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Review of the subfamily Calliphorinae (Dipt.: Calliphoridae) in Iran with two genera and four species as new records

Somayeh Modarresi[1], Samad Khaghaninia[1*], Farnaz Seyyedi Sahebari[2]

1 *Department of Plant Protection, Faculty of Agriculture, University of Tabriz, Tabriz, Iran.*
2 *East Azerbaijan Agricultural and Natural Resources Research and Education Center Plant Protection Research Department, AREEO, Tabriz, Iran.*

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ABSTRACT. Blow flies of the subfamily Calliphorinae (Dipt.: Calliphoridae) were studied in the East Azerbaijan and West Azerbaijan provinces - Iran, during 2017-2018. Six species belonging to three genera were identified of which the genera *Bellardia* Robineau-Desvoidy, 1863; *Cynomya* Robineau-Desvoidy, 1830 and four species *Bellardia pandia* (Walker, 1849); *Bellardia viarum* (Robineau-Desvoidy, 1830); *Bellardia vulgaris* (Robineau-Desvoidy, 1830) and *Cynomya mortuorum* (Linnaeus, 1761) are new records for the Iran insect fauna. A review of Iranian species of the subfamily Calliphorinae is provided.

Key words: Calliphoridae, Calliphorinae, fauna, new records, Iran

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Introduction

There are about 1,525 known calliphorid species belonging to 97 genera and 13 subfamily Calliphoridae worldwide (Pape et al., 2011). About 240 valid species in 47 genera known to occur in the Palaearctic region (Schumann, 1986). To date 20 species belonging to the subfamilies Calliphorinae, Chrysomyinae and Luciliinae, are recorded for Iranian fauna. Members of the subfamily Calliphorinae are characterized morphologically by: stem-vein bare in above; lower calypter with hairs in above surface; costa always bare below beyond junction with R_1; anterior part of anepimeron with handle of hairs in lower section; coxopleural streak absent; parafacial hairy, at least in upper part; palps yellow; abdomen blue, green or olive-green metallic in color, rarely nonmetallic. The females are oviparous or viviparous and larvae are saprophagous, parasites or predators of earthworms. The adults of some species can impact human health, acting as vectors of pathogens by searching for and settling on feces, fresh and cooked meat, dairy products and wounds (Rognes, 1991). Schumann (1986) published a catalogue of the family Calliphoridae from Palaearctic Region. Rognes (1991) studied the taxonomy of the Calliphoridae species in Fennoscandia and Denmark. Verves (2002) provided an annotated checklist of Calliphoridae of the Russian Far East and included eight new

Corresponding author: Samad Khaghaninia, E-mail: *skhaghaninia@gmail.com*

records species from different parts of this region. Hassan et al., (2018) provided an updated checklist of the blow fly fauna of Pakistan and recorded five new species for the country. Modarres Awal (1994) listed a total of 15 species of Calliphoridae for Iran, of which two species belong to the subfamily Calliphorinae. Parchami-Araghi (1995) reviewed the subfamily Chrysomyinae and recorded two further species from Iran. Parchami-Araghi et al. (2001) presented a list of Iranian records of Calliphoridae and Sarcophagidae and wrote a key to the bird blow flies (*Protocalliphora*) in the Palaearctic Region. Tüzün et al. (2010) studied calliphorids of forensic importance in Urmia, Iran. Akbarzadeh et al. (2015) presented a list of species of blow flies of forensic importance in Middle East. Parchami-Araghi et al. (2017) recorded the bird blow fly genus *Trypocalliphora* from Iran for the first time. Prior to this study, only *Calliphora vicina* Robineau-Desvoidy, 1830 and *Calliphora vomitoria* (Linnaeus, 1758) had been reported from Iran (Rak & Anwar, 1974; Shah-Hoseini & Kamali, 1989).

Material and methods

The studied materials in this project were collected using standard entomological net and Malaise trap in various localities of East Azerbayjan and West Azerbayjan provinces, during 2017–2018. In addition, the calliphorid specimens of the Insect Collection of Professor Hassan Maleki Milani, Tabriz, Iran (ICHMM) were examined. To dissect the male genitalia, the postabdomen was removed, then stored in glycerine and examined with sterio-microscope. Images were taken by a (Nikon D5200) digital camera which assembled on optical sterio-microscope (Nikon SMZ 800-N). The terminology followed Rognes (1991). The studied specimens were deposited in the Insect Collection of Prof. Hassan Maleki Milani, University of Tabriz, Iran (ICHMM).

