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The family Calliphoridae (Diptera, Oestroidea) in the Northwest of Iran, with a new record of the subfamily Melanomyinae

Somayeh Modarresi
Department of Plant Protection, Faculty of Agriculture, University of Tabriz, 51664, Tabriz, Iran.
✉ *Somayeh.modaressi@gmail.com* *https://orcid.org/0009-0001-6909-1110*

Farnaz Seyyedi-Sahebari
Plant Protection Research Department, East Azerbaijan Agricultural and Natural Resources Research and Education Center, AREEO, Tabriz, Iran.
✉ *f_seyyedi_sahebari@areeo.ac.ir* *https://orcid.org/0000-0001-6186-7722*

Samad Khaghaninia
Department of Plant Protection, Faculty of Agriculture, University of Tabriz, 51664, Tabriz, Iran.
✉ *skhaghaninia@tabrizu.ac.ir* *https://orcid.org/0000-0002-9787-098X*

Yasaman Sadeghi
Department of Plant Protection, Faculty of Agriculture, University of Tabriz, 51664, Tabriz, Iran.
✉ *sadeghiyassman@gmail.com* *https://orcid.org/0009-0006-3572-8060*

ABSTRACT. This study investigated the blow flies of East Azerbaijan and West Azerbaijan provinces, Iran, across natural habitats (forests and pasturelands), rural areas, fruit orchards, and livestock farms. Sampling was conducted from May to October between 2017 and 2018 using an entomological net and Malaise traps. Additionally, specimens from the insect collection of Professor Hassan Maleki Milani (ICPHMM) in Tabriz, Iran, collected from the same provinces during 2013–2016, were examined. A total of 14 species from seven genera across four subfamilies were identified. Notably, the subfamily Melanomyinae and two species, *Melinda gentilis* (Robineau-Desvoidy, 1830) and *Melinda viridicyanea* (Robineau-Desvoidy, 1830) are reported for the first time from Iran. Based on the new classifications, the number of Chaliphoridae species occurring in Iran is as follows: 4 subfamilies, 8 genera, and 24 species. Diagnostic characters of new records, distribution of species, as well as illustrations from the adult specimens, are given. The identification key for the subfamilies and genera of the blow flies in Iran has also been presented.

Keywords: blow flies, fauna, *Melinda*, necrophagous, identification key

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INTRODUCTION

The family Calliphoridae, commonly known as blow flies, are economically and ecologically important insects due to their effects on public health, farm animals, and the natural world (James, 1947; Greenburg, 1971; Williams et al., 1985; Baumgartner, 1988). Further, studies on blow flies as forensic indicators have become increasingly more popular (Smith, 1986; Greenburg, 1991; Catts & Goff, 1992). Family Calliphoridae, which has lately undergone numerous taxonomic revisions through which some subfamilies were raised to family rank, such as Mesembrinellidae, Rhiniidae, and Polleniidae. This was based on morphological and molecular information, leaving about 932 species, of which 115 species occur in Europe (Verves, 2002; Verves & Khrokalo, 2010; Kutty et al., 2010; Marinho et al., 2012, 2017; Castro et al., 2016; Demirözer et al., 2020; Sivell, 2021). The genus *Milinda* Robineau-Desvoidy of the

Corresponding author: Farnaz Seyyedi-Sahebari, ✉ *f_seyyedi_sahebari@areeo.ac.ir*

subfamily Melanomyinae is an Old World genus with more than 66 species. The biology of a few species is known and involves parasitism of snails (Falk, 2016). The fauna of blow flies has been extensively studied in Europe, East and South Asia, North and South America, and Australasia, with remarkable results in the form of a variety of published catalogues, checklists, keys, and taxonomic monographs (e.g., Schumann, 1986; Rognes, 1991; Verves, 2002; Whitworth, 2006; Szpila, 2010; Szpila, 2012; Hassan et al., 2018; Jones et al., 2019; Demirözer et al., 2020). Few studies were carried out about this family in Iran. Some research has explored the diversity of calliphorids in various regions of the country, including East Azerbaijan and West Azerbaijan provinces (Shah-Hosseini et al., 1989; Modarresi et al., 2019), West and South provinces of Iran (Parchami-Aragi & Tirgari, 1995), and Tehran and its suburbs (Khoobdel et al., 2008). Also, Parchami-Araghi et al. (2001) documented several species from Iran along with a manual for the identification of adult males of the genus *Protocalliphora* Hough.

Some studies have specifically targeted the identification of insects that hold forensic significance, such as the identification of insects of forensic significance in Urmia (Tüzün et al., 2010), delivering the identification key for species of forensically relevant known from the Middle East (Akbarzadeh et al., 2015), and the geographical distribution, biodiversity, and species richness of medically important necrophagous flies in Central Iran (Mozaffari et al., 2020). Furthermore, Izadi et al. (2021) have prepared a checklist of forensically important blow flies in Fars Province, with new records for the country. In the essay on the bloodsucking flies in Haftad-Gholleh protected area, the genus *Trypocalliphora* (Pues) and its species *T. braueri* (Hendel) were reported for the first time from Iran, too (Parchami-Araghi et al., 2017).

This study aims to document new records of the genus *Milinda* in Iran and provide brief notes on their morphology and ecology, contributing to the knowledge of Calliphoridae diversity in the region.

MATERIAL AND METHODS

The studied material was collected using the entomological net and Malaise traps from natural habitats such as forests and pasturelands, as well as rural areas, fruit orchards, and livestock farms of East and West Azerbaijan provinces, during May to October 2017–2018. In addition, the specimens of the Insect Collection of Professor Hassan Maleki Milani (ICPHMM), Tabriz, Iran, were examined. Those were collected from the same provinces during 2013–2016. The main sampling area in this research was the Arasbaran forests, which are located in the northern part of East Azerbaijan province, in the Northwest of Iran. Geographically, these forests are located between the three regions of the Caspian Sea, the Caucasus, and the Mediterranean, and are located (38°40'N, 47°00'E). The sampling areas of West Azerbaijan province were located at Khoy in the north, Urmia in the center, and Mahabad and Miandoab in the south of the province. The highest diversity of species was observed in the Arsbaran and Chichkali forests, in the north of East Azarbaijan and the Sharafkhaneh region, close to Lake Urmia. During the sampling period, we observed that blow flies are active all through the day. The specimens were identified using the keys of Rognes (1991), Szpila (2010), Akbarzadeh et al. (2015), and Falk (2016). Photographs were taken using a Nikon® SMZ 800 stereo-microscope equipped with a Nikon® D5200 digital camera. The terminology of morphology follows Rognes (1991).

