

The family Oestridae in Egypt and Saudi Arabia (Diptera, Oestroidea)

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Abstract

All known taxa of the family Oestridae (superfamily Oestroidea) in both Egypt and Saudi Arabia are systematically catalogued herein. Three oestrid subfamilies have been recorded in Saudi Arabia and/or Egypt by six genera: *Gasterophilus* (Gasterophilinae), *Hypoderma*, *Przhevalskiana* (Hypodermatinae), *Cephalopina*, *Oestrus*, and *Rhinoestrus* (Oestrinae). Five *Gasterophilus* spp. have been recorded in Egypt, namely, *G. haemorrhoidalis* (Linnaeus), *G. intestinalis* (De Geer), *G. nasalis* (Linnaeus), *G. nigricornis* (Loew), and *G. pecorum* (Fabricius). Only two of these species have also been recorded in Saudi Arabia, namely: *G. intestinalis* (De Geer) and *G. nasalis* (Linnaeus). The subfamily Hypodermatinae is represented in the two countries by only four species in two genera, namely, *H. bovis* (Linnaeus) and *H. desertorum* Brauer (in Egypt only), and *H. lineatum* (Villers) (in Saudi Arabia only) and *Przhevalskiana silenus* (Brauer) (in both countries). The subfamily Oestrinae is represented by two widely distributed species in both countries, namely, *C. titillator* (Clark) and *O. ovis* (L.), in addition to another species represented in Egypt only, *R. purpureus* (Brauer). For each species, synonymies, type localities, distribution, Egyptian and Saudi Arabian localities with coordinates, and collection dates are presented.

Keywords

Activity periods, bot flies, distribution, gad flies, heel flies, hosts, localities, parasites, warble flies

Introduction

The Oestridae are a family within the superfamily Oestroidea, together with the families Calliphoridae, Rhiniidae, Sarcophagidae, Mystacinobiidae, Tachinidae, and Rhizophoridae (Pape et al. 2011). These families, except for Calliphoridae, are monophyletic, and the concept of Oestridae as a monophyletic family within the Oestroidea has been clearly established (Pape 1992; Pape 2001; Pape and Arnaud Jr 2001; Marinho et al. 2012).

Flies of the family Oestridae are large robust flies, with hair-like setae or soft setulae, without stout setae, mostly bee- or wasp-like, without vibrissae, and with reduced mouthparts (Marshall et al. 2017). They are commonly known as bot flies, warble flies, heel flies, and gad flies (Mote 1928; Saini and Sankhala 2015). Several species of these flies have significant medical and veterinary importance because of their mammal-parasitizing habits; thus, they receive substantial attention from applied entomologists, wildlife ecologists, and assuredly from taxonomists (Pape 2001).

Bot flies were formerly classified into four families: Cuterebridae, Gasterophilidae, Hypodermatidae, and Oestridae. However, they are conveniently treated now as a single family, Oestridae, including the former families as subfamilies, namely: Cuterebrinae, Gasterophilinae, Hypodermatinae, and Oestrinae (Wood 1987; Pape 1992; Pape 2001). All these subfamilies, except the first, are represented in Saudi Arabia and/or Egypt by six genera (Table 1): *Gasterophilus* (Gasterophilinae), *Hypoderma*, *Przhevalskiana* (Hypodermatinae), *Cephalopina*, *Oestrus* and *Rhinoestrus* (Oestrinae) (Steyskal and El-Bialy 1967; Büttiker and Zumpt 1982).

Larvae of the genus *Gasterophilus* are common obligatory endoparasites of the alimentary tract of equines (*Equus* spp.) including horses, donkeys, and zebras in the family Equidae (Abdel Rahman et al. 2018). They can also affect other animals, such as rhinoceroses, lions, cows, sheep, goats, and even were recorded in a human infant (Royce et al. 1999). These larvae cause gastrointestinal myiasis leading to gastrointestinal ulcerations, gut obstructions or volvulus, rectal prolapses, anemia, diarrhea, and other digestive disorders (Hoseini et al. 2017). Species of the genus *Gasterophilus* have become near cosmopolitan because their distribution coincides with that of their domesticated hosts (Li et al. 2019a). Six *Gasterophilus* spp. have been recorded from the Old World (Zumpt 1965; Soós and Minar 1986a). Five of these have been recorded in Egypt, namely, *G. haemorrhoidalis* (Linnaeus), *G. intestinalis* (De Geer), *G. nasalis* (Linnaeus), *G. nigricornis* (Loew), and *G. pecorum* (Fabricius) (Steyskal and El-Bialy 1967, Soós and Minar 1986a). Only two have also been recorded from Saudi Arabia, namely: *G. intestinalis* and *G. nasalis* (Abu-Thuraya 1982; Büttiker and Zumpt 1982; Abu-Zoherah et al. 1993; Al-Ahamdi and Salem 1999).

The subfamily Hypodermatinae is represented in both Egypt and Saudi Arabia by only four species in two genera, namely, *H. bovis* (Linnaeus) and *H. desertorum* Brauer (in Egypt only), and *H. lineatum* (Villers) and *P. silenus* (Brauer) (in both Egypt and Saudi Arabia) (Steyskal and El-Bialy 1967; Büttiker and Zumpt 1982; Soós and Minar 1986b; El-Azzazy 1997; Morsy et al. 1998). The common and best

Table 1. Oestrid species recorded from Egypt and Saudi Arabia (* = recorded, x = not recorded).

Species	Egypt	Saudi Arabia
Subfamily Gasterophilinae		
<i>Gasterophilus haemorrhoidalis</i> (Linnaeus, 1758)	*	x
<i>Gasterophilus intestinalis</i> (De Geer, 1776)	*	*
<i>Gasterophilus nasalis</i> (Linnaeus, 1758)	*	*
<i>Gasterophilus nigricornis</i> (Loew, 1863)	*	x
<i>Gasterophilus pecorum</i> (Fabricius, 1794)	*	x
Subfamily Hypodermatinae		
<i>Hypoderma bovis</i> (Linnaeus, 1758)	*	x
<i>Hypoderma desertorum</i> Brauer, 1897	*	x
<i>Hypoderma lineatum</i> (Villers, 1789)	x	*
<i>Przhevalskiana silenus</i> (Brauer, 1858)	*	*
Subfamily Oestrinae		
<i>Cephalopina titillator</i> (Clark, 1816)	*	*
<i>Oestrus ovis</i> (Linnaeus, 1758)	*	*
<i>Rhinoestrus purpureus</i> (Brauer, 1858)	*	x

known subcutaneous myiasis in domesticated and wild ruminants called bovine hypodermosis is caused by larvae of *Hypoderma* species across the Old World (Boulard 2002). This disease is endemic in livestock, including cattle, buffaloes, goats, sheep, and deer. Hypodermosis results in a severe decline in the production of meat and milk and depreciation in hide quality from holes and other flaws caused by *Hypoderma* larvae (Hall and Wall 1995). The larvae of *P. silenus* (goat warble fly) are known to cause subcutaneous myiasis distinguished by nodules on the back of goats and sheep. This myiasis causes severe economic problems to the livestock industry, including abortion and reduction in the body weight, fertility, and dairy production of the infested animals, in addition to a reduction in the quality of the hides and wool of the animal (Liakos 1986; El-Azzazy 1997).