Results

In this study totally, six species belonging to three genera of the subfamily Calliphorinae were identified which among them, two genera *Bellardia* Robineau-Desvoidy, 1863 and *Cynomya* Robineau-Desvoidy, 1830 and four species which indicated by asterisks are new records for Iranian fauna. A key to six known Iranian species of this subfamily along with the localities, diagnostic characters and their distributions as well as photos of the species are given.

The list of studied species of the subfamily Calliphorinae in northern west of Iran

Genus: *Bellardia* Robineau-Desvoidy, 1863

**Bellardia pandia* (Walker, 1849) (Fig. 1)

Material examined: 1♂, 02.VI.2013, East Azerbaijan province, Jolfa, Siyah Saran, 38°48′44.47″ N, 45°43′42.24″ E, 1158m a.s.l., sweep net; 10♂♂, 10.VI.2013, West Azerbaijan province, Khoy, Safaeyeh, 38°48′07.60″ N, 44°35′10.49″ E, 2265m a.s.l., sweep net; 29♂♂, 05.VII.2014, East Azerbaijan province, Shabestar, Shanejan, 38°14′12.3″ N, 45°23′11.5″ E, 1649m a.s.l., sweep net; 1♂, 05.VII.2013, East Azerbaijan province, Chichakli, Xomarlu, 38°59′3.54″ N, 46′53′25.5″ E, 1167m a.s.l., sweep net; 1♂, 01.VI.2014, West Azerbaijan province, Khoy, 38°30′55.00″ N, 44°53′38.57″ E, 1160m a.s.l., sweep net; 1♂, 07.VI.2014, East Azerbaijan province, Shabestar, Kuzekonan, 38°30′55.00″ N, 44°53′38.57″ E, 1160m a.s.l., sweep net; 35♂♂, 25.VI.2014, East Azerbaijan province, Kaleybar, 38°51′4.61″ N, 46°59′55.92″ E, 1367m a.s.l., sweep net; 1♂, 24.V.2017, West Azerbaijan province, Urmia, Dareh Ghasemlu, 37°17′24.58″ N, 45°08′06.65″ E, 1741m a.s.l., sweep net; 4♂♂, 04.VII.2017, East Azerbaijan province, Chichakli, 38°30′26.22″ N, 46°36′26.82″ E, 1724m a.s.l., sweep net; 1♂, 27.IV.2017, West Azerbaijan province,

Miandoab, 36°57′39.37″ N, 46°06′17.42″ E, 1269m a.s.l., sweep net; 1♂, 21.VI.2018, East Azerbaijan province, Shabestar, Sharafkhaneh, 38°11′03.18″ N, 45°29′31.34″ E, 1313m a.s.l., Malaise trap; 2♂♂, 22.VI.2018, East Azerbaijan province, Kaleybar, 39°09′55.57″ N, 47°01′04.29″ E, 237m a.s.l., Malaise trap; 2♂♂, 02.VII.2018, East Azerbaijan province, Chichakli, Abbas Abad, 38°55′00.57″ N, 46°49′27.09″ E, 1270m a.s.l., sweep net; 8♂♂, 25.IX.2018, West Azerbaijan province, Mahabad, 36°34′10.16″ N, 45°41′12.98″ E, 1521m a.s.l., Malaise trap. leg., S. Khaghaninia, S. Modarresi, F. Khanzadeh, R. Namaki Khameneh.

Diagnostic characters: Body length 4.5-8.5mm; tergites metallic-green with different patterns of dusting; thorax dark-grey with stripes, slightly metallic reflections; fore tibia always with two posteroventral setae; costa often between the junction with Sc and R_1 hairy ventrally; cerci view heart-shaped basally in posterior view; surstylus strongly curved, depression on external side not reaching apex.

Distribution: Widely distributed (Schumann, 1986; Rognes, 1991). New record for Iran.

***Bellardia viarum* (Robineau-Desvoidy, 1830) (Fig. 2)**

Material examined: 1♂, 04.VII.2017, East Azerbaijan province, Chichakli, 38°30′26.22″ N, 46°36′26.82″ E, 1724m a.s.l., sweep net. leg., S. Khaghaninia.

Diagnostic characters: Body length 4.5-8.5mm; tergites metallic-green or blue with a different patterns of dusting; tergite 4 usually with discal setae; fore tibia with one posteroventral seta; basal veins of wing usually blackish or dark brown; cerci straight, tapering evently; surstylus long and rather narrow, weakly bent, usually diverging from cerci.

Distribution: All over the Palearctic region (Schumann, 1986); Fennoscandia (Rognes, 1991). New record for Iran.

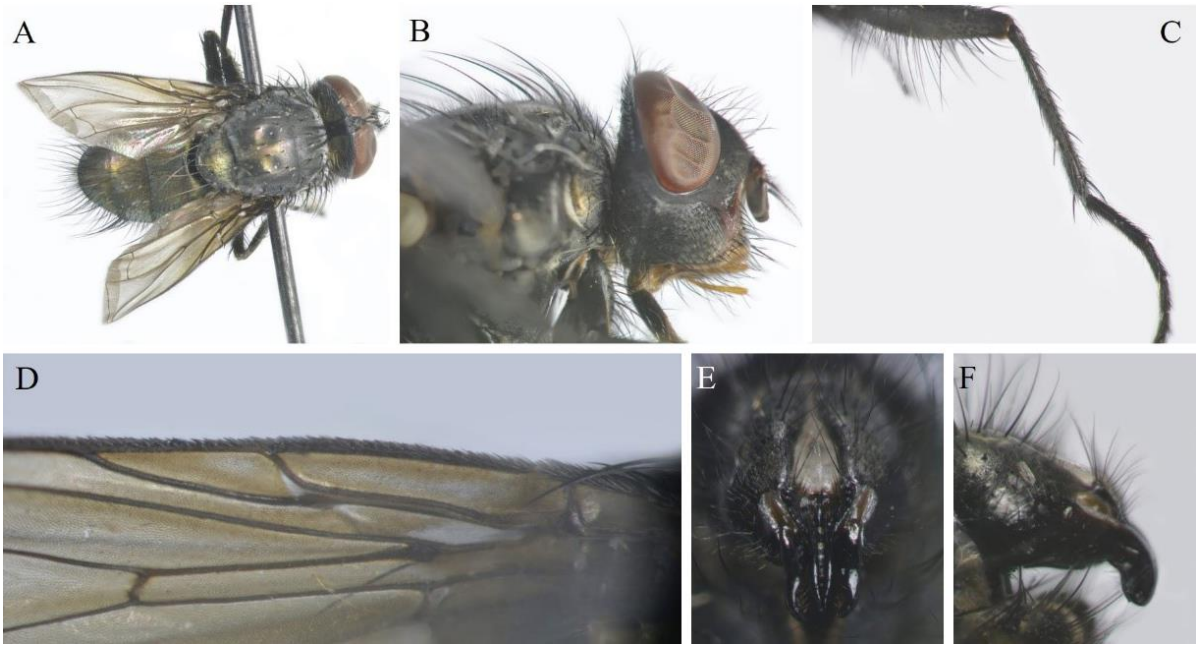

Figure 1. *Bellardia pandia* (Walker, 1849) (male): **A.** dorsal view; **B.** head from lateral side; **C.** posteroventral setae of fore tibia; **D.** dorsal surface of wing; **E.** dorsal view of genitalia; **F.** lateral view of genitalia.

Figure 2. *Bellardia viarum* (Robineau-Desvoidy, 1830) (male): **A.** dorsal view; **B.** dorsal view of wing; **C.** dorsal view of genitalia; **D.** lateral side of genitalia.

******Bellardia vulgaris* **(Robineau-Desvoidy, 1830) (Fig. 3)**

Material examined: 1♂, 15.VI.2013, East Azerbaijan province, Chichakli, 38°39′53.94″ N, 46°31′14.88″ E, 2140m a.s.l., sweep net; 1♂, 05.VII.2013, East Azerbaijan province, Chichakli, Xomarlu, 38°59′3.54″ N, 46°53′25.5″ E, 1167m a.s.l., sweep net; 20♂♂, 25.VI.2014, East Azerbaijan province, Kaleybar, 38°51′4.61″ N, 46°59′55.92″ E, 1367m a.s.l., sweep net; 4♂♂, 25.V.2016, East Azerbaijan province, Kaleybar, 46°26′32.16″ N, 44°54′24.6″ E, 1532m a.s.l., sweep net; 1♂, 04.VII.2017, East Azerbaijan province, Chichakli, 38°30′26.22″ N, 46°36′26.82″ E, 1724m a.s.l., sweep net; 1♂, 02.VII.2018, East Azerbaijan province, Chichakli, Abbas Abad, 38°55′00.57″ N, 46°49′27.09″ E, 1270m a.s.l., sweep net. leg., S. Khaghaninia, S. Modarresi.

Diagnostic characters: Body length 4.5-8.5 mm; tergites metallic-green with a different patterns of dusting; tergite 4 usually without discal setae; fore tibia with one posteroventral seta occationary with two; basal veins of wing usually pale; surstylus longer than cerci, weakly curved in profile, external groove not reaching to apex.

Distribution: Widely distributed in Europe, Fennoscandia, U.S.A (Schumann, 1973, 1986; Rognes, 1991). New record for Iran.

Genus: *Calliphora* Robineau-Desvoidy, 1830

***Calliphora vicina* Robineau-Desvoidy, 1830 (Fig. 4)**

Material examined: 1♂, 2♀♀, 26.IV.2013, West Azerbaijan province, Khoy, Evogli, 38°42.436' N 45°12.246' E, 968m a.s.l., Malaise trap; 3♂♂, 3♀♀, 15.VI.2013, East Azerbaijan province, Kandovan, 37°24′10.86″ N, 46°19′54″ E, 3005m a.s.l., sweep net; 1♂, 25.V.2014, West Azerbaijan province, Urmia, 37°17′35.01″ N, 45°08′49.08″ E, 1473m a.s.l., sweep net; 2♀♀, 01.VI.2014, West Azerbaijan province, Khoy, 38°30′55.00″ N, 44°53′38.57″ E, 1160m a.s.l., sweep net, 1♀, 07.VI.2014, East Azerbaijan province, Shabestar, Kuzekonan, 38°30′55.00″ N, 44°53′38.57″ E, 1160m a.s.l., sweep net; 6♂♂, 5♀♀, 25.VI.2014, East Azerbaijan province, Kaleybar, 38°51′4.61″ N, 46°59′55.92″ E, 1367m a.s.l., sweep net; 1♂, 05.VII.2014, East Azerbaijan province, Shabestar, Shanejan, 38°14′12.3″ N, 45°23′11.5″ E, 1649m a.s.l., sweep net; 1♂, 03.VI.2016, East Azerbaijan province, Jolfa, 38°55′51.85″ N, 45°37′41.88″ E, 729m a.s.l., sweep net; 3♂♂, 2♀♀, 14.VII.2016, East Azerbaijan province, Zonuz, Mahar, 38°32′06.30″ N, 46°19′02.10″ E, 540m a.s.l., sweep net; 1♂, 01.X.2016, East Azerbaijan province, Shabestar , Til, 38°15′31.7″ N, 45°28′50.8″ E, 1489m a.s.l., sweep net; 1♀, 24.V.2017, West Azerbaijan province, Urmia, Dareh Ghasemlu, 37°17′24.58″ N, 45°08′06.65″ E, 1741m a.s.l., sweep net;

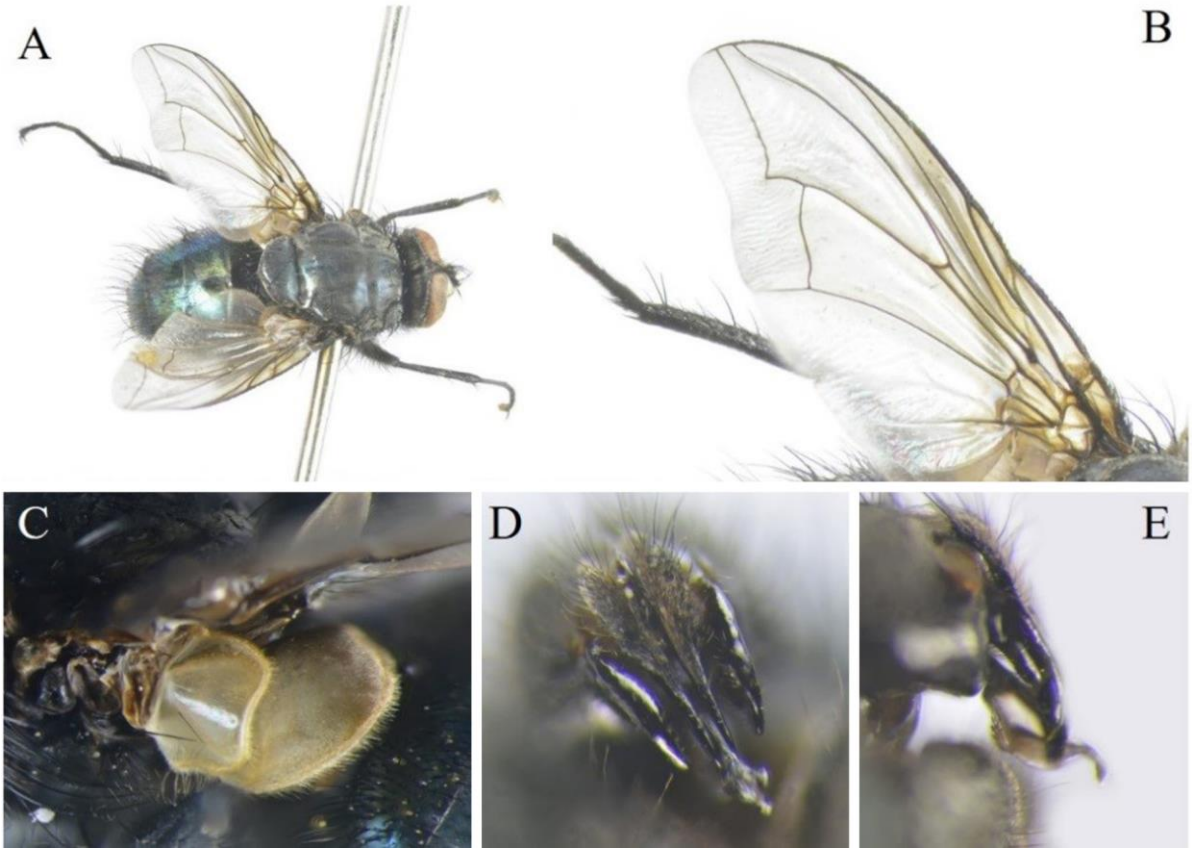

Figure 3. *Bellardia vulgaris* (Robineau-Desvoidy, 1830) (male): **A.** dorsal view; **B.** dorsal view of wing; **C.** lateral view of calypter; **D.** dorsal view of genitalia; **E.** lateral side of genitalia.

Figure 4. *Calliphora vicina* Robineau-Desvoidy, 1830 (female): **A.** dorsal view; **B.** frontal view of head; **C.** lateral view of anterior spiracle; **D.** base costa from lateral side.

3♂♂, 2♀♀, 04.VII.2017, East Azerbaijan province, Chichakli, 38°30′26.22″ N, 46°36′26.82″ E, 1724m a.s.l., sweep net; 2♀♀, 18.VI.2017, West Azerbaijan province, Mahabad, Ghalat shah, 38°46.1′ N, 42°22.37′ E, 1605m a.s.l., sweep net; 2♀♀, 24.VI.2017, West Azerbaijan province, Mahabad, 36°29′29.64″ N, 45°45′33.35″ E, 1485m a.s.l., sweep net; 6♂♂, 4♀♀, 29.VI.2017, West Azerbaijan province, Mahabad, 36°29′29.64″ N, 45°45′33.35″ E, 1485m a.s.l., sweep net; 1♀, 11.VIII.2017, West Azerbaijan province, Mahabad, 36°29′29.64″ N, 45°42′28.82″ E, 1629m a.s.l., sweep net. leg., S. Khaghaninia, S. Modarresi, R. Namaki Khameneh.

Distribution: Widely distributed (Nielsen et al., 1954); Saudi Arabia, China, Mongolia, Japan, Nearctic region (Schumann, 1986); Iran (Rak & Anwar, 1974).

***Calliphora vomitoria* (Linnaeus, 1758) (Fig. 5)**

Material examined: 1♀, 15.VI.2013, East Azerbaijan Province, Kandovan,

37°24′10.86″ N, 46°19′54″ E, 3005m a.s.l., sweep net; 1♂, 25.V.2014, West Azerbaijan Province, Urmia, 37°17′35.01″ N, 45°08′49.08″ E, 1473m a.s.l., sweep net; 1♂, 01.VI.2014, West Azerbaijan Province, Khoy, 38°30′55.00″ N, 44°53′38.57″ E, 1160m a.s.l., sweep net; 1♂, 2♀♀, 25.VI.2014, East Azerbaijan Province, Kaleybar, 38°51′4.61″ N, 46°59′55.92″ E, 1367m a.s.l., sweep net; 1♂, 1♀, 17.VI.2016, West Azerbaijan Province, Urmia, 37°17′35.01″ N, 45°08′49.08″ E, 1473m a.s.l., sweep net; 2♀, 04.VII.2017, East Azerbaijan Province, Chichakli, 38°30′26.22″ N, 46°36′26.82″ E, 1724m a.s.l., sweep net; 6♂♂, 1♀, 02.VII.2018, East Azerbaijan Province, Chichakli, Abbas Abad, 38°55′00.57″ N, 46°49′27.09″ E, 1270m a.s.l., sweep net; 1♀, 25.IX.2018, West Azerbaijan Province, Mahabad, 36°34′10.16″ N, 45°41′12.98″ E, 1521m a.s.l., Malaise trap. leg., S. Khaghaninia, S. Modarresi.

Distribution: Fennoscandia, Alpine (Rognes, 1991); widely distributed in Palaearctic and Nearctic region (Schumann, 1986; Hall, 1965); Oriental region (Delfinado & Hardy, 1977); Iran (Shah-Hoseini & Kamali, 1989).

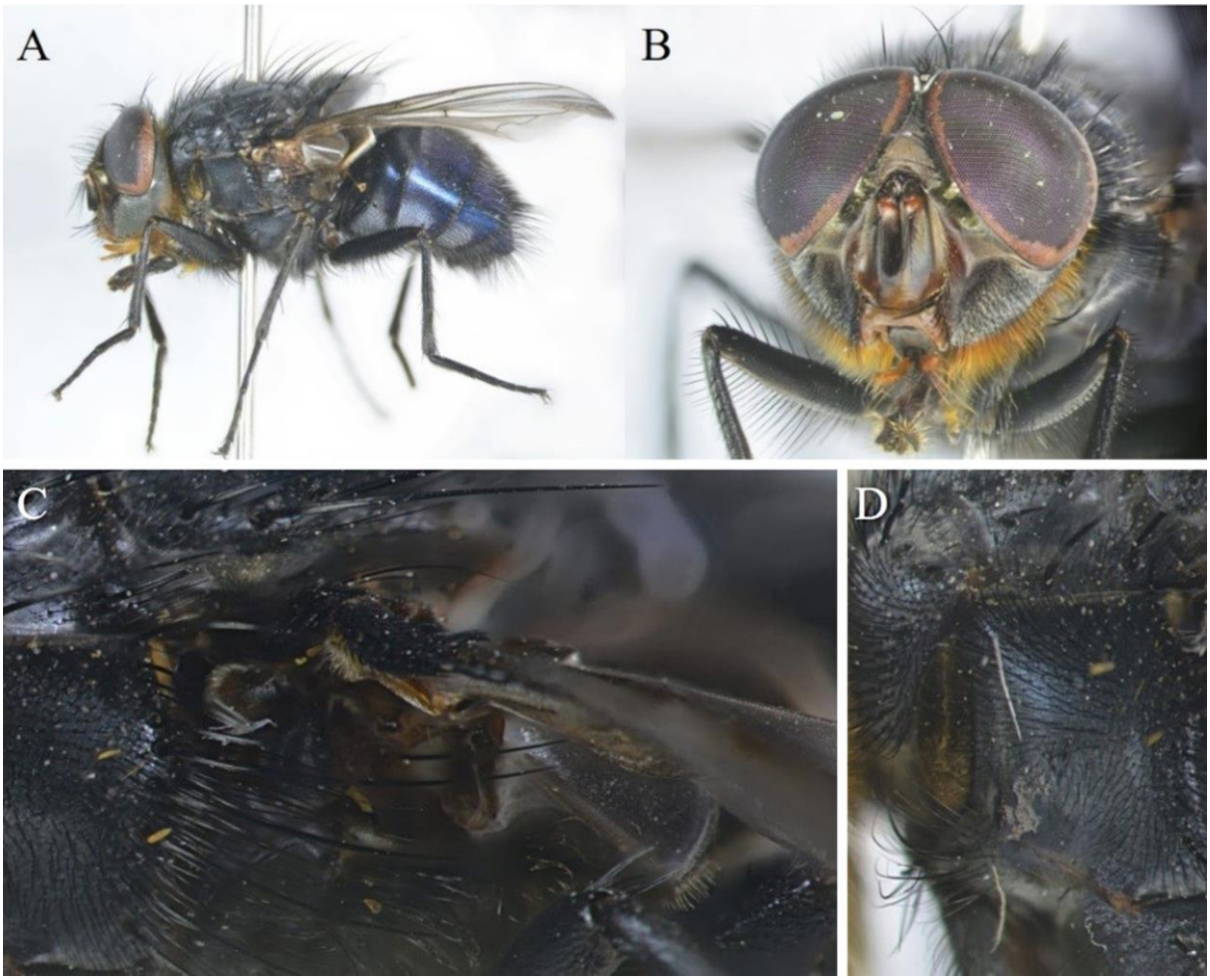

Figure 5. *Calliphora vomitoria* (Linnaeus, 1758) (male): **A.** lateral view; **B.** frontal view of head; **C.** dorsal view of basicosta; **D.** lateral view of anterior spiracle.

Genus: *Cynomya* Robineau-Desvoidy, 1830

***Cynomya mortuorum* (Linnaeus, 1761) (Fig. 6)**

Material examined: 1♀, 15.VI.2013, East Azerbaijan province, Kandovan, 37°24′10.86″ N, 46°19′54″ E, 3005m a.s.l., sweep net; 1♀, 4♂♂, 25.VI.2014, East Azerbaijan province, Kaleybar, 38°51′4.61″ N, 46°59′55.92″ E, 1367m a.s.l., sweep net; 1♂, 25.V.2016, East Azerbaijan province, Kaleybar, 46°26′32.16″ N, 44°54′24.6″ E, 1532m a.s.l., sweep net; 1♀, 20.VIII.2016, East Azerbaijan province, Sufiyan, Mazrae village, 38°36′28.15″ N, 47°03′09.39″ E, 1839m a.s.l., sweep net; 1♀, 04.VII.2017, East Azerbaijan province, Chichakli, 38°30′26.22″ N, 46°36′26.82″ E, 1724m a.s.l., sweep net; 1♀, 3♂♂, 18.VI.2017, West Azerbaijan province, Mahabad, Ghalat shah, 38°46.1′ N, 42°22.37′ E, 1605m a.s.l., sweep net. leg., S. Khaghaninia, S. Modarresi.

Diagnostic characters: Body length 7-13 mm; tergites shining blue or green metallic without any dusting; mesonotum with shifting stripes; one pair of postsutural acrostichal setae; parafacial with bright yellow to orange ground color and golden microtrichia; portions or all of fronto-orbital plate, frontal vitta, antenna, and genal dilation with bright yellow ground color and golden microtrichia; sternite 5 of males large and swollen.

Distribution: Holarctic Region (Rognes, 1991); Palaearctic region (Schumann, 1986; Ozerov, 1986); Pakistan (Hassan et al., 2018). New record for Iran.

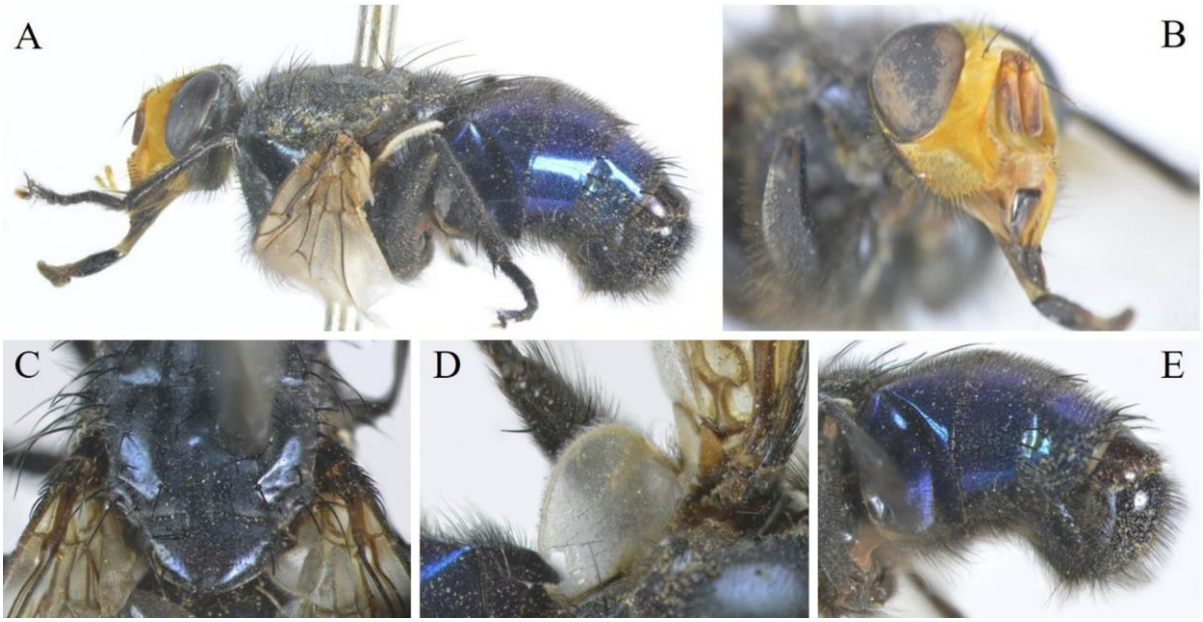

Figure 6. *Cynomya mortuorum* (Linnaeus, 1761) (male): **A.** lateral view; **B.** head from the lateral side; **C.** dorsal view of thorax; **D.** lateral view of lower calypter; **E.** lateral view of tergite.

Key to the known Iranian species of the subfamily Calliphorinae (This key is basically modified from Rognes (1991), Falk (2016) and Whitworth (2006).

1- First flagellomere at most, twice of pedicel length; abdomen blue or olive green (Figs 1A, B) (***Bellardia*** Robineau-Desvoidy). **3**

- First flagellomere more than twice length of pedicel; abdomen bluish (Figs 4A, B). ...**2**

2- Disc of upper and lower calypter white; rim of upper calypters usually tan; rim of lower calypter usually pale (Fig. 6D) (***Cynomya*** Robineau-Desvoidy). ….....
.....***C. mortuorum*** (Linnaeus)

- Disc of upper and lower calypter light to dark brown, rim of calypters pale or dark (Fig. 4A) (***Calliphora*** Robineau-Desvoidy). **5**

3- First tibia with two strong posteroventral setae; section of costa between the end of the subcosta and R_1 with some ventral-facing hairs on lower surface. Male genitalia as (Figs 1E, F). .....
.....***B. pandia*** (Walker)

- First tibia with one posteroventral setae; section of costa between the end of the subcosta and R_1 without any ventral-facing hairs on lower surface. **4**

4- Wing veins usually blackish or dark brown, including on underside. Male genitalia as (Figs 2C, D). .....
.....***B. viarum*** **(**Robineau- Desvoidy)

- Basal wing veins ventrally yellowish-brown. Male genitalia as (Figs 3D, E). .....
.....***B. vulgaris*** (Robineau-Desvoidy)

5- Basicosta yellow to orange; genal dilation with reddish ground color on anterior half or more, anterior thoracic spiracle orange (Figs 4B, C, D). .....
.....***C. vicina*** Robineau-Desvoidy

- Basicosta dark brown or black; genal dilation, when fully colored, black postgena and lower posterior corner of genal dilation and back of head with long yellow-orange setae, anterior thoracic spiracle brownish to blackish (Figs 5B, C, D). .....***C. vomitoria*** (Linnaeus)

Discussion

The present study increases the number of the Calliphoridae species and genera in Iran to 34 and 12, respectively. The studied species of the subfamily Calliphorinae were collected from rural areas, gardens, livestock holdings, forests and grasslands in East Azerbaijan and West Azerbaijan provinces in the northern west of Iran. The Genus *Bellardia* is usually found in grasslands, sub-humid forests fens and damp woods and the biology of its species is largely unknown (Falk, 2016). The females are viviparous and the larvae develop as internal parasitoids of earthworms. Adults are occasionally flower-visitors (Falk, 2016). *Cynomya* larvae develop in carrion of various hosts, especially small mammals while adults visit flowers such as umbellifers, thistles and also stinkhorn fungus (Falk, 2016). The studied areas in north-western Iran have vast grasslands and rangelands with various species of Apiaceae and Asteraceae. The species *Bellardia pandia* and *Bellardia viarum* had the highest and lowest abundance, respectively. The Iranian fauna of Calliphoridae has been nearly poor known, especially in the northern west part. Based on the rich fauna as well as various flora in virgin parts of studied areas, it is expected that more species of the family Calliphoridae can be found in northern west of Iran.

Acknowledgments

We would like to thank Professor Krzysztof Szpila (Nicolaus Copernicus University, Poland) for his help with the identification of the species.

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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مطالعه زیرخانواده Calliphorinae (Diptera: Calliphoridae) در ایران با گزارش دو جنس و چهار گونه جدید

سمیه مدرسی[۱]، صمد خاقانی نیا[۱*] و فرناز سیدی صاحباری[۲]

۱ گروه گیاهپزشکی، دانشکده کشاورزی، دانشگاه تبریز، تبریز، ایران.
۲ مرکز تحقیقات، آموزش و ترویج کشاورزی و منابع طبیعی استان آذربایجان شرقی، تبریز، ایران.
* پست الکترونیکی نویسنده مسئول مکـاتبه: *skhaghaninia@gmail.com*
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چکیــده: مگس‌های زیرخانواده Calliphorinae (Dipt.: Calliphoridae) در استان‌های آذربایجان‌شرقی و آذربایجان‌غربی ایران، طی سال‌های ۱۳۹۶-۱۳۹۷ مطالعه شدند. در نتیجه این مطالعه، شش گونه متعلق به سه جنس شناسایی شدند، که در بین آن‌ها دو جنس *Bellardia* Robineau-Desvoidy, 1863 و *Cynomya* Robineau-Desvoidy, 1830 به همراه چهار گونه *Bellardia pandia* (Walker, 1849)، *Bellardia viarum* (Robineau-Desvoidy, 1830)، *Bellardia vulgaris* (Robineau-Desvoidy, 1830) و *Cynomya mortuorum* (Linnaeus, 1761) برای فون ایران جدید می‌باشند. در این مطالعه، مروری بر گونه‌های شناخته شده از ایران متعلق به زیرخانواده Calliphorinae صورت گرفته است.

واژگــان کلیدی: Calliphorinae، Calliphoridae، فون، گزارش‌هـای جدیـد، ایران