

Research Article

Discovery of the genus *Cinetus* Jurine, 1807 (Hymenoptera: Diapriidae) from Iran, with five species records

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Abstract: In this study, the specimens of the genus *Cinetus* Jurine, 1807 (Hymenoptera: Diapriidae) were collected using the Malaise traps during 2010-2019 in Northern Iran. The genus *Cinetus* and five related species are recorded from Iran for the first time: *Cinetus angustatus* Kieffer, 1910, *C. ditomus* (Kieffer, 1910), *C. fuliginosus* Curtis, 1831, *C. iridipennis* Lepeletier and Serville, 1825 and *C. simulans* Nixon, 1957. Diagnostic characters, illustrations, geographical distributions, and a key to Iranian species of the genus *Cinetus* are provided.

Keywords: diapriid wasps, taxonomy, distribution, parasitoid

Introduction

With more than 2100 described species worldwide, Diapriidae Haliday, 1833 are the largest family of the superfamily Diaprioidea. Most diapriid species are primary endoparasitoids of larvae-pupae or pupae of Diptera, and some species are closely associated with ant nests (Nixon, 1957; Huggert, 1979; Loíacono *et al.*, 2013).

The genus *Cinetus* belongs to the subfamily Belytinae, tribe Cinetini, and with 70 species in the world, of which 51 species are recorded from the Palearctic region (Nixon, 1957; Buhl, 1997; Wall, 1998; Chemyreva, 2019). The biology and host association of the *Cinetus* is poorly known; only *Cinetus lanceolatus* is reported to have been bred from Mycetophilid fly in *Boletus* sp. (Nixon, 1957). Nixon (1957) described 17 new

species of the genus *Cinetus* and provided an identification key to species in Britain. Afterward, keys were published for *Cinetus* species in Finland (Hellen, 1964), Switzerland (Wall, 1967) and the European part of the USSR (Kozlov, 1978). Johnson (1992) listed 55 extant species of the *Cinetus* worldwide. In the years following, several species were identified and described by Buhl (1997) and Wall (1998). Since then, no study has been conducted on the *Cinetus*.

The genus *Cinetus* is easily distinguished from the other Belytinae by the combination of the following characteristics: mandible short; antenna 15-segmented and filiform in females, 14-segmented in males; notauli slightly divergent posteriorly; radial cell closed, stigmal vein straight, perpendicular to the postmarginal vein, marginal vein as long as or longer than its

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distance from basal vein (Nixon, 1957; Kozlov, 1978; Quadros & Brandao, 2017).

Before this study, 26 species of the family Dipariidae had been reported from Iran, including eight genera of the subfamily Belytinae, i.e., *Acanopsilus* Kieffer, 1908 (one species), *Acanosema* Kieffer, 1908 (one species) (Izadzadeh *et al.*, 2023b), *Belyta* (seven species) (Izadzadeh *et al.*, 2023a), *Diphora* Foerster, 1856 (one species) (Izadzadeh *et al.*, 2023b), *Miota* Foerster, 1856 (four species) (Izadzadeh *et al.*, 2023c), *Pantolyta* (two species) (Izadzadeh *et al.*, 2021), *Psilomma* Foerster, 1856 (one species), *Synacra* Foerster, 1856 (one species) (Izadzadeh *et al.*, 2023b), and six genera of the subfamily Diapriinae, i.e., *Aneuropria* Kieffer, 1905 (one species), *Coptera* Say, 1836 (two species) (Amini *et al.*, 2014; Samin *et al.*, 2018), *Diapria* Latreille, 1796 (one species) (Izadzadeh *et al.*, 2020), *Entomacis* Foerster, 1856 (one species), *Spilomicrus* Westwood, 1832 (one species), *Trichopria* Ashmead, 1893 (two species) (Samin *et al.*, 2018). No data are available on the genus *Cinetus* in Iran. This research is a part of our ongoing research on the superfamily Diaprioidea Haliday, 1833 in Iran.

