

Original article (Orijinal araştırma)

***Cercopis sanguinolenta* (Scopoli, 1763) (Hemiptera: Auchenorrhyncha: Cercopidae) dilemma and redescription of rare *Cercopis* Fabricius, 1775 species from Turkey¹**

Cercopis sanguinolenta (Scopoli, 1763) (Hemiptera: Auchenorrhyncha: Cercopidae) ikilemi ve Türkiye'den nadir *Cercopis* Fabricius, 1775 türlerinin yeniden tanımlanması

Ersin DEMİREL^{2*}

Hisamiddin DİNÇ³

Abstracts

This study was conducted to determine the Cercopidae Leach, 1815 (Hemiptera: Auchenorrhyncha) fauna of the Central and Southern Kuseyr Plateau (Hatay/Turkey). For this purpose, samples were collected with a net, hand and tweezers from the different habitats of the region in April-June 2014-2015. However, in the process of evaluating the samples, it was found that *Cercopis sanguinolenta* (Scopoli, 1763) and *Cercopis intermedia* Kirschbaum, 1868 species were frequently confused with each other. This is because two different approaches were adopted that have resulted in a dilemma over the type of *C. sanguinolenta* before the "Principle of Priority" was established. With this study, not only the current controversy is eliminated, but also redescriptions of *Cercopis distincta* (Melichar, 1896), *C. intermedia* and *Cercopis septemmaculata* (Melichar, 1903) is made with informative images and morphometric data. Among these species, complete locality record has been provided for an uncertain Turkey records of *C. septemmaculata* and the first local record of *C. distincta*, which is defined as an endemic species in Turkey but whose terra typica is unknown, was also revealed with this study. New distribution maps of these species are presented with local and worldwide distributional data, and also an identification key is given, including other *Cercopis* Fabricius, 1775 species that occur in Turkey.

Keywords: *Cercopis distincta*, *Cercopis intermedia*, *Cercopis septemmaculata*, fauna

Öz

Bu çalışma, Orta ve Güney Kuseyr Platosu'nun (Hatay/Türkiye) Cercopidae Leach, 1815 (Hemiptera: Auchenorrhyncha) faunasını belirlemek için yapılmıştır. Bu amaçla 2014-2015 yıllarının Nisan-Haziran aylarında, bölgenin farklı habitatlarından; ağ, el ve pensle örnekler toplanmıştır. Ancak örneklerin değerlendirilmesi sürecinde *Cercopis sanguinolenta* (Scopoli, 1763) ve *Cercopis intermedia* Kirschbaum, 1868 türlerinin sıklıkla birbirleriyle karıştırıldığı görülmüştür. Bunun nedeni, "Öncelik İlkesi" tesis edilmeden önce *C. sanguinolenta*'nın tipi üzerinde bir ikileme sonuçlanan iki farklı yaklaşımın benimsenmiş olmasıdır. Bu çalışma ile sadece mevcut tartışma ortadan kaldırılmakla kalmamış, aynı zamanda *Cercopis distincta* (Melichar, 1896), *C. intermedia* ve *Cercopis septemmaculata* (Melichar, 1903) türlerinin, aydınlatıcı görseller ve morfometrik verilerle birlikte yeniden tanımlanmaları yapılmaktadır. Bu türlerden *C. septemmaculata*'nın kesin olmayan Türkiye kayıtları için tam lokalite kaydı sağlanmış ve ülkemize endemik bir tür olarak tanımlanan ancak terra tipi dahi bilinmeyen *C. distincta*'nın ilk yerel kaydı da yine bu çalışma ile ortaya konulmuştur. Yerel ve dünya yayılış verileri ile bu türlerin yeni dağılım haritaları sunulmakta ve ayrıca Türkiye'de görülen diğer *Cercopis* Fabricius, 1775 türlerini de kapsayan bir teşhis anahtarı verilmektedir.

Anahtar sözcükler: *Cercopis distincta*, *Cercopis intermedia*, *Cercopis septemmaculata*, fauna

¹ This study was a part of a master's degree thesis of the second author's that completed at the Graduate School of Natural and Applied Sciences of Hatay Mustafa Kemal University in 2019. The preliminary results of the data obtained from this thesis have been shared as an oral presentation at the "8th European Hemiptera Congress" in Katowice-Zawiercie, Poland, on 24-29 June in 2018.

² Hatay Mustafa Kemal University, Tayfur Sökmen Campus, Faculty of Arts and Sciences, Department of Biology, 31060, Antakya, Hatay, Turkey

³ Hatay Mustafa Kemal University, Tayfur Sökmen Campus, Graduate School of Natural and Applied Sciences, Department of Biology, 31060, Antakya, Hatay, Turkey

* Corresponding author (Sorumlu yazar) e-mail: auchenorrhyncha@mku.edu.tr

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Introduction

Cercopoidea Leach, 1815 (Hemiptera: Cicadomorpha), one of the superfamilies of Cicadomorpha Evans, 1946 (Hemiptera: Auchenorrhyncha), is represented in the world by 366 genera and 2,612 (2,500-3,000) species (Bartlett et al., 2018; Soulier-Perkins, 2020). However, only 42 genera and 158 species are recorded in the Palearctic (Nast, 1972, 1987; Bartlett et al., 2018) (Table 1). Of the species in Palearctic, 51 belong to the Aphrophoridae Amyot & Serville, 1843, 93 belong to the Cercopidae and 14 belong to the Machaerotidae Stål, 1866 (Brambila & Hodges, 2008; Soulier-Perkins, 2020). Despite some doubtful records, the previous studies have shown that this superfamily is represented by 22 species in Turkey, 15 of which are Aphrophoridae and seven of which are Cercopidae (Nast, 1972; Lodos & Kalkandelen, 1981, 1988; Önder et al., 2011).

Table 1. The distribution of Cercopoidea (Hemiptera: Auchenorrhyncha) genera and species by family and zoogeographical areas (Bartlett et al., 2018)

Taxa	NEA ^a		NEO		PAL		IND		AFR		AUS		OCE		World	
	Ge ^b	Sp	Ge	Sp	Ge	Sp	Ge	Sp	Ge	Sp	Ge	Sp	Ge	Sp	Ge	Sp
Cercopoidea	12	48	71	482	42	158	91	726	46	239	24	61	44	233	366	2 612
Aphrophoridae	5	8	4	4	17	51	11	24	9	35	11	28	16	58	157	925
Cercopidae	6	8	63	418	20	93	56	620	32	196	8	22	24	165	173	1 480
Clastopteridae	1	32	1	56	0	0	2	3	0	0	0	0	0	0	3	85
Epipygidae	0	0	3	4	0	0	0	0	0	0	0	0	0	0	3	4
Machaerotidae	0	0	0	0	5	14	22	79	5	8	5	11	4	10	30	118

^a Zoogeographic Regions: NEA, Nearctic Region; NEO, Neotropical Region; PAL, Palearctic Region; IND, Indomalayan Region; AFR, Afrotropical Region; AUS, Australasia Region; OCE, Oceania Region.