RESULTS

In this study, 391 specimens belonging to 4 subfamilies, 7 genera, and 14 species were identified. Among them, the subfamily Melanomyinae, including the genus *Melinda* Robineau-Desvoidy with two species, *Melinda gentilis* (Robineau-Desvoidy, 1830) and *Melinda viridicyanea* (Robineau-Desvoidy, 1830), are reported for the first time from Iran. An updated checklist of Iranian calliphorids (Table 1), along with diagnostic characters of new records, distribution of species, as well as adult photos, is given.

Taxonomic hierarchy

Order Diptera Linnaeus, 1758

Superfamily Oestroidea Leach, 1815

Family Calliphoridae Brauer & Bergenstamm, 1889

Subfamily Calliphorinae Townsend 1934

Genus *Bellardia* Robineau-Desvoidy, 1863

Bellardia pandia (Walker, 1849)

Material examined. 1♂, East Azerbaijan, Jolfa, Siyah-Saran, 38°48'44.47"N, 45°43'42.24"E, 1158 m, 02.06.2013, sweep net, lgt.: S. Modarresi; 1♂, East Azerbaijan, Chichakli, Xomarlu, 38°59'3.54"N, 46°53'25.5"E, 1167 m, 05.07.2013, sweep net, lgt.: S. Khaghaninia; 29♂♂, East Azerbaijan, Shabestar, Shanejan, 38°14'12.3"N, 45°23'11.5"E, 1649 m, 05.07.2014, sweep net, lgt.: S. Khaghaninia; 1♂, East Azerbaijan, Shabestar, Kuzekonan, 38°30'55"N, 44°53'38.57"E, 1160 m, 07.06.2014, sweep net, lgt.: S. Khaghaninia; 35♂♂, East Azerbaijan, Kaleybar, 38°51'4.61″N, 46°59'55.92″E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 4♂♂, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 1♂, East Azerbaijan, Shabestar, Sharafkhaneh, 38°11'3.18"N, 45°29'31.34"E, 1313 m, 21.06.2018, Malaise trap, lgt.: S. Khaghaninia; 2♂♂, East Azerbaijan, Kaleybar, 39°9'55.57"N, 47°1'4.29"E, 237 m, 22.06.2018, Malaise trap, lgt.: S. Modarresi; 2♂♂, East Azerbaijan, Chichakli, Abbas-Abad, 38°55'0.57"N, 46°49'27.09"E, 1270 m, 02.07.2018, Malaise trap, lgt.: S. Modarresi; 3♂♂, West Azerbaijan, Khoy, Safaeyeh, 38°48'7.6"N, 44°35'10.49"E, 2265 m, 10.06.2013, Malaise trap, lgt.: S. Khaghaninia; 7♂♂, West Azerbaijan, Khoy, Safaeyeh, 38°48'7.6"N, 44°35'10.49"E, 2265 m, 04.07.2013, Malaise trap, lgt.: S. Khaghaninia; 1♂, West Azerbaijan, Khoy, 38°30'55"N, 44°53'38.57"E, 1160 m, 01.06.2014, sweep net, lgt.: S. Khaghaninia; 1♂, West Azerbaijan, Urmia, Dareh-Ghasemlu, 37°17'24.58"N, 45°8'6.65"E, 1741 m, 24.05.2017, sweep net, lgt.: S. Modarresi; 1♂, West Azerbaijan, Miandoab, 36°57'39.37"N, 46°6'17.42"E, 1269 m, 27.04.2017, sweep net, lgt.: S. Modarresi; 8♂♂, West Azerbaijan, Mahabad, 36°34'10.16"N, 45°41'12.98"E, 1521 m, 25.09.2018, Malaise trap, lgt.: S. Modarresi.

Distribution. Palaearctic – Widely distributed in Europe, also from Transcaucasia (Georgia), and Russia (Schumann, 1986; Rognes, 1991; Verves, 2002). Iran (Modarresi et al., 2019).

Bellardia viarum (Robineau-Desvoidy, 1830)

Material examined. 1♂, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Khaghaninia.

Distribution. Palaearctic – Widely distributed in Europe (Schumann, 1986; Rognes, 1991; Verves, 2002). Iran (Modarresi et al., 2019).

Bellardia vulgaris (Robineau-Desvoidy, 1830)

Material examined. 1♂, East Azerbaijan, Chichakli, 38°39'53.94"N, 46°31'14.88"E, 2140 m, 15.06.2013, sweep net, lgt.: S. Khaghaninia; 1♂, East Azerbaijan, Chichakli, Xomarlu, 38°59'3.54"N, 46°53'25.5"E, 1167 m, 05.07.2013, sweep net, lgt.: S. Khaghaninia; 20♂♂, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 4♂♂, 1♀, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 1♂, East Azerbaijan, Chichakli, Abbas-Abad, 38°55'0.57"N, 46°49'27.09"E, 1270 m, 02.07.2018, sweep net, lgt.: S. Modarresi.

Distribution. Palaearctic – Widely distributed in Europe, also from Russia (Rognes, 1991; Verves, 2002). Iran (Modarresi et al., 2019).

Genus *Calliphora* Robineau-Desvoidy, 1830

Calliphora vicina (Robineau-Desvoidy, 1830)

Material examined. 3♂♂, 3♀♀, East Azerbaijan, Kandovan, 37°24'10.86"N, 46°19'54"E, 3005 m, 15.06.2013, sweep net, lgt.: S. Khaghaninia; 1♀, East Azerbaijan, Shabestar, Kuzekonan, 38°30'55"N, 44°53'38.57"E, 1160 m, 07.06.2014, sweep net, lgt.: S. Khaghaninia; 6♂♂, 5♀♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 1♂, East Azerbaijan, Shabestar, Shanejan, 38°14'12.3"N, 45°23'11.5"E, 1649 m, 05.07.2014, sweep net, lgt.: S. Khaghaninia; 1♂, East Azerbaijan, Jolfa, 38°55'51.85"N, 45°37'41.88"E, 729 m, 03.06.2016, sweep net, lgt.: S. Modarresi; 3♂♂, 2♀♀, East Azerbaijan,

Zonuz, Mahar, 38°32'6.3"N, 46°19'2.1"E, 540 m, 14.07.2016, sweep net, lgt.: S. Modarresi; 1♂, East Azerbaijan, Shabestar, Til, 38°15'31.7"N, 45°28'50.8"E, 1489 m, 01.10.2016, sweep net, lgt.: S. Modarresi; 3♂♂, 2♀♀, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 1♂, 2♀♀, West Azerbaijan, Khoy, Evogli, 38°42'26.16"N, 45°12'14.76"E, 968 m, 26.04.2013, Malaise trap, lgt.: S. Khaghaninia; 1♂, West Azerbaijan, Urmia, 37°17'35.01"N, 45°8'49.08"E, 1473 m, 25.05.2014, sweep net, lgt.: S. Khaghaninia; 2♀♀, West Azerbaijan, Khoy, 38°30'55"N, 44°53'38.57"E, 1160 m, 01.06.2014, sweep net, lgt.: S. Khaghaninia; 1♀, West Azerbaijan, Urmia, Dareh-Ghasemlu, 37°17'24.58"N, 45°8'6.65"E, 1741 m, 24.05.2017, sweep net, lgt.: S. Modarresi; 2♀♀, West Azerbaijan, Mahabad, Ghalat-Shah, 38°46'6"N, 42°22'22.2"E, 1605 m, 18.06.2017, Malaise trap, lgt.: S. Modarresi; 2♀♀, West Azerbaijan, Mahabad, 36°29'29.64"N, 45°45'33.35"E, 1485 m, 24.06.2017, Malaise trap, lgt.: S. Modarresi; 6♂♂, 4♀♀, West Azerbaijan, Mahabad, 36°29'29.64"N, 45°45'33.35"E, 1485 m, 29.06.2017, Malaise trap, lgt.: S. Modarresi; 1♀, West Azerbaijan, Mahabad, 36°29'29.64"N, 45°42'28.82"E, 1629 m, 11.08.2017, Malaise trap, lgt.: S. Modarresi.

Distribution. Palaearctic – Widely distributed in Europe and the Middle East (Rognes, 1991; Verves & Khrokalo, 2010; Demirözer et al., 2020). Iran (Akbarzadeh et al., 2015).

Calliphora vomitoria (Linnaeus, 1758)

Material examined. 1♀, East Azerbaijan, Kandovan, 37°24'10.86"N, 46°19'54"E, 3005 m, 15.06.2013, sweep net, lgt.: S. Khaghaninia; 1♂, 2♀♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 2♂♂, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 6♂♂, 1♀, East Azerbaijan, Chichakli, Abbas-Abad, 38°55'0.57"N, 46°49'27.09"E, 1270 m, 02.07.2018, sweep net, lgt.: S. Modarresi; 1♂, West Azerbaijan, Urmia, 37°17'35.01"N, 45°8'49.08"E, 1473 m, 25.05.2014, sweep net, lgt.: S. Khaghaninia; 1♂, West Azerbaijan, Khoy, 38°30'55"N, 44°53'38.57"E, 1160 m, 01.06.2014, Malaise trap, lgt.: S. Khaghaninia; 1♂, 1♀, West Azerbaijan, Urmia, 37°17'35.01"N, 45°8'49.08"E, 1473 m, 17.06.2016, sweep net, lgt.: S. Khaghaninia; 1♂, 2♀♀, West Azerbaijan, Mahabad, 36°34'10.16"N, 45°41'12.98"E, 1521 m, 25.09.2018, Malaise trap, lgt.: S. Modarresi.

Distribution. Palaearctic – Distributed in the Canary Islands, Czech Republic, Finland, Poland, Portugal, Ukraine, and Transcaucasia (Rognes, 1991; Verves & Khrokalo, 2010; Demirözer et al., 2020). Iran (Akbarzadeh et al., 2015).

Genus *Cynomya* Robineau-Desvoidy, 1830

Cynomya mortuorum (Linnaeus, 1761)

Material examined. 1♀, East Azerbaijan, Kandovan, 37°24'10.86"N, 46°19'54"E, 3005 m, 15.06.2013, sweep net, lgt.: S. Khaghaninia; 4♂♂, 1♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 1♂, East Azerbaijan, Kaleybar, 46°26'32.16"N, 44°54'24.60"E, 1532 m, 25.05.2016, sweep net, lgt.: S. Modarresi; 1♀, East Azerbaijan, Sufiyan, Mazrae, 38°36'28.15"N, 47°3'9.39"E, 1839 m, 20.08.2016, sweep net, lgt.: S. Modarresi; 1♀, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 3♂♂, 1♀, West Azerbaijan, Mahabad, Ghalat shah, 38°46'6"N, 42°22'22.2"E, 1605 m, 18.06.2017, Malaise trap, lgt.: S. Modarresi.

Distribution. Palaearctic – Widely distributed in Europe and Russia (Rognes, 1991; Verves & Khrokalo, 2010). Iran (Modarresi et al., 2019).

Subfamily Chrysomyinae Robineau-Desvoidy, 183

Genus *Chrysomya* Robineau-Desvoidy, 1830

Chrysomya albiceps (Wiedemann, 1819)

Material examined. 3♂♂, 1♀, East Azerbaijan, Kandovan, 37°24'10.86"N, 46°19'54"E, 3005 m, 15.06.2013, sweep net, lgt.: S. Khaghaninia; 2♀♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 1♀, East Azerbaijan, Shabestar, Shanejan, 38°14'12.30"N, 45°23'11.5"E, 1649 m, 05.07.2014, sweep net, lgt.: S. Khaghaninia; 1♀, East Azerbaijan, Chichakli,

38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 1♂, East Azerbaijan, Shabestar, Sharafkhaneh, 38°11'3.18"N, 45°29'31.34"E, 1313 m, 29.09.2018, sweep net, lgt.: S. Modarresi; 1♀, West Azerbaijan, Mahabad, Ghalat-Shah, 38°46'6"N, 42°22'22.2"E, 1605 m, 18.06.2017, Malaise trap, lgt.: S. Modarresi.

Distribution. Palaearctic – Poland, Portugal, and Ukraine (Szpila, 2010; Verves & Khrokalo, 2010). Iran (Akbarzadeh et al., 2015).

Genus *Protocalliphora* Hough, 1899

Protocalliphora azurea (Fallén, 1817)

Material examined. 2♀♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 1♀, East Azerbaijan, Shabestar, Shanejan, 38°14'12.3"N, 45°23'11.5"E, 1649 m, 05.07.2014, sweep net, lgt.: S. Khaghaninia; 1♂, West Azerbaijan, Urmia, Dareh-Ghasemlu, 37°17'24.58"N, 45°8'6.65"E, 1741 m, 24.05.2017, sweep net, lgt.: S. Modarresi; 1♂, West Azerbaijan, Mahabad, 36°34'10.16"N, 45°41'12.98"E, 1521 m, 25.09.2018, Malaise trap, lgt.: S. Modarresi.

Distribution. Palaearctic – Widely distributed in Europe, Ukraine, and Russia (Rognes, 1991; Falk, 2016). Iran (Parchami-Araghi et al., 2001).

Subfamily Luciliinae Robineau-Desvoidy, 1830

Genus *Lucilia* Robineau-Desvoidy, 1830

Lucilia caesar (Linnaeus, 1758)

Material examined. 1♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 3♂♂, 1♀, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 7♂♂, 4♀♀, East Azerbaijan Province, Chichakli, Abbas-Abad, 38°55'0.57"N, 46°49'27.09"E, 1270 m, 02.07.2018, sweep net, lgt.: S. Modarresi; 1♂, West Azerbaijan, Miandoab, 36°57'39.37"N, 46°6'17.42"E, 1270 m, 02.07.2018, sweep net, lgt.: S. Modarresi.

Distribution. Palaearctic – Canary Islands, Czech Republic, Finland, Germany, Portugal, Kazakhstan, Mongolia, Russia, Ukraine, and the Middle East (Rognes, 1991; Verves & Khrokalo, 2010; Demirözer et al., 2020). Iran (Akbarzadeh et al., 2015).

Lucilia illustris (Meigen, 1826)

Material examined. 3♀♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 1♀, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi.

Distribution. Palaearctic – Finland, France, Germany, Hungary, Italy, the Netherlands, Norway, Russia, Sweden, and the Middle East (Rognes, 1991; Verves, 2002). Iran (Akbarzadeh et al., 2015)

Lucilia sericata (Meigen, 1826)

Material examined. 1♂, East Azerbaijan, Kandovan, 37°24'10.86"N, 46°19'54"E, 3005 m, 15.06.2013, sweep net, lgt.: S. Khaghaninia; 1♀, East Azerbaijan, Shabestar, Kuzekonan, 38°30'55"N, 44°53'38.57"E, 1160 m, 07.06.2014, sweep net, lgt.: S. Khaghaninia; 2♂♂, East Azerbaijan, Shabestar, Shanejan, 38°14'12.3"N, 45°23'11.5"E, 1649 m, 05.07.2014, sweep net, lgt.: S. Khaghaninia; 5♂♂, 26♀♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 2♂♂, East Azerbaijan, Kaleybar, 46°26'32.16"N, 44°54'24.6"E, 1534 m, 25.05.2016, sweep net, lgt.: S. Khaghaninia; 5♀♀, East Azerbaijan, Jolfa, 38°55'51.85"N, 45°37'41.88"E, 729 m, 03.06.2016, sweep net, lgt.: S. Modarresi; 1♂, East Azerbaijan, Shabestar, Til, 38°15'31.7"N, 45°28'50.8"E, 1489 m, 01.10.2016, sweep net, lgt.: S. Modarresi; 1♂, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 1♀, East Azerbaijan, Shabestar, Sharafkhaneh, 38°11'3.18"N, 45°29'31.34"E, 1313 m, 21.06.2018, Malaise trap, lgt.: S. Modarresi; 1♂, 2♀♀, East Azerbaijan, Chichakli, Abbas-Abad, 38°55'0.57"N, 46°49'27.09"E, 1270 m, 02.07.2018, sweep net, lgt.: S. Modarresi; 1♀, West Azerbaijan, Khoy, Safaeyeh,

38°48'7.6"N, 44°35'10.49"E, 2265 m, 04.07.2013, Malaise trap, lgt.: S. Khaghaninia; 1♂, 2♀♀, West Azerbaijan, Urmia, 37°17'35.01"N, 45°8'49.08"E, 1473 m, 25.05.2014, sweep net, lgt.: S. Khaghaninia; 5♀♀, West Azerbaijan, Mahabad, Ghalat-Shah, 38°46'6"N, 42°22'22.2"E, 1605 m, 18.06.2017, Malaise trap, lgt.: S. Modarresi; 18♂♂, 12♀♀, West Azerbaijan, Mahabad, 36°29'29.64"N, 45°45'33.35"E, 1485 m, 16.07.2017, Malaise trap, lgt.: S. Modarresi; 1♂, West Azerbaijan, Mahabad, 36°34'10.16"N, 45°41'12.98"E, 1521 m, 18.06.2018, Malaise trap, lgt.: S. Modarresi.

Distribution. Palaearctic – Widely distributed in Europe, also from Türkiye and Azerbaijan (Rognes, 1991; Verves, 2002; Demirözer et al., 2020). Iran (Akbarzadeh et al., 2015).