Flies in the subfamily Oestrinae are known as nasopharyngeal bot flies; they are host specific and cause obligatory myiasis in many animal species. Their obligatory parasitic larvae are known to cause nasopharyngeal myiasis giving rise to respiratory problems, rhinitis, irritation, purulent mucous exudates, and nasal discharge (Catts and Mullen 2002; Otranto et al. 2003). Two oestrine species are widely distributed in both Egypt and Saudi Arabia, namely, *O. ovis* (sheep nasal bot fly) and *C. titillator* (camel nasal bot fly), which cause economic damage in the animal husbandry industry (Abu-Thuraya 1982; Büttiker and Zumpt 1982; Zayed 1998; Alahmed 2002). Another oestrine species, *R. purpureus* (equine nasal bot fly), is represented in Egypt and causes a parasitic disease in horses and donkeys called rhinoestrosis, which is characterized by clinical signs ranging from inflammation to coughing, sneezing, and dyspnea (Otranto 2004; Hilali et al. 2015).

Egypt and Saudi Arabia are two neighboring Middle Eastern countries separated by the Red Sea and the Gulf of Aqaba (Fig. 1). They are biogeographically comparable being located at the junction of the Palearctic and the Afrotropical Realms (Wallace 1876; Hölzel 1998; El-Hawagry and Gilbert 2014).



Figure 1. A satellite map of Egypt and Saudi Arabia.

An arid desert climate prevails in both countries, with the exception of small strip of the Mediterranean coastline in Egypt and the Asir Highlands along the Red Sea coast of Saudi Arabia. The climate in both countries is characterized by hot summer and a mild winter. From north to south across Egypt, three general climatic zones may be distinguished (Ullrich 1996): The Mediterranean coast zone with 70–200 mm annual precipitation and mean temperature ranging from 9.4 °C in January to 29.7 °C in July; the middle zone with 29N as its latitudinal boundary, with less than 1 mm (Siwa Oasis) to 35 mm (Cairo) annual precipitation, and has only slightly higher temperature than the Mediterranean coast zone and the third zone is the upper Egypt, where rainfall is scant and capricious, ranging from 3 mm (Aswan) to none, with mean temperature (at Aswan) ranging from 9.3 °C in January to 41.8 °C in July. In general, the rainfall is low in the most Egyptian areas and deserts (<80 mm annually). Only the Mediterranean coastal strip from Salloum to Alexandria, Gebel Elba in the extreme southeast, and the mountains of southern Sinai receive higher and less erratic rainfall (ca 200 mm annually). In Saudi Arabia, the average annual temperature is 25.2 °C, the average high temperature is about 37.8 °C during summer (June to August) and is about 11.1 °C during winter (December to February). It is cool, with frost and snow may occur in the Asir Highlands during winter. The precipitation is also low throughout the country (<100 mm). It is more than 480 mm in the highlands of Asir; however, a decade may pass with no precipitation at all in the Rub' al Khali (Empty Quarter) in the southeastern Saudi Arabia (Almazroui 2011).

Efflatoun Bey, often called the “father of Egyptian entomology”, comprehensively surveyed the Diptera of Egypt and established big collections of flies pinned and pre-

served in three Egyptian museums in Cairo University, Ministry of Agriculture, and Entomological Society of Egypt. The oestrid specimens in these collections are considered in the present study.

During the nineteenth century, two species of subfamily Oestrinae, *Oestrus maculatus* Wiedemann, 1830 and *O. libycus* Clark, 1843, originally described from Egypt have been later synonymized with *Cephalopina titillator*. Then Brauer (1897) has described *Hypoderma desertorum* from Helwan (Cairo), Egypt.

No systematic studies on bot flies have been previously conducted in Egypt. Only a list of species of dipterous families in Egypt was published by Steyskal and El-Bialy (1967), where 1,339 species have been listed, including 10 oestrid species (treated as Gasterophilidae and Oestridae). The list involved only family names with a list of species within each family, without any other taxonomic or faunistic data. Subsequently, between 1987 and 2018, the species prevalence and infestation by oestrids have been received attention by entomologists and veterinarians, but no study has been carried out to explore the national prevalence of this group. The infestation of donkeys by *Gasterophilus* and *Rhinoestrus* species has been investigated in the slaughterhouse of the National Cairo Circus and in Giza Zoo abattoir by Hilali et al. (2015) and Attia et al. (2018). In sheep, the infestation by maggots of *Oestrus ovis* in Cairo and *Przhevalskiana silenus* in Sinai has been studied by Amin et al. (1997) and Morsy et al. (1998), respectively. Two studies have been conducted to illustrate the morphological characterization of larval stage of *Gasterophilus* species infest stomach of donkeys (El-Bakry and Fadly 2014, Abdel Rahman et al. 2018).

Although documentation of biological diversity in Saudi Arabia began in the second half of the 1960s, the first traces of the Saudi Arabian oestrid flies are found in a work dated 1982, as five species, *Cephalopina titillator*, *Gasterophilus intestinalis*, *G. nasalis*, *Hypoderma lineatum*, and *Oestrus ovis* have been mentioned from Riyadh Region (Büttiker and Zumpt 1982). In the same year, a book on the agricultural pests in the Kingdom of Saudi Arabia has been published (Abu Thuraya 1982). This book has documented four species *C. titillator*, *G. intestinalis*, *G. nasalis*, and *O. ovis*. El-Azzazy (1997) reported the larvae of the goat warble fly, *Przhevalskiana silenus*, on the backs of goat carcasses at the Jeddah abattoir (Makkah Region) for the first time. Between 1988–2018, entomological, medical and veterinary works have been published, but most of these studies were carried out at provincial scale. The ocular myiasis in man caused by the sheep bot fly *O. ovis* has been firstly reported in Saudi Arabia from Abha (Asir Region) by Omar et al. (1988). The prevalence variation of *C. titillator* infesting dromedary camels has been studied in the Eastern Province (Fatani and Hilali 1994), Jeddah (Gadallah and Bosly 2006) and Riyadh (Alahmed 2002). Also, the prevalence of *O. ovis* infesting sheep has been investigated in Asir (Kenawy et al. 2014), Jazan (Bosly 2013), Jeddah (Alikhan et al. 2018) and Riyadh (Alahmed 2000). Akhter et al. (2000) report two cases of cutaneous infestation in a man and a woman caused by *Dermatobia hominis* in Taif, Saudi Arabia. This record is doubtful as *D. hominis* is native to the Americas, and the species was identified only from larvae.

This study is one in a series of studies planned to catalogue the superfamily Oestroidea in Egypt and Saudi Arabia. Two papers in this series have already been published (El-Hawagry 2018; El-Hawagry and El-Azab 2019).

Materials and methods

The present data were gathered from some adult specimens collected and pinned by the authors from different Egyptian and Saudi Arabian localities, in addition to adult specimens pinned and preserved in Efflatoun Bey's collection, Department of Entomology, Faculty of Science, Cairo University, Egypt (EFC); the Ministry of Agriculture Collection, Plant Protection Research Institute, Dokki, Giza, Egypt (PPDD), and the King Saud University Museum of Arthropods, Riyadh, Saudi Arabia (KSMA). A great deal of biological, faunistic, and taxonomic information, including synonymies, distribution, collection localities, and dates were also obtained from relevant literature.