^b Hierarchical Categories: Ge, Genera; Sp, Species.

Cercopidae, the largest family of the Cercopoidea, are characterized by bright colors and patterns, and because of their production of large amounts of protective foam they are called spittlebugs (Carvalho & Webb, 2005). Numerous Cercopidae species have patterns with a combination of red, orange and yellow with black (Bartlett et al., 2018). Most of the Cercopids are aposematically colorful and many exhibits reflex bleeding (Peck, 2000).

It is possible to classify the studies that have conducted on Cercopidae that included one of the two families in the Cercopoidea in Turkey from the Palearctic Region, as follows: nomenclatural changes (Puton, 1881; Cavanna, 1882; Royer, 1906; Kirkaldy, 1907), checklists (Fabricius, 1775; Le Peletier de Saint-Fargeau & Audinet-Serville, 1825; Walker, 1851; Fieber, 1872; Oshanin, 1910; Lallemand, 1912; Metcalf, 1961; Nast, 1972, 1987), descriptions of new subspecific forms (Péneau, 1912; Haupt, 1919, 1922; Nast, 1933; Lallemand, 1949), an encyclopedic article (Olivier, 1797) and new taxon description studies. When these studies were evaluated as a whole, it was found that there is longstanding confusion regarding the diagnosis of *Cercopis* Fabricius, 1775 genus-group species. Given that many *Cercopis* spp. sensu lato, which are now considered as species, either have been incorrectly synonymized or were defined as subspecific forms. Indeed, it can be seen from the erroneous diagnoses in some studies conducted recently that this dilemma still continues. One of the reasons for this is that almost all of the work was reported only textually and contained little or insufficient images. However, the main reasons are, it is difficult to readily diagnose Cercopidae (Carvalho & Webb, 2005), the diagnostic keys alone are insufficient due to the convergences seen in color patterns between taxa and the distinctive characters between male genital structures are limited, especially as reported in the literature (Cryan, 2005).

It is clearly understood from the frequent synonym errors made that the most difficult species in the diagnosis of this group are *Cercopis sanguinolenta* (Scopoli, 1763) and *Cercopis intermedia* Kirschbaum,

1868, which are often confused with each other. The main reason for this is, two different type descriptions were adopted by different researchers for *C. sanguinolenta* before the "Principle of Priority" was established. While one group performed their studies using the Scopoli's description, which is currently accepted, other studies were based on Linnaeus's description. In many cases, the interpretations were made assuming these two descriptions to be the same, and this has allowed the problem to persist.

Cercopids are represented by three genera and seven species in Turkey, of these five species belong to the genus *Cercopis*. However, the existence of *Cercopis septemmaculata* (Melichar, 1903) has been always seen as a doubtful record. In this study, the status of three *Cercopis* spp. has been occurring the Central and Southern parts of Kuseyr Plateau (Hatay, Turkey) has been reassessed with the addition of new data. Accordingly, *C. septemmaculata*, *Cercopis distincta* (Melichar, 1896) and *C. intermedia* have been redescribed using morphometric data for the important taxonomic characters and supported by detailed images that have not provided by the previous researchers. Local and Palearctic distribution maps of these species are updated, "Turkish *Cercopis* Fabricius, 1775 Identification Key" is included with the addition of the two other *Cercopis* spp. that occur in Turkey along with some zoogeographical comments on these species.

Materials and Methods

The samples were collected from 12 habitats and altitudes of the Central and Southern Kuseyr Plateau (Hatay) by hand, tweezers and sweep net in April to June 2014-2015.

The collected samples were killed in jars containing 70% ethanol and then stored as dried specimens. After morphological examination, in order to dissecting the genital structures of males, the dry pinned samples were moisturized and their genital capsules extracted under Boeco BSZ-405 model stereo microscope and treated with 10% KOH for 15 min by the bain-marie method.

Local, Turkey and Palearctic distribution maps of species were prepared with the ArcView v3.3 software using the data obtained from a Garmin Monterra GPS (Global Positioning System) and by compiling details of previous studies (Nast, 1972, 1987; Lodos & Kalkandelen, 1981, 1988; Holzinger et al., 2003; Önder et al., 2011). The photos of the dorsal, lateral and ventral habitus of the diagnosed species were with a Nikon D750 camera with Nikon AF-S VR Micro-NIKKOR 105mm f/2.8G IF-ED lens, and the photos of the male genitals have been taken with Leica S9D model trinocular stereo microscope attached to a Nikon D750 camera, and then these photos were edited using GIMP (GNU Image Manipulation Program) software. For the terminology of morphology and genital parts, Ossiannilsson et al. (1970) and Lallemand (1949) were followed. The diagnosed samples are preserved in the Zoology Research Laboratory of the Department of Biology at the Faculty of Arts and Science in Hatay Mustafa Kemal University.

Results

Through evaluating 42 samples, 22♂♂ and 20♀♀ collected from the field, three *Cercopis* spp. were determined as occurring in the study area. The diagnosed species with relevant details are listed alphabetically below.

***Cercopis distincta* (Melichar, 1896)**

Triecphora distincta Melichar, 1896

Redescription/Diagnosis

The male length is 12 mm with wings and 9.2 mm without wings (Figure 1a-c) (Table 2). The vertex, frontal plate and the longitudinal slits between the ocelli and compound eyes have almost identical characteristics as reported in previous studies. However, these are approximately at the same level in

lateral view and the two pits behind the frontal plate are divided the back edge of the frontal plate into approximately three equal parts. The tempe is divided into two equal parts with the bases of antennae. The postclypeus is domed or tulip-like, because of its longitudinal carina that is only prominent in the middle. The pronounced transverse grooves are parallel to each other and to the ground in lateral view but their back tips are appeared to be bent downwards in ventral view. Head is completely with long yellow setulae, except the area between the compound eyes and the postclypeus.