Materials and Methods

The specimens were collected from northern Iran (Alborz, Golestan, Guilan, and Mazandaran provinces) using the Malaise traps from 2010 to 2019. The specimens were extracted from the traps, transferred to 70% ethyl-alcohol, and stored in a freezer for further studies. For the preparation of samples, each specimen was placed on a piece of absorbing paper for drying. The dried specimens were card-mounted and labelled. Photographs were taken using an Olympus TM SZX9 stereomicroscope equipped with a 650D Canon digital camera. Image stacks were combined with Helicon Focus ver. 8.2.2 (Helicon Soft Ltd., Kharkiv, Ukraine) (Hadley, 2023). The identifications were mainly carried out using reliable keys (Nixon, 1957; Kozlov, 1978; Wall, 1998). Morphological terminology

and abbreviations follow Masner & García (2002) and Yoder (2004). A map of species distribution is created using online SimpleMapp software (Shorthouse, 2010). Classification and nomenclature of the taxa followed Johnson (1992). Specimens are deposited in the insect collection of the Department of Entomology, Tarbiat Modares University, Tehran (TMUC), and the Research Institute of Forests and Rangelands, Tehran (RIFR).

The following abbreviations are used: A1–A15 = antennomeres are numbered from the scape (A1) to the apical segment (A15). BMNH = The Natural History Museum, London, UK. MNHN = Museum Nationale d’Histoire Naturelle, Paris, France.

Results

Taxonomy

Family Diapriidae

Subfamily Belytinae

Genus *Cinetus* Jurine, 1807

Cinetus Jurine, 1807: 310; *Leptorhaptus* Foerster, 1856: 129, 131, 137; *Stylidolon* Ashmead, 1897: 53; *Percinetus* Wall, 1967: 134, 139; *Necitus* Wall, 1967: 134, 139; *Xenotomoides* Wall, 1967: 135, 140.

Type species: *Cinetus iridipennis* Lepeletier and Serville, 1825, was the first species to be included.

Diagnosis: body length 3.0–5.0 mm; mandibles short; female antennae 15-segmented; male antennae 14-segmented, filiform, the first flagellomere with variable proximal emargination; propleuron with epomia; notauli distinct, divergent posteriorly (Fig. 1C); scutellar fovea large and subquadrate (Fig. 1C); fore wings with radial cell closed; marginal vein as long as or a little shorter than its distance from basal vein; Stigmal vein straight, perpendicular to the postmarginal vein; hind wing with distinct basal cell; propodeum with median keel simple; petiole elongate, at least two times longer than wide, on dorsal surface with longitudinal keels or sculpture; Basal sculpture of macrotergite with long medial furrow and short lateral striation.

***Cinetus angustatus* Kieffer, 1910** (Fig. 1)*Cinetus angustatus* Kieffer, 1910: 642, ♀.

Material examined: Golestan Province, Loveh forest (37°20'43"N, 55°40'40" E, 753 m a.s.l.), 25.VII.2016 (1♀) (TMUC), Leg.: S. Farahani. Shast Kola forest (36°44'10.83" N, 54°24'11.23" E, 754 m a.s.l.), 28.VII.2019 (1♀) (RIFR); Mazandaran province, Neka forest (36°21'43.03" N, 53°32'56.7" E, 1495 m a.s.l.), 25.VII.2018, (1♀) (TMUC); Guilan Province, Shafaroud forest (37°28'18" N, 48°49'23" E, 1114 m a.s.l.), 26.VIII.2018 (1♀) (TMUC), leg.: F. Kazerani.

Diagnosis: female (Fig. 1A), Body length 3.2–3.6mm; head in dorsal view transverse, 1.6 times as wide as long; A3 4 times as long as wide, A4 3.2 times as long as wide (Fig. 1B); anterior scutellar fovea large and subquadrate (Fig. 1C); fore wing length 2.3–2.6mm, radial cell closed, marginal vein as long as its distance from the basal vein; propodeum smooth and shine, with sparse setae, median propodeal keel simple; petiole in dorsal view 3.4–3.6 times as long as wide, with longitudinal keels (Fig. 1C); metasomal T2 anteriorly with a median groove, each side of median groove with short striation (Fig. 1D). Abdomen narrow, its width three times as wide as petiole (Fig. 1D); Tergite 3 elongate, its length shorter than apical width (Fig. 1D).

