holotype).

Head length (HI) 0.93 mm, head width (Hw) 1.93 mm (ratio for head; $Hw/HI = 2.08$). Compound eyes oval, blackish with ribbed margins, nearly same size as lateral ocelli (Figures 5A, B). Lateral ocelli slightly quadrangular-shaped with distinct wavy line, outer margins and inner area brownish, inner margins darker brownish. Median ocellus slightly crescent-shaped, outer margins darker brownish, inner area brownish. Antennae 6-segmented (including scape and pedicel), scape retracted and not easily visible from above. Segment 3 shorter than the total length of segment 4, 5 and 6 (Figure 5C), ratio of Segment 3/Segment 4,5,6 = 0.86. Antennae not extended beyond the anterior margin of the head.

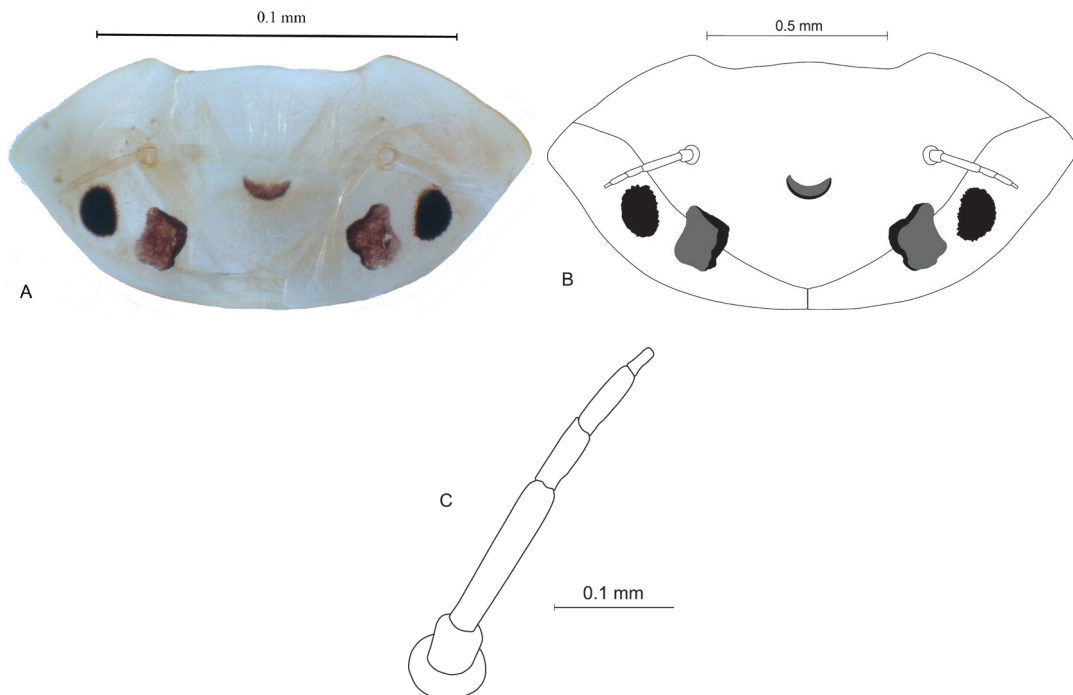


Figure 5. A., B. head of Paratype 1. C. antenna.

Mouth parts; **Labrum** (Figure 6) laterally elongated, wider than long (ratio for labrum; width/length = 3.42), lateral margins strongly sclerotized. Fore margin strongly convex in medial part (without multifid bristles) and straight in (anterolaterally) lateral sides of this convex area (Figure 6A) with dense, long, tiny multifid bristles (these bristles were not observed on the convex area). Lateral tips bluntly pointed. Underside of both lateral tips with fine, 3-4-branched setae (Figure 6B). **Mandible** (Figure 7), outer canine with three strong teeth, inner one slightly longer than the others. Outer margin of the outer canine with 4-5 subapical teeth, first tooth slightly separated from the others and the rest overlapping on each other (Figure 7A). Inner margin of the outer canine with 5-6 sub apical teeth, first tooth large and distinct, other teeth gradually shrinking backwards (Figure 7A). Rod-like, apically bifurcated inner canine approximately third times shorter and narrower than the outer canine (Figure 7A). Inner and outer margins of the inner canine with 3 pointed-teeth. Six serrated, long bristles emerging from the base of the inner canine (Figures 7A, B). The length of the first anterior bristles half length of the rest, remaining bristles approximately same length. One, single, strong, feathered margins, bifurcated bristle in the middle of lateromedial part of the mandible (Figure 7C). Lateromedial margin of the mandible with fine, long, 5 multifid setae (Figure 7D). Left and right mandible isomorphic. **Maxilla** (Figure 8), with one rigid, stable canine and three moveable strong dentisetae. First two anterior dentisetae approximately equal thickness, but third posterior dentisetata conspicuously narrower (Figure 8A). Three strong, long bristles arising from the base of dentisetae, first one finely serrated and shorter than the rest. The other two long bristles with smooth margins (Figure 8A). One simple, much finer seta present near the inner margin of proximal part of the galea (Figure 8A). Maxillary palp 3-segmented, third segment with subapical sensory bristle and channel-like structure (Figure 8B) (this structure continues to the end of third segment). Ratios for the segments of maxillary palp; Seg.1:Seg.2:Seg.3 = 2.5:3.75:1 (Seg.1/Seg.2 = 0.67). **Hypopharynx** (Figure 9), equilateral trapezoid-like shaped with convex apical (strongly) and lateral sides (slightly). Inner parts of the anterolateral sides with long, fine, simple bristles. Hypopharynx with two distinct, strong spines anteromedially (Figure 9). **Labium** (Figure 10) with mentum, paraglossae and glossae fused and widened plate-shaped distally. Anterior and lateral margins of mentum with fine, short multifid bristles (Figure 10A). Ventral surface of mentum chagrin structure and with fine, long multifid bristles only on distal part of mediolateral sides (near margins) (Figure 10A). Dorsal surface of glossae and paraglossae with scattered small spines, and anterolateral corners of glossae and paraglossae with few, fine, short multifid bristles (Figure 10A). Labial palps 3-segmented, not reaching anterior margin of labium (Figure 10B). Ratios for the segments of labial palp; Seg.1:Seg.2:Seg.3 = 3.25:2.7:1 (Seg.2/Seg.1 = 0.83).

