

# Two Species of the Genus *Tibicen* Latreille, 1825 (Hemiptera: Cicadidae) in Iran, with an Identification Key to the Genera of the Family Cicadidae (Hemiptera) in the Country

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**Abstract:** *Tibicen plebejus* (Scopoli, 1763) and *T. esfandiarii* Dlabola, 1970 are the only two species of the genus *Tibicen* in Iran. In this study, the morphology and distribution of both species in the country are compared and an identification key is provided. *Tibicen esfandiarii* is usually larger in size and lighter in colour than *T. plebejus* but overlap in these characters, along with similar male genital structure, can make identification problematic. However, statistically significant morphological differences and geographic separation support the recognition of two species. We discuss a possible evolutionary history in which *T. esfandiarii* may have originated from relict populations of the widespread *T. plebejus*. An identification key for the genera of the Cicadidae in Iran is provided, along with the list of the recorded species of each genus. *Cicadetta naja* Dlabola, 1974 is shown to be *nomen nudum* for *Tettigetia dlabolai* Mozaffarian et Sanborn, 2010.

**Key words:** cicadas, morphology, relict species, Persia

## Introduction

A total of 45 cicada species has been recorded from Iran, including two species of *Tibicen* Latreille, 1825 (type species: *Cicada plebeja* Scopoli, 1763) (GOGALA & SCHEDL 2008, GOGALA *et al.* 2008, MOZAFFARIAN & SANBORN 2010, 2012, 2013, 2015, MOZAFFARIAN *et al.* 2010). *Tibicen* comprises rather large annual cicadas, commonly named dog-day cicadas. The genus previously had a broad distribution across the Nearctic, Palaearctic and Oriental regions (METCALF 1963, NAST 1972, DUFFELS & VAN DER LAAN 1985, SANBORN 2013) but the New World and East Asian species were recently assigned to new genera or synonymised (HILL *et al.* 2015, Lee 2015, SANBORN 2015, WANG *et al.* 2015) leaving six species in the Palaearctic. The genus is currently classified in the subfamily Cicadinae, tribe Cryptotympanini and subtribe Cryptotympanaria (SANBORN 2013) but a petition has been sent to the International Commission of Zoological Nomenclature (BOULARD & PUISSANT

2014; MARSHALL, HILL 2014; SANBORN 2014) that may change the tribal name, as well as suppress *Tibicen* in favour of *Lyristes* Horváth, 1926.

*Tibicen plebejus* (Scopoli, 1763) and *T. esfandiarii* Dlabola, 1970 are the only two species of this genus recorded in Iran (DLABOLA 1970, 1981, NAST 1972, MIRZAYANS *et al.* 1976, LODOS & KALKANDELEN 1981, MIRZAYANS 1995, SCHEDL 1999, ABAIL 2000, MOZAFFARIAN & SANBORN 2010). The species are recognized at the generic level by the head being as wide as or wider than the mesonotum, male timbal organs entirely covered by timbal covers, simple uncus, smooth ventral edge of the pygofer, and the simple and symmetrical penis with a thick aedeagus (EMELJANOV 1967, SANBORN & HEATH 2012). Both species have been recorded as pests on the roots of *Quercus* spp. with mild economic importance (ABAIL 2000). *Tibicen plebejus* is distributed across Europe (from Spain and Portugal to the Caucasus and Greece),

in the Eastern Mediterranean Region, Turkey, Syria, and Iran (METCALF 1963, NAST 1972, SCHEDL 1973, DLABOLA, 1981, DUFFELS & VAN DER LAAN 1985, GOGALA *et al.* 2005, SANBORN 2013). In contrast, *T. esfandiarrii* is currently known to be an endemic species of Iran (MOZAFFARIAN & SANBORN 2010). There are no records available to demonstrate the presence of these two species in countries to the south or east of Iran. Although SALJOQI *et al.* (2010) mentioned *Tibicen* spp. as pests in vineyards of Afghanistan, the authors did not identify the species and did not discuss the morphology of the examined species. Based on other comments in the manuscript it is doubtful they were working with a species of *Tibicen*.

Due to the widespread distribution of *T. plebejus*, the species is well known (e.g., BOULARD & MONDON 1996, SUEUR *et al.* 2004, PUISSANT 2006). *Tibicen esfandiarrii*, in contrast, was described by DLABOLA (1970) from Fars Province in the south of Iran, and in spite of its resemblance to *T. plebejus*, a diagnosis for *T. plebejus* was not presented resulting in some misidentifications in collections (see below). *Tibicen esfandiarrii* has appeared rarely in the literature since then (see references in DUFFELS & VAN DER LAAN 1985, SANBORN 2013) with little published on the biology of the species. In the current study, in addition to an identification key to the genera of the family Cicadidae in Iran, the morphology and the distribution of the two *Tibicen* species in Iran are compared, and a possible evolutionary history between the two species is suggested.