Distribution (Fig. 8A): Ireland, Germany, England, Hungary, Italy, Russia (European part), Switzerland (Kieffer, 1910; Nixon, 1957; Wall, 1967, 1998; Kozlov, 1978) and Iran (**new record**).

***Cinetus ditomus* (Kieffer, 1910)** (Figs. 2, 3)*Scorpioteleia ditoma* Kieffer, 1910: 685, ♀, MNHN.

Material examined: Golestan Province, Loveh forest (37°20'43" N, 55°40'40" E, 753 m a.s.l.), 12.VI.2016 (4 ♀, 12♂) (TMUC), 04.VII.2016 (13♀, 6♂) (TMUC), 25.VII.2016 (1♀) (TMUC); Ali Abad, Zarin Gol village (36°48'58" N, 55°02'13" E, 694 m a.s.l.), 15.VII.2016, (2♀) (TMUC); Leg.: S. Farahani. Shast Kola forest (36°44'10.83" N, 54°24'11.23" E, 754 m a.s.l.), 26.VI.2019 (2♀)

(TMUC); Mazandaran Province, Kheyroud Kenar (36°34'36.23" N, 51°34'37.94" E, 722 m a.s.l.), 24.VII.2018, (2♀) (RIFR), 28.VIII.2018 (1♀) (RIFR), 21.X.2018 (1♀) (TMUC); Neka forest (36°21'43.03" N, 53°32'56.7" E, 1495 m a.s.l.), 25.VII.2018, (2♀) (RIFR); Guilan Province, Shafaroud forest (37°28'18" N, 48°49'23" E, 1114 m a.s.l.), 26.VIII.2018 (1♀) (TMUC), leg.: F. Kazerani.

Diagnosis: female (Fig. 2A), Body length 2.9–3.2mm; head in dorsal view transverse, two times as wide as long; A3 4 times as long as wide, A4 3.0 times as long as wide (Fig. 2D); anterior scutellar fovea large and subquadrate (Fig. 2B); fore wing length 2.3–2.6mm, radial cell closed, marginal vein as long as its distance from basal vein; propodeum smooth and shiny, with sparse setae, median propodeal keel simple; petiole in dorsal view 1.8–2.1 times as long as wide, with longitudinal keels; metasomal T2 anteriorly with a median groove, each side of median groove with short striation; tergites after T2 strongly shortened and ring-shaped (Fig. 2C). **Male** (Fig. 3A), Body length 2.5–2.8 mm; A1 as long as A3 (Fig. 3C); petiole 2.0–2.1 times as long as wide in dorsal view (Fig. 3B).

Distribution (Fig. 8B): Austria, Finland, Germany, England, Italy, Russia (European part), Sweden (Nixon, 1957; Hellen, 1964; Kozlov, 1978; Wall, 1998) and Iran (**new record**).

***Cinetus fuliginosus* Curtis, 1831** (Fig. 4)*Cinetus fuliginosus* Curtis, 1831: 380.

Material examined: Mazandaran province, Noor, Chamestan, Tangehvaz (36°18'51.42" N, 52°07'48.00" E, 1359 m a.s.l.), 28.IV.2011 (2♀) (TMUC), Leg.: M. Khayrandish. Golestan province, Loveh forest (37°20'43" N, 55°40'40" E, 753 m a.s.l.), 03.XII.2016, (1♀) (TMUC). Leg.: S. Farahani. Shast Kola forest (36°44'10.83" N, 54°24'11.23" E, 754 m a.s.l.), 12.X.2019 (4♀) (TMUC); Mazandaran Province, Neka forest (36°21'43.03" N, 53°32'56.7" E, 1495 m a.s.l.), 16.V.2018, (1♀) (TMUC), 25.VII.2018 (3♀) (RIFR); Guilan province, Rezvan Shahr (37°31'00" N, 49°2'7"

E, 199 m a.s.l), 13.V.2018 (1♀) (TMUC); leg.: F. Kazerani.

