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# New records and an annotated checklist of the thick-headed flies from Algeria (Conopidae, Brachycera, Diptera)

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## Abstract

**Background:** The Conopidae are an interesting family of small- to large-sized endoparasitic flies, commonly known as thick-headed flies. These flies have been proposed as potential biological control agents of invasive social wasps (subfamilies: Polistinae and Vespinae, family: Vespidae).

**Results:** All known Algerian thick-headed flies (family Conopidae) are listed in the present study. Four subfamilies, nine genera and 23 species were treated. Three of these species are recorded herein from Algeria for the first time, namely *Myopa pellucida* (Robineau-Desvoidy), *M. picta* Panzer and *Thecophora fulvipes* (Robineau-Desvoidy). As far as they are known, Algerian localities and collection dates are provided, which comprise some new locality records. The data for this study were compiled from both available literature and material collected from some Algerian localities.

**Conclusion:** The family Conopidae (thick-headed flies) is hitherto represented in Algeria by four subfamilies, nine genera and 23 species. Three of these species are recorded herein for the first time.

**Keywords:** Thick-headed flies, Algerian localities, Dates of collection, Fauna, North Africa, Palearctic Region

## Background

The Conopidae are an interesting family of small- to large-sized endoparasitic flies, commonly known as thick-headed flies. Adult females often aggressively attack adult aculeate Hymenoptera and deposit their eggs within them, where the larvae hatch and feed on hemolymph and host tissues. These flies have been proposed as potential biological control agents of invasive social wasps (subfamilies: Polistinae and Vespinae, family: Vespidae) (Darrouzet et al. 2015), although the practicality of this usage is still controversial and needs more investigations (Villemant et al. 2015). Adults are variable in shape but are often wasp-like in appearance; they can be recognized by their unique wing venation and elongate slender

mouthparts. They usually frequent flowers to feed on nectar using their long proboscis and are considered to be important pollinators (El-Hawagry et al. 2021).

The family occurs in all regions of the world, except the Pacific islands and Antarctica, with more than 800 valid species and 57 genera worldwide (Stuke 2017). Conventionally, the family Conopidae is divided into five extant subfamilies (Conopinae, Dalmanniinae, Myopinae, Stylogastrinae and Zotioninae) and one fossil subfamily (Palaeomyopinae) (Stuke 2017). All these subfamilies, except Stylogastrinae, are represented in Algeria, with nine genera and 23 species (Table 1).

There are no previous systematic or faunistic studies on the Conopidae of Algeria, but all the species previously described or recorded from Algeria were treated within more comprehensive studies on the Diptera of Algeria or of wider geographic regions, including Becker (1907), Meigen (1824), Wiedemann

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**Table 1** Conopid taxa recorded from Algeria

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Subfamily CONOPINAE  
 Tribe CONOPINI  
 Genus *CONOPS* Linnaeus, 1758  
*C. (Asiconops) elegans* Meigen, 1804  
*C. (C.) rufiventris* Macquart, 1849  
 Genus *LEOPOLDIUS* Rondani, 1843  
*L. coronatus* (Rondani, 1857)  
 Tribe PHYSOCEPHALINI  
 Genus *PHYSOCEPHALA* Schiner, 1861  
*P. antiqua* (Wiedemann, 1830)  
*P. chrysorrhoea* (Meigen, 1824)  
*P. nigra* (De Geer, 1776)  
*P. vittata* (Fabricius, 1794)  
 Subfamily DALMANNIINAE  
 Genus *DALMANNIA* Robineau-Desvoidy, 1830  
*D. aculeata* (Linnaeus, 1761)  
*D. dorsalis* (Fabricius, 1794)  
 SUBFAMILY MYOPINAE  
 Tribe MYOPINI  
 Genus *MELANOSOMA* Robineau-Desvoidy, 1853  
*M. bicolor* (Meigen, 1824)  
*M. mundum* Czerny & Strobl, 1909  
 Genus *MYOPA* Fabricius, 1775  
*M. buccata* (Linnaeus, 1758)  
*M. dorsalis* Fabricius, 1794  
*M. occulta* Wiedemann, 1824  
*M. palliceps* (Bigot, 1887)  
*M. pellucida* (Robineau-Desvoidy, 1830)—New record  
*M. picta* Panzer, 1798—New record  
*M. stigma* Meigen, 1824  
 Tribe SICINI  
 Genus *SICUS* Scopoli, 1763  
*S. ferrugineus* (Linnaeus, 1761)  
 Tribe THECOPHORINI  
 Genus *THECOPHORA* Rondani, 1845  
*T. atra* (Fabricius, 1775)  
*T. fulvipes* (Robineau-Desvoidy, 1830)—New record  
 Subfamily ZODIONINAE  
 Genus *ZODION* Latreille, 1797  
*Z. cinereum* (Fabricius, 1794)  
*Z. erythrurum* Rondani, 1865