## Materials and Methods

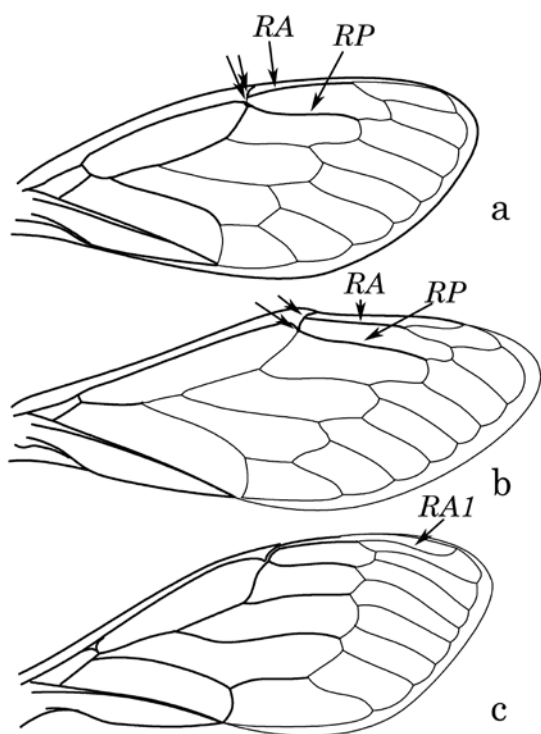
A total of 56 male and 49 female specimens of *T. esfandiarrii*, and 24 male and 51 female specimens of *T. plebejus* from Iran were examined. Morphological data were compared between species using a two-tailed t-test. The specimens were deposited in the Hayk Mirzayans Insect Museum, Tehran, Iran (HMIM) and Sanborn Collection, Miami Shores, Florida, USA (AFSC). Measurements were made using Vernier callipers. The distribution map for both species was produced using ArcMap, Version 9.3, using the localities recorded in publications and on the labels of specimens examined for this work. Some of the locality information that was not already georeferenced in the recorded publications and on the labels were translated to lat/long point coordinates for mapping using Encarta World Atlas and Road Atlas of Iran (GITASHENASI GEOGRAPHICAL AND CARTOGRAPHIC INSTITUTE 2011). Statistical analyses were performed with InStat 3 for the Macintosh. A dichotomous identification key to the genera of Cicadidae of Iran and

genus *Tibicen* was generated according to the literature and examining specimens from the collection of the Hayk Mirzayans Insect Museum.

## Results

### Identification key to the genera of the family Cicadidae in Iran

- 1-Basal cell of forewing quadrangle ..... 2
- Basal cell of forewing pentagonal ..... 7
- 2-Male timbals entirely or almost entirely covered ..... *Platypleura* [*P. testacea* (Walker, 1858)]
- Male timbals exposed ..... 3
- 3-Veins R+M and CuA on forewing originated from basal cell with a common stem ..... 4
- Veins R+M and CuA on forewing originated from basal cell without a common stem ..... 6
- 4-Common stem of veins CuA and R+M on forewing nearly as long as arculus ..... *Cicadivetta* [*C. tibialis* (Panzer, 1798)]
- Common stem of veins CuA and R+M on forewing significantly longer than arculus ..... 5
- 5-Fore femora with three teeth and one smaller one near apex; veins RA and RP in forewing arising nearly from the same point on node (Fig. 1a) ..... *Tettigetia* [*T. dlabolai* Mozaffarian et Sanborn, *T. golestani* Gogala et Schedl, 2008, *T. megalopercula* Mozaffarian et Sanborn, 2012 and *T. safavii* Mozaffarian et Sanborn, 2012]
- Fore femora with two teeth and one smaller one near apex; veins RA and RP in forewing arising from separate points of node (Fig. 1b)..... *Melampsalta* [*M. caspica* (Kolenati, 1857), *M. fraseri* China, 1938, *M. musiva* (Germar, 1830) and *M. sinuatipennis* (Oshanin, 1906)]
- 6- Vein RA1 and consequent apical cell in forewing spoon-like (Fig. 1c)..... *Pagiphora* [*P. annulata* (Brulle, 1832)]
- Vein RA1 and consequent apical cell in forewing not spoon-like..... *Cicadetta* [*C. montana* (Scopoli, 1772). A name *C. naja* Dlabola, 1974 was published in MIRZAYANS (1995) but was never described. Examining a paratype deposited in Hayk Mirzayans Insect Museum (Tehran) and also photos of other paratypes in the National Museum of Natural History (Paris) confirmed this name as *nomen nudum* for *Tettigetia dlabolai*.]
- 7-Male timbals completely covered by timbal covers ..... *Tibicen* [*T. esfandiarrii* Dlabola, 1970 and *T. plebejus* (Scopoli, 1763)]
- Male timbals partially or entirely exposed ..... 8