Diagnosis: female (Fig. 4A), Body length 2.9–3.2mm; head in dorsal view transverse, 1.5 times as wide as long; A3 5 times as long as wide, A4 four times as long as wide (Fig. 4B); anterior scutellar fovea large and subquadrate; fore wing length 2.5–2.8mm, radial cell closed, marginal vein as long as its distance from the basal vein; propodeum smooth and shine, with sparse setae, median propodeal keel simple; petiole in dorsal view

3.7–3.9 times as long as wide, with longitudinal keels (Fig. 4C); metasomal T2 anteriorly with a median groove, each side of median groove with short striation (Fig. 4C); Tergite 3 elongate, its length 1.1 times as long as apical width (Fig. 4C).

Distribution (Fig. 8C): Ireland, Germany, England, Hungary, Romania, Russia (European part), Scotland, Sweden, Switzerland (Nixon, 1957; Kozlov, 1978; Wall, 1967, 1998; Chemyreva, 2019) and Iran (new record).



Figure 1 *Cinetus angustatus* Kieffer, 1910: female, A – general habitus; B – antenna; C – thorax in dorsal view; D – metasoma in dorsal view.



Figure 2 *Cinetus ditomus* (Kieffer, 1910): female, **A** – general habitus; **B** – head and thorax in dorsal view; **C** – metasoma in lateral view; **D** – antenna.

***Cinetus iridipennis* Lepeletier et Serville, 1825**
(Figs. 5, 6)

Cinetus iridipennis Lepeletier et Serville, 1825
in Latreille *et al.*, 1825: 210, ♂, ♀.

Material examined: Alborz province, Chalous Road, Shahrestanak (35°58'16.26" N, 51°21'25.80" E, 2225m a.s.l.), 15.VI.2010 (2♀) (TMUC), 06.VII.2010 (1♂) (TMUC), 14.VII.2010 (1♀, 1♂) (TMUC), 20.VII.2010 (1♀) (TMUC); Chalous Road, Shahrestanak (35°57'34.98" N, 51°22'20.34" E, 2305 m a.s.l.), 28.VII.2010 (1♀) (TMUC); Chalous Road, Arangeh (35°55'07.20" N, 51°05'09.24" E, 1891 m a.s.l.), 16.VIII.2010 (2♀) (TMUC); Shahriar

(35°40'03.06" N, 50°56'52.14" E, 1168 m a.s.l.), 07.VI.2010 (2♀) (TMUC); Karadj (35°46'08.88" N, 50°56'55.20" E, 1277 m a.s.l.), 05.X.2010 (1♀) (TMUC); Karadj (35°46'20.16" N, 50°56'44.94" E, 1278 m a.s.l.), 05.X.2010 (1♀) (TMUC), Leg.: A. Nadimi. Guilan province, Roodsar, Rahim abad, Ghazichak (36°45'52.62" N, 50°20'01.08" E, 1787 m a.s.l.), 19.IV.2010 (1♀) (TMUC), Leg.: M. Khayrandish. Rezvan Shahr (37°31'00" N, 49°2'7" E, 199 m a.s.l.), 13.V.2018 (1♀) (RIFR); Mazandaran Province, Kheyroud Kenar (36°34'36.23" N, 51°34'37.94" E, 722 m a.s.l.), 21.X.2018, (1♀) (RIFR), Leg.: F. Kazerani.



Figure 3 *Cinetus ditomus* (Kieffer, 1910): male, **A** – general habitus; **B** – thorax and base of metasoma in dorsal view; **C** – antenna.