This study catalogues all known taxa of the family Oestridae recorded from Egypt and Saudi Arabia. Subfamilies are arranged phylogenetically according to Pape (2001). Genera and species within subfamilies are arranged alphabetically. Synonyms comprised all available and unavailable names of genera and species are listed chronologically.

Family-group and genus-group names are written in bold uppercase letters and left-justified, with the genus-group names italicized. The genus-group names are listed again and left-justified under the headings, and written in bold italicized letters, with the first letter in uppercase and the remaining letters in lowercase, followed by the author, year, journal, and pages. Type species for each genus is given at the end, followed by the method by which it was fixed. Species names are left-justified as well, and written in bold italicized letters. Names of taxonomically valid species (senior synonyms) are listed again, combined with their original genera and left-justified under the headings followed by the author, year, journal, and pages. Synonyms of genera and species are listed in chronological order and written in regular italicized letters, followed by the author, year, journal, and pages as in senior taxa. The type locality for each species, including both senior and junior synonyms, is provided from the original descriptions. World distribution of each species based on relevant literature is listed alphabetically. The concept of Kirk-Spriggs and Sinclair (2017) regarding the boundaries between the Palearctic and Afrotropical realms is considered herein. Exceptions are the southwestern part of Saudi Arabia, south to the Tropic of Cancer and Gebel Elba, the southeastern triangle of Egypt, which are considered herein as Afrotropical (Sclater 1858; Wallace 1876; Ghazanfar and Fisher 1998; El-Hawagry and Gilbert 2014; Al Dhafer and El-Hawagry 2016; El-Hawagry 2017; El-Hawagry et al. 2018). The collection localities and dates in both Egypt and Saudi Arabia are given in tables to provide the local distribution and activity periods of oestrid flies. Localities within each Egyptian ecological zone and Saudi Arabian region are arranged in alphabetical order. The recording method, e.g., literature, museum material, and collected material are provided. Coordinates of each locality are mostly given, and distribution maps for species are provided using ArcMap 10.4.

Abbreviations used:

AF	Afrotropical Realm
AU	Australasian Realm
EFC	Collection of the Department of Entomology, Faculty of Science, Cairo University, Egypt (Eflatoun's collection)
KSA	Kingdom of Saudi Arabia
KSMA	King Saud University Museum of Arthropods, Riyadh, Saudi Arabia
Is	Island
MCCB	Museum of Community College, Al-Baha University, KSA
MSHC	Personal collection M. El-Hawagry
NE	Nearctic Realm
NEO	Neotropical Realm
OR	Oriental Realm
PA	Palaearctic Realm
PPDD	Collection of the Plant Protection Research Institute, Ministry of Agriculture, Dokki, Giza, Egypt
St.	Saint
USA	United States of America

Catalogue of the family Oestridae in Egypt and Saudi Arabia

Order: Diptera

Suborder: Cyclorrhapha

Superfamily: Oestroidea

Family Oestridae

Subfamily Gasterophilinae

Genus *Gasterophilus* Leach, 1817

Gasterophilus Leach, 1817: 2. Type species: *Oestrus equi* Clark, 1797 (= *Oestrus intestinalis* De Geer, 1776), by subsequent designation of Curtis, 1826: 146.

Gastrus Meigen, 1824: 174. Type species: *Oestrus intestinalis* De Geer, 1776, by subsequent designation of Coquillett, 1910: 546.

Gastrophilus Agassiz, 1846: 160. Invalid emendation of *Gasterophilus*.

Enteromyza Rondani, 1857: 20. Unnecessary replacement name for *Gasterophilus*.

Rhinogastrophilus Townsend, 1918: 152. Type species: *Oestrus nasalis* Linnaeus, 1758, by original designation.

Enteromyia Enderlein, 1934: 425. Type species: *Oestrus haemorrhoidalis* Linnaeus, 1758, by original designation.

Stomachobia Enderlein, 1934: 425. Type species: *Oestrus pecorum* Fabricius, 1794, by original designation.

Haemorrhoestrus Townsend, 1934: 406. Type species: *Oestrus haemorrhoidalis* Linnaeus, 1758, by original designation.

Progastrophilus Townsend, 1934: 406. Type species: *Oestrus pecorum* Fabricius, 1794, by original designation.

***Gasterophilus haemorrhoidalis* (Linnaeus, 1758)**

Oestrus haemorrhoidalis Linnaeus, 1758: 584. Type localities: Probably Sweden, Germany, and France (see Li et al. 2019b).

Oestrus salutiferus Clark, 1816: 3. Type locality: England.

Oestrus duodenalis Schwab, 1840: 35. Type locality: Europe.

Gastrophilus pallens Bigot, 1884: 4. Type locality: Sudan (Suakin).

Gasterophilus pseudohaemorrhoidalis Gedoelst, 1923: 272. Type localities: Eritrea (Asmara); Republic of the Congo, Katanga Province (Biano), and Zambia.

Oestrus hemorrhoidalis Clark, 1815: 71. Incorrect subsequent spelling of *haemorrhoidalis* Linnaeus, 1758.

Oestrus hemorroidalis Guérin-Méneville, 1827: 96. Incorrect subsequent spelling of *haemorrhoidalis* Linnaeus, 1758.

Oestrus aemorrhoidalis Rondani, 1857: 21. Incorrect subsequent spelling of *haemorrhoidalis* Linnaeus, 1758.

Common name. Nose bot fly or Lip bot fly.

Distribution. AF: Burkina Faso, Democratic Republic of the Congo, Eritrea, Ethiopia, Kenya, Namibia, Republic of the Congo, Senegal, South Africa, Sudan, Tanzania, Zambia. AU: Australia, Hawaii, New Zealand, Tasmania. NE: Canada (Alberta, British Columbia, Manitoba, Saskatchewan), Mexico, USA (widespread). NEO: Argentina, Venezuela. OR: India. PA: Widespread. (see Soós and Minar 1986a; Kettle 1995; Li et al. 2019b).

Localities, hosts, and dates of collection. See Table 2 and Figure 3.

***Gasterophilus intestinalis* (De Geer, 1776)**

Fig. 2a

Oestrus intestinalis De Geer, 1776: 292. Type locality: Sweden.

Oestrus equi Clark, 1797: 298. Preoccupied by Fabricius, 1787. Type locality: England.

Oestrus gastricus major Schwab, 1840: 31. Unavailable name.

Oestrus bengalensis Macquart, 1843: 182. Type localities: Bangladesh and India.

Oestrus gastrophilus Gistel, 1848: 153. Type locality: Probably Germany.

Oestrus schuabianus Gistel, 1848: 153. Type locality: Probably Germany (Bavaria).

