



The genus *Maiestas* Distant, 1917 (Hemiptera, Cicadellidae, Deltocephalinae, Deltocephalini) in Iran, with a new record for the Palearctic region

Maliheh Khosravi¹ , Soltan Ravan¹ , Fariba Mozaffarian² & Michael R. Wilson³

1- Department of Plant Protection, College of Agriculture, University of Zabol, Zabol, Iran

✉ maliheh_khosravi@yahoo.com

<https://orcid.org/0009-0004-3051-6638>

✉ soltanravan@gmail.com

<https://orcid.org/0009-0004-9113-6815>

2- Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection, Agricultural Research, Education and Extension Organization, Tehran, Iran

✉ faribamozaffarian@gmail.com

<https://orcid.org/0000-0003-0163-7997>

3- Department of Natural Sciences, National Museum of Wales, Cardiff, CF10 3NP, UK

✉ mike.wilson@museumwales.ac.uk

<https://orcid.org/0000-0002-4052-6993>

Abstract. The present study is focused on the species belonging to the genus *Maiestas* Distant, 1917 (Hemiptera: Cicadellidae: Deltocephalinae, Deltocephalini) in Iran, based on some specimens collected during 2016 to 2019 from Southeast Iran and species that have been previously reported: *M. borvathi* (Then, 1896), *M. pruthii* (Metcalf, 1967), *M. schmidtgeni* (Wagner, 1939), and *M. trifasciata* (Lindberg, 1954). *M. pruthii*, previously known from the Oriental region (India and Pakistan), is recorded for the first time in the Palearctic region from Southeast Iran and *M. borvathi* is a new record for the fauna of Sistan and Baluchestan Province. An identification key and distribution maps for the Iranian *Maiestas* species are provided.

Keywords: Auchenorrhyncha, fauna, taxonomy, diversity, leafhopper, Sistan and Baluchestan

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Introduction

Deltocephalinae is the largest and the most economically important of the 40 known subfamilies of the family Cicadellidae (Ramya *et al*, 2017). It consists of 38 Tribes, 923 genera, and 6683 known species (Zahniser & Dietrich, 2013). These leafhoppers inhabit the grasslands and are abundant and widely distributed in tropical, subtropical, and temperate forest ecosystems (Webb & Viraktamath, 2009). Nielson (1968) listed 151 cicadellid vector species, of which 117 vector species belong to the subfamily Deltocephalinae. Members of this subfamily are also important vectors of plant diseases (Weintraub & Beanland, 2006). Mozaffarian & Wilson (2016) mentioned 232 species within the Deltocephalinae in Iran, categorized into 20 distinct tribes.

The genus *Maiestas* Distant, 1917 together with the genera *Recilia* Edwards, 1922 and *Deltocephalus* Burmeister, 1838 belong to *Deltocephalus* group of the tribe Deltocephalini Dallas, 1870. These taxa are distinguished by the following combination of male genital characters: pygofer without both processes or a posterior comb-like row of spines; subgenital plates separate with macrosetae arising laterally; apical process of style from short to moderately long, hook-like to digitate; connective and aedeagal shaft short to moderately long, the shaft less than 1½ times length of connective, cylindrical or trough-like, without lateral processes or if lateral processes present (subapically) then shorter than adjacent shaft apex, with or without a spine-like apical extension but if present not shelf-like (Webb & Viraktamath, 2009). The genus *Maiestas* was initially established by Distant (1917), with the type species *Maiestas illustris* Distant, 1917 originating from the Seychelles. Webb & Viraktamath (2009) re-assessed the identities of the *Deltocephalus* group taxa, resulting in most species of *Recilia* being transferred to *Maiestas*. Subsequently, Zhang and Duan (2011) revised this group of taxa in China, and currently, the genus comprises 98 species (Duan *et al*, 2017). *Maiestas* can be distinguished from *Deltocephalus* [and *Recilia* also] by a) the aedeagal shaft,

Corresponding author: Maliheh Khosravi (Email: maliheh_khosravi@yahoo.com)



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which is minimally dorsally curved; and b) aedeagus lacks a notch at the apex. In some cases, it may have a thin process or spine with the gonopore situated apically on the dorsal surface (Duan, 2017). Some leafhoppers of the genus *Maiestas* are major pests, as both adults and nymphs feed on plants sap and may transmit some diseases. (Mathur & Chaturvedi, 1980).