**Fig. 1.** Forewings of a) *Tettigetia dlabolai* b) *Melampsalta caspica* c) *Pagiphora an* (RA) radius anterior; (RP) radius posterior.

- 8-Forewing whitish; male operculum very short, not longer than meracanthus ..... *Paharia* [*P. putoni* (Distant, 1892)]
- Forewing hyaline; male operculum with normal size ..... 9
- 9- Fore femora with two denticles ..... *Cicada* [*C. ornii* Linnaeus, 1758]
- Fore femora with three denticles ..... 10
- 10-Head prominent anteriorly, rostrum nearly reaching posterior edge of prothorax ..... *Adeniana* [*A. longiceps* (Puton, 1887)]
- Head not prominent anteriorly, rostrum nearly reaching posterior end of mesothorax ..... 11
- 11- Apical edge of first cubital cell of hindwing as long as apical edge of second cubital cell .... *Tibicina* [*T. haematodes* (Scopoli, 1763)]
- Apical edge of first cubital cell of hindwing much longer than apical edge of second cubital cell .... 12
- 12- Dark infuscation present on apical cross veins of forewing ..... *Psalmocharias* [*P. flava* Dlabola, 1970, *P. plagifera* (Schumacher, 1922) and *P. querula* (Pallas, 1773)]
- Dark infuscation absent on apical cross veins of forewing ..... 13
- 13-Male timbals without any timbal cover and entirely exposed ..... *Klapperichicen* [*K. acoloratus* Dlabola, 1960, *K. turbatus* (Melichar, 1902) and *K. viridissimus* (Walker, 1858b)]

- Males timbals with timbal covers ..... 14
- 14-Timbal covers very short and male timbals entirely exposed ..... *Chloropsalta* [*C. ochreatea* (Melichar, 1902), *C. smaragdula* Haupt, 1920 and *C. viridiflava* (Distant, 1914)]
- Timbal covers larger and male timbals partially covered ..... *Cicadatra* [*C. alhageos* (Kolenati, 1857), *C. atra* (Olivier, 1790), *C. barbodi* Mozaffarian et Sanborn, 2013, *C. bistunensis* Mozaffarian et Sanborn, 2010, *C. genoina* Dlabola, 1979, *C. hagenica* Dlabola, 1987, *C. hyalina* (Fabricius, 1798), *C. kermanica* Dlabola, 1970, *C. lorestanica* Mozaffarian et Sanborn, 2010, *C. mirzayansi* Dlabola, 1981, *C. naja* Dlabola, 1979, *C. pazukii* Mozaffarian et Sanborn, 2013, *C. persica* Kirkaldy, 1909, *C. platyptera* Fieber, 1876, *C. ramanensis* Linnavuori, 1962, *C. shapur* Dlabola, 1981, *C. vulcania* Dlabola et Heller, 1962 and *C. zahedanica* Dlabola, 1970. An identification key for the Iranian species of the genus was published in MOZAFFARIAN & SANBORN (2015)]

### Genus *Tibicen* Latreille, 1825

In spite of the similarity of the external morphology and the male genitalia of the two species of the genus *Tibicen* in Iran, the diagnoses characters between them have not been published. Studies on the specimens collected from different parts of the country showed significant differences in size and colour between the two species (Table 1). However, the variation of specimens in the populations showed overlap areas for these differences (Table 1, Figs. 2–7).