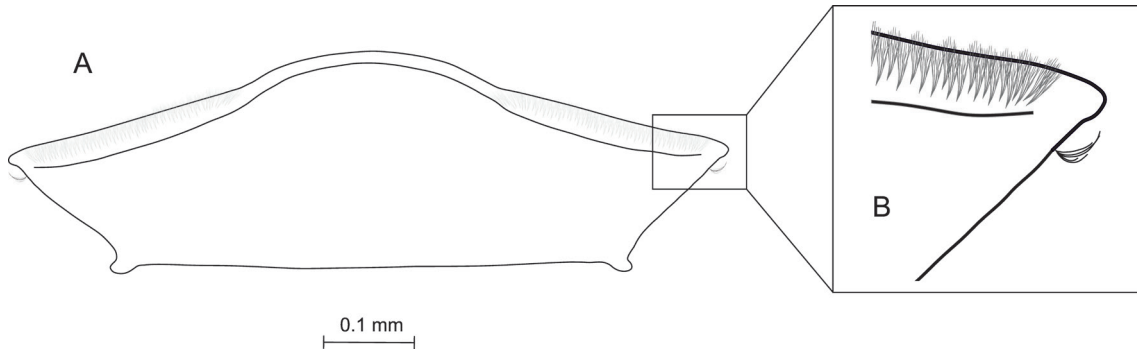


Figure 6. Labrum. **A.** dorsal view. **B.** lateral side and the tip of the labrum with bristles.

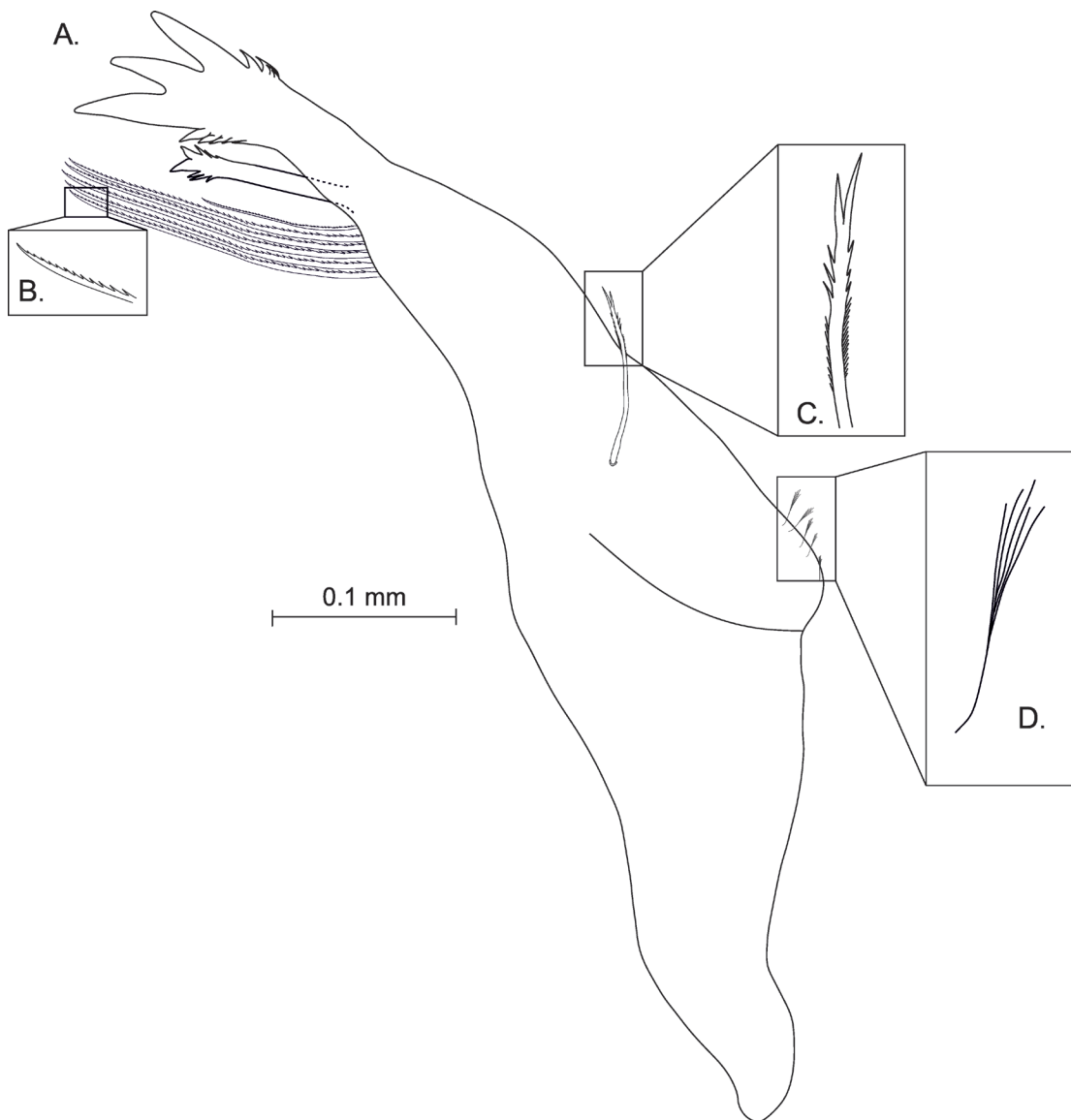


Figure 7. Mandible. **A.** right mandible. **B.** serrated, long bristles. **C.** single, strong, feathered bristle. **D.** multifid bristles.