Diagnosis: female (Fig. 5A), Body length 2.5–3.2mm; head in dorsal view transverse, 1.5 times as wide as long; A3 4.2 times as long as wide, A4 3.5 times as long as wide (Fig. 5D); anterior scutellar fovea large and subquadrate (Fig. 5B); fore wing length 2.4–2.6mm, radial cell closed, marginal vein 1.2–1.3 times as long as its distance from the basal vein; propodeum smooth and shiny, with sparse setae, median propodeal keel simple; petiole in dorsal view 3.1–3.3 times as long as wide, with longitudinal keels (Fig. 5C); metasomal T2 anteriorly with a median groove, each side of median groove with short striation (Fig. 5C); Tergite 3 elongate, its length

shorter than its apical width (Fig. 5C). **Male** (Fig. 6A), Body length 2.7–2.8 mm; A1 1.4 times as long as A3 (Fig. 6C); petiole 3.6 times as long as wide in dorsal view (Fig. 6B).

Distribution (Fig. 8D): Finland, Norway, Denmark, Germany, England, Ireland, Austria, Switzerland, France, Russia (European part), Portugal, Andorra, Spain, Italy, Greece and Slovenia (Kieffer, 1916; Nixon, 1957; Hellen, 1964; Kozlov, 1978; Wall, 1967, 1998; Chemyreva, 2019) and Iran (**new record**).

***Cinetus simulans* Nixon, 1957** (Fig. 7)

Cinetus simulans Nixon, 1957: 94, ♀, BMNH.

Material examined: Mazandaran province, Neka forest (36°30'00.4" N, 53°27'14.2" E, 828 m a.s.l), 24.VII.2018, (1♀) (TMUC), leg.: F. Kazerani.

Diagnosis: female (Fig. 7A), Body length 2.5mm; head in dorsal view transverse, 1.6 times as wide as long; A3 4.0 times as long as wide, A4 3.0 times as long as wide (Fig. 7B); anterior scutellar fovea large and subquadrate (Fig. 7C); fore wing length 2.2mm, radial cell

closed, marginal vein 1.1 times as long as its distance from the basal vein; propodeum smooth and shiny, with sparse setae, median propodeal keel simple; petiole in dorsal view 3.0 times as long as wide, with longitudinal keels (Fig. 7D); metasomal T2 anteriorly with a median groove, each side of median groove with short striation (Fig. 7D); Tergite 3 elongate, its length shorter than its apical width (Fig. 7D).



Figure 4 *Cinetus fuliginosus* Curtis, 1831: female, **A** – general habitus; **B** – antenna; **C** – metasoma in dorsal view.