### Identification key to the species of the genus *Tibicen* in Iran

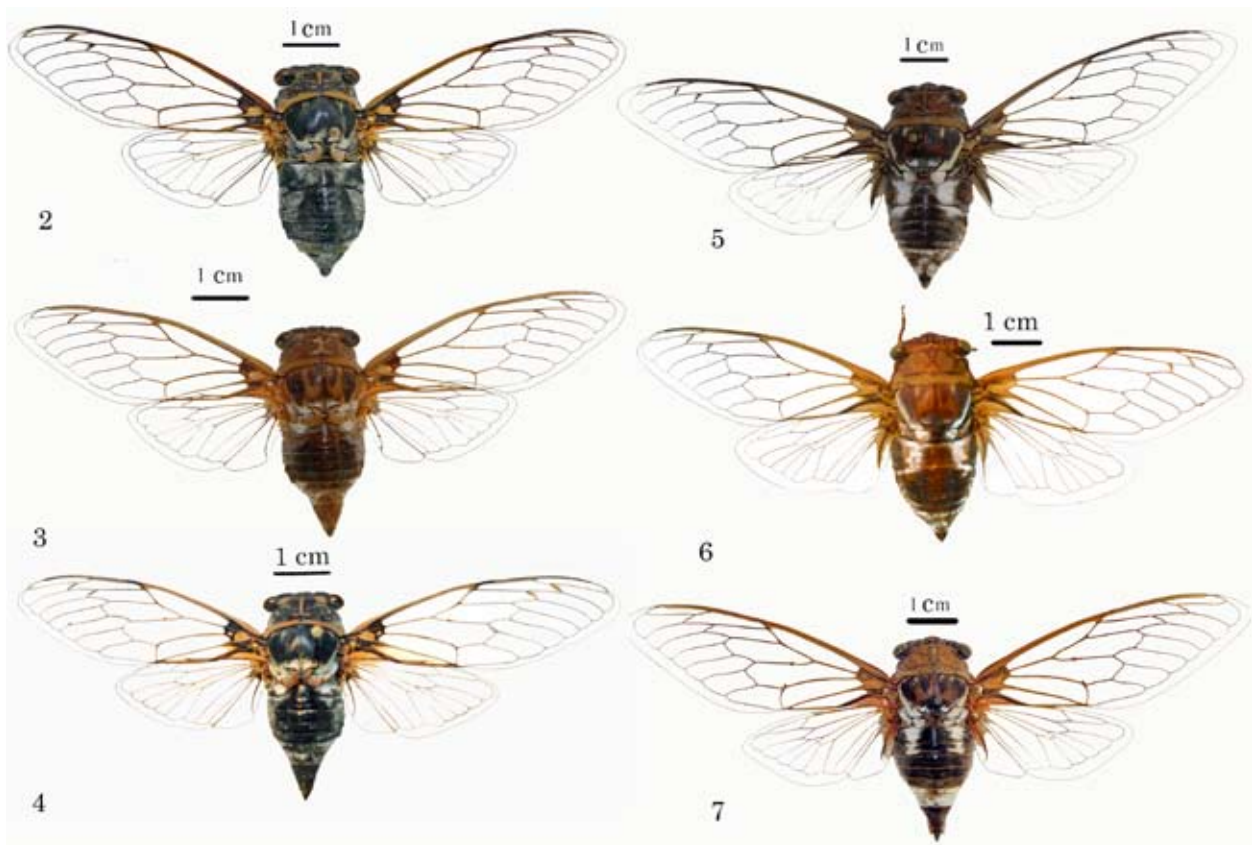
- 1- Pronotal collar rather narrow (Figs. 2–4). Dorsal beak of male pygofer straight (Fig. 8a); Male uncus with rectangular notch in lateral view (Fig. 8a). Aedeagus as in Fig. 8d; male sternite VIII with straight dorsoposterior margin (Fig. 9a); female sternite VII with notch beginning at or medial to base of gonocoxite IX (Fig. 9b) ..... *Tibicen plebejus*
- Pronotal collar rather broad (Figs. 5–7). Dorsal beak of male pygofer slightly curved to strongly bent inwardly (Fig. 8b and c). Male uncus with small curved notch in lateral view (Fig. 8b); Aedeagus as in Fig. 8e; male sternite VIII with curved dorsoposterior margin (Fig. 9c); female sternite VII with notch beginning lateral to base of gonocoxite IX (Fig. 9d) ..... *Tibicen esfandiarii*

### *Tibicen esfandiarii* Dlabola, 1970

*Tibicen esfandiarii* DLABOLA, 1970: 95; NAST (1972), DLABOLA (1970, 1981), MIRZAYANS

**Table 1.** Morphological differences and their overlaps between *T. plebejus* and *T. esfandiarrii*. Statistics are reported as mean  $\pm$  standard deviation with range in parentheses. All species pairs are statistically significant at  $P < 0.0001$ 

Morphological variable	<i>Tibicen plebejus</i> (Scopoli, 1763)	<i>Tibicen esfandiarrii</i> Dlabola, 1970	t value	Observed overlap
Male body length (mm)	33.10 $\pm$ 1.385 (30.10–35.00), n= 27	38.67 $\pm$ 1.858 (34.60–42.70), n= 48	13.564 (d.f.=73)	34.60–35.00
Female body length (mm)	33.84 $\pm$ 1.986 (29.90–37.26), n=18	37.73 $\pm$ 1.738 (33.00–42.16), n= 52	7.878 (d.f.=68)	33.00–37.26
Male forewing length (mm)	42.34 $\pm$ 1.610 (38.74–45.00), n= 27	50.02 $\pm$ 2.255 (45.00–55.06), n= 48	15.573 (d.f.=73)	45.00
Female forewing length (mm)	42.85 $\pm$ 1.868 (39.00–46.4), n= 18	49.59 $\pm$ 2.483 (42.00–54.12), n= 52	10.513 (d.f.=68)	42.00–46.4
General colour of body	Black to dark brown, with yellow patterns. (Figs. 2–4)	Light to dark brown with yellow patterns. (Figs. 5–7)		Dark brown
Colour of pronotum	Black to light brown (Mostly black and dark brown; Figs. 2–4)	Light to dark brown (Mostly light brown Figs. 5–7)		Dark brown

**Fig. 2-7.** General appearance of male and female of *T. plebejus*: 2) male; 3 and 4) female, *T. esfandiarrii*: 5 and 6) male; 7) female

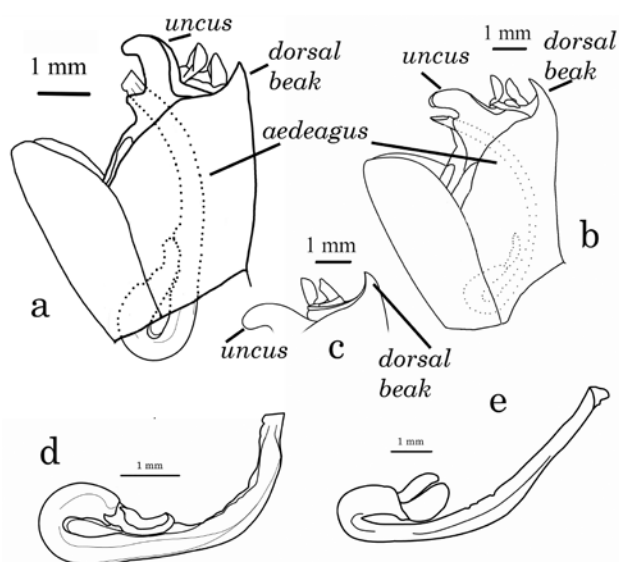
*et al.* (1976), MIRZAYANS (1995), ABAIL (2000), MOZAFFARIAN & SANBORN (2010).

*Tibicen plebejus* (Scopoli, 1763): Misidentification of two female specimens collected from Hormozgan in MOZAFFARIAN & SANBORN (2010).

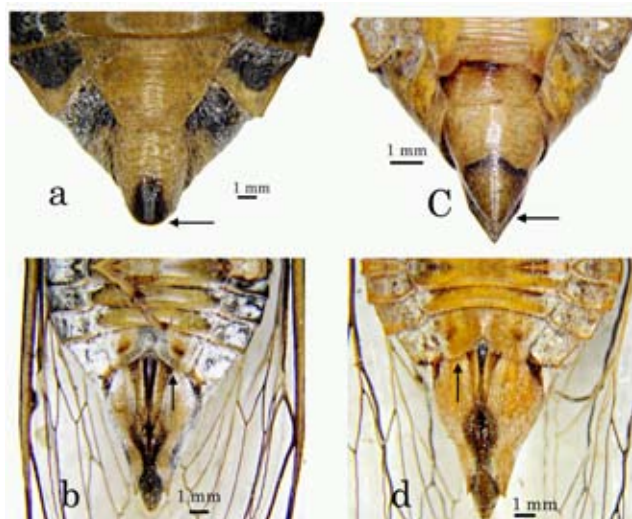
Specimens examined:

Chaharmahal va Bakhtiari Province: Ardal,

Dopolan, Mashayekh Bakhtiar, 24.VI.2005, leg. Zahir/ Nematian/ Falsafi, one ♂ (HMIM); Bazoft, 1510 m a.s.l., 30.VII.2002, leg. Ghayourfar/ Hajiesmailian, one ♀, one ♂ (HMIM); Lordegan, 1615 m a.s.l., 1.VIII. 2002, leg. Ghayourfar/ Hajiesmailian, one ♂ (HMIM); Mavarz, Bazoft, 1450 m a.s.l., 19–20.VIII.1995, leg. Mirzayans/ Badii, 33 ♀♀, 17 ♂♂ (HMIM).



**Fig. 8.** Male genitalia of *Tibicen* spp. in Iran. Male pygofer: a) *Tibicen plebejus* b,c) *Tibicen esfandiarii* Aedeagus: d) *Tibicen plebejus* e) *Tibicen esfandiarii*



**Fig. 9.** Ventral view of terminal abdominal segments of *T. plebejus*: a) male b) female *T. esfandiarii*: c) male d) female

Fars Province: Fasa, Mianjangal, 1800 m a.s.l., 4.VI.2001, leg. Ebrahimi/ Mofidi/ Osten, two ♂♂ (HMIM); Firuzabad, 2.VI.1972, leg. Kashkuli, three ♂♂ (HMIM); Javark, 4.VII.1967, leg. Kashkuli, nine ♂♂, four ♀♀ (HMIM, one ♂ AFSC); Kazerun, Chah- Chenar, LT, 14.VIII.1976, leg. Abaii, v ♀ (HMIM); Mehkuh, 10.VII.1976, leg. Kashkuli, seven ♂♂, three ♀♀ (HMIM); Shiraz, 110 km of Noudan, 1000 m a.s.l., 14.VII.1975, leg. Abaii, two ♀♀ (HMIM); Shiraz, 18.VII.1964, leg. Haghighi, 1 ♂ (HMIM).

Hormozgan Province: 36 km of E. Gawbandi, Konardan, 210 m a.s.l., 23.IV.1977, leg. Pazuki/ Hashemi, one ♀ (HMIM); Bandarabbas, 14.V.1948,

leg. Fassihi, one ♀ (HMIM); Bandarabbas, 16.VI.1948, Fassihi, one ♀ (HMIM).

Kerman Province: Bonhavieh, N 28° 50' 18.7'', E 56° 51' 31.4'', 2291 m a.s.l., 30.VII.2013, leg. Mozaffarian, two ♂♂ and two ♀♀ (HMIM); Godar e Sabz, N 28° 53' 16.1'', E 56° 50' 9.0'', 2083 m a.s.l., 30.VII.2013, leg. Mozaffarian, five ♂♂ and one ♀ (HMIM).

Kohkiluyeh va Boyerahmad province: 12 km SE of Sisakht, 1920 m a.s.l., 15.8.1978, leg. Pazuki/ Borumand, one ♂, one ♀ (HMIM); Beyza, Tangeh-Tir, 29.V.1966, leg. Kashkuli, four ♂♂ (HMIM); Gavkoshak, 28.VI.1975, 5.VII.1975, leg. Abaii, one ♀ (AFSC); Sisakht, 29.VII.1949, leg. Mirzayans, one ♂ (HMIM).

**Distribution and habitat:** The species is known as an endemic species for Iran and has been collected in the southern part of the country (Fig. 10), from elevation ranging between 210 and 2291 m a.s.l. according to our examined material and the published data (DLABOLA 1970, 1981, NAST 1972, MIRZAYANS *et al.* 1976, MIRZAYANS 1995, MOZAFFARIAN & SANBORN 2010). It has been recorded as a pest on the roots of *Quercus* spp. with mild economic importance (ABAII 2000). According to local people in the Kerman Province, large numbers of specimens of this species emerge in the summers after rather frequent rains in the previous winter, singing together, and they are even eaten by people there. However, no meteorological data and any specimen from a mass emergence are available to confirm the information.

**Etymology:** DLABOLA (1970) described *T. esfandiarii* from specimens collected from Fars Province. He did not mention the etymology in his publication as was common in some publications of the time. We take this opportunity to remind and appreciate Dr Esfandiar Esfandiar (1910–1995), a botanist who was the head of the Iranian Research Institute of Plant Protection during Dlabola's and other members of the Czech scientific expeditions to Iran, as well as some earlier cooperation. HOBERLANDT (1981) acknowledged the Iranian institutions during their trip with special thanks to Dr Esfandiar.

### *Tibicen plebejus* (Scopoli, 1763)

*Cicada plebejus* Scopoli, 1763: 117.

*Lyristes plebejus* (Scopoli, 1763): SCHEDL (1999), LODOS & KALKANDELEN (1981).

*Tibicen plebejus* (Scopoli, 1763): NAST (1972), DLABOLA (1981), LODOS & KALKANDELEN (1981), MIRZAYANS (1995), ABAII (2000), MOZAFFARIAN & SANBORN (2010), MEHDIPOUR *et al.* (2014).

Specimens examined:

Gilan Province: Asalem, 18.VII.1972, leg.

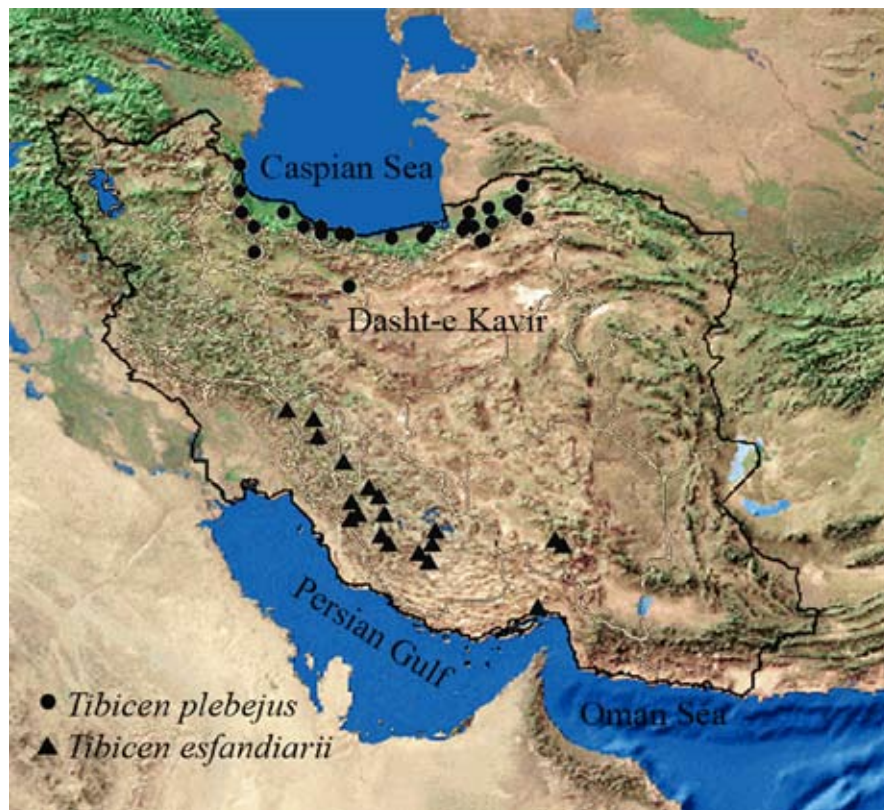


Fig. 10. Distribution map of *Tibicen* spp. in Iran

Abaii, one ♂ (HMIM); Masuleh, Zudel, 720m, 6.VIII.1999, leg. Mofidi/ Badii/ Ebrahimi, one ♀ (HMIM).

Golestan province: 27.VII.1972, Iranshahr, one ♂ (AFSC); Golestan Forest, 24.VI.1965, leg. Dezfulian, one ♂ (HMIM); Golestan forest, Yakhtikalān, 1500 m a.s.l., 20.VII.1996, leg. Nazari/ Ebrahimi, one ♂ (HMIM); Golestan forest, Yakhtikalān, 1550 m a.s.l., 20.VII.1996, leg. Nazari/ Ebrahimi, one ♂ (HMIM); Gonabadkavus, 19.VII.1967, leg. Bayat, one ♂ (HMIM); Gonabadkavus, 19.VII.1967, leg. Bayat, one ♂ (HMIM); Gorgan, Ramian, 12.VIII.1967, leg. Abai, one ♂, one ♀ (HMIM); Gorgan, leg. Lashkari, two ♂♂ (HMIM); Gorgan, S.W. hills, 19.VI.1975, leg. Mashayekhi, one ♂ (HMIM); Gorgan, Shastkola, 28.VII.1996, leg. Nazari/ Ebrahimi, one ♂ (HMIM); Tang-e gol, 700–1000 m a.s.l., 27–28.VI.2000, leg. Barari/ Mofidi/ Deuve, one ♂ (HMIM); Tang-e gol, 700 m a.s.l., 24.VII.1996, leg. Nazari/ Ebrahimi, one ♀ (HMIM); Tang-e gol, 700 m a.s.l., 24.VII.1996, leg. Nazari/ Ebrahimi, four ♀ (HMIM).

Mazandaran province: Babol, 2.VII.1949, leg. Babaii, one ♂ (HMIM); Bastamchal, 27.VI.1965, leg. Dezfulian, one ♂, one ♀ (HMIM); Behshahr, 20.VII.1957, leg. K. M., one ♂ (HMIM); Behshahr, 5.VIII.1947, Esfandiari, one ♀ (HMIM); Behshahr, Gharatappeh, 5.VII.1947, one ♂ (HMIM); Chalus, 27.VII.1967, leg. Kashkuli, one ♂ (HMIM);

Tonekabon, 250 m a.s.l., 22.VII.1980, leg. Hashemi/ Zairi, two ♂♂, three ♀♀ (HMIM, one ♀ AFSC);

Semnan province: Shahrud; Bastam, 27.VI.1965, Dezfulian, one ♂ (HMIM); Shahrud, Bastam, 25.VII.1996, leg. Barari, one ♀ (HMIM).

Tehran: Varamin, V.2006, leg. Jamali, one ♂ (HMIM)

Zanjan: Abhar, Aspas, 1665 m a.s.l., N 36° 09' 39.7", E 49° 06' 20.4", 14.VII.2006, leg. Mozaffarian/ Hajiesmailian, one ♂ (HMIM); Gilvan-Zanjan Rd., Altinkosh, 656 m a.s.l., N 36° 42' 58.7", E 49° 07' 50.7", 12.VII.2006, leg. Mozaffarian/ Hajiesmailian, one ♂ (HMIM).

**Distribution and habitat:** The species is distributed across the Palearctic: Western, Southern, Central, Eastern and South-eastern Europe, Syria, Turkey and Northern Iran (Fig. 10: METCALF 1963, NAST 1972, DLABOLA 1981, LODOS & KALKANDELEN 1981, DUFFELS & VAN DER LAAN 1985, SANBORN 2013, present study). DLABOLA (1981) recognised the species as a Ponto-Mediterranean faunal element. It has been found in Iran on Hyrcanian vegetation and dry forests with *Quercus* spp. and *Parrotia* spp. between 250 and 1665 m a.s.l. (DLABOLA 1981, MIRZAYANS 1995, SCHEDL 1999, MOZAFFARIAN & SANBORN 2010, present study). The species has also been recorded as a pest with mild economic importance on *Quercus* spp. (ABAI 2000). The mass emergence of the individuals

of this species has been recorded by local people in the north of Iran but there is not any specimen from those emerges available to verify the identification.

## Discussion

Comparing the morphology of the two *Tibicen* species in Iran, *T. esfandiraii* can be distinguished from *T. plebejus* by its larger size and the lighter colour. However, studying the morphological variation of a number of specimens of both species, overlapping for the range of size and colour, and other morphological traits were found (Table 1). With respect to the male genitalia, the pygofer, anal styles, uncus and aedeagus were similar except for the potentially bent dorsal beak of *T. esfandiraii*, the different shape of the uncus, the angle of the bent basal part of the aedeagus to the total length (Fig. 8), and the shape of terminal sternites (Fig. 9).

In addition to these morphological differences, the distribution pattern of *T. plebejus* and *T. esfandiraii* in Iran shows a complete geographical separation (Fig. 10). This supports the idea of geographic isolation and the presence of two species. According to our current knowledge, the Palaearctic distribution of *T. plebejus* from Western Europe reaches Northern Iran while the similar species, *T. esfandiraii* occurs only in the southern parts of the Zagros Mountains. Thus, the distribution of *T. esfandiraii* is separated from *T. plebejus* by the central desert of Iran (Dasht-e Kavir). Due to the similar morphology

of the two species, we could speculate that the populations of *T. esfandiraii* are relict populations of the widely distributed *T. plebejus* that were separated as the Dasht-e Kavir began forming in the centre of Iran. STUCKY (2013) discussed a similar case of the sister species *T. neomexicensis* Stucky, 2013 and *T. chiricahua* Davis, 1923, which have similar external morphology and male genital structure and were separated by the Albuquerque Basin and Chihuahuan Desert in North America. GANJI (1978) while studying the geological history of the central deserts of Iran, mentioned the coverage of these lands by extensive lakes during the Tertiary, followed by an arid climate at its end, pluvial conditions, diminished lakes and shortened rivers during the Pleistocene, and desiccation in the post-Glacial climate. The southern parts of the Zagros have already been shown to be a zone rich of endemic species for other groups of Auchenorrhyncha (MOZAFFARIAN 2013), and may be the reason for limiting the distribution of *T. esfandiraii* to the area. However, confirming this evolutionary relationship needs more detailed studies and evidence.

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