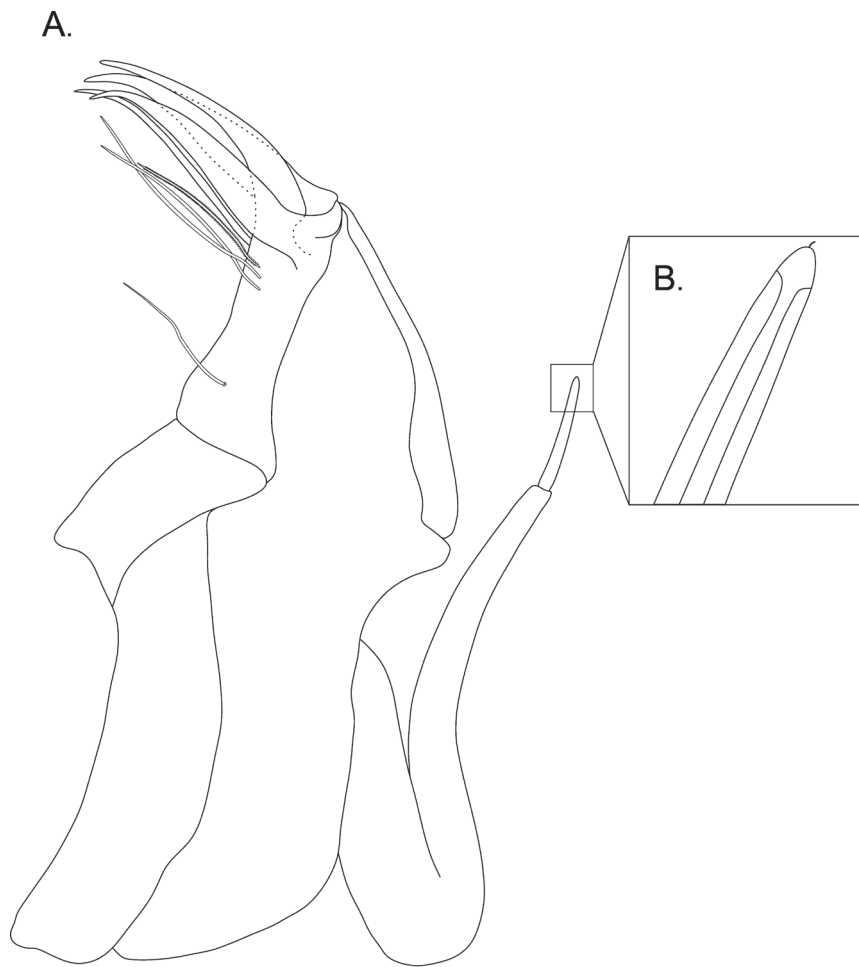


Figure 8. Maxilla. **A.** right maxilla **B.** tip of third segment of maxillary palp and channel-like structure.

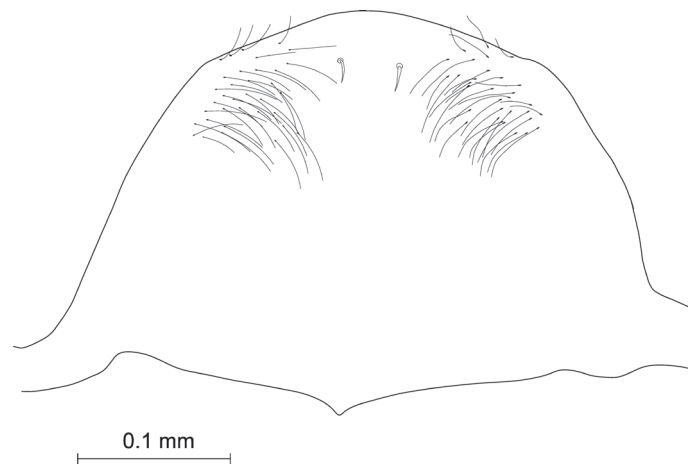


Figure 9. Hypopharynx.

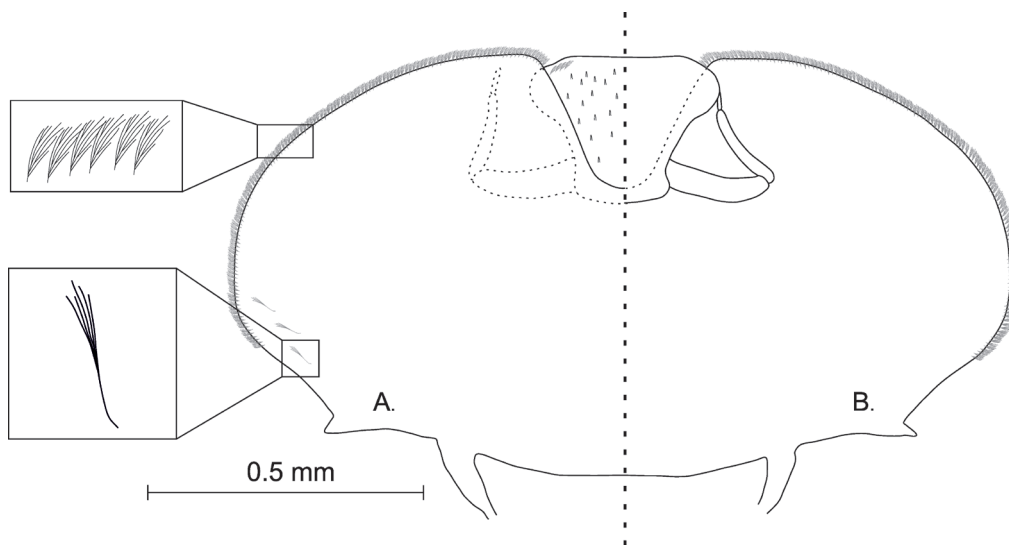


Figure 10. Labium and mentum. **A.** ventral view. **B.** dorsal view.

Legs; surface of coxa and femora of all legs with chagrin structure on dorsal surface (Figure 11C). Fore femora with 3-4 fine, small, multifid bristles basomarginally (Figure 11D). Dorsal margin of fore femora with 16-17 hair-like bristles (Figure 11A). Row of 5, feathered, pointed-tip, stout bristles (Figure 11B) along submarginal area of dorsal surface on fore femur (Figure 11A). Ventral submarginal area of fore tibia with a group of 7 simple, pointed bristles (Figure 11E) forming a distinct row (two of them on distal part slightly separated from the others) (Figure 11A). Ventral distal margin of fore tibia with 7 conspicuous, strong, unilaterally serrated bristles (with about 7-8 acute teeth) and one small, simple, rounded distal seta (Figure 11F). Fore tarsus with 4-6 simple, long, pointed bristles submarginally on both dorsal and ventral side (Figure 11A) and 3 short, pointed spines on ventral margin (Figure 11G).

Gills; first gill with long, flat and slender lamella with finely serrated margins and extended, rounded tip (in Figure 12A, lamella folded over filaments). Ventral part of first gill filamentous with 6-7 main stems and 19-20 filaments (Figure 12A). The tips of each filament with small, pointed spine (Figure 12B). Second gill roughly trapezoidal with convex and concave margins. Outer margin straight with large, rounded tip. Margins of this rounded area serrated. Inner margin serrated, distinctly concave with a notch medially. Anterior margin serrated, slightly concave. Posterior margin not serrated, slightly convex (Figure 12C). Third gill with 6 main stems and 15-16 filaments, fourth and fifth gill with 4 main stems and 12-13 filaments. Sixth gill very small, irregular rectangular shaped.