Lucilia silvarum (Meigen, 1826)

Material examined. 5♂♂, 5♀♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 1♂, East Azerbaijan, Shabestar, Shanejan, 38°14'12.3"N, 45°23'11.5"E, 1649 m, 05.07.2014, sweep net, lgt.: S. Khaghaninia; 3♀♀, East Azerbaijan, Varzeqan, 38°30'30.84"N, 46°39'27.39"E, 1669 m, 11.07.2016, sweep net, lgt.: S. Khaghaninia; 1♀, East Azerbaijan, Marand, Mahar, 38°32'6.3"N, 46°19'2.10"E, 1540 m, 14.07.2016, sweep net, lgt.: S. Modarresi; 2♂♂, 2♀♀, East Azerbaijan, Marand, Dogijan cave, 38°39'25.1"N, 46°1'46.84"E, 2104 m, 18.06.2017, sweep net, lgt.: S. Modarresi; 1♂, 1♀, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi.

Distribution. Palaearctic – Widely distributed in Europe, also from Transcaucasia and the Middle East (Verves & Khrokalo, 2010; Demirözer et al., 2020). Iran (Akbarzadeh et al., 2015).

Subfamily Melanomyinae Townsend, 1919 *

This subfamily is distinguished by the combination of the following characters. Background color black; thorax and abdomen non-metallic or dark blue metallic, more or less dusted, non-metallic individuals muscid-like and frequently small, the blue metallic ones large with compact construct; parafacial without very strong setae; palpi black; prementum short; lower parts of anterior half of anepimeron generally bare; coxopleural streak absent; stem-vein of wing bare above; costa hairy below beyond junction with R_1; wing cell r_{4+5} open very close to apex of wing in non-metallic species; lower calypter bare above, slim and subcircular with internal edge diverging from body-axis or posteriorly broad with internal edge converging with body-axis; hind coxa bare above (Rognes, 1991). Herein, the subfamily Melanomyinae with the genus *Melinda* Robineau-Desvoidy and two species are reported for the first time from Iran.

Genus *Melinda* Robineau-Desvoidy, 1830 *

Type species. *Musca cognata* Meigen, 1910.

Melinda is an Old World genus with 66 described species, which has a great diversity in Oriental regions. It has been found in Western Europe, North Africa, even Samoa, Fiji, and Australia. Two European species, *Milinda gentilis* and *Milinda viridicyanea*, occupy different habitats ranging from woodlands and wetlands to coastal and disturbed sites. They parasitize snails such as *Cernuella virgata* and *Discus rotundatus*, with eggs laid in the pulmonary cavity of the hosts (Falk, 2016). Adults of both species visit a variety of flowers, indicating their potential role as pollinators.

Diagnostic characters. Body length 5–10 mm; face, frons, gena and antenna always dark; body ground-color black, thorax and abdomen dark metallic blue, with white dusting; mesonotum in posterior view with stripes before the suture; width of gena no more than one-third the height of an eye; the lower facial margin somewhat projecting below and extends to the vibrissae; parafacial heavily dusty and with altering spots, hairy on upper part; fronto-orbital plate silvery dusted, except for posterior part; occiput with short black setae; arista plumose; palpi yellow-brown to almost black; posterior spiracle dark with dark anterior lappets; scutellum with 3 pairs of strong marginal setae; lower calypter white, bare on dorsal surface, posteriorly broad with internal edge converging with body-axis; wing veins dark; abdomen at least with some white dusting, with full marginal rows of strong setae on tergites 3–4 and discal setae on tregite 5, tergite and sternite 6 without setulae. (Rognes, 1991).

Melinda gentilis (Robineau-Desvoidy, 1830) * (Fig. 1A-E)

Material examined. 1♂, East Azerbaijan, Chichakli, 38°39'53.94"N, 46°31'14.88"E, 2140 m, 15.06.2013, sweep net, lgt.: S. Khaghaninia; 2♂♂, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 1♂, East Azerbaijan, Chichakli, Abbas-Abad, 38°55'0.57"N, 46°49'27.09"E, 1270 m, 02.07.2018, sweep net, lgt.: S. Modarresi; 1♂, West Azerbaijan, Mahabad, 36°34'10.16"N, 45°41'12.98"E, 1521 m, 25.09.2018, Malaise trap, lgt.: S. Modarresi.

Diagnostic characters. Body length 5–10 mm; body black, thorax and abdomen metallic blue (Fig. 1A) with white dusting; arista plumose; frons about half the width of first flagellomere, narrower than posterior ocelli inclusive (Fig. 1B); frontal vitta interrupted; palpi more translucent brownish (Fig. 1C); mesonotum in posterior view with five stripes before the suture; presutural intra-alar setae strong; lower calypters white, bare in dorsal surface (Fig. 1D); legs black; abdominal tergites 3–4 with dorsal erect setae not denser and finer than the ventral one (Fig. 1E).

Distribution. Palaearctic – Widely distributed in Europe (Rognes, 1991; Demirözer et al., 2020). Iran (**New record**).

Melinda viridicyanea (Robineau-Desvoidy, 1830) * (Fig. 1F–K)

Material examined. 1♂, East Azerbaijan, Chichakli, 38°39'53.94"N, 46°31'14.88"E, 2140 m, 15.06.2013, sweep net, lgt.: S. Khaghaninia; 2♀♀, East Azerbaijan, Sufiyan, 38°16'40.29"N, 45°58'52.65"E, 1392 m, 07.07.2013, sweep net, lgt.: S. Khaghaninia; 2♂♂, 1♀, East Azerbaijan, Kaleybar, 38°51'4.61"N, 46°59'55.92"E, 1367 m, 25.06.2014, sweep net, lgt.: S. Khaghaninia; 1♀, East Azerbaijan, Shabestar, Kalankash, 38°17'23.83"N, 46°5'57.36"E, 1618 m, 03.06.2016, sweep net, lgt.: S. Khaghaninia; 1♂, 4♀♀, East Azerbaijan, Chichakli, 38°30'26.22"N, 46°36'26.82"E, 1724 m, 04.07.2017, sweep net, lgt.: S. Modarresi; 1♂, East Azerbaijan, Chichakli, Abbas-Abad, 38°55'0.57"N, 46°49'27.09"E, 1270 m, 02.07.2018, sweep net, lgt.: S. Modarresi; 1♂, West Azerbaijan, Urmia, Dareh-Ghasemlu, 37°17'24.58"N, 45°8'6.65"E, 1741 m, 24.05.2017, sweep net, lgt.: S. Modarresi.

Diagnostic characters. Body length 5–9 mm; body black, thorax and abdomen metallic blue, with white dusting (Fig. 1F, 1I); mesonotum in posterior view with three stripes before the suture (Fig. 1G), the lateral one rater broad; arista plumose; palpi black; presutural intra-alar seta absent; lower calypters white, bare in dorsal surface; legs black. Male: frons about as wide as first flagellomere, border than posterior ocelli inclusive (Fig. 1G); abdominal tergites 3–4 with discal erect setae much denser and finer than the ventral ones (Fig. 1H). Female: frons narrower than each eye when seen from above (Fig. 1J); frontal vitta at most as wide as fronto-orbital plate; abdominal tergite 4 with dorsal setae (Fig. 1K); tergite 5 about 1.5 times as long as tergite 4.

Distribution. Palaearctic – France, Finland, Denmark, Germany, the Netherlands, Norway, Portugal, Russia, Sweden, United Kingdom, and Kazakhstan (Schumann, 1986; Rognes, 1991; Falk, 2016). Iran (**New record**).

Key to the identification of the subfamilies and genera of blow flies of Iran (derived from the keys of Rognes (1991) and Jones et al. (2019)).

1 Stem-vein with row of hairs above. ..... **(Chrysomyinae) 4**

– Stem-vein without row of hairs above. **2**

2 Lower calypter with hairs on dorsal surface; thorax non-metallic, dark and dusted. .... **(Calliphorinae) 6**

– Lower calypter without hairs on dorsal surface; thorax bright green metallic, rarely bluish or cuprous. **3**

3 Coxopleural streak absent; palpi dark (Fig. 1C); costa hairy below beyond junction with R1; body none-metallic or dark blue metallic (Fig. 1A, F, I). ..... **(Melanomyinae) *Melinda* Robineau-Desvoidy**

– Coxopleural streak present; palpi yellow or dark; body bright green metallic. .... **(Luciliinae) *Lucilia* Robineau-Desvoidy**

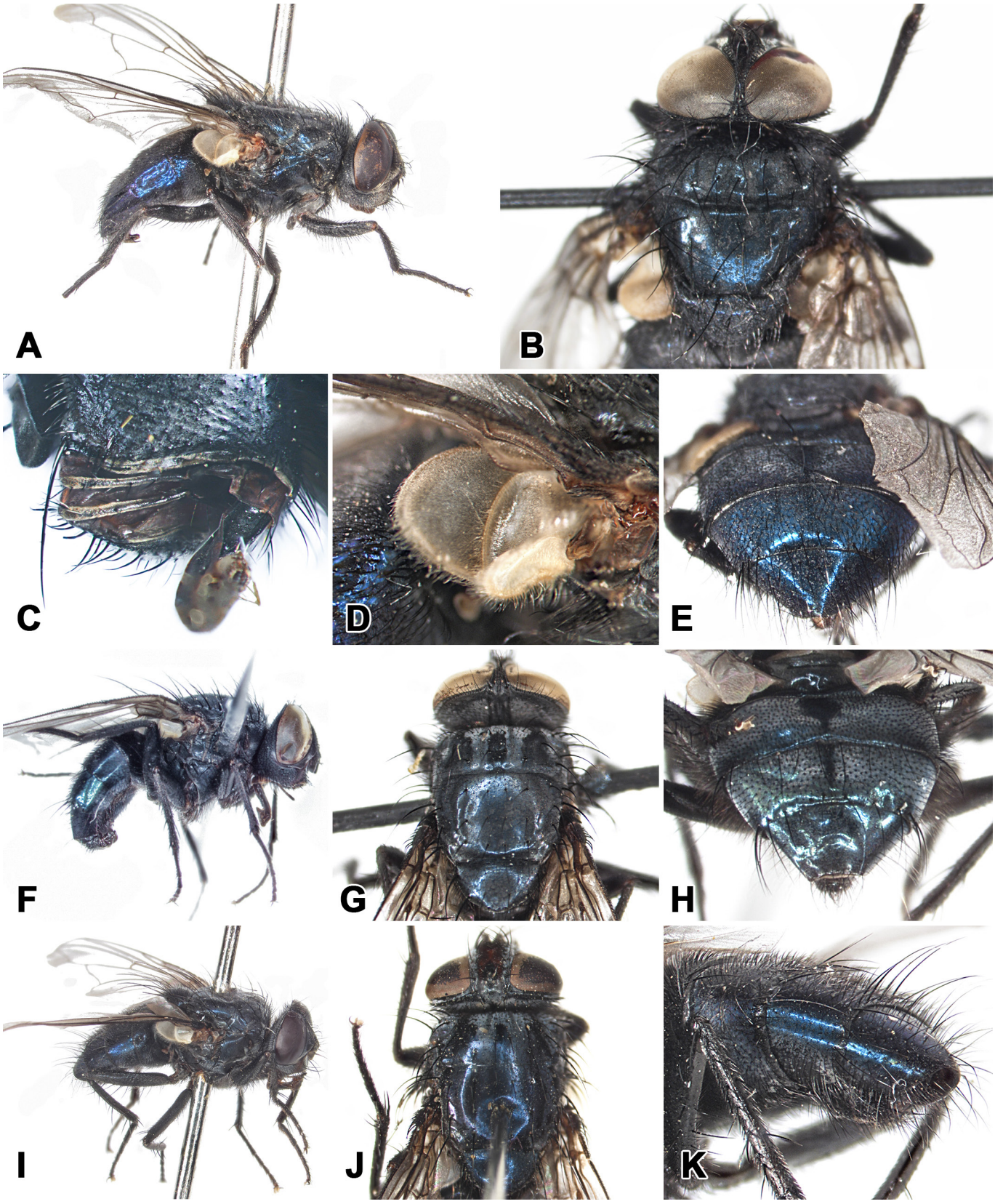

Figure 1. The newly recorded calliphorids. **A–E.** *Melinda gentilis* (Robineau-Desvoidy, 1830): **A.** General habitus, lateral view; **B.** Head and thorax, dorsal view; **C.** Palpi; **D.** Calypter; **E.** Abdomen, dorsal view; **F–K.** *Melinda viridicyanea* (Robineau-Desvoidy, 1830): **F.** General habitus (male), lateral view; **G.** Head and thorax (male), dorsal view; **H.** Abdomen (male), dorsal view; **I.** General habitus (female), lateral view; **J.** Head and thorax (female), dorsal view; **K.** Abdomen (female), Lateral view.

4 Greater ampulla with stiff erect hairs; dorsal surface of lower calypter with dense hairs; tergites 1+2 dark or black, and posterior margin of tergites 3 and 4 black. ..... ***Chrysomya*** **Robineau-Desvoidy**

— Greater ampulla bare or with short fine setulae; tergites 1+2 and posterior margin of tergites 3 and 4 metallic green or blue; dorsal surface of lower calypter bare or with a few pale hairs. **5**

5 Basicosta, both thoracic spiracles and both calypters bright yellow; postalar wall practically bare (a few short inconspicuous hairs sometimes present)..... ***Trypocalliphora*** **Hendel**

— Basicosta and both thoracic spiracles brown, dark brown, or blackish; both calypters white or lower one sometimes infuscate brown; postalar wall with or without long hairs. ..... ***Protocalliphora*** **Hough**

6 Only one pair of postsutural acrostichals, the prescutellar pair; tergites entirely undusted and brightly shining blue or turquoise. ..... ***Cynomya*** **Robineau-Desvoidy**

— Three pairs of postsutural acrostichals; tergites in most species with obvious dusting. **7**

7 Tergites metallic-blue; parafacialia only hairy on upper part (hairs not extending much lower than a level equivalent to the aristal insertion point); lower calypter often hairy over most of their upper surface; third antennal segment 3–5 times as long as wide and often extensively red or orange; face, frons and gena often extensively yellow, orange, or reddish. ..... ***Calliphora*** **Robineau-Desvoidy**

— Tergites metallic-green, turquoise or bronze; parafacialia hairy over much of length (hairs extending down to a level equivalent to the middle of the third antennal segment or beyond; lower calypter only hairy over about one-third of their upper surface, broadly bare around their margins; third antennal segment 2–2.5 times as long as wide, at most red at extreme base; face, frons and gena entirely or mainly dark. ..... ***Bellardia*** **Robineau-Desvoidy**

DISCUSSION

This study represents the second survey of the family Calliphoridae in East and West Azerbaijan provinces of northwestern Iran. Prior to this study, six species belonging to three genera of the subfamily Calliphorinae were reported from the mentioned areas, of which two genera *Bellardia* and *Cynomya*, as well as four species, were new records for the Iranian fauna (Modarresi et al., 2019). Herein, we report eight species belonging to the subfamilies Chrysomyinae, Luciliinae, and Melanomyinae from the northwest of Iran, and all are widely distributed species found in Europe and Scandinavian countries. In addition, six species have a much wider distribution reaching the Nearctic region. Before the raising of some subfamilies to the family rank and our new findings, the family Calliphoridae included 37 species in Iran, distributed in five subfamilies and twelve genera. According to the recent phylogenetic study of Cerretti et al. (2019), the subfamily Polleniinae was raised to the family rank. The Rhiniinae were also later elevated to the family rank (Sivell, 2021). So the number of species occurring in Iran was reduced to 24 species treated under four subfamilies and eight genera (Table 1). Based on this list, the highest diversity of species was associated with the subfamily Chrysomyinae, with three genera and nine species. The genus *Chrysomya* Robineau-Desvoidy was the most specious, comprising seven species in Iran, of which the *Chrysomya albiceps* (Wiedemann) was collected from our studied areas. The genera *Cynomya* Robineau-Desvoidy, *Protocalliphora* Hough, and *Trypocalliphora* Pues are each known to have one recorded species in Iran.

The subfamily Melanomyinae, with the genus *Melinda* and two species, *M. gentilis* and *M. viridicyanea*, is reported for the first time from Iran. Both of these species are distributed in the Palaearctic and Afrotropical regions (Rognes, 1991; Pohjoismaki & Kahanpaa, 2014; Falk, 2016). Arsbaran and Chichakli pastures and woodlands exhibited the highest species diversity. This is attributed to the better preservation of these areas and the greater variety of mature plants, which provide more food sources. In addition, activities of livestock and the presence of open dumpsites in the regions close to Lake Urmia may justify the abundance of blow flies. The species *Bellardia pandia* was the most common species, with 97 out of 391 specimens in the present study. Larvae of this species are known to develop as internal parasitoids within earthworms and inhabit grasslands, sub-humid forests, fens, and damp woods (Falk, 2016). The species *Bellardia viarum* appears to be a rare species with only a single specimen collected in our study.

Table 1. A list of Calliphoridae (Diptera) known from Iran.

Subfamily	No.	Species	Distribution	References
Calliphorinae	1	*Bellardia pandia* (Walker, 1849)	East Azerbaijan; West Azerbaijan	Modarresi et al. (2019)
	2	*Bellardia viarum* (Robineau-Desvoidy, 1830)	East Azerbaijan	Modarresi et al. (2019)
	3	*Bellardia vulgaris* (Robineau-Desvoidy, 1830)	East Azerbaijan	Modarresi et al. (2019)
	4	*Calliphora pattoni* Aubertin, 1931	Fars	Izadi et al. (2021)
	5	*Calliphora vicina* Robineau-Desvoidy, 1830	Fars; East Azerbaijan; West Azerbaijan	Rak & Anwar (1974) Khoobdel et al. (2008)
	6	*Calliphora vomitoria* (Linnaeus, 1758)	Tehran; East Azerbaijan; West Azerbaijan	Shah-Hoseini et al. (1989)
	7	*Cynomya mortuorum* (Linnaeus, 1761)	East Azerbaijan; West Azerbaijan	Modarresi et al. (2019)
Chrysomyinae	8	*Chrysomya albiceps* (Wiedemann, 1819)	Bushehr; Ilam; Fars; Kerman; Hormozgan; Kermanshah; Khorasan; Khuzestan; Tehran; East Azerbaijan; West Azerbaijan	Parchami-Araghi (1995) Parchami-Aragi & Tirgari (1995)
	9	*Chrysomya bezziana* Villeneuve, 1914	Fars; Hormozghan	Parchami-Araghi (1995)
	10	*Chrysomya marginalis* (Wiedemann, 1830)	Baluchistan	Parchami-Araghi et al. (2001)
	11	*Chrysomya megacephala* (Fabricius, 1794)	Baluchistan; Bushehr; Fars; Kermanshah; Khuzestan; Hormozgan	Parchami-Aragi & Tirgari (1995)
	12	*Chrysomya phaonis* Seguy, 1928	Fars	Izadi et al. (2021)
	13	*Chrysomya regalis* Robineau-Desvoidy, 1830	Baluchistan; Bushehr; Fars; Ilam; Hormozgan	Parchami-Aragi & Tirgari (1995)
	14	*Chrysomya rufifacies* (Macquart, 1844)	Baluchistan; Bushehr; Fars; Ilam; Kermanshah; Khuzestan	Parchami-Araghi (1995)
	15	*Protocalliphora azure* (Fallen, 1817)	Kohkiluyeh-Boyerahmad; Markazi; East Azerbaijan; West Azerbaijan	Parchami-Araghi et al. (2017)
	16	*Trypocalliphora braueri* (Hendel, 1901)	Markazi	Parchami-Araghi et al. (2017)
Luciliinae	17	*Lucilia caesar* (Linnaeus, 1758)	East Azerbaijan; West Azerbaijan	Akbarzadeh et al. (2015)
	18	*Lucilia cuprina* (Wiedemann, 1830)	Fars	Akbarzadeh et al. (2015)
	19	*Lucilia illustris* (Meigen, 1826)	East Azerbaijan	Akbarzadeh et al. (2015)
	20	*Lucilia richardsi* (Collin, 1926)	Tehran	Khoobdel et al. (2008)
	21	*Lucilia sericata* (Meigen, 1826)	Tehran; Fars; East Azerbaijan; West Azerbaijan	Akbarzadeh et al. (2015)
	22	*Lucilia silvarum* (Meigen, 1826)	East Azerbaijan	Akbarzadeh et al. (2015)
Melanomyinae*	23	*Melinda gentilis* (Robineau-Desvoidy, 1830) *	East Azerbaijan; West Azerbaijan	Current study
	24	*Melinda viridicyanea* (Robineau-Desvoidy, 1830) *	East Azerbaijan; West Azerbaijan	Current study

* New record for Iran.

The observations show, the highest activity and abundance of species are in the months May, June, July, and early October. Favorite factors to blow flies, such as temperatures and the availability of hosts and suitable vegetation, might influence this pattern. The presence of various grasslands and rangelands with diverse flora in northwestern Iran encourages continuation of the taxonomic and ecological research on Calliphoridae in this area and other parts of Iran.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: S. Modarresi: Manuscript preparation, collecting the specimens, taxonomic identification; F. Seyyedi-Sahebari: Revising the manuscript and correspondence; S. Khaganinia: Supervising the project and taxonomic works; Y. Sadeghi: Assistance in the collection of specimens and photography. The authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in the insect collection of Professor Hassan Maleki Milani (ICPHMM) in Tabriz, Iran, and are available from the curator upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study only included arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

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

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عنوان فارسی: مطالعه خانواده Calliphoridae (Diptera, Oestroidea) در شمال غرب ایران همراه با گزارش زیرخانواده Melanomyinae برای کشور

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

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 الکترونیک نویسنده مسئول مکاتبه: *f_seyyedi_sahebari@areeo.ac.ir*

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چکیده: دوبالان خانوادهٔ Calliphoridae در استان‌های آذربایجان‌شرقی و آذربایجان‌غربی در زیستگاه‌های طبیعی (جنگل‌ها و مراتع)، مناطق روستایی، اطراف باغ‌ها و مزارع دامپروری مطالعه شدند. نمونه‌برداری از ماه مه تا اکتبر بین سال‌های ۲۰۱۷ و ۲۰۱۸ با استفاده از تور حشره‌گیری و تله‌های مالایز انجام شد. علاوه بر این، نمونه‌هایی از کلکسیون حشرات پروفسور حسن ملکی میلانی (ICPHMM)، دانشگاه تبریز، ایران، که از همان استان‌ها در طول سال‌های ۲۰۱۳ تا ۲۰۱۶ جمع‌آوری شده بود، مورد بررسی قرار گرفت. در مجموع ۱۴ گونه از هفت جنس در چهار زیرخانواده شناسایی شد. قابل ذکر است که زیرخانواده Melanomyinae و دو گونه *Melinda gentilis* (Robineau-Desvoidy, 1830) و *Melinda viridicyanea* (Robineau-Desvoidy, 1830) برای اولین بار از ایران گزارش می‌شوند. بر اساس طبقه‌بندی‌های جدید، خانواده Chaliphoridae در ایران شامل ۴ زیرخانواده، ۸ جنس و ۲۴ گونه است. ویژگی‌های افتراقی آرایه‌های به تازگی گزارش شده، پراکنش گونه‌ها و همچنین تصاویری از نمونه‌های بالغ ارایه شد. کلید شناسایی زیرخانواده‌ها و جنس‌های این خانواده در ایران نیز ارایه شد.

واژگان کلیدی: مگس لاشه، فون، *Melinda*، لاشه‌خوار، کلید شناسایی