The study conducted by Mozaffarian & Wilson (2016) has provided findings regarding a total of three *Maiestas* species *M. horvathi* (Then, 1896), *M. schmidtgeni* (Wagner, 1939), *M. trifasciata* (Lindberg, 1954) in Iran. In the present study, *M. pruthii* (Metcalf, 1967) is added to the existing list of the *Maiestas* species. An identification key to species and distribution maps are provided.

Materials and methods

The *Maiestas* specimens examined have been collected in Southeast Iran during 2016 to 2019. The specimens were generally collected by D- VAC, sweeping net, light traps, and only a few by malaise traps. Morphological terminology follows Dietrich (2005). Digital photographs were taken with a Canon® EOS Kiss X2 digital camera connected to an Olympus® BH2-UMA stereo microscope. Subsequently, the images were post-processed using Adobe Photoshop® CS software. Distribution maps were made using ArcMap 910.2.0.3348, based on the specimens examined and previously published data. The specimens will be deposited in Hayk Mirzayans Insect Museum, Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection, Tehran, Iran (HMIM).

Results

Taxonomic hierarchy

Family Cicadellidae Latreille, 1825
Subfamily Deltocephalinae Dallas, 1870
Tribe Deltocephalini Dallas, 1870
Genus *Maiestas* Distant, 1917
Maiestas Distant, 1917: 312.

Type species: *Maiestas illustris* Distant, 1917

Distribution. Old World (Duan *et al*, 2017).

Remarks. This genus, comprising 98 species, differs from *Deltocephalus* Burmeister and *Recilia* Edwards by the aedeagal shaft being at most only slightly curved dorsally with apex entire and sometimes produced into a thin process or spine with the gonopore apical on the dorsal surface (Duan *et al*, 2017).

***Maiestas horvathi* (Then, 1896) (Fig. 1A- F)**

Thamnotettix horváthi Then, 1896a:193; *Deltocephalus horváthi* Horváth, 1897c:49; *Deltocephalus horvathi* Wagner, 1939a:164; *Recilia horvathi* Dlabola, 1967a; *Maiestas horvathi* Webb & Viraktamath, 2009a:16.

Material examined. Iran, Sistan and Baluchestan province, Chabahar; Dashtiari, Bahu Kalat; (25°42'05"N, 61°25'24"E), 4. iii.2016, D-VAC in the orchard, M. Khosravi leg., 1 male (HMIM).; Sistan and Baluchestan province, Chabahar; Zarabad; (25°41'12"N, 59°19'27"E), 16. iv.2016, D-VAC in the orchard, M. Khosravi leg., 1 male (HMIM).

Diagnosis. Forewing without zig-zag marking and without brown spot on clavus (Fig. 1A, F). Aedeagal shaft broad, not hooked apically in lateral view, subapical ventral margin smooth (Fig. 1C, D); style apophysis not swollen in middle, moderately long, digitate (Fig. 1B); subgenital plate lateral margin slightly convex, with macrosetae, subtriangular (Fig. 1B); connective nearly equal in length to aedeagus (Fig. 1C, D); pygofer lobe with rounded hind margin (Fig. 1E); inner anteapical cell open basally (Fig. 1F).