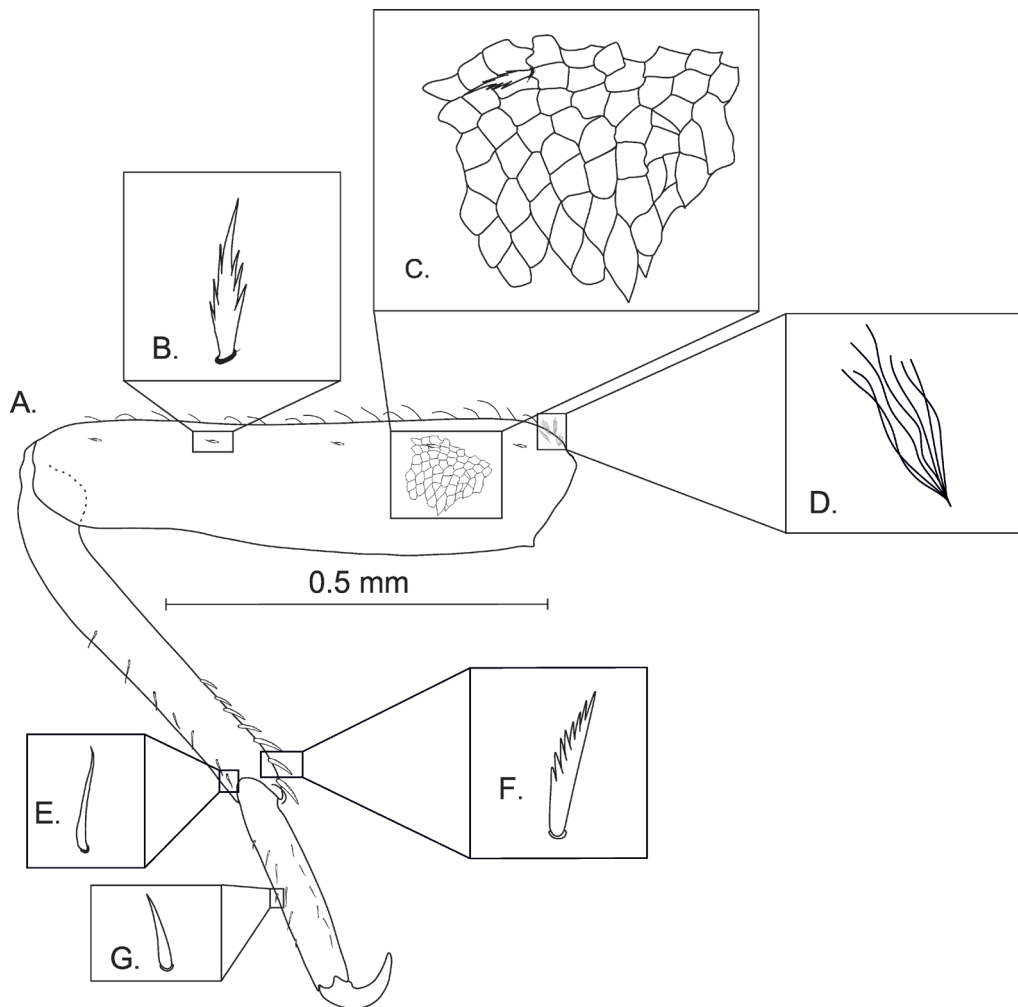


Figure 11. A. fore leg. B. feathered, pointed-tip, stout bristle on dorsal surface of femur. C. chagrin structure. D. multifid bristles on basomarginal part of femur. E. simple bristles on ventral side of tibia. F. unilaterally serrated bristles on distal ventral margin of tibia. G. spines on ventral margin of tarsus.

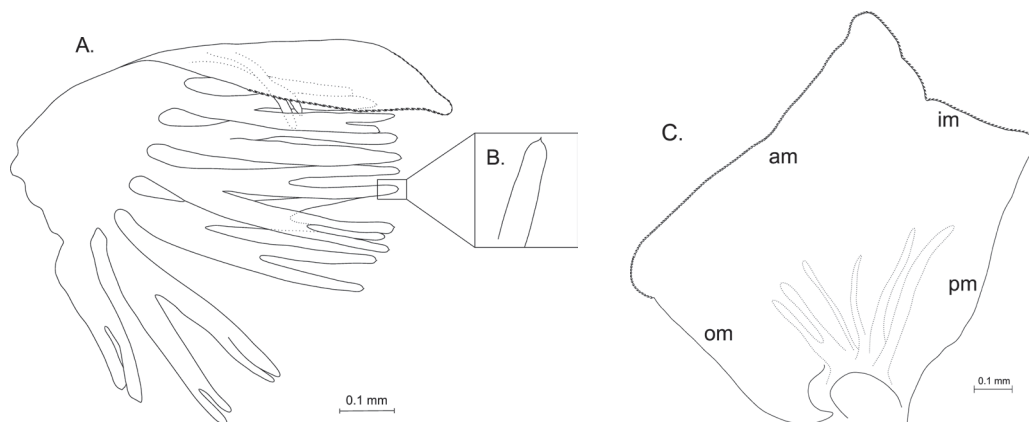


Figure 12. A. first gill. B. tip of a gill filament. C. second gill. (om: outer margin; im: inner margin; am: anterior margin; pm: posterior margin).

Abdomen; first six abdomen segments fused (margins visible on sternal plate, Figure 4). Segments 7-10 separated and visible from above (Figures 13A, B). Lateral projections on segments 7-9 bluntly pointed, inner margins straight and outer margins highly convex. Posterior margins of segments 7-8 slightly rounded but angular near lateral projections. Anterior margins of segment 10 rounded with straight lateral sides (Figure 13A). Cerci retracted, hardly visible from dorsal and ventral view (Figures 13A, B).