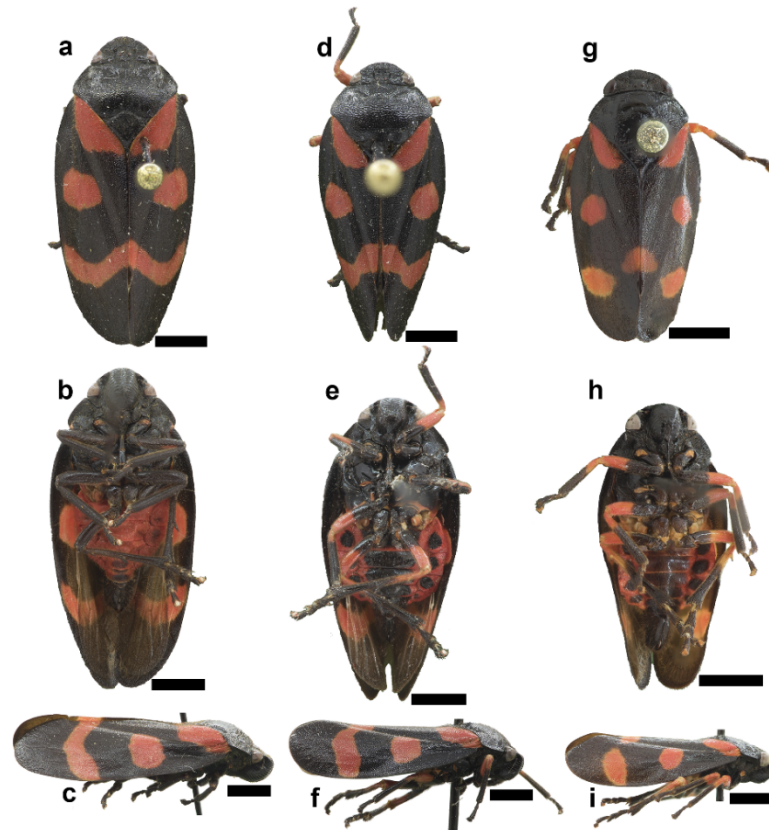


Figure 1. Dorsal, ventral and lateral views of *Cercopis* spp. occurring in the Central and Southern parts of Kuseyr Plateau (Hatay, Turkey). *Cercopis distincta*: a) dorsal habitus, b) ventral habitus, c) lateral habitus; *Cercopis intermedia*: d) dorsal habitus, e) ventral habitus, f) lateral habitus; *Cercopis septemmaculata*: g) dorsal habitus, h) ventral habitus, i) lateral habitus (scale bar = 2 mm).

The dorsal appearance of the pronotum is hexagonal. The front side edges are slightly raised to upward laterally. The front edge of this hexagon is almost straight and its back edge is perceived as having two spherical lobes. There are shallow but large symmetrical depressions on both sides of the pronotum with a vaguely longitudinal carina up to the front half of its midline. Due to the structure of the postclypeus, the head is long and the pronotum is distinctly in the form of hump in lateral view.

The wings have patterns of red on black and these are composed of four red spots and a red stripe. Two of the red spots extending towards the corium are at the anterior end of the clavus, and the back edges perpendicular to the body are recessed and aligned with the back end of the scutellum. The other two spots are located in the middle of corium and they seem to be rectangular. The outer edges of these spots do not reach the costa; the inner edges contact the claval suture but do not cross the clavus. The tips of the red stripe at the posterior of the wings are more or less touching the costa and they resembles the end of a scimitar. The stripe width is consistent over the rest of the area (Figure 1a, c).

The legs are entirely black, except that the outside of the hind tibia is yellowish-brown. There are two thorns with the same color on the outer part of this tibia (Figure 1b).

Table 2. Important morphometric data of *Cercopis* spp. determined for specimens collected in the study area

Character	<i>C. distincta</i>	<i>C. intermedia</i>	<i>C. septemmaculata</i>
Vertex width/length	2.0	2.2	2.4
Frontal plate width/length	1.6	1.4	1.6
Diameter of pits (μm)	41.0	66.0	37.0
Distance between pits (μm)	238.0	195.0	168.0
Distance between pits and lateral edges of frontal plate (μm)	273.0	149.0	209.0
Compound eye length/width (Dorsal)	1.8	1.7	1.7
Compound eye length/width (Ventral)	1.4	1.5	1.2
Distance between compound eyes (μm)	1717.0	1615.0	1509.0
Distance between compound eyes and frontal plate (μm)	488.0	522.0	448.0
Distance between compound eyes and posterior edge of vertex (μm)	136.0	117.0	74.0
Diameter of ocelli (μm)	124.0	93.0	60.0
Distance between ocelli (μm)	216.0	221.0	172.0
Distance between ocelli and compound eyes (μm)	617.0	583.0	588.0
Distance between ocelli and frontal plate (μm)	232.0	201.0	161.0
Distance between ocelli and posterior edge of vertex (μm)	184.0	145.0	113.0
Width of tempe (μm)	577.0	497.0	538.0
Postclypeus length/width	1.3	1.2	1.0
Postclypeus dorsal edge/ventral edge	2.1	1.9	1.3
Length of anteclypeus (μm)	906.0	737.0	667.0
Width of anteclypeus dorsal edge (μm)	626.0	577.0	698.0
Width of anteclypeus ventral edge (μm)	197.0	221.0	187.0
Width of anteclypeus in middle (μm)	398.0	501.0	356.0
Length of lorum/width	2.0	2.2	2.1
Length of rostrum (μm)	1497.0	1399.0	1378.0
First segment length of rostrum (μm)	537.0	515.0	515.0
Last segment length of rostrum (μm)	571.0	501.0	501.0
Pronotum width/length (in middle)	2.1	2.0	2.0
Pronotum width/length (on lateral)	1.9	1.8	1.9
Pronotum anterior edge/posterior edge	1.3	1.5	1.4
Pronotum anterior side edge/posterior side edge	1.2	1.3	1.3
Front wings length/width	3.7	3.9	3.3
Claval suture length/width	5.4	6.3	4.8
Length of hind tibia with apical platellae (mm)	3.4	3.7	2.5
Length of hind tibia without apical platellae (mm)	3.3	3.4	2.3
Distance between hind tibia small thorn and knee (μm)	653.0	720.0	549.0
Distance between hind tibia large thorn and the knee (μm)	1578.0	1796.0	1248.0
Length of second thorn/first thorn	2.0	1.5	1.7
Genital plate length/width	2.1	2.2	2.2
Paramere length/width	1.8	1.9	2.0
Aedeagus length/height	2.5	2.0	2.2
Base thickness of aedeagus (μm)	232.0	242.0	203.0
Thickness of aedeagus in middle (μm)	145.0	159.0	131.0
Narrowest point of aedeagus (μm)	77.0	106.0	114.0
Distance from phallobase to appendages/appendages to tip	2.2	3.6	3.5
Long appendages length/width	12.0	28.2	29.8
Short appendages length/width	10.5	15.2	17.7
Long appendages length/short appendages	1.5	1.7	1.7
Long appendages width/short appendages	1.3	0.9	1.0

The abdomen is red, except for the weak blackish coloration in the middle of the last few of the abdominal sterna and the distinct blackness in the genital capsule (Figure 1b).

The dorsal part of the genital plate tip is distinctively ramuscule towards to the posterior. There is a short and straight edge located perpendicular to the ground just below at this structure. The ventral edge of the plate is slightly but completely convex. The surface of the plate is covered with setulae except only along the narrow strip-shaped area of the ventral edge.

The middle of the posterior edge of the paramere is ended conical and the tip of this conic structure seems like a "head of match". A weak chitinous setulae cluster is located on the dorsal corner of this structure. The shoulder-shaped structure just placed below this one is reduced and it nearly looks like a part of the ventral edge of paramere. There are few weak chitinous long setulae both on the first 1/3 part of the ventral edge and the shoulder. The elevation on the right in the middle of the dorsal edge is sphere-like and has a few long and non-chitinous setae. The ventral edge of paramere is completely convex and naked, with the exception of 1/3 of the posterior tip.

There are two pairs of appendages on the ventral posterior of the gonopore of the aedeagus: one is short and located ahead, the other one is long and located just behind it. These long appendages from base to the terminal end up forming a pointed tip, by bending first inward, then outward and finally inward. On the other hand, the short appendages are narrow at the base, thickens in the middle, and finalizes by forming a pointed tip narrowed both two sides equally at the terminal. The part after the appendages reminds the crocodile head in the lateral view.

The length of anal tube from the dorsal is 763 μm and the widest part is 345 μm .

Material examined. 6♂♂, 2♀♀ Hatay, Defne (Antakya), Döver, Piknik Alanı, 36°12'39" N, 36°14'4" E, 279 m, 17.IV.2015; ♂, 3♀♀, Hatay, Defne, Balıklıdere, Sinanlı, 36°10'12" N, 36°9'6" E, 35 m, 17.IV.2015; ♂, Hatay, Defne, Sinanlı, Dağdüzü, 36°7'52" N, 36°8'36" E, 346 m, 17.IV.2014; 2♀♀, Hatay, Defne, Döver, Harbiye Yolu, 36°7'47" N, 36°8'30" E, 236 m, 15.V.2015; 2♂♂, Hatay, Defne, Sinanlı-Dağdüzü Yolu, Dağdüzü Girişi, 36°4'30" N, 36°5'3" E, 336 m, 15.V.2015; ♀, Hatay, Yayladağı, Dağdüzü-Karacurun Arası, 36°2'32"N, 36°5'37" E, 686 m, 15.V.2015; ♂, Hatay, Yayladağı, Sürütme-Sungur Yolu, 36°3'52"N, 36°5'44" E, 788 m, 15.V.2015; 3♀♀, Hatay, Defne-Döver Yolu, 36°7'16" N, 36°8'46" E, 459 m, 05.VI.2015 (Figure 2c).

Distribution in Palearctic Region. Turkey (Anatolia) (Melichar, 1896; Nast, 1933; Lallemand, 1949; Nast, 1972) (Figure 2a).

Distribution in Turkey. Exact terra typica location of this species is not specified in the original description (Taurus). This is the first report of this species from Turkey with a defined locality record, even after a 124-year delay (Figure 2b).

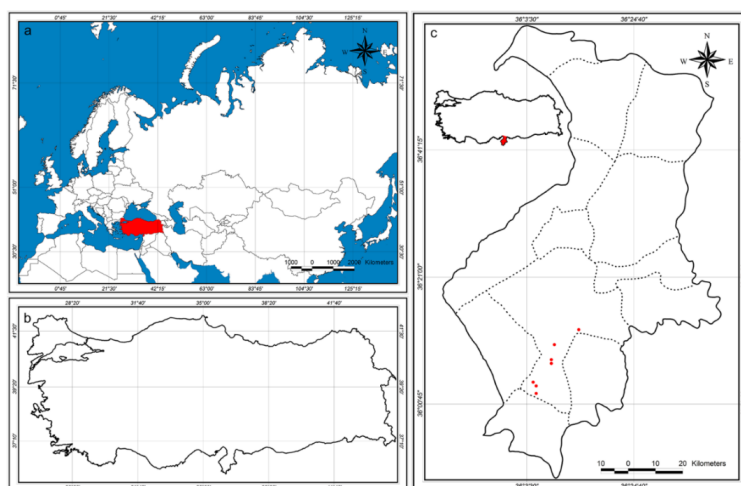


Figure 2. Distribution of *Cercopis distincta* (Melichar, 1896): a) Palearctic; b) Turkey; c) local.

Cercopis intermedia* Kirschbaum, 1868Cercopis obliterated* Kirschbaum, 1868*Triecphora intermedia nigra* Royer, 1906*Triecphora intermedia simulans* Peneau, 1912*Cercopis sanguinolenta turkestanica* Lindberg, 1923*Cercopis sanguinolenta intermedia bipunctata* Ribaut, 1946*Cercopis sanguinolenta intermedia quadrimaculata* Ribaut, 1946*Cercopis sanguinolenta intermedia septempunctata* Ribaut, 1946*Cercopis sanguinolenta intermedia sexmaculata* Ribaut, 1946**Redescription/Diagnosis**

The male length is 11 mm with wings, 8.8 mm without wings (Figure 1d-f) (Table 2). The vertex more or less semi-elliptic. The frontal plate with rare setulae and indistinct carina is a broad and shallow pentagonal view; the pits, longitudinal slits and the temple are positioned just like in the *C. distincta*. The ocelli and compound eyes are approximately at the same level in lateral, however, the frontal plate is under the level of the ocelli in the middle. The postclypeus is in the form of a three-faced prism due to its three carinae. The lateral longitudinal carinae are parallel to each other at the upper side of the frons and they close up together towards to the anteclypeus but terminated much before without contact. The parallel transverse grooves are distinct and uninterrupted in lateral surfaces but become indistinct towards the weak mid-carina. In contrast with *C. distincta*, the side surfaces of the postclypeus, the lorum, anteclypeus, and the lower back part of the compound eye are covered with shorter dark colored setulae. The other parts of the head is naked or covered rarely with setulae so, all these areas are metallic black.

The front side edges of the pronotum are nearly straight in laterally. Its front edge is straight, the back edge is shallower wavy than the *C. distincta* and the back ends of its lobes are almost flat. There is no depression or a longitudinal carina in the front half of the pronotum, however, there are indistinct elevations on both sides. The upper part of the pronotum is metallic black and covered with sparsely black setulae. Due to the structure of the postclypeus, the head is short and the pronotum is weakly in the form of hump in lateral view.

The posterior edges of the red spots on the anterior of the clavus are convex and these edges are reaching only up to the middle half of the scutellum. The red spots in the corium are smaller and rounded, also they do not cross the clavus. And last but not least, the red band at the posterior of the wing whose tips touch more or less to the costae, is formed by combination of two obround red spots on the corium and the trapezoid spot on the clavus (Figure 1d, f).

The half parts of the first and second pairs of the femora and the tip parts of the tibia are red but half of the outer part of the both two segments are red on the third pairs, the inner parts are yellowish-brown. The large black thorn is nearly in the middle of hind tibia but the small yellow-reddish one is near the femur. All the coxae are more or less metallic black (Figure 1e).

The middle of the abdomen sterna, the centers of the connexiva and the genital capsule are black but the other areas are red (Figure 1e).

The genital plate is divided into two equal parts because of the indentation in the middle of the posterior edge. The part remaining in the dorsal shows a wavy edge structure and turns to the anterior then

ends with a prominently pointed protrusion distally, but the ventral part ended with a rounded corner. The surface and the ventral edge of the plate is showed similarity to the *C. distincta*.

The posterior edge of the paramere finalizes like *C. distincta* but unlike from it, the shoulder-shaped structure very prominent and has a small number of weakly chitinous setulae. There is an overturned trapezium-shaped elevation in the middle of the dorsal rim of the paramere, which has weak, long but numerous chitinous setae. Also, a secondary, very small and nodule-shaped elevation is located on the posterior of this structure. The ventral edge of the paramere is completely bare and with a concave curvature at the first 1/3 of the posterior part of it.

The appendages of aedeagus are almost straight-edged, and while the tips of the long appendages are tapered in both directions, bent slightly towards anteriorly in short ones. There is a formation that looks like an Adam's apple at the anterior of the appendages and also the tip part of gonopore resembles a Fowler's head.

The length of anal tube from the dorsal is 720 μm and the widest part is 372 μm .

Material examined. 2♂♂, Hatay, Yayladağı, Kulaç Yolu, 35°55'7" N, 36°7'31" E, 792 m, 17.IV.2015; ♀, Hatay, Yayladağı, Ziyaret Dağı, Hirbi Yayla, Türbinler Mevkii, 36°03'08" N, 36°07'48" E, 825 m, 15.V.2015 (Figure 3c).

Distribution in Palearctic Region. Albania, Algeria, Armenia, Bulgaria, France, Georgia, Germany, Greece (Holotype), Iran, Israel, Italy, Lebanon, Morocco, Portugal, Russia (Dagistan), Spain, Switzerland, Syria, Turkey (Anatolia), Turkmenistan, Ukraine, Uzbekistan (Nast, 1972, 1987; Holzinger et al., 2003) (Figure 3a).

Distribution in Turkey. Adıyaman, Aksaray, Amasya, Ankara, Antalya, Artvin, Balıkesir, Çanakkale, Çorum, Diyarbakır, Elâzığ, Eskişehir, Gaziantep, Giresun, Gümüşhane, Hakkâri, Hatay, Isparta, İzmir, Kahramanmaraş, Kayseri, Kırıkkale, Kırklareli, Konya, Kütahya, Mardin, Rize, Samsun, Siirt, Şanlıurfa, Tokat, Uşak (Dlabola, 1971; Lodos & Kalkandelen, 1981; Kartal et al., 1994; Demir, 2006a, b, 2008, 2019; Önder et al., 2011) (Figure 3b).

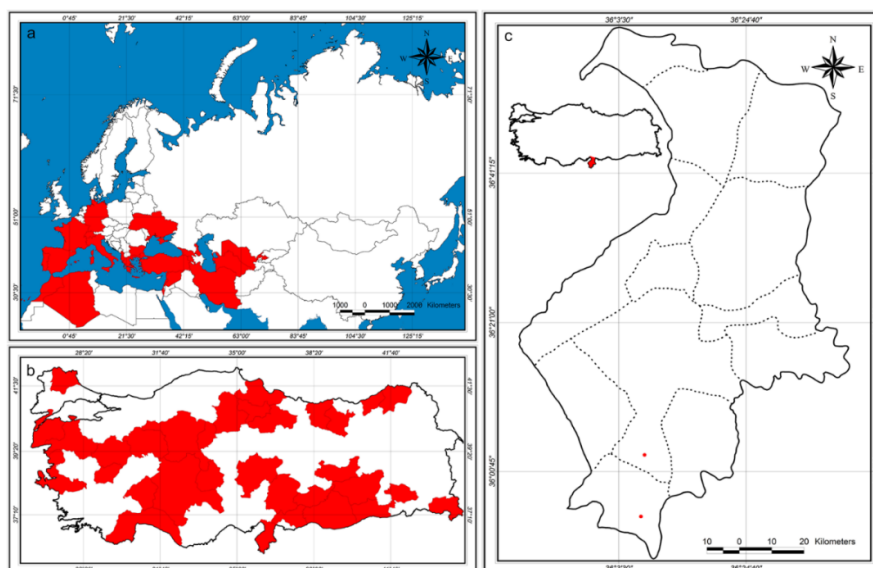


Figure 3. Distribution of *Cercopis intermedia* Kirschbaum, 1868: a) Palearctic; b) Turkey; c) local.

Cercopis septemmaculata* (Melichar, 1903)Triecphora septemmaculata* Melichar, 1903**Redescription/Diagnosis**

The male length is 9 mm with wings, 7.8 mm without wings (Figure 1g-i) (Table 2). The vertex is slightly curved banana-shaped. The frontal plate is almost semicircular, with vaguely carinated and setulae. The two pits distance located behind the frontal plate equal to each other on the side parts. Unlike the other two species, the ocelli are higher than the other structures and the longitudinal depressions are not clear. The temple is divided into two equal parts with the bottom of the antenna as in *C. distincta* and *C. intermedia*. Longitudinal carina in the middle of postclypeus is vague and complete but, the lateral carinae are incomplete. However, the face still gives the impression of with three parts. The transverse grooves are not apparent and do not touch to each other in the middle. The lorum, gena, back parts of the compound eye and anteclypeus are covered with sparsely and weak yellowish setulae.

The front side edges of the pronotum are short and straight in the lateral view. The front edge of the pronotum nearly straight but the back edge shallowly undulated form. Consequently, the lobes are not fluffy and prominent. There is no carina on the front half of the metallic black pronotum but there is an undulation, which is very lightly polished from the center towards sides and resembles a dickey bow without a knot. This area is nearly naked but the remaining areas are covered with sparse setulae and small pits. The pronotum does not swell like a hump towards to the anterior in lateral view.

The front wings have a pattern on black, consisting of seven red spots. The two spots on located anterior of clavus with convex back edges and front tips have a black edge formation on the area of facing the pronotum and scutellum. The two red spots on the corium are almost circular and neither contact the clavus nor the costa. The strip on the posterior of the wing is replaced by three red spots (Figure 1g, i).

The inner half parts of the third pairs of tibiae are yellowish-red and the rest are blackish brown. The large thorn is dark brown-blackish and in the middle of the hind tibia but the small and yellow-reddish one is close to the femur. All the coxae are more or less metallic brown-black (Figure 1h).

Nearly all the abdomen sterna, the centers of connexiva and the genital capsule are black, the remaining areas are red (Figure 1h).

The genital plate is divided into two equal parts because of the shallow indentation in the middle of the posterior edge. The part remaining in the dorsal shows a straight edge structure and turns towards the anterior, then ends with an indistinct blunt protrusion at the distal but the ventral part ended without creating any corners at the distal. Almost the entire surface of the plate is covered with setulae, except only a narrow area of the posterior half of the ventral edge.

The shoulder-shaped structure on the posterior edge of the paramere and its ventral corner has a small number of weakly but long chitinous setulae and the neck structure above this is thicker. There is a parallelogram-shaped elevation in the middle of the dorsal edge with a small number of long weak chitinous setae. Also, there is a very slightly single-curved at the posterior of this structure. A concave curvature is ranged in the middle of the ventral edge of the paramere.

The longer appendages of aedeagus first curling outward, second inward and finally outward again then ends up with a pointed tip. The short ones are located in the form of a mirror image of the long ones from the middle to the distal. However, the first fold is outward, just like the long ones. The part after the gonopore resembles the mouth of an antique pitcher.

The length of anal tube from the dorsal is 659 μm and the widest part is 270 μm .

Material examined. 2♂♂, 3♀♀, Hatay, Defne, Balıklıdere, Sinanlı, 36°10'12" N, 36°9'6" E, 35 m, 17.IV.2015; 4♂♂, ♀, Hatay, Yayladağı, Köşrelilik Köyü Çıkışı, Leylekli Barajı, 35°56'36" N, 36°3'44" E, 510 m, 17.IV.2015; ♀, Hatay, Defne, Sinanlı, Dağdüzü, 36°7'52" N, 36°8'36" E, 346 m, 17.IV.2014; 3♂♂, ♀, Hatay, Yayladağı, Kulaç Yolu, 35°55'7" N, 36°7'31" E, 792 m, 17.IV.2015; ♀, Hatay, Defne, Döver, Bahçeköy (Aşağı Döver), 36°7'36" N, 36°6'55" E, 73 m, 15.V.2015; ♀, Hatay, Defne-Döver Yolu, 36°7'16" N, 36°8'46" E, 459 m, 05.VI.2015 (Figure 4c).

Distribution in Palearctic Region. Israel, Jordan, Lebanon, Palestine, Syria (Diabola, 1965; Nast, 1972) (Figure 4a).

Distribution in Turkey. The distribution record of this species has been given by Lodos and Kalkandelen as Adana, İzmir, Kastamonu, Mardin and Siirt Provinces but missing the other important information (Lodos & Kalkandelen, 1988). This is the first regional and complete locality record for this species (Figure 4b).

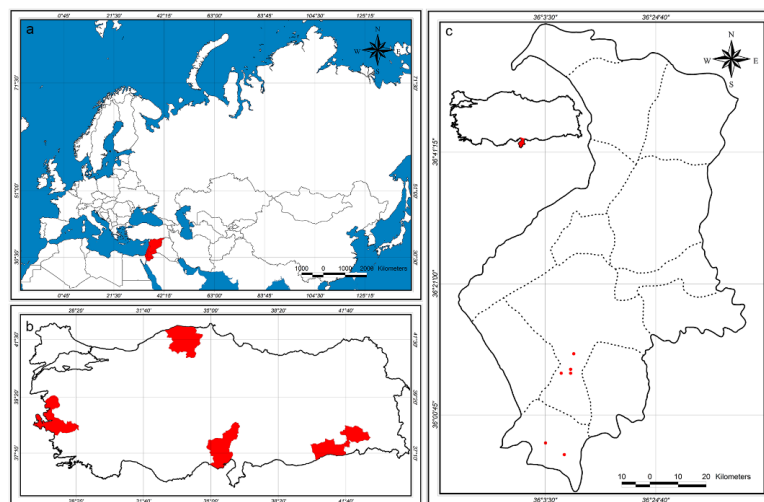


Figure 4. Distribution of *Cercopis septemmaculata* (Melichar, 1903): a) Palearctic; b) Turkey; c) local.

Discussion

Through the evaluation of the samples from the study area it was determined that three *Cercopis* spp., *C. distincta*, *C. intermedia* and *C. septemmaculata*, occur in the region. *Cercopis distincta* is the most common species with 22 samples collected from five locations, followed by *C. septemmaculata* with 17 samples from four locations. *Cercopis intermedia* was the least commonly collected species.

When the quantitative data (Table 2) and general appearances of these morphological structures are evaluated together, the features of the vertex, the diameter of the ocelli, the pronotum and the ratios of the long to short appendages of the aedeagus are the most distinctive. The vertex is triangular in *C. distincta*, semi-ellipsoid in *C. intermedia* and banana-shape in *C. septemmaculata* (Figure 5 a, d, g). Also, the vertex width/length ratio differs from species to species (Table 2). Ocelli diameters appear to be markedly different between these species. While the smallest eye diameter occurs in *C. septemmaculata*, *C. intermedia* is 1.5-times and *C. distincta* is two-times larger (Table 2). Given the shape of the undulation on the posterior edge of the hexagonal pronotum results in variable proportions between the species (Table 2). However, the anterior edge to posterior edge ratio is smallest in the relatively larger *C. distincta* (Table 2). The ratios of the long and short appendages of the aedeagus are one of the important characteristics used in the diagnosis of *Cercopis* Fabricius, 1775 species. However, the ratio of the long appendages length/width or the short appendages length/width revealed more useful differences for the identification of species.

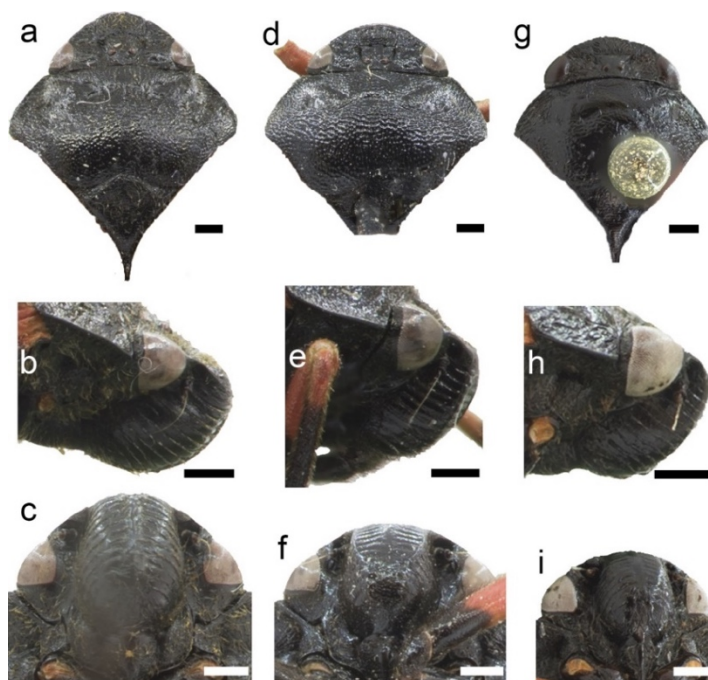


Figure 5. Head of *Cercopis* spp.: *Cercopis distincta*: a) male adult, dorsal view, b) male adult, lateral view, c) male adult, ventral view; *Cercopis intermedia*: d) male adult, dorsal view, e) male adult, lateral view, f) male adult, ventral view; *Cercopis septemmaculata*: g) male adult, dorsal view, h) male adult, lateral view, i) male adult, ventral view (scale bar = 500 μ m).

The doubtful Syrian record for *C. distincta* (Lallemand, 1912; Nast, 1933) was corrected in subsequent studies (Metcalf, 1961; Nast, 1972; Lodos & Kalkandelen, 1981). It was confirmed as an endemic species for Turkey at least for now by these studies. Despite this the terra typica of this species is unknown and no local record has been found in any publication before this study.

The color pattern descriptions of *C. distincta* show similarities with the previous reports (Melichar, 1896; Nast, 1933). Although, it was stated by Nast that the postclypeus extends beyond the edge of the vertex in dorsal view (Nast, 1933), it is considered that this was due to the incorrect perspective (Figure 5a). In the same study, although the frontal plate was declared to be carinated or traced, this is not the case in our specimens, nor is it mentioned in the original definition (Figure 5a). The entire body of the adult is covered with yellow-brown setulae (Figure 5a-c).

Despite slight differences, the definitions of the wing band and the legs are similar to these publications, however, the red spot in the corium does not appear to touch the claval suture in the illustrations of wings (Nast, 1933). On the contrary, in our specimens, the spot is touching the suture as broadly as in the original definition (Melichar, 1896) (Figure 1a, c). The detailed characteristics of the spots were not provided in either publication.

Again, the male genital structures are not described in detail in these reports. Although parts other than the anal tube are given in Nast's paper, the drawings for the genital plate and the paramere are especially far from sufficient (Figure 7a-e).

Cercopis intermedia was originally described quite simply, then given as a subspecies of *C. sanguinolenta* by Nast (1933) and last revaluated as a valid species by Diabola (1965). Neither of these reports provided images for this species, except the lateral view of its aedeagus (Diabola, 1965). Even if we disregard other ambiguous statements in the original description; the inconsistent matter is: *C. intermedia* species with red knees, has been likened to *Cercopis distinguenda* Kirschbaum, 1868 which is now known to be a synonym of the species *C. sanguinolenta*. Given that the legs of *C. distinguenda* were

described as completely black by the author in the same publication without leaving room for doubt (Kirschbaum, 1868) (Figure 6). The more ironic thing is this apparent characteristic was almost given as the only difference between the nominative subspecies from *Cercopis sanguinolenta intermedia* Kirschbaum, 1868 by Nast (Nast, 1933). Nevertheless, this publication does not mention what the genital differences of these two subspecies are (Figure 7f-j). For many other morphological characters preferred in the definitions, ambiguous or inconsistent expressions were often used. All these problems make the identification key dysfunctional and ineffectual. In the study of Giustina, while there are insufficient images of adults from the dorsally and genital structures only from the lateral of the paramere and the aedeagus, illustrations from other perspectives, and genital structures that will facilitate the diagnosis of the species were not included (Giustina, 1983).



Figure 6. Mating adults of *Cercopis sanguinolenta* (Scopoli, 1763) (Holzinger, 2008).

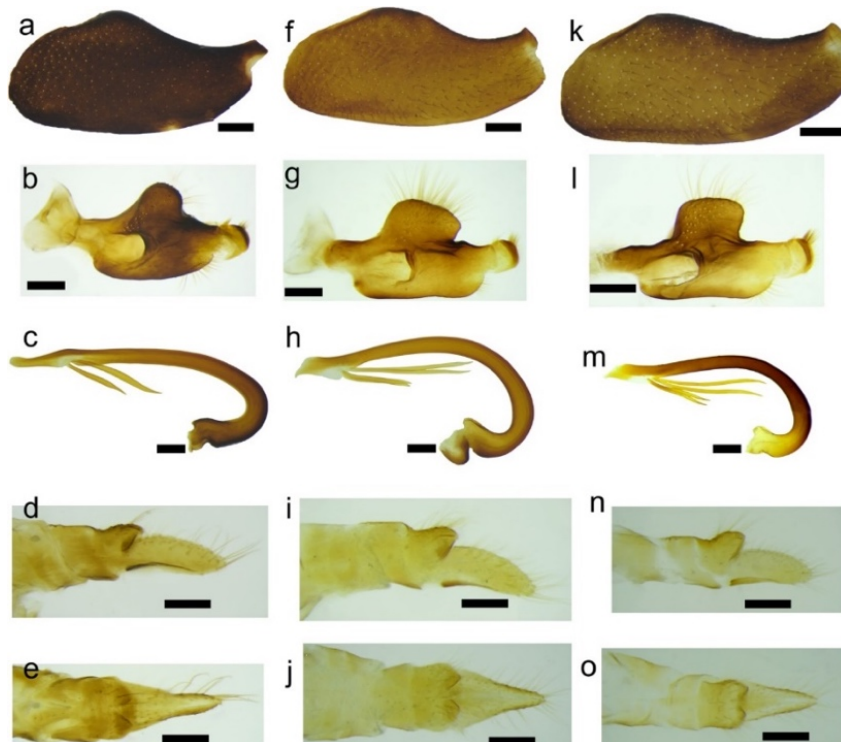


Figure 7. Genitalia parts of *Cercopis* spp.: *Cercopis distincta*: a) ventrolateral view of the left genital plate, b) exterior view of the left paramere, c) lateral view of the aedeagus, d) lateral view of the anal tube, e) dorsal view of the anal tube; *Cercopis intermedia*: f) ventrolateral view of the left genital plate, g) exterior view of the left paramere, h) lateral view of the aedeagus, i) lateral view of the anal tube, j) dorsal view of the anal tube; *Cercopis septemmaculata*: k) ventrolateral view of the left genital plate, l) exterior view of the left paramere, m) lateral view of the aedeagus, n) lateral view of the anal tube, o) dorsal view of the anal tube (scale bar = 250 μ m).

Considering the current distributions of *C. sanguinolenta* and *C. intermedia* species, which are often confused due to color, pattern and size similarities; While *C. sanguinolenta* mostly occurs in the countries in the middle and north of the Western Palearctic Region, it is seen that the *C. intermedia* species is stuck in the middle and south border of the same region. The color pattern convergence of both species cause the existing uncertainty especially where their occurrence overlap and it is considered that this problem remains in many regions. Therefore, locality records given in the past for both species from the north and northwest of Turkey should be reviewed using freshly collected specimens from these regions.

The incorrect local records provided for *C. intermedia* in previous studies (Lodos & Kalkandelen, 1981; Kartal et al., 1994) have been identified or corrected. Accordingly, Bitlis, İstanbul, Niğde and Trabzon Provinces were removed from the distribution of this species, and Tokat, Aksaray and Gümüşhane Provinces added.

Austria, Czech Republic, Hungary, Poland, Romania and Slovakia given by Önder et al. as the Palearctic distribution of *C. intermedia* are not included in this publication because the source details were not specified (Önder et al., 2011).

The adults of *C. intermedia* can be collected from annual plants like *Astragalus* L., *Onopordum* L., *Verbascum* L., *Medicago sativa* L. and trees such as *Pistacia vera* L., *Prunus domestica* L., *Acacia* spp., *Salix* spp. and *Alnus* spp. from the start of May until the beginning of August (Lodos & Kalkandelen, 1981).

With the exception of the simple description made by Melichar for three samples collected from Palestine and material provided by Dlabola (Dlabola, 1965), there is no available data on *C. septemmaculata*. In Melichar's description, this species is illegitimately associated with *Triecphora sanguinolenta* Linnaeus, 1767 which has no validity today. Also, in his study, Dlabola provided a drawing of only the lateral view of the aedeagus and made a description with no useful distinction from the original but only shortened (Dlabola, 1965). Although Nast considered this species to be one of the three melanotic aberrations of *C. intermedia* (Nast, 1933), when the morphological and male genital structures of adults were examined (Figure 7k-o), it is concluded that is completely different.

Although this species is fundamentally given as a new record for Turkey (Lodos & Kalkandelen, 1988) (Figures 4 & 8), it has always been considered doubtful because of data deficiencies (date, collector, number of specimens etc.). Consequently, this record is the first regional and complete locality record for this species. Addition to this, if all these deficiencies was ignored and the distribution information given is processed on the map, it is clear that occurrence in the provinces of İzmir and Kastamonu would be inconsistent with the current distribution of the species and its known habitats. Therefore, it is considered appropriate to exclude these provinces from the distribution information of this species until proven otherwise. It is clear from the original work that Leopold MELICHAR did not select either of his specimens as a holotype for *C. septemmaculata*, so their syntype status is preserve until a lectotype is designated.

Family: Cercopidae Leach, 1815.

** Cercopis septemmaculata (Melichar, 1903).

Distribution: Adana (Ceyhan), İzmir (Bozdağ), Kastamonu (İnebolu), Mardin (Ömerli), Siirt (Aydınlar).

** Poophilus nebulosus (Lethierry, 1876).

Distribution: Mardin (Cizre, Hasankeyf).

Figure 8. An image of the record given by Lodos & Kalkandelen (1988).

The Turkish *Cercopis* Fabricius, 1775 identification key below was created by joining the two other species occurring in Turkey [*Cercopis vulnerata* Rossi, 1807 and *C. sanguinolenta*] with the redescribed species in this study.

Turkish *Cercopis* Fabricius, 1775 Identification Key

1. All leg segments black (Figure 1b)..... 2
 - Femora and tibiae half red (Figure 1e, h)..... 4
2. Ratio of black and red nearly equal, transverse red stripe at the back tip of the wing thick forming horseshoe shape on wing corium... ***C. vulnerata***
 - Black predominant over red with thin, more or less curled, transverse red stripe on the rear tip of the wing..... 3
3. Connexiva of the ventral plates red with central black spot..... ***C. sanguinolenta***
 - Connexiva of the ventral plates completely red (Figure 1b)..... ***C. distincta***
4. Postclypeus without lateral keel (Figure 5h, i) ***C. septemmaculata***
 - Postclypeus with two lateral keels (Figure 5e, f)..... ***C. intermedia***

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