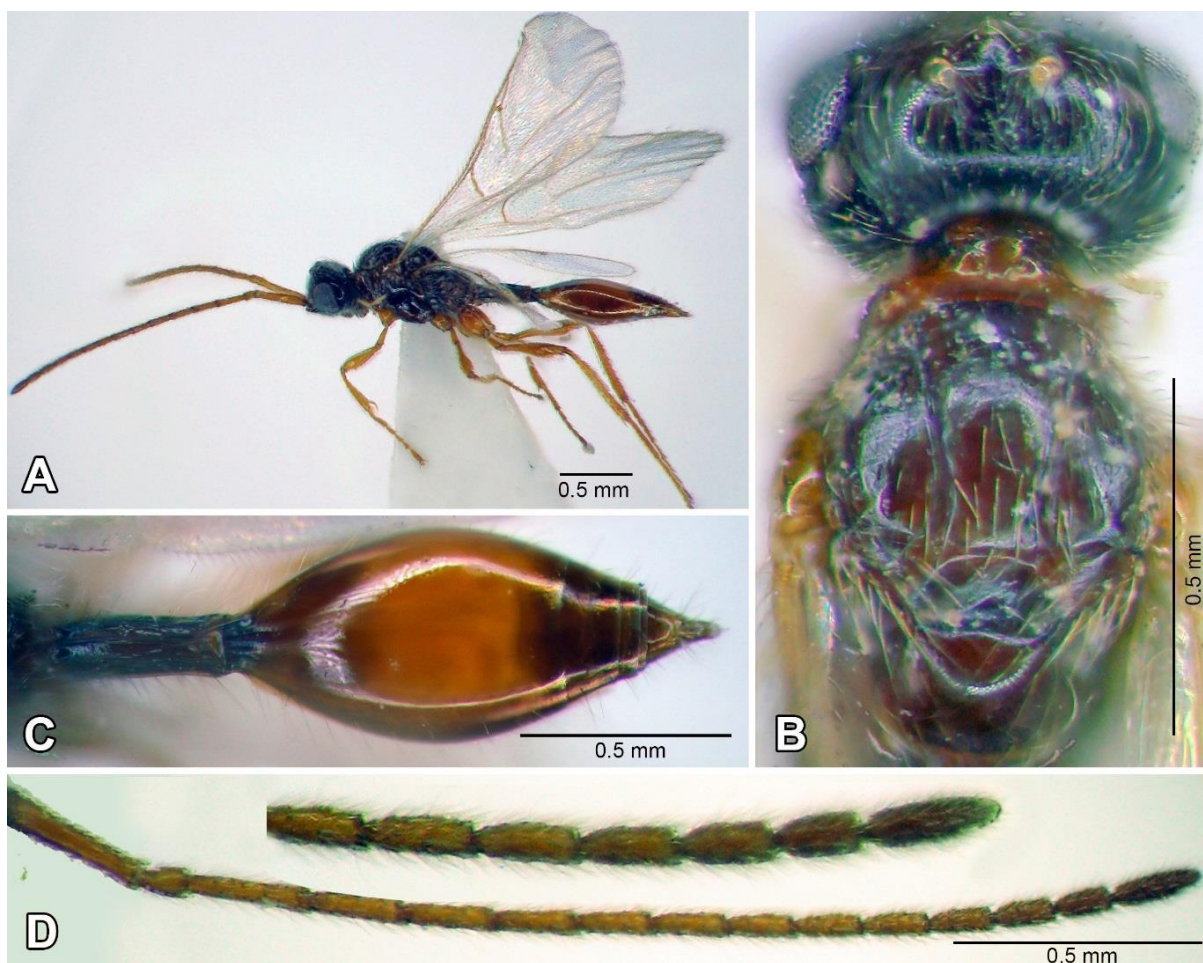


Figure 5 *Cinetus iridipennis* Lepeletier et Serville, 1825: female, **A** – general habitus; **B** – head and thorax in dorsal view; **C** – metasoma in dorsal view. **D** – antenna.

Distribution (Fig. 8E): Germany, Russia (European part), Scotland, Switzerland (Nixon, 1957; Kozlov, 1978; Wall, 1967, 1998; Chemyreva, 2019) and Iran (**new record**).

Identification key to the species of the genus *Cinetus* (Female) in Iran (modified from Nixon, 1957 and Wall, 1998)

- 1- Tergites 2 and 3 not fused together, [at least 2–3 ring shape segments present after large tergite; Last sternite strongly elongated and the apical tergite bent upwards (Fig. 2C)] *C. ditomus*
- Tergite 2 and 3 fused (Fig. 1D) 2
- 2- Abdomen narrow, its width at most 3 times as wide as the petiole (Fig. 1D)..... *C. angustatus*

- Abdomen broader, its width at least 4 times as wide as petiole (Fig. 7D) 3
- 3- Width of abdomen at most 4 times as wide as petiole (Fig. 7D)..... *C. simulans*
- Width of abdomen more than 4 times as wide as petiole (Figs. 4C, 5C)..... 4
- 4- Tergite 3 elongate, its length 1.1 times as long as its apical width (Fig. 4C) *C. fuliginosus*
- Tergite 3 shorter, its length 0.8 times as long as its apical width (Fig. 5C) *C. iridipennis*

Discussion

In this study, five species of the genus *Cinetus* are recorded from Iran for the first time. These species are distributed in the west Palaearctic region and mainly were reported from Europe

(Fig. 8) (Kieffer, 1916; Nixon, 1957; Hellen, 1964; Stelfox, 1966; Chambers, 1975; Kozlov, 1978; Wall, 1967, 1998). In the adjacent countries of Iran, only 11 species of this genus have been recorded from Russia (Chemyreva, 2019), and none have yet been recorded from other neighboring countries such as Afghanistan, Pakistan, Iraq, Turkmenistan, Azerbaijan, Turkey, and Armenia. In this study, the *Cinetus* specimens were collected using Malaise traps and therefore, their hosts

are unknown. Also, there is little information about their biology in previous studies, and only one species was bred on fungus gnats (Diptera: Mycetophilidae) (Nixon, 1957). So far, only a few species of fungus gnats, from the families Mycetophilidae (Lastovka and Matile, 1969; Barzegar et al., 2013) and Sciaridae (Moravvej et al., 2022) have been reported from Iran. This research was conducted in the southern and northern slopes of Alborz Mountains.



Figure 6 *Cinetus iridipennis* Lepeletier et Serville, 1825: male, **A** – general habitus; **B** – thorax and base of metasoma in dorsal view; **C** – antenna.

The southern slopes of the Alborz Mountains with Alborz province belonging to the Irano-Anatolian hotspot. The northern slopes of the Alborz Mountains with Guilan, Mazandaran, and Golestan provinces is the eastern extension of the Caucasus biodiversity hotspot (Myers *et al.*, 2000), and this hotspot contains one of the greatest biological diversity of temperate forest regions across the world (Japoshvili and Ljubomirov, 2023). Consequently, a greater diversity of fungus gnats and *Cinetus* species is expected to inhabit this area.

Considering the five new records in this research and previous literature (Izadzadeh *et al.*, 2020; 2021, 2023a, b, c), the total species

number of Iranian Diapriidae has now increased to 31 species. Iran is a large country comprising various ecosystems, placed at the crossroads of the Oriental and Afrotropical ecozones, Central Asia, and Caucasus (Zehzad *et al.*, 2002). Previous studies on Iranian Braconidae (Rakhshani *et al.*, 2019), Pteromalidae (Rahmani *et al.*, 2022), Chrysidoidea (Barahoei *et al.*, 2022), Platygastriidae and Scelionidae (Minab *et al.*, 2023) and Proctotrupidae (Izadzadeh *et al.*, 2022) revealed the presence of elements from the Palearctic, Afrotropical, and Oriental regions. Hence, we anticipate a substantial increase in the species count of the genus *Cinetus* in Iran in the future, by additional collections from unexplored areas of the country.



Figure 7 *Cinetus simulans* Nixon, 1957: female, **A** – general habitus; **B** – antenna; **C** – thorax in dorsal view; **D** – metasoma in dorsal view.

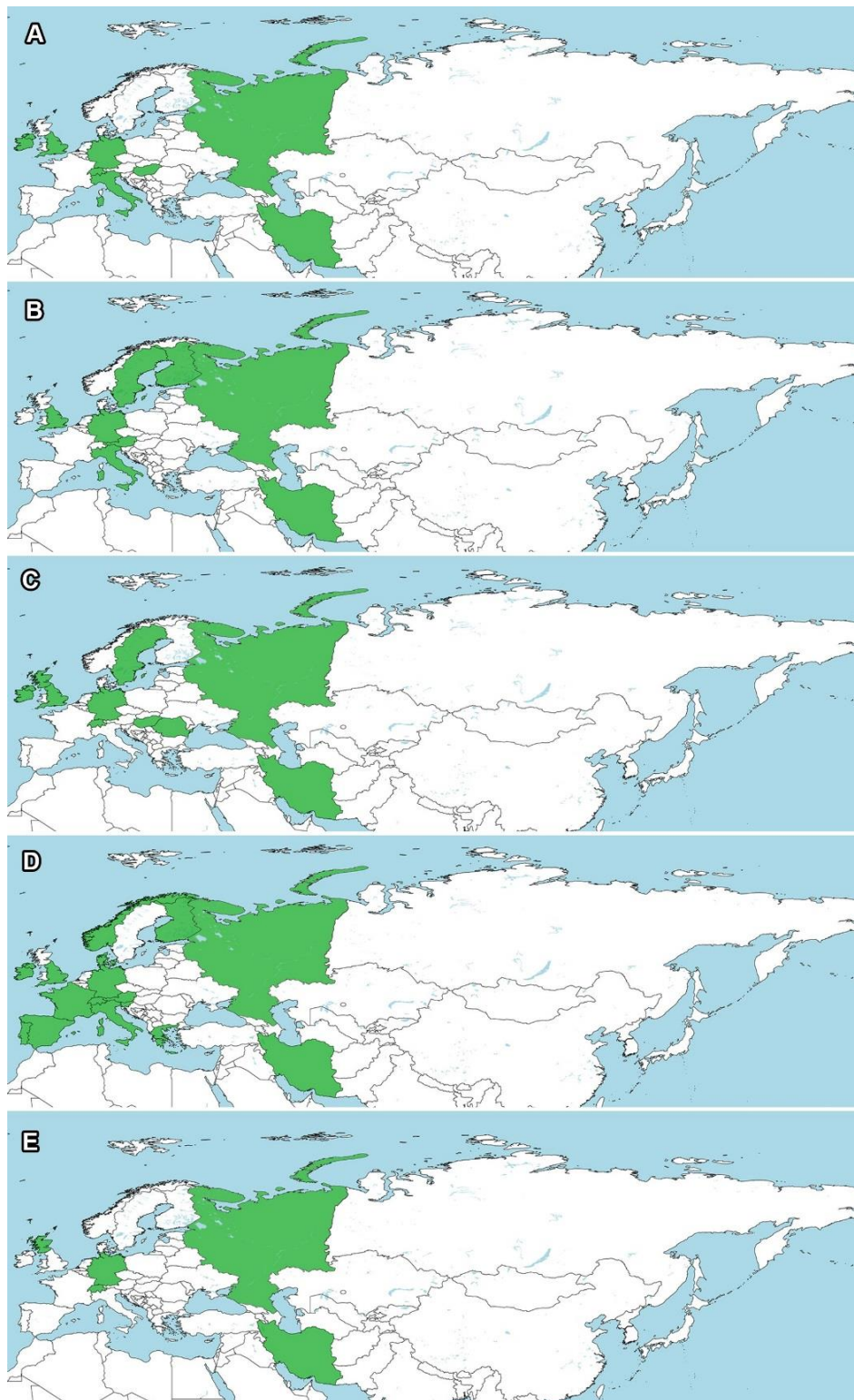


Figure 8 Distribution map of *Cinetus* species in the Palearctic region. **A** – *C. angustatus*; **B** – *C. ditomus*; **C** – *C. fuliginosus*; **D** – *C. iridipennis*; **E** – *C. simulans*.

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شناسایی جنس *Cinetus* Jurine, 1807 (Hymenoptera: Diapriidae) برای اولین بار از ایران، به همراه گزارش جدید پنج‌گونه

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چکیده: در این پژوهش، نمونه‌های جنس *Cinetus* Jurine, 1807 (Hymenoptera: Diapriidae) به وسیله تله مالیز در طی سال‌های ۱۳۸۹ تا ۱۳۹۸ از شمال ایران جمع‌آوری شدند. جنس *Cinetus* و پنج گونه از این جنس برای اولین بار از ایران گزارش شد: *Cinetus angustatus* Kieffer, 1910، *C. ditomus* (Kieffer, 1910)، *C. fuliginosus* Curtis, 1831، *C. simulans* Nixon, 1957 و *iridipennis* Lepeletier and Serville, 1825 ویژگی‌های افتراقی، عکس گونه‌ها، انتشار جغرافیایی و کلید شناسایی گونه‌های جنس *Cinetus* ارائه شده است.

واژگان کلیدی: زنبورهای diapriid، طبقه‌بندی، انتشار، پارازیتوئید