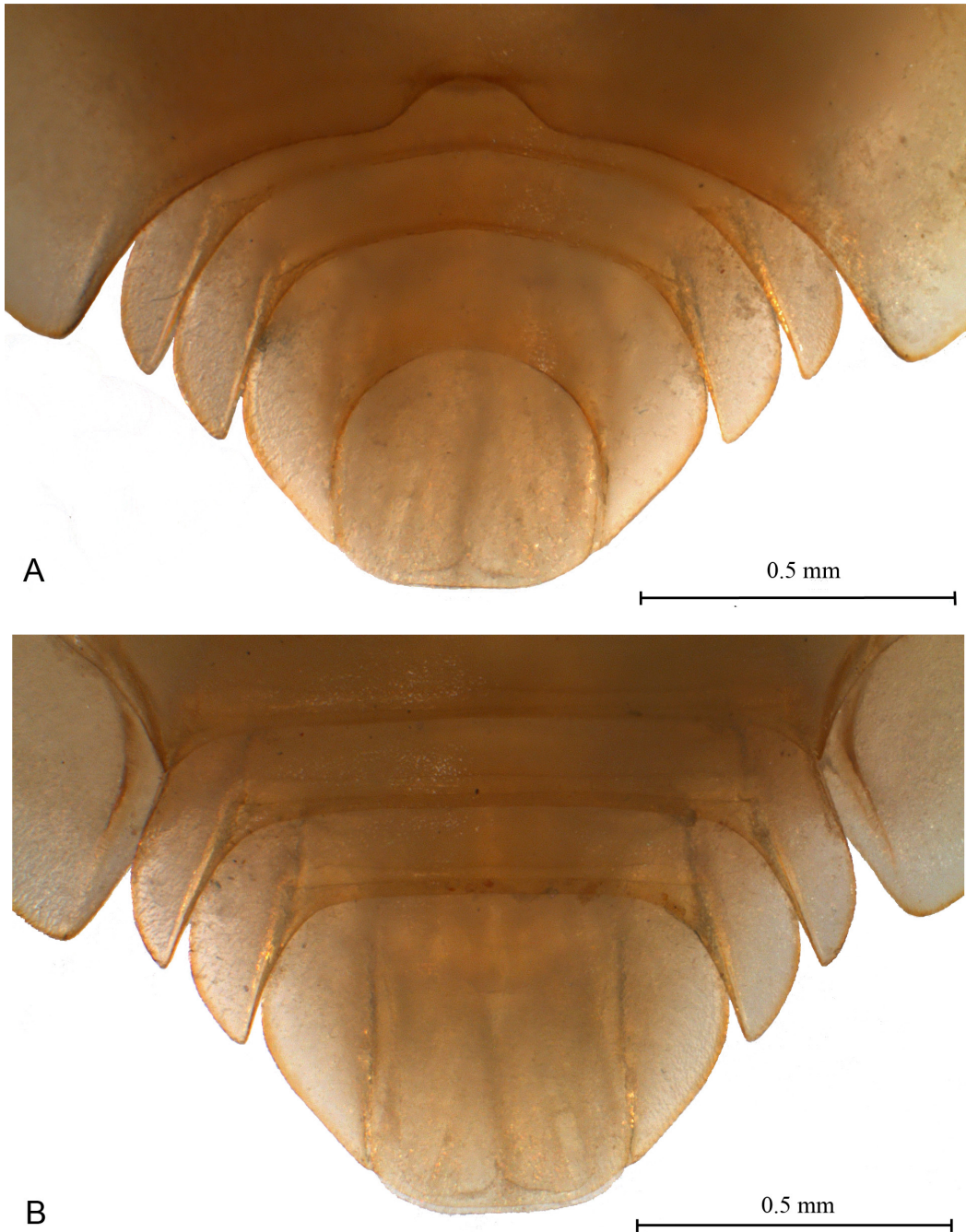


Figure 13. Abdominal segments 7-10 (Holotype). **A.** dorsal view. **B.** ventral view.

DISCUSSION

Diagnosis

Larvae of *P. turcica* **sp. n.** are clearly separated from other West Palaearctic *Prosopistoma* species by the combination of some characters and comparative ratios (the order of the characters and ratios below were presented in the same order as in (Bojkova and Soldan (2015; p.6, Table 1) for easy comparison). These are;

Total body length; full grown larvae of *P. turcica* **sp. n.** (4.1 mm) bigger than those of *P. helenae* (4 mm), *P. oronti* (3.5-4 mm), but smaller than *P. orhanelicum* (5.5 mm). Larvae of *P. turcica* **sp. n.** have similar body length to *P. pennigerum* (4-6 mm) and *P. alaini* (3.5-4 mm).

Ornamentation on carapace; full grown larvae of *P. turcica* **sp. n.** have distinct ornamentation on carapace (see the arrows in Figure 2) as in *P. oronti* (but different pattern). These ornamentations are indistinct in *P. helenae*, *P. orhanelicum* and *P. alaini*. For *P. pennigerum*, Bojkova and Soldan (2015) stated that the ornamentation on carapace was distinct for the specimens from Portugal, Hungary and France. However, Schletterer *et al.* (2016) stated that the ornamentation on carapace of *P. pennigerum* was indistinct for the specimens from Volga River (Russia). The chagrin structure on both carapace surface and sternum surface resemble to *P. pennigerum*, but differ in *P. orhanelicum*.

Width/length ratio of head; the head of *P. turcica* **sp. n.** is two times wider than the length with the ratio of 2.08. This ratio is almost the same in *P. pennigerum* and *P. alaini* (2 and 2.1, respectively). However, width/length ratio of head of *P. turcica* **sp. n.** is smaller than *P. helenae* (3), *P. oronti* (2.3) and *P. orhanelicum* (2.3).

Number of antennal segments (including scape and pedicel); antennal segments of *P. turcica* **sp. n.** is 6 (Figure 5C), as seen in *P. pennigerum* and *P. helenae*, while *P. oronti* has 5-segmented and *P. orhanelicum* and *P. alaini* has 7-segmented antennae. In addition, Schletterer *et al.* (2016) stated that the number of segments in left and right antennae could sometimes be different for *P. pennigerum*, 6- or 7-segmented and 7th segment is very short). Number of antennal segments and the ratio of segment 3 to remaining segments is one of the discriminating characters for *Prosopistoma* species (Peters 1967, Barber-James 2010) However, it is very likely that errors have been made in counting of these segments. In previous *Prosopistoma* studies (Gilles 1954, Peters 1967, Alouf 1977, Soldan and Braasch 1984, Tong 2000, Sartori and Gattolliat 2003, Zhou and Zheng 2004, Dalkıran 2009) the longest segment was counted as segment 2, and pedicel was counted as segment 1. However, Barber-James (2010) stated that these were not correct, and if scape and pedicel is counted as antennal segment, the next segment after pedicel (the longest one) should be counted as third segment (or the first segment of flagellum).

Antenna reaching or not reaching to the anterior margin of head; antenna of *P. turcica* **sp. n.** does not reach the anterior margin of head (Figures 5A, B), as in *P. oronti*, *P. orhanelicum* and *P. alaini*. However, it does reach in *P. pennigerum* and *P. helenae*. To observe this distinguishing character, it is important to prepare slides. Examining from different angles (also slight convexity of head) may lead to misjudgment.