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(1830), Séguy (1938) and Macquart (1849), or on the Conopidae of the Palaearctic Region or Africa, including Kröber (1914, 1915a, b, c, d, e, f, g, 1916a, b, c). There are also some miscellaneous studies that are cited throughout the text.

## Methods

The present study was based mainly on material collected by the second author from various Algerian localities using a sweep net, with the addition of two specimens representing two different species preserved

in the Community College museum in Al-Baha University, KSA. We also considered data obtained from all the previous studies on Algerian flies in order to present a comprehensive list of the species currently known from Algeria.

The collected specimens were identified using relevant keys, such as Stuke (2006), Stuke and Clements (2008), Khaghaninia and Kazerani (2014a), Khaghaninia and Kazerani (2014b) and Azmy et al. (2016). Photographs of some species were checked by Dr. J-H Stuke (personal communication). The classification and nomenclature followed that used by Stuke (2017), with the addition of the tribal arrangement suggested by Gibson and Skevington (2013). A comprehensive set of synonyms of species and genera are not given, but we list only synonyms of species described or mentioned in previous literature as recorded from Algeria. Exhaustive listing of synonyms and global distribution of species were given in Stuke (2017).

Administrative divisions (provinces) in the present study were used (Table 2) as Algeria is not divided into specific ecological zones by ecologists. Localities within each Algerian province are alphabetically arranged and written after a colon following each province, followed

**Table 2** A gazetteer of Algerian localities of the family Conopidae

Province	Locality	Latitude (N)	Longitude (E)
Algiers	Algiers	36.70141	3.00743
Annaba	Annaba	36.918058	7.75486
Biskra	Biskra	34.87742	5.69026
Bordj Bou Arréridj	Ain Taghrout, Ez Zamala	36.130881	5.07911
Bordj Bou Arréridj	Bordj Ghédir, Ez Zamala	35.88906	4.92554
Bordj Bou Arréridj	Forest of Bordj Zemoura	36.2671	4.84570
Bordj Bou Arréridj	University of Mohamed El Bachir El Ibrahimi	36.047172	4.80309
Constantine	Constantine	36.367652	6.64925
Djanet	Djanet	23.94944	9.63097
El-Bayadh	Chellala	33.02613	0.05039
El Taref	Cercle de Lacalle	36.892523	8.446589
El Taref	El Kala	36.892523	8.446589
El Taref	lac Tonga	36.872435	8.490201
El Taref	marais d'Ain-Dréan	36.68676	7.707267
Oran	Oran	35.705043	-0.6280
Sidi Bel Abbès	Sidi Bel Abbès	35.19646	-0.61629
M'Sila	Sidi Hadjeres	35.650035	4.128622
Skikda	Skikda	36.85675	6.911245
Tiaret	Mt. Ben Omar	35.433267	0.866947

by the collection dates in parentheses, if known. Sources for the Algerian localities and dates of collection for species are given in square brackets. Colored photographs were taken using a Nikon D3400 camera with Tamron SP 90 mm F/2.8 Di Macro lens by second author. Coordinates of Algerian conopid localities are listed in Table 2. A local distribution map of newly recorded species is given, using SimpleMapp (Shorthouse 2010).

## Results

### List of Algerian Conopidae

#### Subfamily CONOPINAE

#### Tribe CONOPINI

#### Genus *CONOPS* Linnaeus, 1758

#### *Conops (Asiconops) elegans* Meigen, 1804

*Conops elegans* Meigen, 1804: 275. Type locality: France (Marseille).

*Conops elegans* var. *fuscipennis* Macquart, 1849: 472. Type locality: Algeria (environs du Cercle de Lacalle, marais d'Ain-Drean et du lac Tonga).

*Conops algira* Macquart, 1849: 473. Type locality: Algeria (environs du Cercle de Lacalle).

*Conops fuscipennis* Bigot, 1887: 32. Type locality: Italy (Sicily).

*Conops ruficornis* Becker, 1913: 89–90. Type locality: Morocco (Tanger).

*Conops elegans* var. *minutus* Kröber, 1915e: 48. Type locality: Algeria, Democratic Republic of the Congo (Katona), Tunisia, Egypt (Cairo), Ethiopia ["Abyssinien"].

*Conops elegans* var. *djanetianus* Séguy, 1938: 42. Type locality: Algeria (Djanet).

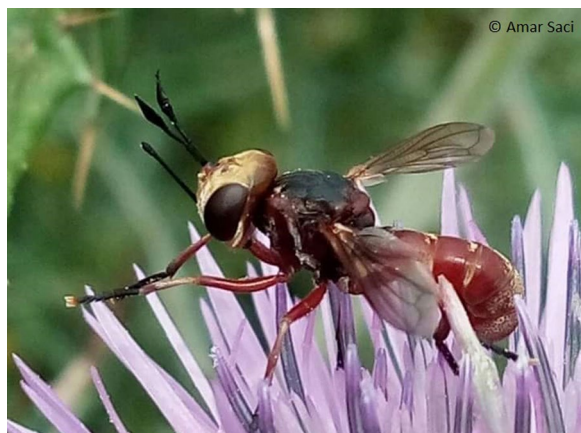
#### Known Algerian localities and dates of collection.

Algiers Province: Algiers (date not given) [Kröber (1915d) as *minutus* and *algira*]; Djanet Province: Djanet (date not given) [Séguy (1928, 1938) as *djanetianus*]; El Taref Province: El Kala, Ain-Dréan, Lac Tonga [as "environs du Cercle de Lacalle, marais d'Ain-Drean et du lac Tonga"] (July) [Macquart (1849) as *fuscipennis*], El Kala "as Lacalle" (June) [Macquart (1849) as *algira*]; Oran Province: Oran (date not given) [Kröber (1924)].

#### *Conops (Conops) rufiventris* Macquart, 1849 (Fig. 1)

*Conops rufiventris* Macquart, 1849: 474. Type locality: Algeria (Constantine) [as "dans les jardins de Salah'- Bey, aux environs de Constantine"].

**Known Algerian localities and dates of collection.** Biskra Province: Biskra (date not given) [Kröber (1915e)]; Bordj Bou Arréridj Province: University of Mohamed El Bachir El Ibrahimi, El Anasser (May) [collected material]; Constantine Province: Constantine [as "dans les jardins de Salah'- Bey, aux environs de Constantine"] (May) [Macquart (1849)]; Oran Province: Oran (date not given) [Kröber (1915e)]; Sidi Bel



**Fig. 1** *Conops rufiventris* Macquart on *Centaurea* sp. © Amar Saci

Abbès Province: Sidi Bel Abbès (date not given) [Stuke and Kehlmaier (2008)]; Skikda Province: Skikda (April) [observed material].

**Material examined.** ALGERIA • 1 male; University of Mohamed El Bachir El Ibrahimi, El Anasser; 36.047172°N, 4.803086°E; 3.V.2021; Boulaouad leg.; sweeping net on *Scabiosa atropurpurea* ssp. *maritima*; PCB • 1 female; same data; 5.V.2021.

**Note.** Two specimens of this species were collected from University of Mohamed El Bachir El Ibrahimi, El Anasser on *Scabiosa atropurpurea* ssp. *maritima*. Another specimen (sex unknown) was observed on *Centaurea* sp. in Skikda (36.856750°N, 6.911245°E) on 28 April 2020. It was observed and photographed by Mr. Amar Saci (Fig. 1).

**Genus LEOPOLDIUS** Rondani, 1843

*Leopoldius coronatus* (Rondani, 1857)

*Brachiglossum coronatum* Rondani, 1857: 143. Type locality: Austria (Windobona).

**Known Algerian localities and dates of collection.**

Algiers Province: Algiers (August) [Kröber (1914, 1930) and Séguy (1928)].

**Tribe PHYSOCEPHALINI**

**Genus PHYSOCEPHALA** Schiner, 1861

*Physocephala antiqua* (Wiedemann, 1830)

*Conops antiqua* Wiedemann, 1830: 239. Type locality: Egypt.

**Known Algerian localities and dates of collection.**

Tiaret Province: Mt. Ben Omar (date not given) [Kröber (1939)].

*Physocephala chrysorrhoea* (Meigen, 1824) (Fig. 2)

*Conops chrysorrhoea* Meigen, 1824: 128. Type locality: Austria.

**Known Algerian localities and dates of collection.**

Biskra Province: Biskra (date not given) [Kröber (1939)



**Fig. 2** *Physocephala chrysorrhoea* (Meigen) male, lateral

and Séguy (1930)]; Bordj Bou Arréridj Province: Forest of Bordj Zemoura (May) [collected material].

**Material examined.** ALGERIA • 1 male; Forest of Bordj Zemoura; 36.2671°N, 4.8457°E; 24.V.2021; Boulaouad leg.; sweeping net on *Scabiosa atropurpurea* ssp. *maritima*; PCB.

*Physocephala nigra* (De Geer, 1776)

*Conops nigra* De Geer, 1776: 265. Type locality: not given [presumably Sweden].

**Known Algerian localities and dates of collection.** Unknown [Séguy (1930)].

*Physocephala vittata* (Fabricius, 1794)

*Conops vittata* Fabricius, 1794: 392. Type locality: Germany (Kiel).

*Physocephala truncata* var. *maculigera* Kröber, 1915a: 71; type locality: Egypt, Tunisia, Syria and Algeria (Constantine, Biskra).

**Known Algerian localities and dates of collection.** Algiers Province: Algiers (date not given) [Kröber (1915a, 1924) as *vittata*]; Biskra Province: Biskra (date not given) [Kröber (1915a, 1939) as *maculigera*]; Constantine Province: Constantine (date not given) [Kröber (1915a) as *maculigera*]; Oran Province: Oran (date not given) [Kröber (1927) as *vittata*].

**Subfamily DALMANNIINAE**

**Genus DALMANNIA** Robineau-Desvoidy, 1830

*Dalmannia aculeata* (Linnaeus, 1761)

*Conops aculeata* Linnaeus, 1761: 468. Type locality: Sweden.

**Known Algerian localities and dates of collection.** Biskra Province: Biskra (date not given) [Kröber (1924) and Séguy (1930)].

*Dalmannia dorsalis* (Fabricius, 1794)

*Stomoxys dorsalis* Fabricius, 1794: 396. Type locality: France.

*Myopa flavescens* Meigen, 1804: 289. Type locality: not given.

**Known Algerian localities and dates of collection.**

Algiers Province: Algiers (March) [Macquart (1849) as *flavescens*].

**SUBFAMILY MYOPINAE****Tribe MYOPINI**

**Genus MELANOSOMA** Robineau-Desvoidy, 1853

*Melanosoma bicolor* (Meigen, 1824)

*Myopa bicolor* Meigen, 1824: 147. Type locality: Austria ["Oesterreich"].

**Known Algerian localities and dates of collection.**

Not given [Kröber (1915b, 1924)].

*Melanosoma mundum* Czerny & Strobl, 1909

*Melanosoma mundum* Czerny & Strobl, 1909: 260.

Type locality: Spain ["Banõs"].

**Known Algerian localities and dates of collection.**

Biskra Province: Biskra (date not given) [Kröber (1915b, 1924)].

**Genus MYOPA** Fabricius, 1775

*Myopa buccata* (Linnaeus, 1758)

*Conops buccata* Linnaeus, 1758: 605. Type locality: Europe.

**Known Algerian localities and dates of collection.** Algiers Province: Algiers (date not given) [Kröber (1924)]; El Taref Province: El Kala (March) [Macquart (1849)]; other sources with localities and dates not given: Becker (1907), Kröber (1916a, b) and Séguy (1928).

*Myopa dorsalis* Fabricius, 1794

*Myopa dorsalis* Fabricius, 1794: 397. Type locality: Germania.

**Known Algerian localities and dates of collection.**

Unknown [Séguy (1928)].

*Myopa occulta* Wiedemann in Meigen, 1824

*Myopa occulta* Wiedemann in Meigen, 1824: 145. Type locality: Germany.

**Known Algerian localities and dates of collection.**

Not given [Becker (1907)].

*Myopa palliceps* (Bigot, 1887)

*Glossigona palliceps* Bigot, 1887: 205–206. Type locality: Algeria.

*Myopa dorsalis* var. *minor* Strobl, 1899: 148. Type locality: Spain (Madrid).

*Myopa vaulogeri* Séguy, 1930: 136. Type locality: Algeria (Algiers, Chellala), Morocco (Casablanca), Spain (Barcelona).

**Known Algerian localities and dates of collection.**

Algiers Province: Algiers (date not given) [Kröber (1924) as *minor* and *palliceps*, and Séguy (1930) as *vaulogeri*]; Biskra Province: Biskra (March) [Stuke and Kehlmaier (2008), Kröber (1916a, b) as *minor*]; El-Bayadh Province: Chellala [Séguy (1930) as *vaulogeri*] (date not given); other sources with localities and dates not given: Bigot (1887).

*Myopa pellucida* (Robineau-Desvoidy, 1830) (Fig. 3)



**Fig. 3** *Myopa pellucida* (Robineau-Desvoidy, 1830) male, lateral



**Fig. 4** *Myopa picta* Panzer on *Salvia rosmarinus*

*Myopa pellucida* Robineau-Desvoidy, 1830: 244. Type locality: France (Paris).

**Known Algerian localities and dates of collection** (Fig. 8). Bordj Bou Arréridj Province: Ain Tagrout and Bordj Ghédir, Ez Zamala (April) [collected material].

**Material examined.** ALGERIA • 1 male; Ain Taghrout, Bordj Bou Arréridj; 36.130881°N, 5.079106°E; 9.IV.2021; Boulaouad leg.; sweeping net on *Lepidium drapa*; PCB • 1 female; Bordj Ghédir, Ez Zamala; 35.889060°N, 4.925543°E; 22.IV.2021; Boulaouad leg.; sweeping net on *Asphodelus ramosus*; PCB.

**Note.** This species is recorded herein for the first time from Algeria. It was collected on *Lepidium drapa* and *Asphodelus ramosus*.

*Myopa picta* Panzer, 1798 (Fig. 4)

*Myopa picta* Panzer, 1798: 22. Type locality: Austria.

**Known Algerian localities and dates of collection** (Fig. 8). Bordj Bou Arréridj Province: University of Mohamed El Bachir El Ibrahimy, El Anasser (May) [collected material].

**Material examined.** ALGERIA • 1 male; University of Mohamed El Bachir El Ibrahimi, El Anasser; 36.013571°N, 4.801824°E; 30.III.2021; Boulaouad leg.; sweeping net on *Salvia rosmarinus*; PCB.

**Note.** This species is recorded herein for the first time from Algeria. It was firstly observed and photographed feeding on *Salvia rosmarinus* (= *Rosmarinus officinalis*) in University of Mohamed El Bachir El Ibrahimi, El Anasser in March 2021 (Fig. 4), just then another specimen was collected by second author.

*Myopa stigma* Meigen, 1824

*Myopa stigma* Meigen, 1824: 148. Type locality: Austria.

**Known Algerian localities and dates of collection.** Algiers Province: Algiers (date not given) [Becker (1907)].

#### Tribe SICINI

**Genus SICUS** Scopoli, 1763

*Sicus ferrugineus* (Linnaeus, 1761)

*Conops ferrugineus* Linnaeus, 1761: 468. Type locality: Sweden.

**Known Algerian localities and dates of collection.** Algiers Province: Algiers (date not given) [Kröber (1924)]; Constantine Province: Constantine (date not given) [Kröber (1927)].

#### Tribe THECOPHORINI

**Genus THECOPHORA** Rondani, 1845

*Thecophora atra* (Fabricius, 1775) (Fig. 5)

*Myopa atra* Fabricius, 1775: 799. Type locality: Denmark.

**Known Algerian localities and dates of collection.** Algiers Province: Algiers (date not given) [Becker (1907) and Kröber (1916c, 1924)]; Annaba Province: Annaba (May 2011) (Collected material); Bordj Bou

Arréridj Province: Forest of Bordj Zemoura (May) [collected material].

**Material examined.** ALGERIA • 1 female; Annaba; 36.918058°N 7.75486°E; 3.V.2011; Ahmed leg.; PCB • 1 male; 2 females; Forest of Bordj Zemoura; 36.2671°N, 4.8457°E; 9.V.2021; Boulaouad leg.; sweeping net; PCB.

*Thecophora fulvipes* (Robineau-Desvoidy, 1830)

*Myopa fulvipes* Robineau-Desvoidy, 1830: 246. Type locality: France (Paris).

**Known Algerian localities and dates of collection** (Fig. 8). Annaba Province: Annaba (May 2011) (Collected material).

**Material examined.** ALGERIA • 1 male; Annaba; 36.918058°N 7.75486°E; 3.V.2011; Ahmed leg.; MCCB.

**Note:** This species is recorded herein for the first time from Algeria.

#### Subfamily ZODIONINAE

**Genus ZODION** Latreille, 1797

*Zodion cinereum* (Fabricius, 1794) (Fig. 6)

*Myopa cinerea* Fabricius, 1794: 399. Type locality: Italy.

**Known Algerian localities and dates of collection.** Algiers Province: Algiers (date not given) [Kröber (1915g, 1924)]; Biskra Province: Biskra (date not given) [Kröber (1915g, 1924)]; Bordj Bou Arréridj Province: Forest of Bordj Zemoura (May) [collected material]; Oran Province: Oran (date not given) [Kröber (1927)].

**Material examined.** ALGERIA • 1 male; Forest of Bordj Zemoura; 36.2671°N, 4.8457°E; 24.V.2021; Boulaouad leg.; sweeping net; sweeping net on *Scabiosa atropurpurea* ssp. *Maritima*; PCB.

*Zodion erythrurum* Rondani, 1865 (Fig. 7)



**Fig. 5** *Thecophora atra* (Fabricius) male, lateral



**Fig. 6** *Zodion cinereum* (Fabricius) male, lateral



**Fig. 7** *Zodion erythrurum* Rondani 1865 male

*Zodion erythrurum* Rondani, 1865: 146. Type locality: Italy.

*Zodion vittipes* Strobl, 1906: 331–332. Type locality: Spain.

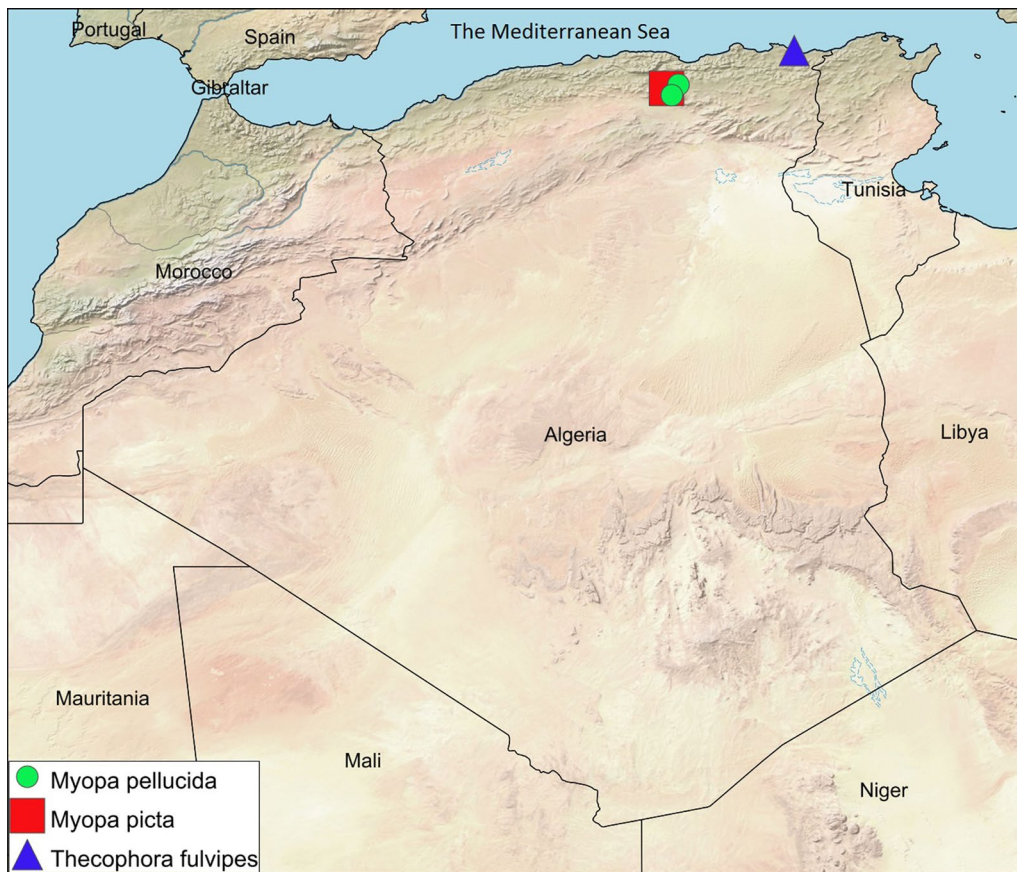
**Known Algerian localities and dates of collection.**

Algiers Province: Algiers (date not given) [Kröber (1915g) as *erythrurum* and *vittipes*, and Kröber (1924) as *vittipes*]; Biskra Province: Biskra (March) [Kröber (1915g) as *erythrurum* and Stuke and Kehlmaier (2008) as *erythrurum*]; M'Sila Province: Sidi Hadjeres (May) [collected material] (Fig. 8).

**Material examined.** ALGERIA • 1 male; Sidi Hadjeres; 35.650035°N, 4.128622°E; May.2022; Boulaouad leg.; sweeping net; sweeping net; PCB.

**Discussion**

We think that the number of taxa listed here is too low and does not represent the real conopid fauna of a large country such as Algeria, located at the junction of two major and faunistically rich biogeographic regions, the Afrotropical and Palaearctic. Nevertheless, in the present study, three species are recorded for the first time from



**Fig. 8** A distribution map of newly recorded conopid species from Algeria

Algeria, namely *Myopa pellucida* (Robineau-Desvoidy), *M. picta* Panzer and *Thecophora fulvipes* (Robineau-Desvoidy), in addition to some new locality records of some other species previously recorded elsewhere in Algeria. The low diversity may be the result of a lack of sampling effort in the country. The majority of the records came from the Northern provinces, most likely because most collections were predominantly focused in these provinces. Extensive systematic and faunistic studies covering the whole country are required, and more collecting effort would be highly desired in the future.

Some researchers have proposed the usage of conopid flies as natural enemies in the biological control of invasive social wasps (subfamilies Polistinae and Vespinae, family Vespidae) (Darrouzet et al. 2015). However, this usage is still controversial and needs more investigations as many of these proposals still are not proved as successful due to impracticality, high-risk association or several other factors supposed by some researchers (Villemant et al. 2015). Janssens (1955) observed that some conopids parasitize some important hymenopteran pollinator or predator, e.g., vespids, bees and sphecids, i.e., they may be considered as pests. For example, Severin (1937) observed that *Zodion fulvifrons* is a parasitoid of worker honeybees in South Dakota and could cause heavy damage to colonies (Khaghaninia and Kazerani 2014a). The conopids can be cautiously used as biocontrol agents of some harmful wasps, and more studies are needed to investigate this potential usage and its practicality.

## Conclusions

The family Conopidae (thick-headed flies) is hitherto represented in Algeria by four subfamilies, nine genera and 23 species. Three of these species are recorded herein for the first time, namely *Myopa pellucida* (Robineau-Desvoidy), *M. picta* Panzer and *Thecophora fulvipes* (Robineau-Desvoidy).

## Abbreviations

MCCB: Community College Museum, University of Al-Baha, Saudi Arabia; PCB: Personal collection of A. Boulaouad, Department of Agronomy, Université Mohamed El Bachir El Ibrahimy de Bordj Bou Arréridj, Algeria.

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## Author contributions

ME identified the flies, conceptualized the study and drafted the manuscript. BB collected, mounted and photographed the flies. AS participated in identifying the flies and drafting the manuscript. AE participated in identifying the flies. HD participated in conceptualizing the study. All authors have

participated in the study design and coordination and interpreted the data. All authors have read and approved the manuscript.

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## Availability of data and materials

Data supporting the conclusions of this article are presented in the main manuscript.

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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