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## An overview of the Iranian Chironomidae (Diptera) diversity with an updated checklist with the provincial distribution

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**Abstract.** An assessment of the Iranian Chironomidae diversity with an updated checklist is provided. In total, 65 species from 12 out of 31 provinces of Iran are recorded. Based on the distributional data obtained for these species, much of the biodiversity of this country is unknown, especially for central, south, and eastern regions. The most studied area of the country is Kurdistan Province in the west, with 36 known species, of which three new species and 31 new faunistic records were recently obtained from studies of rivers and streams of this region. Based on the records obtained, we can tentatively report *Boreoheptagyia iranica* Makarchenko, 2020, *Palatovia lorestanica* Makarchenko et Semenchenko, 2020, and *Eraniella kurdistanensis* Namayandeh, Ghaderi, Ghobari et Mohammadi, 2021 described from the Zagros Mountains are endemic to the country. The biogeographical location of Iran and its diverse geography, habitats, and reservoir of freshwaters suggest that the diversity of Iranian Chironomidae is far more than the current estimate. Therefore, there is an urgency in obtaining baseline data on the distribution and taxonomic abundance to understand the Iranian Chironomidae's diversity.

**Key words:** Diptera, Chironomidae, fauna, Iran.

### Обзор иранских хирономид (Diptera: Chironomidae) с обновленным списком видов и распределением по провинциям

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**Резюме.** Приведена оценка разнообразия иранских комаров-звонцов (Diptera: Chironomidae) с обновленным списком видов. Всего зарегистрировано 65 видов для 12 из 31 провинции Ирана. Основываясь на данных о распространении видов, можно констатировать, что биоразнообразие хирономид этой страны остается слабо изученным, особенно в центральных, южных и восточных регионах. Лучше всего фауна Chironomidae исследована в западной провинции Курдистан, где обитает 36 известных видов, из которых недавно в результате изучения рек и ручьев этого региона было описано 3 таксона и указан 31 вид. *Boreoheptagyia iranica* Makarchenko, 2020, *Palatovia lorestanica* Makarchenko et Semenchenko, 2020 и *Eraniella kurdistanensis* Namayandeh, Ghaderi, Ghobari et Mohammadi, 2021, описанные с горной системы Загрос, являются эндемичными для страны. Биogeографическое положение страны, ее разнообразные ландшафты, биотопы и разветвленная сеть пресных водоемов дают основание предположить, что разнообразие иранских хирономид намного превышает текущую оценку. Необходимо дальнейшее изучение таксономического состава и распределения видов для суммирования данных о разнообразии фауны Chironomidae Ирана.

**Ключевые слова:** Diptera, Chironomidae, фауна, Иран.

### Introduction

The modern systematic entomological investigation of Iranian taxa began in 1933 [Abivardi, 2001]. Since then, research on biodiversity of the insect fauna has mainly focused on medically and agriculturally important insects. In the last few decades, as with much of the modern world, Iran has faced major environmental problems affecting its

freshwater, including long drought cycles [Abarghouei et al., 2011; Keshavarz et al., 2013, 2017]. As a result, there is an urgent need for obtaining current baseline knowledge of aquatic fauna, especially environmentally important dipterans such as Chironomidae.

Chironomidae are diverse and abundant insects that play a vital role in sustaining a healthy freshwater ecosystem as a primary food source, and as environmental indicator

species [Cranston, 1995; Ferrington, 2007; Andersen et al., 2013]. The lack of baseline data of Chironomidae biodiversity of Iran can be due to two major factors. First, most Chironomidae taxonomic works conducted in Iran are written in Persian (Farsi) which can limit international readership; secondly, often these studies are conducted on the larval stages only, and with low taxonomic refinement [Mohammadi et al., 2021a, b]. Taxonomic research written in English from other Middle Eastern countries is, by comparison, more numerous, for example, studies from Turkey [Casper, Reiss, 1989; Taşdemir, Ustaoglu, 2009; Taşdemir, 2010a, b, 2012; Taşdemir et al., 2011; Arslan et al., 2013; Akyıldız et al., 2015, 2019; Fındık, Aras, 2016], Kuwait and the United Arab Emirates [Reeves, Epler, 2016], Arabian Peninsula [Cranston, 1989; Cranston, Judd, 1989], and Lebanon [Moubayed-Breil et al., 2012; Moubayed-Breil, Dia, 2017; Moubayed, Langton, 2019].