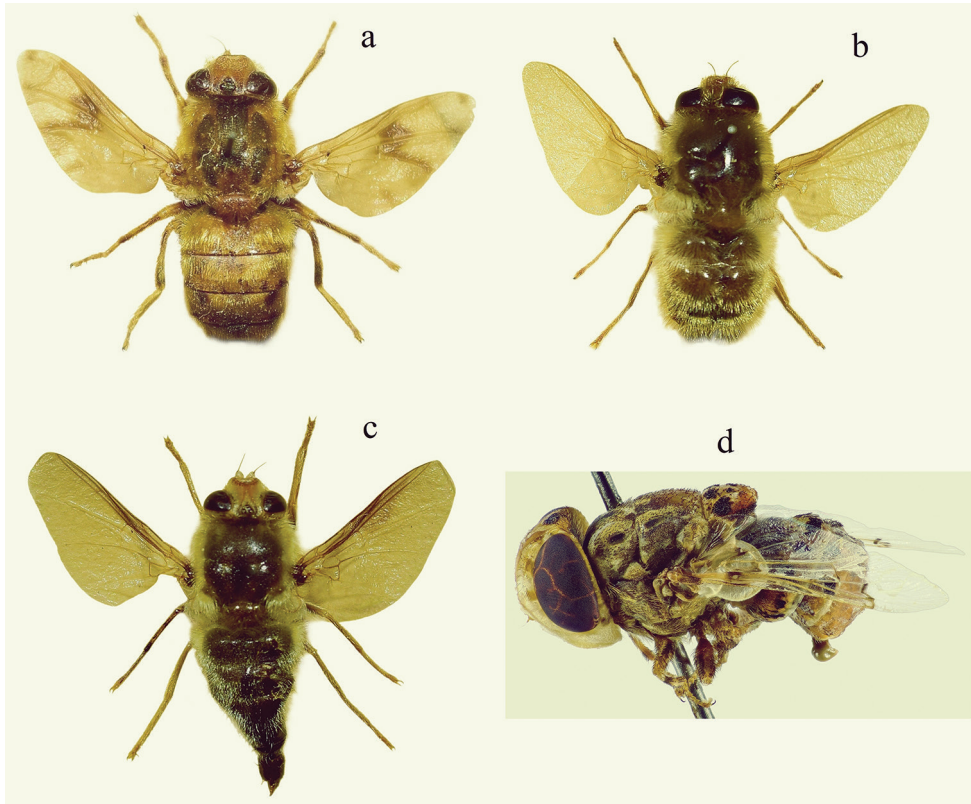
Gastrophilus equi var. *asininus* Brauer, 1863: 71. Type localities: Egypt and Sudan (“Egypten” & “Nubien”).

Gastrophilus aequi: Brauer 1863: 28. Incorrect subsequent spelling of *equi* Clark, 1797.

Gasterophilus magnicornis Bezzi, 1916: 29. Type locality: Eritrea.

Table 2. Localities, hosts, and dates of collection of *G. haemorrhoidalis*.

Country	Zone or Region	Locality	Coordinates	Host/s	Months of collection	Reference
Egypt	Coastal Strip	Alexandria	31.203358N, 29.917285E	mules and donkeys (from stomachs)	from October to April	El-Bakry and Fadly (2014)

**Figure 2.** **a** *Gasterophilus intestinalis* (habitus, dorsal) **b** *G. nasalis* (habitus, dorsal) **c** *G. nigricornis* (habitus, dorsal) **d** *Cephalopina titillator* (habitus, lateral).

Common name. Horse bot fly.

Distribution. AF: Burkina Faso, Chad, Eritrea, Ethiopia, Ghana, Kenya, Morocco, Nigeria, Republic of the Congo, Senegal, South Africa, St. Helena, Sudan, Tanzania, United Arab Emirates. AU: Australia (New South Wales, Norfolk Is, Tasmania), Hawaii, New Zealand. NE: Canada (Alberta, British Columbia, Manitoba, New Brunswick, Ontario, Quebec, Saskatchewan), Mexico (Aguascalientes, Chiapas), USA (widespread). NEO: Argentina, Brazil (Rio Grande do Sul), Chile (Bío Bío Region), Jamaica, Venezuela. OR: India. PA: Widespread. (see Soós and Minar 1986a; Kettle 1995; Li et al. 2019b).

Localities, hosts, and dates of collection. See Table 3 and Figure 3.

Table 3. Localities, hosts, and dates of collection of *G. Intestinalis*.

Country	Zone or Region	Locality	Coordinates	Host/s	Months of collection	Reference
Egypt	Coastal Strip	Alexandria	31.203358N, 29.917285E	mules and donkeys (from stomachs)	from October to April	El-Bakry and Fadly (2014)
	Lower Nile Valley & Delta	Cairo (at slaughterhouse of the National Cairo Circus)	30.122446N, 31.360598E	donkeys	throughout the year	Hilali et al. (1987)
		Cairo (at Cairo Manure Co.)	30.102160N, 31.253994E	mules and donkeys (from stomachs)	April to December	museum material (see material examined)
		Cairo (abattoir)	30.040022N, 31.244248E	donkeys (from stomachs)	June	museum material (see material examined)
		Giza (Giza Zoo)	30.027973N, 31.215963E	donkeys (from stomachs)	throughout the year	Abdel Rahman et al. (2018); Attia et al. (2018)
KSA	widespread in all regions, especially abundant in Al-Ehsaa, El-Kharj and Riyadh	Al-Ehsaa	25.388528N, 49.596223E	donkeys and horses (from stomachs)	March to September	Abu-Thuraya (1982)
		El-Kharj	24.148402N, 47.305011E	donkeys and horses (from stomachs)	March to September	
		Riyadh (near slaughterhouse)	24.578977N, 46.736175E	from dead domestic horse	March	Büttiker and Zumpt (1982)

**Figure 3.** Distribution map of *G. haemorrhoidalis* and *G. intestinalis*.

Material examined. EGYPT • 1 male; Cairo Manure Co.; 30.102160N, 31.253994E; 13.Nov.1924; from the stomach of a donkey; EFC • 1 male; same data as for preceding; 22.Apr.1930 • 1 male; same data as for preceding; 23.Nov.1930 • 1 female; same data as for preceding; 29.Oct.1924; PPDD • 1 ?male; same data as for preceding; Cairo abattoir; 30.040022N, 31.244248E; 7.Jun.1924.

***Gasterophilus nasalis* (Linnaeus, 1758)**

Fig. 2b

Oestrus nasalis Linnaeus, 1758: 584. Type locality: Sweden.

Oestrus equi Fabricius, 1787: 321. Type locality: Probably Europe.

Oestrus veterinus Clark, 1797: 312. New replacement name for *Oestrus nasalis* Linnaeus, 1758.

Oestrus salutaris Clark, 1815: pl. 1. *Nomen nudum*.

Gasterophilus clarkii Leach, 1817: 2. Type locality: England (Bantham).

Gastrus jumentarum Meigen, 1824: 179. Type locality: Probably Denmark.

Oestrus gastricus minor Schwab, 1840: 40. Unavailable name.

Gastrus subjacens Walker, 1849: 687. Type locality: Canada (Nova Scotia).

Oestrus stomachinus Gistel, 1848: 153. Type locality: Probably Germany (Bavaria).

Gasterophilus crossi Patton, 1924: 963. Type locality: India (Punjab).

Gastrophilus albescens Pleske, 1926: 228. Type locality: Egypt (Cairo).

Gastrophilus nasalis var. *nudicollis* Dinulescu, 1932: 28, 32. Type locality: Unknown.

Gastrophilus veterinus var. *aureus* Dinulescu, 1938: 315. Type locality: Unknown.