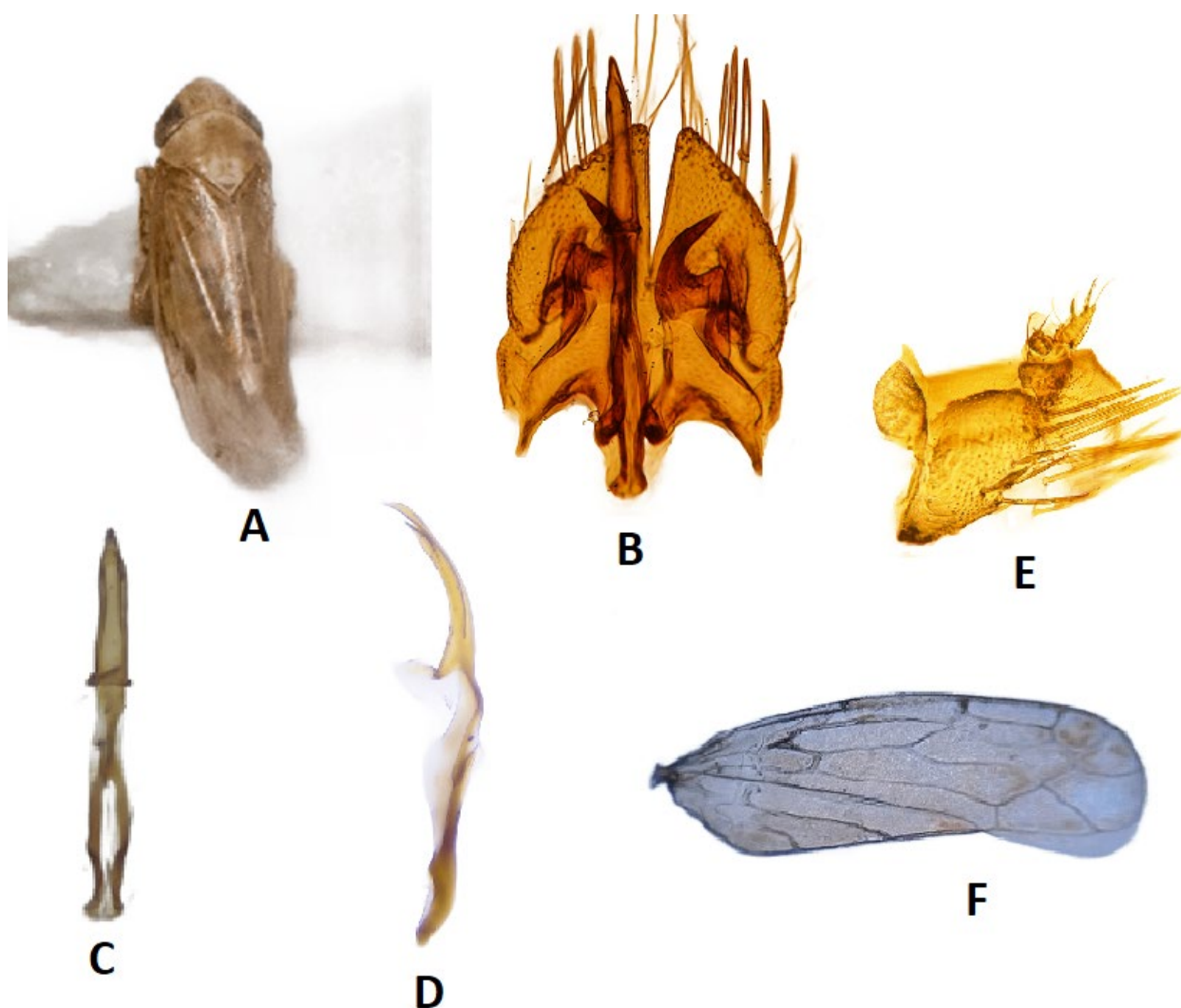


Fig. 1. *Maiestas borvathi* (Then, 1896). **A.** habitus, dorsal view; **B.** style, subgenital plates ventral view; **C.** connective and aedeagus, ventral view; **D.** connective and aedeagus, lateral view, **E.** male pygofer lobe, lateral view; **F.** Forewing.

Distribution in Iran (Fig. 3A). South, southwest, southeast [new record], east and north

(Dlabola, 1981, Mirzayans, 1995; Pakarpour *et al*, 2015; Mozaffarian & Wilson, 2016).

World distribution. **Oriental** (China); **Palearctic** (Austria, Bulgaria, China, Czech Republic, Germany, Hungary, Iran, Italy, Kazakhstan, Korea, Mongolia, Romania, Russia, Serbia, Slovakia, Slovenia, Switzerland, Tunisia, Turkey, Ukraine, Uzbekistan) (Metcalf, 1967; Nast, 1972).

Remarks. This species' range extends from Mongolia to central Europe, where it occurs in rather isolated populations in xerothermic sites (Nickel, 2003). The documented habitat of *M. borvathi* is situated within sunlit or partially shaded areas, characterized by dry and sparsely vegetated inland dunes. These habitats often exhibit patches of disturbance and support a mixture of annual and perennial vegetation. (Nickel & Bückle, 2014).

***Maiestas pruthii* (Metcalf, 1967) (Fig. 2A-E)**

Deltocephalus notatus Singh-Pruthi, 1936a:128; *Deltocephalus pruthii* Metcalf, 1967b:1173; *Deltocephalus (Recilia) pruthii* Dash & Viraktamath, 1998a:31; *Maiestas pruthii* Webb & Viraktamath, 2009a:20.

Material examined. Iran, Sistan and Baluchestan province, Chabahar, Tiskupan (25°21'36"N, 60°37'21"E), 22.v.2016, D-VAC in the natural ecosystem, M. Khosravi leg., 3 males (HMIM).; Sistan and Baluchestan province, Chabahar, Kambel-e Soleyman 25°24'17"N, 60°36'17"E, 10. iv.2016, D-VAC in the natural ecosystem, M. Khosravi leg, 2 males (HMIM).

Diagnosis. Adults are brownish, with variation in head markings. *M. pruthii* can be easily recognized by their reticulate wing pattern, forewings with variation and dark brown pigment thickly deposited near veins (Fig 2A), pygofer oval shape, longer than broader (Fig 2E). Connective linear and fused with aedeagus; aedeagal shaft broad at the base and tapering towards apex upturned dorsal view of aedeagus with the spine-like process. (Fig 2C, D); style base broader, apophysis small stout process without crenulate margin (Fig 2B); subgenital plate triangular with few long setae on outer margin (Fig 2B)

Distribution in Iran (Fig. 3B). Southeast. This species is recorded from Iran for the first time.

World distribution. Oriental (India, Pakistan) (Webb & Viraktamath, 2009). Palaeartic (Iran [new record])

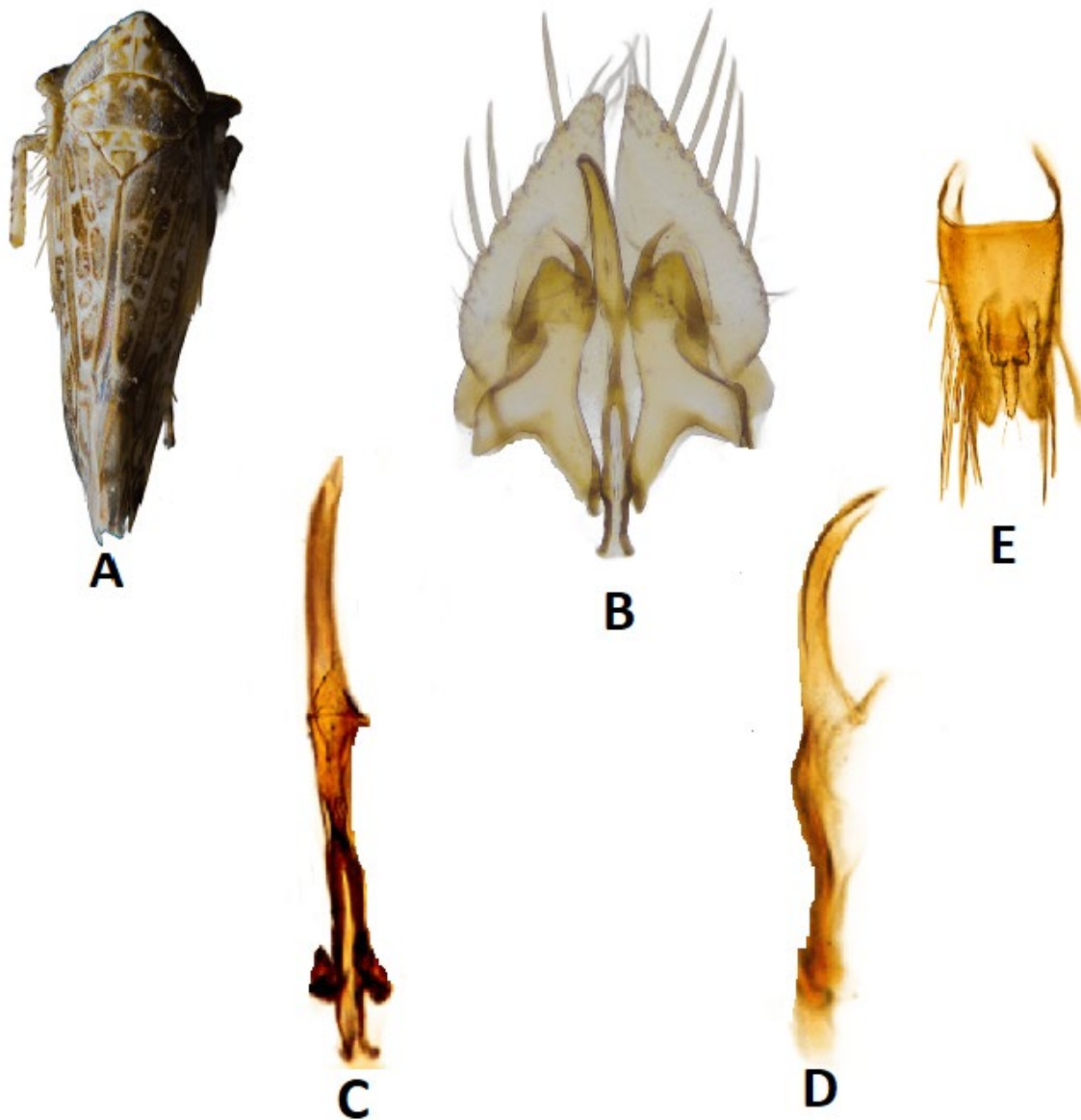


Fig. 2. *Maiestas pruthii* (Metcalf, 1967). **A.** habitus, dorsal view; **B.** style, subgenital plates ventral view; **C.** connective and aedeagus, ventral view; **D.** connective and aedeagus, lateral view, **E.** male pygofer lobe, dorsal view

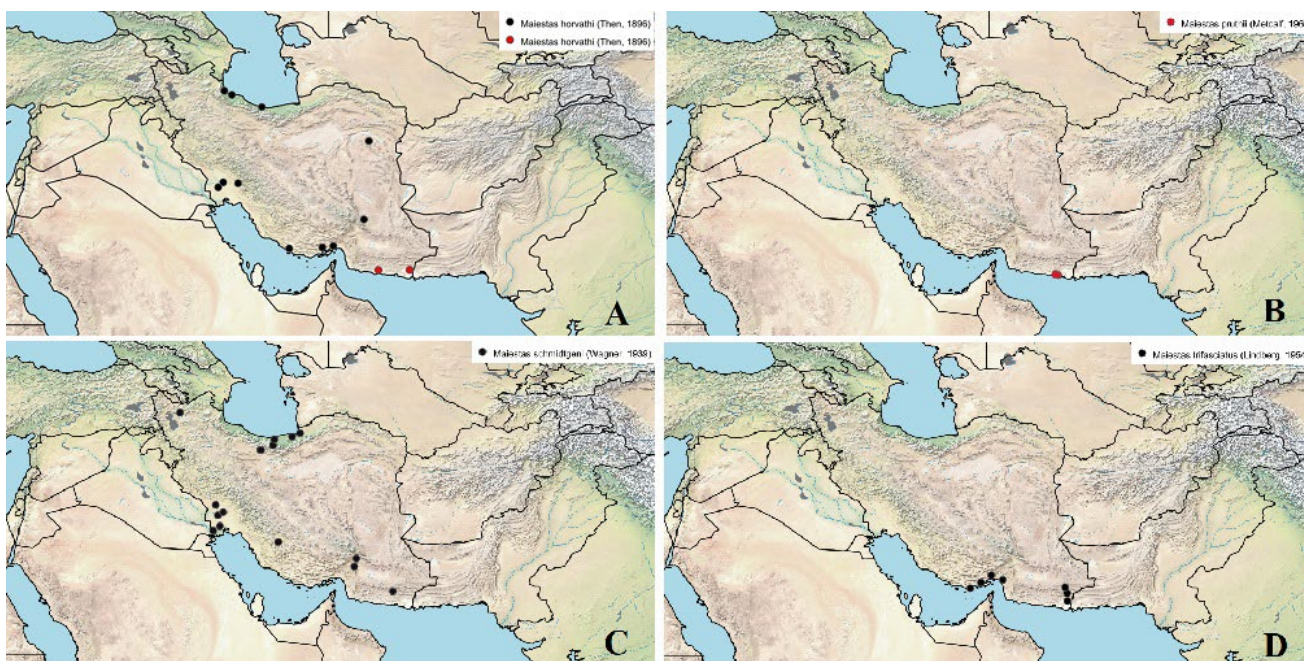


Fig. 3. Distribution maps of *Maiestas* sp. In Iran (black dots: published record, red dots: examined specimens in this study): A. *Maiestas horvathi* (Then, 1896); B. *Maiestas pruthii* (Metcalf, 1967); C. *Maiestas schmidtgeni* (Wagner, 1939); D. *Maiestas trifasciata* (Lindberg, 1954).

Remarks. *M. pruthii* can be easily recognized by reticulate wing pattern, pygofer longer than broad, broader aedeagal shaft than connective and lateral expansion at the base (Ramya *et al*, 2017).

***Maiestas schmidtgeni* (Wagner, 1939)**

Thamnotettix coronifer Fieber, 1872a:11; *Deltocephalus schmidtgeni* Wagner, 1939a:164; *Recilia schmidtgeni* Dlabola, 1948a:5; *Deltocephalus (Recilia) schmidtgeni* Ribaut, 1952a:250; *Maiestas schmidtgeni* Webb & Viraktamath, 2009a:16.

Diagnosis. Aedeagal shaft with ventral margin extending beyond gonopore process-like, without triangular membranous area apically in lateral view; aedeagus without heel at the base of shaft; inner antepical cell closed basally; pygofer lobe with rounded hind margin; subgenital plate with lateral macrosetae (Zhang & Duan, 2011).

Distribution in Iran (Fig. 3C). North, northwest, center, southwest, south, and southeast. (Dlabola, 1960; 1981; Mirzayans, 1995; Pakarpour *et al*, 2015; Mozaffarian and Wilson, 2016).

World distribution. Palearctic (Afghanistan, Albania, Austria, Azerbaijan, Bulgaria, China, Czech Republic, France, Georgia, Germany, Greece, Hungary, Iran, Israel, Italy, Jordan, Kazakhstan, Kyrgyzstan, Malta, Moldova, Morocco, Romania, Russia, Saudi Arabia, Slovakia, Slovenia, Switzerland, Tajikistan, Turkey, Turkmenistan, Ukraine, United Kingdom, Uzbekistan) (Metcalf, 1967; Nast, 1972; Dlabola, 1979)

***Maiestas trifasciata* (Lindberg, 1954)**

Deltocephalus trifasciatus Lindberg, 1954a:212; *Recilia trifasciata* Dlabola, 1994:41; *Maiestas trifasciata* Webb & Viraktamath, 2009a:17.

Diagnosis. It exhibits distinct characteristics, notably a distinctive coloration consisting of a black body adorned with three white bands prominently displayed on the forewings (Zhang & Duan, 2011).

Distribution in Iran (Fig. 3D). South and southeast (Dlabola, 1994; Mozaffarian & Wilson, 2016).

World distribution. Afrotropical (Burkina Faso); **Palearctic** (Canary Islands, Iran, United Arab Emirates) (Metcalf, 1967; Dlabola, 1994; Gnezdilov, 2022).

Key to species of *Maiestas* Distant from Iran (males)

- 1- Forewing with three white bands..... ***Maiestas trifasciata* (Lindberg, 1954)**
 -Forewing without three white bands..... 2

- 2- Aedeagal shaft tubular and dorsal apex with spine like process (Fig. 2C, D)..... *M. pruthii* (Metcalf, 1967)
 - Aedeagal shaft broad at base and tapering towards apex upturned (Fig. 1 D)..... 3
 3- Inner anteapical cell closed basally..... *M. schmidtgeni* (Wagner, 1939)
 - Inner anteapical cell open basally (Fig. 1G)..... *M. horvathi* (Then, 1896)

Discussion

Despite the wide diversity of *Maiestas* (98 species) in the world, the number of species reported in Iran is limited. According to the checklist presented by Mozaffarian & Wilson (2016), three species belonging to the genus *Maiestas*, are reported from Iran. In this study *Maiestas pruthii* is recorded from the Palaearctic region and from the southeast Iran for the first time. However, by comparing the number of known species in Iran and in the world and the climatic diversity of Iran, it is expected that through future comprehensive sampling endeavors, a more precise evaluation of the leafhopper fauna especially the *Deltocephalus* group in Iran can be attained.

An overall look at the distribution map of *Maiestas* species (Fig 3A-D) in Iran indicates that although they have been distributed in the whole country, their richness is much higher in the southeast and even two of them (*M. pruthii* and *M. trifasciata*) are limited to that area.

Emeljanov (1974) included Iran in the Palaearctic region and treated this territory in frame of the Sethian desert region. This biogeographical scheme was followed also by Gnezdilov *et al.* (2014) for Issidae distribution. The region of Baluchestan in southeast of Iran is shared by the three countries Iran, Pakistan and Afghanistan, and connects the Iranian Plateau with the countries of Southeast and Central Asia. This area is arid and hot during summer (Parchami Araghi *et al.*, 2017). The southeast of Iran is a crossroads for three biogeographic regions, the Palaearctic, Oriental and Afrotropical regions, and its fauna is spectacularly diverse and different from that of the rest of the country (Mirzayans, 1995, Parchami Araghi *et al.*, 2017).

The species *M. pruthii* (Metcalf, 1967) is newly recorded from the Palaearctic region and from Iran. The report of *M. pruthii*, from the Oriental territories such as India and Pakistan (Webb & Viraktamath, 2009) implies a potential linkage between the Iranian fauna (in the southeast) and these particular areas. The occurrence of *M. trifasciata* in both the Afrotropical and Palaearctic regions (Metcalf, 1967; Dlabola, 1994) presents a noteworthy subject of investigation and confirms the presence of Afrotropical elements in the southeast of Iran. Because few of the known localities' distribution of *Maiestas* species are in the northeast and eastern of the country, it may indicate the preference of the species to tropical and subtropical and temperate areas.

The distribution patterns of species can be affected by various ecological or historical factors (Morrone, 2015). However, today some events affect natural distribution of many species that are mostly due to human activities such as importing agricultural products or inputs related to them, which causes the transfer of insect species. In particular, there are extensive agricultural exchanges on the common border between Iran and Pakistan.

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معرفی جنس *Maiestas* Distant, 1917 (Cicadellidae, Deltocephalinae, Deltocephalini) در ایران با

گزارش جدید برای منطقه پالئارکتیک

ملیحه خسروی^۱، سلطان رون^۱، فریبا مظفریان^۲ و مایکل ویلسون^۳

۱- گروه گیاهپزشکی، دانشکده کشاورزی، دانشگاه زابل، زابل، ایران

✉ maliheh_khosravi@yahoo.com <https://orcid.org/0009-0004-3051-6638>

✉ soltanravan@gmail.com <https://orcid.org/0009-0004-9113-6815>

۲- بخش رده بندی حشرات، موسسه تحقیقات گیاهپزشکی کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران

✉ faribamozaffarian@gmail.com <https://orcid.org/0000-0003-0163-7997>

۳- بخش علوم طبیعی، موزه ملی ولز، کاردیف، انگلستان

✉ mike.wilson@museumwales.ac.uk <https://orcid.org/0000-0002-4052-6993>

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چکیده

مطالعه حاضر به بررسی گونه‌های متعلق به جنس *Maiestas* Distant, 1917 (Cicadellidae: Deltocephalinae, Deltocephalini) در ایران می‌پردازد. بر اساس گزارش‌های موجود و نمونه‌برداری طی سال‌های ۹۷-۱۳۹۴ از جنوب شرق ایران گونه‌های *M. borvathi* (Then, 1896), *M. pruthii* (Metcalf, 1967), *M. schmidgeni* Wagner, *M. trifasciata* (Lindberg, 1954) و (1939) گزارش می‌شود. گونه *M. pruthii* که قبلاً از منطقه اورینتال (هند و پاکستان) ثبت شده است، برای اولین بار در منطقه پالئارکتیک از جنوب شرق ایران گزارش می‌شود و گونه‌ی *M. borvathi* یک گزارش جدید برای سیستان و بلوچستان است. کلید شناسایی و نقشه پراکنش گونه‌های *Maiestas* در ایران ارائه شده است.

کلمات کلیدی: Auchenorrhyncha، فون، رده‌بندی، زنجبرک، تنوع، سیستان و بلوچستان

نویسنده مسئول: ملیحه خسروی (پست الکترونیک: maliheh_khosravi@yahoo.com)

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