Based on the published literature, there is no evidence to suggest significantly higher Chironomidae biodiversity in Iran than in other Middle Eastern countries. However, from Iran's diverse geography and habitats, there are probably far more species than currently known. Typically, a Mediterranean climate with some continental influences and subtropical conditions in the southern areas characterizes Iran [Sagheb Talebi et al., 2014]. The Iranian plateau sits at 30°N latitude, and experiences mainly arid and semiarid climates. However, the presence of large mountain chains in the north (Alborz Mountains), west and southwest (Zagros Mountains), and the southeast (Taftan) provide unique microclimatic refuges of more moderate temperatures and high precipitation, and a variety of eozones with unique floral and faunal biodiversity in the region. The existence of mountains in the north and west, provides a large reservoir and network of surface and ground water, ideal habitat for the Chironomidae. In addition, mountains create a mosaic of temperature regimes, resulting in a variety of phytogeographical regions in Iran with variable canopy cover and riparian zones.

In Iran generally, three distinct phytogeographical areas are recognized: the Euxino-Hyrcanian province of the Euro-Siberian region in the north, the Saharo-Sindian region in the south, and the Irano-Turanian region in the western and central sectors of the country [Sabeti, 1976]. The Hyrcanian region, dominated by deciduous broadleaf forests with the natural vegetation of the temperate oceanic-suboceanic areas of West Eurasia, is the relics of primary undisturbed temperate broadleaf forests [Knapp, 2005]. In the Hyrcanian region, Aras, Sefidrud, Qizil Uzun, Chalus, Tajan, Atrak, and Gorganrud rivers are the major lotic systems flowing to the Caspian Sea. In the Irano-Turanian region, dominated by oak forests, Zarinerud, Siminerud, Sirwan, Zayanderud, Karun, Karkhe, and Arvandrud comprise the major lotic systems (i.e., Zagros Mountains), providing up to 40% of the total water resources of the country. Zarinerud and Siminerud rivers flow into Lake Urmia and the remaining aforementioned rivers eventually flow into the Persian Gulf. In the southeast of the country, the Helmand River flows into Hamun Lake at the border with Afghanistan [Sagheb Talebi et al., 2014]. Further south, Mond, Mehran, and Sarbaz rivers are the primary running waters flowing into the Persian Gulf and the Sea of Oman.

Iran also contains numerous standing waters, Urmia in the north, Parishan in the southwest, and Hamun Lake in the southeast being the largest [Sagheb Talebi et al., 2014]. As the second-largest country in the Middle East, with 1.648.195 km<sup>2</sup> surface area, and a surface water area of 116.527 km<sup>2</sup>, 7.1% of the country, making available aquatic habitat seven to ten times more abundant than other countries in the region. For example, the United Arab Emirates has a negligible surface water area. Saudi Arabia has 0.7%, Turkey has 1.3%, and Iraq has 1.1% of its surface areas containing surface waters [United Nations Statistical Division, 2011].

Biogeographically, the location of Iran within the continent has resulted in its being faunistically influenced by other biogeographical realms: the Palaearctic from the north, south by the Afrotropical, and southeast by the Oriental region [Crosskey, 2002; De Moore, Ivanov, 2007; Vafaei et al., 2009; Darilmaz et al., 2017, 2018; Bojková et al., 2018; Gentili et al., 2018; Schneider et al., 2018; Paksa et al., 2019]. Adding to this, diverse freshwater and terrestrial resources, and wide range of geologic complexities has contributed to a high degree of speciation and endemism of fauna in the country. For instance, Schneider et al. [2018] identified 100 autochthonous Odonata taxa and two migratory species in Iran. Of these taxa, they identified about half to be present in Europe, about 20 species having an Oriental or mixed origin, about 12 had African or mixed origin, few were of central or north Asian origin, and seven were endemic to the region. Darilmaz et al. [2017] reported 67 species of Hydraenidae (Coleoptera) with 22 endemic species from Iran, and Gentili et al. [2018] reported 107 species of Hydrophilidae (Coleoptera) with three endemic species from Iran.

There is an urgent for baseline distribution and taxonomic abundance data, in order to understand the diversity of Iranian Chironomidae. This paper provides a necessary starting point for this research, a first checklist of known species from Iran. This is an up-to-date and comprehensive account of the Iranian Chironomidae biodiversity. In our paper, we also identify those regions of the country where these data are lacking, to inform future faunistic studies from those provinces in the central, south, and eastern regions.

## Material and methods

We only included records from English and Persian taxonomic literature and our team's research in Kurdistan Province. The geographic records deemed doubtful were omitted from this study. These records included those that lacked taxonomic identifications and those that their records were from outside the Palaearctic. For instance, records of species identified with distribution only in the Nearctic and without taxonomic description were deemed unreliable. Much of the data obtained for this checklist is through our investigation in Kurdistan Province [Mohammadi et al., 2021a, b; Namayandeh et al., 2021]. Other references used in this study are as follow: Dowling [1979], Fakhri [2001], Ebrahimnezhad, Fakhri [2005], Ashe, O'Connor [2009, 2012a, b], Ebrahimnezhad, Allahbakhshi



Table 1 (completion).  
Таблица 1 (окончание).

Species Виды	Provinces of Iran Провинции Ирана											Type of distribution* Тип распространения*	
	Alborz / Альборз	Chaharmahal and Bakhtiari Чехармахаль и Бахтиярия	Gilan / Гилян	Golestan / Голестан	Isfahan / Исфахан	Kurdistan / Курдистан	Lorestan / Лурестан	Markazi / Маркази	Mazandaran / Мазандеран	Tehran / Тегеран	West Azerbaijan / Западный Азербайджан		Yazd / Йезд
<i>Eukiefferiella gracei</i> (Edwards, 1929)						+							PAL
<i>Eukiefferiella ilkleyensis</i> (Edwards, 1929)						+							HOL
<i>Eraniella kurdistanensis</i> Namayandeh, Ghaderi, Ghojari et Mohammadi, 2021						+							PAL
<i>Lapposmittia parvibarba</i> Edwards, Krüger et Thienemann, 1939					+								PAL
<i>Orthocladius (Euorthocladius) luteipes</i> Goetghebuer, 1938						+							HOL
<i>Orthocladius (Euorthocladius) telochaetus</i> Langton, 1985	+												PAL
<i>Orthocladius (Orthocladius) nitidoscutellatus</i> Lundström, 1915	+												HOL
<i>Orthocladius (Orthocladius) rubicundus</i> (Meigen, 1818)						+							HOL
<i>Paracladius conversus</i> (Walker, 1856)						+							HOL
<i>Parametriochnemus stylatus</i> (Kieffer, 1924)						+							PAL, OR
<i>Rheocricotopus fuscipes</i> (Kieffer, 1909)						+							PAL
<i>Tvetenia clavescens</i> (Edwards, 1929)					+	+							HOL, AF
Chironominae													
<i>Chironomus (Chironomus) albidus</i> Konstantinov, 1956			+	+					+				PAL
<i>Chironomus (Chironomus) "annularius"</i> sensu Strenzke [1959]						+							HOL
<i>Chironomus (Chironomus) anthracinus</i> Zetterstedt, 1860									+				HOL
<i>Chironomus (Chironomus) aprilinus</i> Meigen, 1818											+		PAL
<i>Chironomus (Chironomus) curabilis</i> Beljanina, Sigareva et Loginova, 1990			+										PAL
<i>Chironomus (Chironomus) plumosus</i> (Linnaeus, 1758)			+										HOL
<i>Chironomus (Chironomus) riparius</i> Meigen, 1804			+			+							HOL
<i>Cladotanytarsus atridorsum</i> (Kieffer, 1922)										+			HOL
<i>Cladotanytarsus mancus</i> (Walker, 1856)										+			HOL
<i>Endochironomus albipennis</i> (Meigen, 1830)						+							PAL
<i>Microspectra atrofasciata</i> (Kieffer, 1911)						+							PAL, AF
<i>Microchironomus tener</i> (Kieffer, 1918)						+							PAL
<i>Paratanytarsus natvigi</i> (Goetghebuer, 1933)						+							HOL
<i>Paratendipes albianus</i> (Meigen, 1818)						+							HOL
<i>Polypedilum (Polypedilum) nubeculosum</i> (Meigen, 1804)						+					+		HOL
<i>Rheotanytarsus curtistylus</i> (Goetghebuer, 1921)						+							HOL
<i>Stictochironomus pictulus</i> Meigen, 1830						+							HOL
<i>Tanytarsus ronaki</i> Namayandeh et Ghaderi, 2021						+							PAL
<i>Xenochironomus xenobasis</i> (Kieffer, 1916)						+							NT, HOL

Note. \* – type of distribution: AF – Afrotropical, HOL – Holarctic, NT – Neotropical, OR – Oriental, PAL – Palearctic.

Примечание. \* – тип распространения: AF – афротропический, HOL – голарктический, NT – неотропический, OR – ориентальный, PAL – палеарктический.

[2013], Karami et al. [2014], Ashe et al. [2015], Mirzajni et al. [2015], Arkia et al. [2017a, b, 2019], Tavol Koteri, Mousavi Nadoushen [2018], Salehzadeh et al. [2019], Aydin, Samin [2020], Hourri Parvin et al. [2020], Makarchenko et al. [2020], Tavol Koteri, Alizadeh Sabet [2018].

## Results and discussion

Based on our assessment, 62 Chironomidae genera are reported from Iran, with 27 genera only reported in the larval stage and no confirmed species report. These genera include: *Conchapelopia* Fittkau, 1957, *Nilotanytus* Kieffer, 1923, *Rheopelopia* Fittkau, 1962, and *Trissopelopia* Kieffer, 1923 (Tanypodinae); *Acricotopus* Kieffer, 1921, *Cardiocladius* Kieffer, 1912, *Chaetocladius* Kieffer, 1911, *Euryhopsis* Oliver, 1981, *Heleniella* Gowin, 1943, *Limnophyes* Eaton, 1975, *Nanocladius* Kieffer, 1913, *Paracricotopus* Brundin, 1956, *Paraphenocladius* Thienemann, 1924, *Psectrocladius* Kieffer, 1906, *Pseudosmittia* Edwards, 1932, *Synorthocladius* Thienemann, 1935, *Theinemaniella* Kieffer, 1911 (Orthoclaadiinae), *Beckidia* Sæther, 1977, *Constempellina* Brundin, 1947, *Cryptochironomus* Kieffer, 1918, *Demicryptochironomus* Lenz, 1941, *Glyptotendipes* Kieffer, 1913, *Harnischia* Kieffer, 1921, *Kiefferulus* Goetghebuer, 1922, *Phaenopsectra* Kieffer, 1921, *Robackia* Sæther, 1977, *Stempellina* Thienemann et Bause, 1913, *Zavrelia* Kieffer, Thienemann et Bause, 1913 (Chironominae).

Based on the obtained provincial records (with only 12 out of 31 having records) the total number of species currently reported from Iran is 65 (Table 1). Therefore, it is clear that much of the country is still unexplored, especially provinces in the central, south, and eastern regions (Table 1). Kurdistan Province with total of 36 known species is the most studied area of the country. Recent studies of rivers and streams of this province has yielded three new species and 31 new faunistic records [Mohammadi et al., 2021a, b; Namayandeh et al., 2021].

Mohammadi et al. [2021b] have discussed the biogeography of the Iranian Chironomidae in details. Here we mention that the majority of Chironomidae we recorded from Iran have a Palearctic distribution with 31 species having extended distribution to the Nearctic (Holarctic), 12 to the Oriental, three to the Neotropical, and two to the Afrotropical region (Table 1). Based on the records obtained we can tentatively report *Boreoheptagyia iranica* Makarchenko, 2020, *Palatovia lorestanica* Makarchenko et Semenchenko, 2020, and *Eraniella kurdistanensis* Namayandeh, Ghaderi, Ghobari et Mohammadi, 2021 described from the Zagros Mountains as endemic to the country [Makarchenko et al., 2020; Mohammadi et al., 2021b].

## Correction to the record

Mohammadi et al. described unusually coloured larvae they identified as *Orthocladius* (*Orthocladius*) *pedestris* Kieffer, 1909, based on the characteristic of thoracic horn, visible in the 4<sup>th</sup> instar larva [Mohammadi et al., 2021a: fig. 14]. The colouration pattern of the larva is

similar to those of *Cricotopus* (*Paratrithocladius*) species. However, the morphology of the head places the larva in *Orthocladius*. The mentum characteristic of *Orthocladius* (*Orthocladius*) *pedestris* is quite different than this larva [Hubb Cuppen, personal communication, November 29, 2020]. Therefore, for now, we assign this species from Kurdistan to *Orthocladius* (*Orthocladius*) sp. until we obtain definitive molecular results and adult specimens for further analysis.

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