Gastrus jumentorum: Brauer, 1863: 87, 280. Incorrect subsequent spelling of *jumentarum* Meigen, 1824.

Oestrus nasulis: Fabricius, 1787: 321. Incorrect subsequent spelling of *nasalis* Linnaeus, 1758.

Common name. Throat bot fly or Horse nasal bot fly.

Distribution. Cosmopolitan.

Localities, hosts, and dates of collection. see Table 4 and Figure 4.

Material examined. EGYPT • 1 male; Abu-Rawash; 30.045837N, 31.091406E; 18.May.1935; EFC • 1 female; Cairo Manure Co.; 30.102160N, 31.253994E; 11.Jun.1924; from the stomach of a mule; EFC • 1 male; Helwan; 29.839022N, 31.300160E; 18.May.1934 • 1 female; Maadi; 29.961203N, 31.266910E; 9.Apr.1916; EFC.

***Gasterophilus nigricornis* (Loew, 1863)**

Fig. 2c

Gastrus nigricornis Loew, 1863: 38. Type locality: Moldova (Bessarabia).

Table 4. Localities, hosts, and dates of collection of *G. nasalis*.

Country	Zone or Region	Locality	Coordinates	Host/s	Months of collection	Reference
Egypt	Coastal Strip	Alexandria	31.203358N, 29.917285E	mules and donkeys (from stomachs)	from October to April	El-Bakry and Fadly (2014)
	Lower Nile Valley & Delta	Abu-Rawash	30.045837N, 31.091406E	not given	May	museum material (see material examined)
		Cairo (at slaughter house of the National Cairo Circus)	30.122446N, 31.360598E	donkeys	throughout the year	Hilali et al. (1987)
		Cairo (no further data)	–	–	–	Li et al. (2019b)
		Cairo (at Cairo Manure Co.)	30.102160N, 31.253994E	mules (from stomachs)	June	museum material (see material examined)
		Helwan	29.839022N, 31.300160E	not given	April and December	museum material (see material examined)
		Maadi	29.961203N, 31.266910E	not given	April	museum material (see material examined)
KSA	Widespread in all regions, especially abundant in Al-Ehsaa, El-Kharj and Riyadh	Al-Ehsaa	25.388528N, 49.596223E	donkeys and horses (from stomachs)	March to September	Abu-Thuraya (1982)
		El-Kharj	24.148402N, 47.305011E	donkeys and horses (from stomachs)	March to September	
		Riyadh (near slaughterhouse)	24.578977N, 46.736175E	from dead domestic horse	March	Büttiker and Zumpt (1982)

Gastrophilus viridis Sultanov, 1951: 41. Type locality: Kazakhstan.

Gasterophilus migricornis: Colwell, 2006: 291. Incorrect subsequent spelling of *nigricornis* Loew, 1863.

Common name. Horse stomach bot fly.

Distribution. PA: China, Egypt, Kazakhstan, Kyrgyzstan, Moldova, Mongolia, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan (see Soós and Minar 1986a; Kettle 1995; Li et al. 2019b).

Localities, hosts, and dates of collection. See Table 5 and Figure 4.

Material examined. EGYPT • 1 female; Helwan; 29.839022N, 31.300160E; 13.Apr.1935; EFC.

Table 5. Localities, hosts, and dates of collection of *G. nigricornis*.

Country	Zone or Region	Locality	Coordinates	Host/s	Months of collection	Reference
Egypt	Lower Nile Valley & Delta	Helwan	29.839022N, 31.300160E	not given	April	museum material (see material examined)

**Figure 4.** Distribution map of *G. nasalis*, *G. nigricornis*, and *G. pecorum*.

Gasterophilus pecorum (Fabricius, 1794)

Oestrus pecorum Fabricius, 1794: 230. Type locality: Probably Europe.

Oestrus vituli Fabricius, 1794: 231. Type locality: Not given, probably Sweden and France.

Gastrus jubarum Meigen, 1824: 179, 180. Type locality: Austria.

Gastrus lativentris Brauer, 1858b: 465. Type locality: Latvia (Curland).

Gastrus ferruginatus Zetterstedt, 1844: 978. Type locality: Sweden (Skåne, Tranås socken, Esperöd).

Gasterophilus pecorum var. *zebrae* Rodhain & Bequaert, 1920: 181. Type localities: Kenya and Tanzania.

Gastrophilus vulpecula Pleske, 1926: 227. Type locality: China (Inner Mongolia, Alxa League).

Gastrophilus gammeli Szilády, 1935: 140. Type locality: Hungary.

Gastrophilus hammeli: Paramonov, 1940: 34, 46. Incorrect subsequent spelling of *gammeli* Szilády, 1935.

Gastrus selysi Walker, 1849: 687. *Nomen nudum*.

Common name. Dark-winged horse bot fly.

Table 6. Localities, hosts, and dates of collection of *G. pecorum*.

Country	Zone or Region	Locality	Coordinates	Host/s	Months of collection	Reference
Egypt	Coastal Strip	Alexandria	31.203358N, 29.917285E	mules and donkeys (from stomachs)	from October to April	El-Bakry and Fadly (2014)

Distribution. AF: Burkina Faso, Kenya, Namibia, Senegal, South Africa, Tanzania, Uganda, Zambia. OR: India. PA: Belgium, China (Heilongjiang, Inner Mongolia, Xinjiang), Czech Republic, Denmark, Egypt, France, Germany, Hungary, Iran, Italy, Latvia, Lithuania, Mongolia, Poland, Romania, Sweden, Switzerland, The Netherlands, Turkey, Ukraine, United Kingdom (see Soós and Minar 1986a; Kettle 1995; Li et al. 2019b).

Localities, hosts, and dates of collection. See Table 6 and Figure 4.

Subfamily Hypodermatinae

Genus *Hypoderma* Latreille, 1818

Hypoderma Latreille, 1818: 272. Type species: *Oestrus bovis* Linnaeus, 1758, by monotypy.

Marmaryga Gistel, 1848: 9. Unjustified name for *Hypoderma*.

Atelecephala Townsend, 1916: 617. Type species: *Hypoderma diana* Brauer, 1858a, by monotypy.

Hypoderma bovis (Linnaeus, 1758)

Oestrus bovis Linnaeus, 1758: 584. Type locality: Not given (? Sweden).

Oestrus ericetorum Clark, 1815. *Nomen dubium*.

Oestrus subcutaneus Greve, 1818: 2. Type locality: Not given.

Oestrus bovinus Schwab, 1840: 43. Type locality: Not given.

Hypoderma heteroptera Macquart, 1843: 181. Type locality: Algeria (Oran).

Hypoderma bellieri Bigot, 1862: 113. Type locality: France (Corsica).

Common name. Ox warble fly.

Distribution. AU: Hawaii, New Zealand. NE: Widespread. PA: Widespread.

Localities, hosts, and dates of collection. Unknown.

Notes. This species is known to be recorded in Egypt only from the list of Steyskal and El-Bialy (1967), but no specimens of this species were collected or found in the Egyptian museums.

Hypoderma desertorum Brauer, 1897

Hypoderma desertorum Brauer, 1897: 377. Type locality: Egypt (Helwan).

Table 7. Localities, hosts, and dates of collection of *H. desertorum*.

Country	Zone or Region	Locality	Coordinates	Host/s	Months of collection	Reference
Egypt	Lower Nile Valley & Delta	Helwan	29.839022N, 31.300160E	not given	April	Brauer (1897)

**Figure 5.** Distribution map of *C. titillator*, *H. desertorum*, and *H. lineatum*.

Common name. No specific common name.

Distribution. PA: Egypt.

Localities, hosts, and dates of collection. See Table 7 and Figure 5.

Notes. Steyskal and El-Bialy (1967) listed this species as a junior synonym of *Hypoderma bovis* (Linnaeus, 1758); however, Soós and Minar (1986b) catalogued it as a valid species. No specimens are available to confirm its validity. Grunin (1965) keyed the *Hypoderma* spp. in the Palearctic Region and used the colour of hairs on mesonotum, shape of antennal segments and body length to differentiate between *H. desertorum* and *H. bovis*. Holotype is deposited in Naturhistorisches Museum Wien, Wien, Austria (NMW).

Hypoderma lineatum (Villers, 1789)

Oestrus lineatum Villers, 1789: 349. Type locality: Not given (Europe).

Hypoderma bonassi Brauer, 1875: 75. Type locality: USA (Colorado).

Oestrus supplens Walker, 1849: 685. Type locality: Canada (Nova Scotia).

Common name. Lesser cattle warble fly.

Distribution. Cosmopolitan.

Localities, hosts, and dates of collection. See Table 8 and Figure 5.

Table 8. Localities, hosts, and dates of collection of *H. lineatum*.

Country	Zone or Region	Locality	Coordinates	Host/s	Months of collection	Reference
KSA	Riyadh	Dhurma	24.613516N, 46.151759E	a dairy cow air-shipped from Canada	unknown	Büttiker and Zumpt (1982)
	Makkah	Wadi Qatan	22.200883N, 41.556635E	domestic goat	November	Büttiker and Zumpt (1982)

Genus *Przhevskiana* Grunin, 1948

Przhevskiana Grunin, 1948: 469 (as subgenus of *Hypoderma* Latreille, 1818). Type species: *Hypoderma orongonis* Grunin, 1948, by monotypy.

Crivellia Grunin, 1956: 716. Type species: *Hypoderma corinnae* Crivelli, 1862, by original designation.

Przhevskiana silenus (Brauer, 1858)

Hypoderma silenus Brauer, 1858b: 460. Type localities: Italy (Sicily, Palermo); Egypt (Sinai).

Hypoderma aegagri Brauer, 1863: 134, 281. Type locality: Greece (Crete).

Hypoderma gazellae Gedoelst, 1916: 263. Type locality: Tanzania (Massai).

Hypoderma crossi Patton, 1922: 573. Type locality: India (Punjab).

Hypoderma aeratum Austen, 1931: 423. Type locality: Cyprus (Tillyria, Kyrenia).

Hypoderma capreum Gausser, 1940: 38. Type locality: Azerbaijan.

Common name. Goat warble fly.

Distribution. AF: East Africa, Saudi Arabia [as “South western part”]. OR: India. PA: Central Asia, Middle East, North Africa, southern Europe.

Localities, hosts, and dates of collection. See Table 9 and Figure 6.

Material examined. SAUDI ARABIA • 1 female; Al-Mekhwah; 19.759526N, 41.428219E; 3.Feb.2009; El-Hawagry leg.; sweeping net; MCCB.

Subfamily Oestrinae

Genus *Cephalopina* Strand, 1928

Cephalopina Strand, 1928: 48 (replacement name for *Cephalopsis*).

Cephalopsis Townsend, 1912: 53. Type species: *Oestrus maculatus* Wiedemann, 1830 (= *Oestrus titillator* Clark, 1816), by original designation. Preoccupied by Fitzinger, 1873 in Pisces.

Table 9. Localities, hosts, and dates of collection of *P. silenus*.

Country	Zone or Region	Locality	Coordinates	Hosts and/or methods of collection	Months of collection	Reference
Egypt	Sinai	Al Arish (abattoir)	31.131795N, 33.795749E	goats (larvae from slaughtered goats, and adults by baited traps)	throughout the year	Morsy et al. (1998)
		Bir Al Abd	31.005486N, 33.111721E	goats (larvae from slaughtered goats, and adults by baited traps)	throughout the year	Morsy et al. (1998)
		Hasanah	30.800220N, 33.815971E	goats (larvae from slaughtered goats, and adults by baited traps)	throughout the year	Morsy et al. (1998)
KSA	Al-Baha	Al-Mekhwa	19.759526N, 41.428219E	sweeping net by El-Hawagry	February	collected specimen (see material examined)
	Makkah	Jeddah (Jeddah Abattoir)	21.483464N, 39.201734E	goats (nodules caused by larvae are noticed on the backs of goat carcasses)	December to April	El-Azzazy (1997)

**Figure 6.** Distribution map of *O. ovis*, *P. silenus*, and *R. purpureus*.***Cephalopina titillator* (Clark, 1816)**

Fig. 2d

Oestrus titillator Clark, 1816: 4. Type locality: Syria.*Oestrus maculatus* Wiedemann, 1830: 256. Type locality: Egypt.*Oestrus libycus* Clark, 1841: 100. *Nomen nudum*.*Oestrus libycus* Clark, 1843: 93. Type locality: Egypt.*Pharyngobalbus cameli* Steel, 1887: 27. Type localities: Sudan, ?Afghanistan.

Common name. Camel nasal bot fly.

Distribution. AF: East Africa, Saudi Arabia [as “South western part”]. AU: Australia. OR: India. PA: Widespread in association with camels, particularly, Afghanistan, Middle East, Mongolia, North Africa, South Europe.

Localities, hosts, and dates of collection. See Table 10 and Figure 5.

Material examined. EGYPT • 1 male; Cairo abattoir; 30.040022N, 31.244248E; 6.Jun.1924; Efflatoun leg.; from nose of camel; EFC • 1 male; same data as for preceding; 2.Jul.1924 • 1 female; same data as for preceding; 19.Nov.1929 • 1 male; Kerdassa;

Table 10. Localities, hosts, and dates of collection of *C. titillator*.

Country	Zone or Region	Locality	Coordinates	Hosts and/or methods of collection	Months of collection	Reference
Egypt	Lower Nile Valley & Delta	Abu-Rawash	30.045837N, 31.091406E	dromedary camels (from the nasal cavities)	May	museum material (see material examined)
		Birqash	30.162842N, 31.039242E	sweeping, by El-Hawagry	June	collected specimens (see material examined)
		Cairo (Cairo abattoir)	30.040022N, 31.244248E	dromedary camels (from the nasal cavities)	throughout the year	museum material (see material examined)
		El-Bassatin (abattoir)	29.995917N, 31.276171E	camels	not given	Hendawy et al. (2012)
		El-Warrak (abattoir)	30.110544N, 31.210915E	camels	not given	Hendawy et al. (2012)
		Kerdassa	30.025663N, 31.113349E	dromedary camels (from the nasal cavities)	May	museum material (see material examined)
	Sinai	W. El-Sheikh	28.56568N, 33.96525E	not given	April	museum material (see material examined)
KSA	all regions	widespread	–	dromedary camels (nasal cavities)	throughout the year	Abu-Thuraya (1982); Alahmed (2002)
	Riyadh	Riyadh (slaughterhouse)	24.578977N, 46.736175E	dromedary camels	March to May	Büttiker and Zumpt (1982)
	Makkah	Jeddah (Jeddah abattoir)	21.483464N, 39.201734E	dromedary camels	throughout the year	Gadallah and Bosly (2006)

30.02566N, 31.11335E; 19.May.1924; R.M. leg.; from nose of camel; EFC • 1 male, 1 female; Sinai, W. El-Sheikh; 28.56568N, 33.96525E; 21–27.Apr.1939; B.C.E. leg.; EFC • 1 female; Cairo abattoir; 30.040022N, 31.244248E; 20.Jan.1924; H.C.E. leg.; from the nose of a camel; PPDD • 1 female, 1 male; Birqash; 30.162842N, 31.039242E; 21.Jun.1999; El-Hawagry leg.; sweeping net; MSHC.

SAUDI ARABIA • 2 females; Riyadh, slaughterhouse; 24.578977N, 46.736175E; 30.Oct.1999; Azzam Alahmed leg.; from dromedary camels; KSMA.

Genus *Oestrus* Linnaeus, 1758

Oestrus Linnaeus, 1758: 584. Type species: *Oestrus ovis* Linnaeus, 1758, by original designation of Curtis, 1826: 106.

Cephalemyia Latreille, 1818: 273. Type species: *Oestrus ovis* Linnaeus, 1758, by monotypy. *Cephalomyia* Agassiz, 1846: 71. Unjustified emendation of *Cephalemyia*.

***Oestrus ovis* (Linnaeus, 1758)**

Oestrus ovis Linnaeus, 1758: 585. Type locality: Not given (? Sweden).

Oestrus argalis Pallas, 1776: 29. Type locality: Not given (? Middle Asia).

Oestrus perplexus Hudson, 1892: 63. Type locality: New Zealand. *Nomen nudum*.

Common name. Sheep nasal bot fly.

Distribution. Cosmopolitan (introduced with sheep in most parts of the world, see Papavero (1977)).

Localities, hosts, and dates of collection. See Table 11 and Figure 6.

Material examined. EGYPT • 1 male; Burg; 30.916760N, 29.533268E; 16.Mar.1935; H.C.E & M.T leg.; EFC • 3 males, 3 females; Cairo, Cairo abattoir; 30.040022N, 31.244248E; 5.Jun.1929; Efflatoun leg.; from sheep's nose; EFC • 1 male, 1 female; same data as for preceding; 23.Dec.1929 • 2 males; same data as for preceding; 26.Nov.1929 • 1 male, same data as for preceding; 2.Jul.1924 • 1 male, same data as for preceding; 2. Apr.1924 • 1 female, same data as for preceding; 5. Apr.1924 • 1 female; Kerdassa; 30.025663N, 31.113349E; 18.Mar.1924; from the nose of sheep; EFC • 1 female; same data as for preceding; 22.May.1924; R. M. leg. • 1 female; Wadi Hoff; 29.880357N, 31.312991E; 14.Apr.1921; Efflatoun leg.; EFC • 1 female; Wadi Rishrash; 29.41666N, 31.51666E; 16.Apr.1932; ET & R leg.; EFC • 1 female; Wadi Rishrash; 29.41666N, 31.51666E; 29.Mar.1935; H.C.E. & M.T. leg.; EFC • 1 male; Ashmoun Gereiss; 30.325046N, 30.925513E; Wardan; 30.321045N, 30.905128E; 23.Mar.1924; H.C.E. leg.; reared from larvae from the nose of sheep; PPDD • 1 female; El-Mallah, East of Helwan; 3.May.1926; Farag leg.; PPDD • 1 female; El-Katta; 30.225859N, 30.970563E; 20.Sep.1924; PPDD • 1 male; Kerdassa; 30.025663N, 31.113349E; 15.May.1938; Mabrouk leg.; PPDD.

Table 11. Localities, hosts, and dates of collection of *O. ovis*.

Country	Zone or Region	Locality	Coordinates	Hosts and/or methods of collection	Months of collection	Reference	
Egypt	Coastal Strip	Burg	30.916760N, 29.533268E	not given	March	material (see material examined)	
	Eastern Desert	Wadi El-Mallah	–	not given	May	material (see material examined)	
		Wadi Hoff	29.880357N, 31.312991E	not given	April	material (see material examined)	
		Wadi Rishrash	29.41666N, 31.51666E	not given	November to April	material (see material examined)	
	Lower Nile Valley & Delta	Ashmoun Gereiss	30.325046N, 30.925513E	sheep (reared from larvae from nose)	March	material (see material examined)	
		Cairo, Cairo (abattoir)	30.040022N, 31.244248E	sheep (from nose)	April to December	museum material (see material examined) and Amin et al. (1997)	
		El-Hager	30.282066N, 30.913711E	sweeping net by El-Hawagry	April	collected specimens (see material examined)	
		El-Katta	30.225859N, 30.970563E	not given	September	museum material (see material examined)	
		Kerdassa	30.025663N, 31.113349E	sheep (from nose)	March and April	museum material (see material examined)	
		Wardan	30.321045N, 30.905128E	sheep (reared from larvae from nose)	March	material (see material examined)	
	KSA	all regions	widespread	–	sheep and goats (from the nasal cavities and head sinuses)	March to June	Abu-Thuraya (1982)
		Asir	widespread (slaughterhouses)	–	not given	throughout the year	Kenawy et al. (2014)
		Jazan	Abu Arish	16.9595N, 42.8348E	Sheep (heads)	throughout the year	Bosly (2013)
Riyadh		Riyadh (slaughterhouse)	24.578977N, 46.736175E	sheep and goats	May	Büttiker and Zumpt (1982)	

Genus *Rhinoestrus* Brauer, 1886

Rhinoestrus Brauer, 1886: 300. Type species: *Cephalomyia purpurea* Brauer, 1858, by monotypy.

Hippoestrus Townsend, 1933: 447. Type species: *Rhinoestrus hippopotami* Grünberg, 1904, by original designation.

Table 12. Localities, hosts, and dates of collection of *R. purpureus*.

Country	Zone or Region	Locality	Coordinates	Hosts and/or methods of collection	Months of collection	Reference
Egypt	Lower Nile Valley & Delta	Cairo	29.999896N, 31.270483E	Donkey (from head)	May	museum material (see material examined)
		El-Magadlah	–	not given	April	museum material (see material examined)
		Giza	30.015432N, 31.207837E	not given	May	museum material (see material examined)
		Giza, Giza zoo abattoir (donkeys originally obtained from four governorates: Giza, Monofia, Fayoum, and Bani Sweif)	30.027973N, 31.215963E	donkeys	throughout the year	Hilali et al. (2015)

Rhinoestrus purpureus (Brauer, 1858)

Cephalomyia purpurea Brauer, 1858b: 457. Type locality: Austria (Bisamberg).

Rhinoestrus nasalis: Brumpt, 1913: 700. Misidentification.

Common name. Equine nasal bot fly.

Distribution. AF, OR: Widespread (introduced with horses, see Papavero (1977)). PA: Widespread.

Localities, hosts, and dates of collection. See Table 12 and Figure 6.

Material examined. EGYPT • 1 male; Cairo; 29.999896N, 31.270483E; 10.May.1922; Efflatoun leg.; from donkey's head; EFC • 1 male; El-Magadlah; 27.Apr.1924; R. Mabrouk leg.; EFC • 1 female; Giza; 30.015432N, 31.207837E; 2.May.1907; EFC.

Discussion

Egypt and Saudi Arabia are biogeographically comparable being located at the junction of the Palearctic and the Afrotropical Realms. In Egypt, the Afrotropical Realm is thought to involve the southeastern triangle of the country, which known as the Gebel Elba ecological zone. This is the only ecological zone in Egypt, which has an Afrotropical faunal affiliation. However, the faunal affiliation of the other seven ecological zones is mostly Palearctic, namely, the Coastal Strip, Eastern Desert, Western Desert, Fayoum, Lower Nile Valley, and Delta, Sinai, and Upper Nile Valley (Fig. 1) (El-Hawagry and Gilbert 2014; El-Hawagry 2017; El-Hawagry et al. 2018; El-Hawagry et al. 2020). In Saudi Arabia, many biogeographers agree that the border of the Afrotropical Realm should be extended up to Taif City, i.e., up to the Tropic of Cancer, covering the

southwestern part of the country (Wallace 1876; Hölzel 1998; El-Hawagry et al. 2017; El-Hawagry and Al Dhafer 2019; El-Hawagry et al. 2019). All these biogeographic facts undoubtedly reflects on the distribution of oestrid species treated in the present study as all reported species, except three, are of both Palaearctic and Afrotropical affinities. Only *Gasterophilus nigricornis* and *Hypoderma bovis* are Palaearctic, and *Hypoderma desertorum* is endemic to Egypt. Some of the reported species are also known as cosmopolitan and should be widespread in both Egypt and Saudi Arabia; however, the majority of species were reported only from some restricted regions. Surprisingly, no records of oestrid flies were reported from Upper Nile Valley, Western Desert and Gebel Elba in Egypt. This is most likely due to the fact that most collections were focused predominantly in Alexandria, Greater Cairo (slaughterhouses, circus, Giza Zoo, Manure Co., near pyramids and wadies southwestern to Cairo) and Sinai Peninsula. The same situation is in Saudi Arabia as few records were reported especially from Al-Baha, Eastern Province, Makkah, and Riyadh regions (Abu-Thuraya 1982).

Oestrid flies in Egypt and Saudi Arabia, as far as is known, infest domesticated animals and in some cases humans. Infections with *Cephalopina titillator* larvae have been reported in the dromedary camel (Family Camelidae) (Abu-Thuraya 1982, Büttiker and Zumpt 1982, Hussein et al. 1982, Fatani and Hilali 1994, Alahmed 2002, Hendawy et al. 2012). Attacks by larvae of different *Gasterophilus* species have been reported in donkeys and horses (family Equidae) (Abu-Thuraya 1982, Büttiker and Zumpt 1982, Hilali et al. 1987, El-Bakry and Fadly 2014, Abdel Rahman et al. 2018, Attia et al. 2018) and *Rhinoestrus purpureus* (Hilali et al. 2015). The goats and sheep (Family Bovidae) have been reported as hosts for the larvae of *Hypoderma lineatum* (Büttiker and Zumpt 1982), *Oestrus ovis* (Abu-Thuraya 1982, Büttiker and Zumpt 1982, Amin et al. 1997, Bosly 2013), and *Przhevalskiana silenus* (El-Azzazy 1997, Morsy et al. 1998). Ophthalmomyiasis infestation of human eye with larvae of *O. ovis* was documented from Saudi Arabia (Omer et al 1988). Two cases of gastric myiasis with larvae of unidentified *Oestrus* sp. were reported from Egypt, Minia Governorate (Ahmad et al. 2011).

The low abundance and diversity of species in both Egypt and Saudi Arabia should be taken with caution, since the family seems to lack sampling efforts in both countries. We think that the distributional data of these economically important flies within Egypt and Saudi Arabia is still scanty, and more efforts would be highly desirable in the future. Nevertheless, the present catalogue presented some new locality records especially for *Gasterophilus intestinalis*, *Gasterophilus nasalis*, *Gasterophilus nigricornis*, *Przhevalskiana silenus*, *Cephalopina titillator*, *Oestrus ovis* and *Rhinoestrus purpureus*. This catalogue undoubtedly will act as a baseline for further study in both countries.

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References

- Abdel Rahman MM, Hassanen EA, Abdel Mageed MA (2018) Light and scanning electron microscopy of *Gasterophilus intestinalis* (larvae and adult fly) infesting donkeys with emphasis on histopathology of the induced lesions. *Egyptian Veterinary Medical Society of Parasitology Journal* 14: 15–31. <https://doi.org/10.21608/evmspj.2018.33951>
- Abu-Thuraya NH (1982) General survey, agricultural pests in Saudi Arabia. Ministry of Agriculture and Water, Agriculture Research Department of Plant Protection: Kingdom of Saudi Arabia, 326 pp.
- Abu-Zoherah R, Al-Taher K, Tilkian S (1993) List of insects recorded from Saudi Arabia. Ministry of Agriculture and Water, National Agriculture and Water Research Centre, Riyadh, Kingdom of Saudi Arabia, 394 pp.
- Alahmed AM (2000) Seasonal infestation of *Oestrus ovis* larvae in sheep heads in central region of Saudi Arabia. *Journal of the Egyptian Society of Parasitology* 30(3): 895–901.
- Alahmed AMI (2002) Seasonal Prevalence of *Cephalopina titillator* Larvae in camels in Riyadh Region, Saudi Arabia. *Arab Gulf Journal of Scientific Research* 20(3): 161–164.
- Al-Ahmadi AZ, Salem MM (1999) Entomofauna of Saudi Arabia, Part 1: Checklist of insects. Academic Publishing & Press, King Saud University, Kingdom of Saudi Arabia, 240 pp.
- Al Dhafer HM, El-Hawagry MS (2016) Records for the Family Ulidiidae (Diptera, Tephritoidea) in Saudi Arabia. *African Entomology* 24(1): 225–232. <https://doi.org/10.4001/003.024.0225>
- Agassiz JLR (1846) *Nomenclatoris zoologici index universalis: continens nomina systematica classium, ordinum, familiarum, et generum animalium omnium, tam viventium quam fossilium*. Jent & Gassmann: Switzerland, 393 pp.
- Ahmad AK, Abdel-Hafeez EH, Makhloof M, Abdel-Raheem EM (2011) Gastrointestinal Myiasis by Larvae of *Sarcophaga* sp. and *Oestrus* sp. in Egypt: Report of Cases, and Endoscopic and Morphological Studies. *Korean Journal of Parasitology* 49: 51–57. <https://doi.org/10.3347/kjp.2011.49.1.51>
- Akhter J, Qadri SM, Imam AM (2000) Cutaneous myiasis due to *Dermatobia hominis* in Saudi. *Saudi Medical Journal* 21(7): 689–691.
- Alikhan M, Al-Ghamdi K, