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Faunestic study of Biting Midge (Diptera: Ceratopogonidae) from Markazi Province, Iran

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Abstract

The biting midges (Ceratopogonidae) are relatively well studied dipteran family that includes over 6000 extant species in 110 genera. They are known as vectors of several arboviruses of veterinary importance including bluetongue, bovine ephemeral fever, African horse sickness and Akabane virus, as well as the medically important Oropouche virus. A key For Ceratopogonidae of Markazi province is presented. Four genera, 8 subgenera and 9 species were found. 5 species which marked with an asterisk (*), are new records for Iran.

Dasyhelea (*Prokempia*) *flaviventris* * (Goetghebuer, 1910); *D.* (*Dasyhelea*) *malleola* *Remm, 1962; *D.* (*Dicryptoscena*) *modesta* (Winnertz, 1852) [Dasyheleinae]. *Atrichopogon (Psammopogon) bulla** Remm; *A. (Meloehelea) meloesugans** Kieffer; *A. (Atrichopogon) rostratus** (Winnertz), 1852; *A.* (*Atrichopogon*) sp.; *Forcipomyia* (*Forcipomyia*) *rustica* Kieffer, 1919 [Forcipomyiinae]. *Culicoides* (*Monoculicoides*) *puncticollis* (Becker, 1903) [Ceratopogoninae].

Key words: Ceratopogonidae, new records, checklist, Markazi Province

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Introduction

The biting midges (Ceratopogonidae), can make life a misery when they are present in large numbers, and the reaction to their bite is often intense. They are a serious threat to the tourist and leisure industries in several parts of the world, including parts of Scotland, Florida and the Caribbean. They are known vectors of several arboviruses of veterinary importance including bluetongue, bovine ephemeral fever, African horse sickness and Akabane virus, as well as the medically important Oropouche virus (Lehane, 2005).

Biting midges (Ceratopogonidae) are a relatively well studied dipteran family that includes over 6000 extant species in 110 genera (Borkent, 2009). They are small flies, 1-6 mm long, slender to moderately robust, female with biting and sucking mouthparts; bloodsucker of vertebrates or insects, males with plumose antennae, wings held horizontally at rest one above the other, sometimes strongly patterned. Early stages usually found in moist or aquatic habitats; larvae are apneustic, often elongate in form, and a strong swimmer (Downes & Wirth, 1981).

The first contribution to the fauna of Ceratopogonidae of Iran was made by Mesghali (1963) who reported some new records of midges of the genus *Culicoides* from Iran. Navai and Mesghali (1968) reported 26 species of *Culicoides* that 14 species were recorded for the first time in Iran. Navai and Mesghali studied the *Culicoides circumscriptus* Kieffer (Abivardi, 2011). Navai (1970) collected midge from Mazandaran province (in the vicinity of Shahsavar). *Culicoides lailae* Khalaf, was a new record for Iran. Navai (1971; 1973) investigates the genus of *Culicoides* from southern part of Lut Desert and the Persian Gulf area, Iran respectively. Navai (1971) described two new species; Navai (1973) described two new species: *C. mesghalii* and *C. shahgudiani*. Mesghalii and Shahgudiani (1973) reported two new species of *Culicoides* from the Persian gulf area of Iran.

Navai (1974) provides a list of 43 species of *Culicoides* and reviewed their population dynamics in Iran (See Abivardi, 2011). Dominiak & Alwin (2013) described five new species and further new records for Iran, Israel, Lebanon and Yemen. The objective of our research was to determine faunistic study of the Ceratopogonidae of Markazi province. The current study is a part of M.Sc. thesis of the first author.

Material and Methods

The study was conducted in Markazi province, Arak region, Iran. The province is located in the central region of Iran and is surrounded by Esfahan, Lorestan, Hamedan, Qazvin, Alborz, Tehran and Qom provinces (Fig. 1). The unevenness of this province includes the central mountains and parts of the Zagros Mountains Range in the south of the province. Sampling locations were selected to cover different types of habitats across the province.

Fig 1- Location of Markazi province in Iran

The adult flies were collected from different localities of the region (table.1) during 2008-2009. Collection was made during daytime with a sweeping net on crop and laze lands and preserved in ethanol 75%. All specimens examined were mounted in the mixture of phenol and canada balsam using the technique described by Wirth & Marston (1968). Identified specimens are deposited in the collection of Islamic Azad University, Arak Branch and some species deposited in Razi Vaccine and Serum Research Institute of Iran.

Table 1- List of sampling localities in Iran

Locality	X_coordina	Y_coordina	Height(m)
Mahdi abad	347540.84375	3768819.5	1900
Eskan	347681.84375	3772535.25	1916
Hesar	343741.34375	3766915.25	1936
Alborz	341095.84375	3724424.25	1940
Emarat	368560.9375	3748171.75	2006
Gavar	376191.21875	3759296.5	2000
Aman abad	399855.375	3763483.25	1800
Shanagh	N34.01.147	E05012.378	2149
Hafteh	366635.5625	3748372.75	2000
Bazeneh	364218.78125	3749623	2000
Tafresh	N34.40.143	E04958.927	2023

Results

As a result, 4 genera, 8 subgenera and 9 species of Ceratopogonidae were identified, of which 5 asterisked (*) species are new records for Iran.

Checklist and material examined

Subfamily Forcipomyiinae Lenz, 1934

Genus *Atrichopogon* Kieffer, 1906

Subgenus *Psammopogon* Remm, 1979

Atrichopogon (*Psammopogon*) *bulla** Remm, 1980

Material examined: On *Medicago sativa* L., Bazeneh, 10 Oct. 2008 (6♂2♀); On *Medicago sativa* L., Aman abad, 10Oct. 2008(1♂); On *Anethum graveolens* L.,Gavar, 26Sep. 2008(1♀) , Leg. M. Pilvari.

Distribution: Turkmenistan (Mayers, 2014).

Subgenus *Meloehelea* Wirth, 1956

Atrichopogon (*Meloehelea*) *meloesugans** Kieffer, 1922

Material examined: On *Medicago sativa* L., Shanagh, 31May 2009(1♀), Leg. M. Pilvari.

Distribution: Europe, North Africa (Wirth, 1980).

Subgenus *Atrichopogon* Kieffer, 1906

Atrichopogon (*Atrichopogon*) *rostratus** (Winnertz, 1852)

Material examined: On *Trifollium* sp., Mahdi abad, 19Aug.2008 (1♂), Leg. M. Pilvari.

Distribution: Canary Isl., Algeria, Turkey, Italy, Greece, Macedonia, Hungary, Romania, Germany, Poland(Szadziewski and Dominiak, 2006).

Atrichopogon (*Atrichopogon*) sp. indet.

Material examined: On *Medicago sativa* L., Emarat, 22Sep. 2008(1♂), Leg. M. Pilvari.

Genus *Forcipomyia* Meigen, 1818
Subgenus *Forcipomyia* Meigen, 1818
Forcipomyia (*Forcipomyia*) *rustica* Kieffer, 1919
Material examined: On *Medicago sativa* L.*,* Eskan, 26Aug. 2008(1♂); On *Vigna sinensis* End.*,* Hesar, 29Aug2008(1♂); On weeds*,* Tafresh, 11 Jul. 2009(3♀), Leg. M. Pilvari.
Distribution: Mediterranean species recorded from Yugoslavia, Bulgaria, Hungary, Crimea and Caucasus, Algeria (Szadziewski, 1983).

Subfamily Dasyheleinae Lenz, 1934
Genus *Dasyhelea* Kieffer, 1911
Subgenus *Prokempia* Kieffer, 1913
Dasyhelea (*Prokempia*) *flaviventris** (Goetghebuer, 1910)
Material examined: On *Vigna sinensis* End.*,* Hesar, 29Aug.2008 (1♂), Leg. M. Pilvari.
Distribution: Estonia, Lithuania, Germany, Poland, Belgium, Czech Republic, France, Austria, Hungary, Romania, Bulgaria, Spain, Georgia, Azerbaijan, North Korea, Morocco, Algeria (Dominiak & Szadziewski, 2010).

Subgenus *Dasyhelea* Kieffer, 1911
Dasyhelea (*Dasyhelea*) *malleola* *Remm, 1962
Material examined: On *Vigna sinensis* End.*,* Bazeneh, 10Oct. 2008(1♂), Leg. M. Pilvari.
Distribution: Estonia, Germany, Poland, Czech Republic, Ukraine (Crimea), Spain, Andorra, Algeria (Dominiak & Szadziewski, 2010).
Dasyhelea (*Dasyhelea*) sp. indet.
Material examined: On weeds*,* Bazeneh, 1 Jul. 2009(1♀), Leg. M. Pilvari.

Subgenus *Dicryptoscena* Enderlein, 1936
Dasyhelea (*Dicryptoscena*) *modesta* (Winnertz, 1852)
Material examined: On *Zea mays* L.*,* Eskan, 26Aug.2008 (1♀); On *Vigna sinensis* End.*,* Hesar, 29Aug. 2008 (1♂); On weeds ,Hafteh, 26Jun 2009 (1♀); On *Medicago sativa* L.*,* Shanagh, 31May 2009 (1♀); On *Vigna sinensis* End.*,* Bazeneh, 10Oct. 2008 (2♂1♀), Leg. M. Pilvari.
Distribution: Norway, Sweden, Russia (Karelia, Leningrad Oblast, North Ossetia), Estonia, Lithuania, Great Britain, Poland, Germany, Netherlands, Belgium, Czech Republic, France, Switzerland, Austria, Hungary, Romania, Ukraine (Crimea), Bulgaria, Andorra, Spain, Georgia, Azerbaijan, Afghanistan, Iran, China, Japan, Algeria, Egypt and Yemen (Dominiak & Szadziewski, 2010).

Subfamily Ceratopogoninae Newman, 1834
Genus *Culicoides* Latreille, 1809
Subgenus *Monoculicoides* Khalaf, 1954
Culicoides (*Monoculicoides*) *puncticollis* (Becker, 1903)
Material examined: On *Medicago sativa* L.*,* Alborz, 29Aug.2008 (1♀), Leg. M. Pilvari.
Distribution: Balearic Is., Belgium, Britain Is., Corsica, Cyprus, Dodecanese Is., French mainland, Hungary, Italian mainland, Poland, Portuguese mainland, Slovakia, Spanish mainland, Turkey, Ukraine, East Palaearctic, Near East and North Africa (Talavera *et al*., 2011).

Key To the Ceratopogonidae of Markazi Province

1- Empodia_well-developed, at least in female (Fig. 2- b); claws strongly curved. Wing usually with numerous macrotrichia (Fig. 2- d)…..…… ……..……....Forcipomyiinae..2
-Empodia small or vestigial; claws more gently curved (Fig. 2- a). Wing usually with macrotrichia less numerous or absent (Fig. 2- c).....6
2- Costa reaching well beyond middle of wing; cell r_{2+3} usually twice as long as cell r_1; microtrichia large and conspicuous; macrotrichia when present scattered, suberect, not scale-like; fringe of

posterior border of wing simple, consisting of a single row of alternating longer and shorter hairs (Fig. 2- c) ……..……..*Atrichopogon*.3
- Costa short or long; cell r_{2+3}, usually short, but if long distinctly narrow; microtrichia minute; macrotrichia moderately abundant, sloping, often scale-like, covering most of wing; fringe complex, not a single row of hairs (Fig. 2- d)..... *Forcipomyia* (*Forcipomyia*) *rustica* Kieffer, 1919
3- Two seminal capsules present. Eye bare……..…….…… 4
- One seminal capsules present. Eye bare or pubescent…….…...…..……...5
4- Proboscis short, straight or bent anteriorly, making lateral profile of face concave (Fig. 2- l). 3rd palpal segment with sensory pit located at mid length.....
.....*Atrichopogon (Meloehelea) meloesugans* Kieffer, 1922
- Proboscis very long with apex bent posteriorly. 3rd palpal segment with sensory pit located near apex, Caudomedian projection of aedeagus heavily sclerotized, with broad roof let (Fig. 2- n). Thoracic paratergite, in addition to single long bristle, with 1-6 distinct setae (Fig. 2-m), length of larger seminal capsule higher than 180 m. …….....…….
.....*Atrichopogon (Atrichopogon) rostratus* (Winnertz), 1852
5- Abdominal sternite 7 and 8 with armature composed of distinct spines. Eye pubescent. 5th palpal segment usually conical…….…….….. *Atrichopogon* (*Psilokempia*)
- Abdominal without special armature. Eye bare or pubescent. 5th palpal segment with rounded apex; Paratergite with more than 3 setae. Thorax and head bicoloured, yellow and brown; scutum with yellow stripes. Eye bare……..… *Atrichopogon* (*Psammopogon*) *bulla* Remm, 1980
6- Flagellomeres sculptured (Fig. 2- k).Cell r_1 nearly or completely closed; cell r_{2+3} squareended, usually ending at or before middle of wing, sometimes closed (Fig. 2- d). Female claws small and equal (Fig. 2- a)…… …….…….Dasyheleainae.8
- Flagellomeres not sculptured. Either cell r_1 or cell r_{2+3} or both well-developed (except in Rhynchohetea and Brachypogon); cell r_{2+3} not markedly square-ended, ending beyond middle of wing (except- in- Paradasyhelea). Female claws various ……..…..Ceratopogoninae.7
7- Cells r_1 and r_{2+3} usually well-formed; C usually extending past middle of wing; wing comrnonly adorned with pale or dark spots. Palpus five-segmented; female mouthparts usually fitted for bloodsucking, with mandible tooth; Spermatheca elongate to U-shaped with large opening to duct (Fig. 2- h). Female without sensorial on flagellomeres 9-13. Parameres fused basally (Fig. 2- e). ……..……..… *Culicoides* (*Monoculicoides*) *puncticollis* (Becker, 1903)
- Spermatheca elliptical with narrow opening to duct (Fig. 2- g). Female with sensoria present on some of flagellomeres 9-13. Parameres separate (Fig. 2- f) ……..…*Culicoides* (*Beltanmyia*) spp.
8- Wing with two radial cells, Clypeus entire with lateral lobes, Fifth palpal segment 1.5 times longer than fourth palpal segment, with two rows of long Setae. *Dasyhelea* (*Dicryptoscena*) *modesta* (Winnertz, 1852)
- Wing with one radial cell…….....……...…….……9
9- Frontal sclerite broader than long, elliptical, pentagonal or slightly heart-shaped, with long slender ventral projection. Posterior margin of male sternite 9 straight, arch-like or slightly concave. Female antennal flagellomeres elongate, bottle-shaped, with sculptured reticulations; flagellomere 13 with apical prolongation; Apex of gonostylus broad. Female subgenital plate with leaf-shaped notum. (Fig. 2-j) ..... *Dasyhelea* (*Dasyhelea*) *malleola* Remm, 1962
- Frontal sclerite longer than broad, ovoid, with ribbon-like lateral borders, distinctly sclerotized in mid-portion. Posterior margin of male sternite 9 with pincer-like median process. Female antennal flagellomeres short, spherical, only some are slightly reticulated; flagellomere 13 without apical prolongation; Gonostylus with divided apex; submedian processes of aedeagus broad, funnel-shaped (Fig. 2-i) ……..... *Dasyhelea* (*Prokempia*) *flaviventris* (Goetghebuer, 1910)

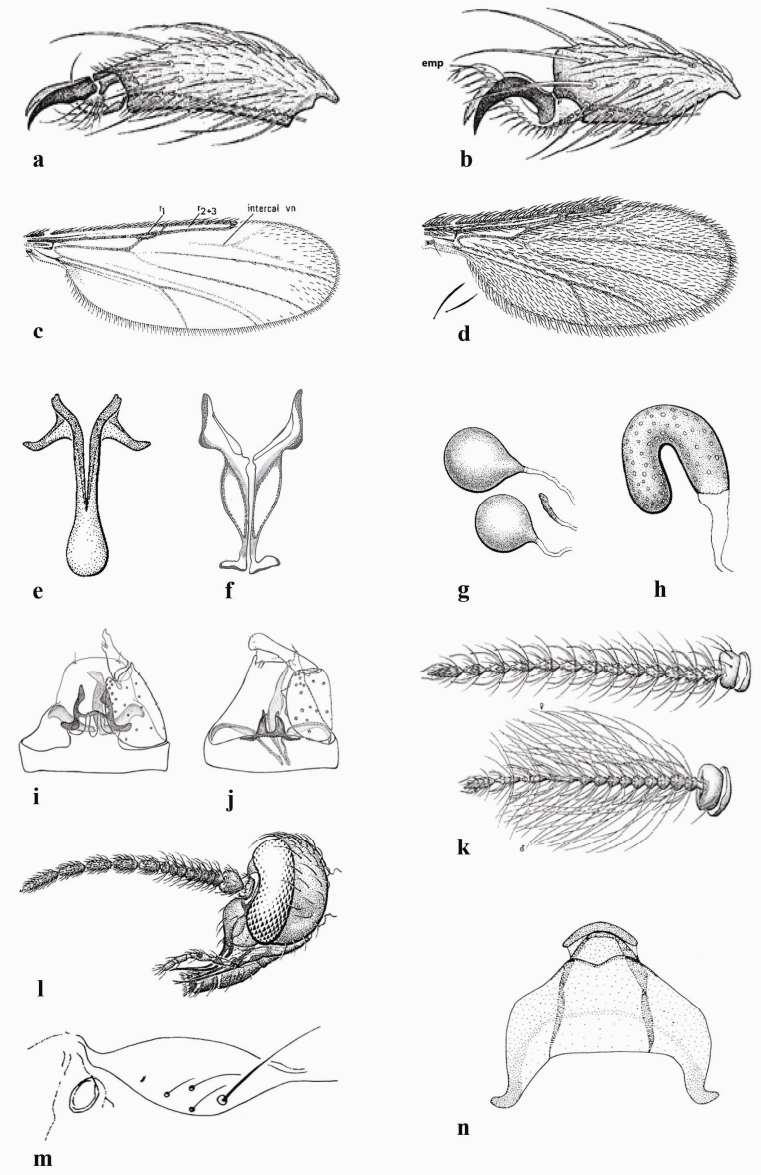

Fig. 2- Pictorial characteristic of Ceratopogonidae: a, b: tarsus (Empodia and claws); c, d: Wing; e,f: Parameres; g, h: Spermatheca; i, j: Male genitalia ;k: antanae (Flagellomeres); l: head (Proboscis); m: Thoracic paratergite; n: aedeagus (Downes & Wirth, 1981).

Discussion

Nine species of this family were found in this region. Two genera, 4 subgenera and 5 species of the subfamily Forcipomyiinae, 1 genera, 3 subgenera and 3 species of the subfamily Dasyheleainae and 1 genera, 1 subgenera and 1 species of the subfamily Ceratopogoninae. Among collected specimens of this family, D. (*D.*) *modesta*, *F.*(*F.*) *rustica* and *A.* (*P.*) *bulla* are most common species. they have been found on most host plant range and different localities.

According to collected data, the species, *A.* (*M.*) *meloesugans*, *A.* (*L.*) *rostratus*, *A.* (*Atrichopogon*) sp., *D.*(*P.*) *flaviventris*, *D.*(*D.*) *malleola*, *D.*(*Dasyhelea*) sp. and *C.* (*M.*) *puncticollis* were rare species. Collected Ceratopogoninae from Markazi province have been found in altitude between 1900- 2149 (m AMSL).

Many species of *Culicoides* have been classified as ornithophilic or mammalophilic, based on collections from caged animals, baited traps or observations. There was no evidence that the *Culicoides* preferred the wild animals to the domestic ones when the differences in host size were considered. This suggests an overall lack of host specificity for these *Culicoides* and opportunism in obtaining a blood meal from available hosts. Number of blood meals that either species of *Culicoides* is capable of taking in nature has not been determined, so the significance of a wide host range on disease transmission is not known (Koch & Axtell, 1979). It seems that the most important collected species (veterinary aspect) is the *C.* (*M.*) *puncticollis.*

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مطالعه فون پشه‌های گزنده (Diptera: Ceratopogonidae) در استان مرکزی، ایران

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چکیده

پشه‌های گزنده خانواده (Ceratopogonidae) به‌خوبی مورد مطالعه قرار گرفته و شامل بیش از ۶۰۰۰ گونه در ۱۱۰ جنس هستند. آن‌ها به‌عنوان ناقلین چندین ویروس (arbovirus) مهم دامپزشکی شامل ویروس زبان آبی (بلوتانگ)، بیماری افریقایی اسب ، آکابان ویروس و ویروس Oropouche در پزشکی شناخته شده‌اند. گزارش‌های جدیدی برای فون سراتوپوگونیدهای ایران به‌همراه کلیدی برای نمونه‌های استان مرکزی ارایه شد. در این مطالعه چهار جنس، ۸ زیرجنس و ۹ گونه یافت شد که ۵ گونه ستاره‌دار، برای ایران گزارش جدید هستند:

Dasyhelea (*Prokempia*) *flaviventris* * (Goetghebuer, 1910); *D.* (*Dasyhelea*) *malleola* *Remm, 1962; *D.* (*Dicryptoscena*) *modesta* (Winnertz, 1852) [**Dasyheleinae**]. *Atrichopogon (Psammopogon) bulla** Remm; *A. (Meloehelea) meloesugans** Kieffer; *A. (Atrichopogon) rostratus** (Winnertz), 1852; *A.* (*Atrichopogon*) sp.; *Forcipomyia* (*Forcipomyia*) *rustica* Kieffer, 1919 [**Forcipomyiinae**]. *Culicoides* (*Monoculicoides*) *puncticollis* (Becker, 1903) [**Ceratopogoninae**].

واژه‌های کلیدی: Ceratopogonidae، گزارش جدید، چک لیست، استان مرکزی

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