Length ratio of antennal segment 3 to remaining segments; antennal segment 3 (the longest one, or the first segment of flagellum) is shorter than the remaining segments (segment 4, 5 and 6, together) in *P. turcica* **sp. n.** (Figure 5C) with the ratio of 0.86. *Prosopistoma helenae* (0.8), *P. alaini* (0.6) and *P. orhanelicum* (ratio not given) have also shorter antennal segment-3 than remaining segments. This segment is longer in *P. oronti*, but equal in *P. pennigerum*.

Number of bristles on right mandible; *P. turcica* **sp. n.** has the same number of bristle (5) on right mandible (Figure 7A) only with *P. helenae* among other West Palaearctic *Prosopistoma* species (7-8 in *P. pennigerum*, 7-9 in *P. oronti*, 7 in *P. orhanelicum*, 8-9 in *P. alaini*). The number of bristles on right and left mandible could be different, but right and left mandible of *P. turcica* **sp. n.** is isomorphic. In addition, Schletterer *et al.* (2016) stated that right and left mandible of *P. pennigerum* specimens from Volga River was isomorphic, as well.

Number of subapical teeth on outer margin of outer canine; *P. turcica* **sp. n.** has 4 or 5 subapical teeth on outer margin of outer canine (Figure 7A). This is almost the same in *P. helenae* (4-6) and *P. alaini* (5). As a detail for *P. turcica* **sp. n.**, first subapical teeth slightly separated from the others, and the rest overlapping on each other (Figure 7A). The other West Palaearctic *Prosopistoma* species have more subapical teeth than *P. turcica* **sp. n.** (6-8 in *P. pennigerum*, 6-9 in *P. oronti*, 7-8 in *P. orhanelicum*)

Number of subapical teeth on inner margin of outer canine; *P. turcica* **sp. n.** has a similar number of subapical teeth (5-6) on inner margin of outer canine (Figure 7A) with the other West Palaearctic *Prosopistoma* species (6-7 in *P. pennigerum*, 4-5 in *P. helenae*, 4-5 in *P. oronti*, 6-7 in *P. orhanelicum*, 5-7 in *P. alaini*). However, Schletterer *et al.* (2016) stated that *P. pennigerum* (from Volga River) has 7-8 subapical teeth on inner margin of outer canine.

Number of subapical teeth on inner canine; this distinguishing character is similar in *P. turcica* **sp. n.** (3) (Figure 7A) and in the other West Palaearctic *Prosopistoma* species (3 in *P. helenae* and *P. oronti*, 3-4 in *P. pennigerum*, *P. orhanelicum* and *P. alaini*).

Length ratio of segment 1 to Segment 2 of maxillary palp; this ratio is similar in *P. turcica* **sp. n.** (0.67) and in the other West Palaearctic *Prosopistoma* species (0.6-0.7 in *P. pennigerum*, *P. helenae* and *P. oronti*, 0.5-0.7 in *P. orhanelicum*) except *P. alaini*. This ratio is low in *P. alaini* (0.5-0.6).

Length ratio of segment 2 to Segment 1 of labial palp; this distinguishing character is similar in *P. turcica* **sp. n.** (0.83) and in the other West Palaearctic *Prosopistoma* species (0.8-0.9 in *P. pennigerum*, *P. oronti* and *P. alaini*, 0.7-0.9 in *P. helenae* and *P. orhanelicum*).

Shape of distal medial margin of carapace; the shape of this carapace part is generally concave in West Palaearctic *Prosopistoma* species (including *P. turcica* **sp. n.**) except *P. orhanelicum*. Distal medial margin of carapace of *P. orhanelicum* is convex. Although the other West Palaearctic *Prosopistoma* species have concave shapes of distal medial margin of carapace, there are slight differences between these species. For example, this carapace part of *P. turcica* **sp. n.**, *P. helenae* and *P. oronti* is distinctly concave, while this area is shallowly concave in *P. pennigerum* and weakly concave with straight part in *P. alaini*.

Width/length ratio of carapace; the carapace of *P. turcica* **sp. n.** is wider than long and this distinguishing feature is similar in other West Palaearctic *Prosopistoma* species with slight differences, such as 1.13 in *P. turcica* **sp. n.**, 1.2-1.3 in *P. helenae*, 1.1-1.2 in *P. oronti*, 1.1-1.4 in *P. orhanelicum* and 1.1 in *P. alaini*. However, Bojkova and Soldan (2015) gave this ratio for *P. pennigerum* as 0.8-0.9 (longer than wide) for the specimens from Portugal, Hungary and France. For the specimens from Volga River, Schletterer *et al.* (2016) stated that carapace of *P. pennigerum* was slightly wider than long (length/width ratio (not width/length) 0.92-0.94).

Apex of lamella of gill 1; this part of gill 1 as extended lobe in *P. turcica* **sp. n.** (Figure 12A), like in *P. pennigerum* and *P. alaini*. However, apex of lamella of gill 1 is rounded asymmetrically in *P. helenae* and *P. oronti*, rounded symmetrically in *P. orhanelicum*.

Lateral outer margin of gill 2; this distinguishing character is completely different in *P. turcica* **sp. n.** when it is compared to the other West Palaearctic *Prosopistoma* species. Outer margin of gill 2 is concave in *P. oronti* and *P. alaini*, but convex in *P. orhanelicum*. Bojkova and Soldan (2015) stated that the outer margin of gill 2 was concave. However, this area is straight in *P. pennigerum* in Schletterer *et al.* (2016; p.22, Plate 4, e2). In *P. turcica* **sp. n.**, this area is straight along the lateral line but convex in apically (like a lobe) and this convex area is serrated (Figure 12B).

Number of main stem of gill 1; this is another completely different character observed in *P. turcica* **sp. n.** compared with the other West Palaearctic *Prosopistoma* species. The number of main stem of gill 1 is the lowest in *P. turcica* **sp. n.** (7 main stems) (Figure 12A). This number is 8-10 in *P. pennigerum*, 8-9 in *P. helenae*, *P. oronti* and *P. alaini*, 11-12 in *P. orhanelicum*.

Number of serrated spines on ventral distal margin of fore tibia; *P. turcica* **sp. n.** has 7 serrated spines on ventral distal margin of fore tibia (Figure 11A), and this number is very similar in *P. helenae* (6-7) and *P. oronti* (6-7). However, *P. orhanelicum* and *P. alaini* have more serrated spines (9-10 and 10-14, respectively). Bojkova and Soldan (2015) stated that *P. pennigerum* had 10-11 spines on inner (=ventral) margin of fore tibia, but Schletterer *et al.* (2016) stated that this number should be 5-8 for *P. pennigerum*.

Shape of posterior margin of abdominal segments 7-9; the shape of this area is angular in West Palaearctic *Prosopistoma* species (including *P. turcica* **sp. n.**, Figure 13) except *P. helenae*. Shape of posterior margin of abdominal segments 7-9 is rounded in *P. helenae*.

Other distinguishing characters for *P. turcica* **sp. n.**: **Labrum;** detailed descriptions and ratios are lacking for the labrum of most West Palaearctic *Prosopistoma* species. Only Schletterer *et al.* (2016) gave proportional information for labrum of *P. pennigerum* by stating that almost three times wider than its long. Labrum of *P. turcica* **sp. n.** is more than three times wider than long compared to *P. pennigerum* with the ratio of 3.42. In addition, there is one 3- or 4-branched fine setae underside of lateral tips of labrum (Figure 6B). These setae were not observed (or mentioned) in any of West Palaearctic *Prosopistoma* species. **Ocelli;** the shape of lateral ocelli and median ocellus are completely different from all West Palaearctic *Prosopistoma* species. Although the colorization pattern of lateral ocelli of *P. turcica* **sp. n.** (Figures 2A, 5A, 5B) resembles those of *P. pennigerum*, distinct wavy line of lateral ocelli is different from *P. pennigerum*. **Multifid bristles/setae;** the shape of multifid bristles or setae on any part of the body of *P. turcica* **sp. n.** is fine and relatively long compared to *P. pennigerum*. **Hypopharynx;** like labrum, detailed descriptions are lacking for the hypopharynx of West Palaearctic *Prosopistoma* species. Again, only Schletterer *et al.* (2016) gave information for hypopharynx of *P. pennigerum*. When hypopharynx of *P. turcica* **sp. n.** is compared with *P. pennigerum*, *P. turcica* **sp. n.** has less long, fine bristles on inner parts of anterolateral sides of hypopharynx (Figure 9) than *P. pennigerum*. *Prosopistoma turcica* **sp. n.** has also two distinct spines anteromedially (Figure 9), while these are absent on hypopharynx of *P. pennigerum*. **Femora;** while fore femora of *P. turcica* **sp. n.** has 3-4 fine, small, multifid bristles basomarginally (Figure 11D), *P. pennigerum* has 5-7 multifid bristles on the same part. In addition, Bojkova and Soldan (2015) stated that *P. pennigerum* had over 20 fine and simple setae on dorsal margin of fore femora for the specimens from Portugal, Hungary and France, and Schletterer *et al.* (2016) stated that *P. pennigerum* specimens from Volga River had 10 strong, pointed bristles along dorsal margin of fore femora. However, *P. turcica* **sp. n.** has 16-17 hair-like bristles on dorsal margin of fore femora.

Key to the *Prosopistoma* species of Turkey and nearby area

- 1a. Antenna 5- or 6-segmented (Figure 5C); first gill with 5-9 main stems (Figure 12A)..... **2**
1b. Antenna 7-segmented; first gill with 11-12 main stems..... ***P. orhanelicum***
- 2a. Apex of first gill rounded **3**
2b. Apex of first gill with extended lobe (Figure 12A) **4**
- 3a. Antenna 5-segmented, and not reaching anterior margin of head (Figure 5B); mandibles with 7-9 long bristles emerging from the base of inner canine; posterior margins of abdominal segments VII-IX angular (Figure 13B) ***P. oronti***
3b. Antenna 6-segmented (Figure 5C), and reaching anterior margin of head; mandibles with 5 long bristles emerging from the base of inner canine; posterior margins of abdominal segments VII-IX rounded ***P. helenae***
- 4a. Mandibles with 7-8 long bristles emerging from the base of inner canine; first gill with 8-9 main stems; fore tibia with 10-11 strong, unilaterally serrated bristles..... ***P. pennigerum***
4b. Mandibles with 6 long bristles emerging from the base of inner canine (Figure 7A); first gill with 6-7 main stems (Figure 12A); fore tibia with 7 strong, unilaterally serrated bristles (Figure 7A, 7F) ***P. turcica***

Etymology

The new species is named after Turkey.

Type material

Holotype: Mature larva (body parts on slides). Turkey, Kars Province, Kağızman District, Demirkapı area, Erzurum-Iğdır Road, Aras River; 40°3'59.00"N, 42°53'37.50"E, 1307 m a.s.l.; 24 Jul. 2014 (Figures 14-16).

Paratypes: 20 larvae and parts on slides from the same locality with holotype. Holotype and 18 paratypes (two of them are mounted on slides and 16 of them are ethanol preserved specimens) deposited in the collection of Nilgün Kazancı and Gencer Türkmen in Hacettepe University, Faculty of Science, Department of Biology, Hydrobiology Section, Biomonitoring Laboratory in Ankara, Turkey. Two paratypes (mounted on slides) are deposited in the collection of Jindriska Bojkova in Masaryk University, Faculty of Science, Department of Botany and Zoology in Brno, Czech Republic.



Figure 14. The collecting point of *Prosopistoma turcica* sp. n.



Figure 15. General view of the collecting site of *Prosopistoma turcica* sp. n.



Figure 16. The other general view of the collecting site of *Prosopistoma turcica* **sp. n.**

Type locality and ecological notes

The collecting site of *Prosopistoma turcica* **sp. n.** is situated on Aras River in Kars, Turkey. Larvae were collected from the metarhithron part of the stream and they were found in the riffle area of the collecting site. Stream width was 8 m in dry period and 20 m in wet period. The depth of the water at the collecting point was 50 cm (max. depth approx. 1.5 m) with 0.80 m/s current velocity, and turbid water. The water temperature at collecting time was 16°C and there was rarely riparian vegetation along the stream banks (approx. 10% riparian vegetation cover on both sides of the stream), without any submerged macrophytes cover. The bottom structure of the collecting site consisted of 70% cobble, 20% gravel and 10% sand. Some characteristics which are required by System A and System B of European Union Water Framework Directive (Council of European Communities 2000) and some physical characteristics of the collecting site are given in Table 1.

In the collecting site, benthic macroinvertebrate fauna consisted of only insect families (9 families – 131 individuals). *Prosopistoma turcica* **sp. n.** was found with Heptageniidae, Leptophlebiidae, Baetidae, Oligoneuriidae (Ephemeroptera), Hydropsychidae (Trichoptera), Elmidae (Coleoptera), Gomphidae (Odonata) and Athericidae (Diptera). Ephemeropteran families constituted 80% of dominance. Most abundant family was Baetidae (30 individuals – 23% dominance). The other dominant families were Oligoneuriidae (27 individuals – 21% dominance), Heptageniidae (25 individuals – 19% dominance) and Prosopistomatidae (as *Prosopistoma turcica* **sp. n.**) (21 individuals – 16% dominance).

Table 1. Characteristics of the collecting site according to System A and System B of European Union Water Framework Directive.

Collecting Site	Altitude (System A)	Altitude (System B)	Catchment Area (System A)	Latitude (System B)	Longitude (System B)	Geology (System A and System B)
		1307 m	High (>800 m)	Large (1000-10000km ²)	40°3'59.00"N	42°53'37.50"E
	Substratum	Riparian Vegetation	Stream zonation	Stream width in dry period	Stream width in wet period	Depth at collecting point
	70% Cobble					
	20% Gravel	10%	Metarhithron	8 m	20 m	0.5 m
	10% Sand					

As biotic index, two different BMWP were applied; original BMWP and TR-BMWP (modified BMWP according to the benthic macroinvertebrate fauna of Turkey (Kazancı et al. 2016)). In both index results, the collecting site was classified as III. class (original BMWP score was 42, TR-BMWP score was 65). When index scores and benthic macroinvertebrate fauna of the collecting site were compared, TR-BMWP showed more proper results than the original BMWP. This was because certain families which are absent in the BMWP are included in the TR-BMWP, and scores for some families are adjusted to suit Turkish river conditions. Some families, such as Oligoneuriidae, Prosopistomatidae and Athericidae, were absent in original BWMP. The scores of some families, such as Gomphidae, Heptageniidae and Elmidae, were also different in TR-BMWP. Presence of Heptageniidae, Leptophlebiidae and Prosopistomatidae along with Athericidae and Elmidae showed that the habitat quality of the collecting site was high. However, low BMWP results indicated that sensitive families such as Heptageniidae, Leptophlebiidae and Prosopistomatidae may disappear in future if poor conditions continue. For this reason, *Prosopistoma turcica* **sp. n.** may extinct in future, as well.

Prosopistoma species are very sensitive to organic pollution and habitat degradation. *Prosopistoma turcica* **sp. n.** was found in an isolated area in the river basin. However, there are some small settlements and agricultural areas around the collecting locality. Domestic waste waters should be controlled and water treatment facilities should be built if necessary. Flow regime is also important for this species. The interventions to change the flow regime should be avoided.

REFERENCES

- Alouf, N.J., 1977. Sur la présence du genre *Prosopistoma* au Liban. Description de *P. oronti* n. sp. et de *P. phoenicium* n. sp. (Ephemeroptera). *Ann. Limnol.* 13:133–139.
- Barber-James, H.M., 2009. A preliminary phylogeny of Prosopistomatidae (Ephemeroptera) based on morphological characters of the larvae, and an assessment of their distribution. *Aquat. Insect.* 31:149–166.
- Barber-James, H.M., 2010. Neotype erection, redescription of the larva and first description of the winged stages of *Prosopistoma variegatum* Latreille, 1833 (Insecta: Ephemeroptera) from Madagascar. *Aquat. Insect.* 32: 215–243.
- Barber-James, H.M., Gattolliat, J.L., Sartori, M. and Hubbard, M.D., 2008. Global diversity of mayflies (Ephemeroptera: Insecta) in freshwater. *Hydrobiologia* 595:339–350.
- Barber-James, H.M., Sartori, M., Gattolliat, J.L. and Webb, J., 2013. World checklist of freshwater Ephemeroptera species. World Wide Web electronic publication. Available from <http://fada.biodiversity.be/group/show/35> (accessed on 4 October 2017).
- Bojkova, J. and Soldan, T., 2015. Two new species of the genus *Prosopistoma* (Ephemeroptera: Prosopistomatidae) from Iraq and Algeria. *Zootaxa* 4018:109–123.
- Council of European Communities, 2000. Water Framework Directive (WFD) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. *OJEC* 327: 1–72.
- Dalkıran, N., 2009. A new species of *Prosopistoma* Latreille, 1833 (Ephemeroptera: Prosopistomatidae) from northwestern Turkey. *Aquat. Insect.* 31:119–131.
- Ephemeroptera of the World, 2018. Available online: <http://www.insecta.bio.spbu.ru /z/ Eph-spp/Prosopistoma.htm> (accessed on 01.03.2018)
- Gillies, M.T., 1954. The adult stages of *Prosopistoma* Latreille (Ephemeroptera) with descriptions of two new species from Africa. *T. Roy. Ent. Soc. London* 105, 355–372.
- Koch, S., 1985. Eintagsfliegen aus der Türkei und Beschreibung einer neuen *Baetis*-Art: *B. macrospinosus* n. sp. (Insecta: Ephemeroptera: Baetidae). *Senck. Biol.* 66:105–110.
- Peters, W.L., 1967. New species of *Prosopistoma* from the Oriental region (Prosopistomatoidea: Ephemeroptera). *Tijdschr. Entomol.* 110: 207–222.
- Sartori, M. and Gattolliat, J.L., 2003. First record and new species of the genus *Prosopistoma* Latreille, 1833 (Ephemeroptera, Prosopistomatidae) from Borneo (East Kalimantan, Indonesia). *Mitt. Schweiz. Entomol. Ges.* 76: 301–305.
- Schletterer, M., Bauerfeind, E. and Lechthaler, W., 2016. Larval redescription of *Prosopistoma pennigerum* (MÜLLER, 1785) from the River Volga near Rzhev, Tver Region, Russia (Insecta: Ephemeroptera). *Zoosymposia* 11: 015–027.

- Soldan, T. and Braasch, D., 1984. Two new species of the genus *Prosopistoma* (Ephemeroptera, Prosopistomatidae) from Vietnam. *Acta Entomol. Bohemos.* 81:370–376.
- Tong, X., 2000. Dudgeon D. A new species of *Prosopistoma* from China (Ephemeroptera: Prosopistomatidae). *Aquat. Insect.* 22: 122–128.
- Zhou, C.F. and Zheng, L.Y., 2004. The genus *Prosopistoma* from China, with description of two new species (Ephemeroptera: Prosopistomatidae). *Aquat. Insect.* 26: 3–8.
- Kazancı, N., Türkmen, G., Başören, Ö. and Ekingen, P., 2016. TR-BMWP (Turkish-BMWP) biotic index. *Rev. Hydrobiol.* 9,2: 147-151.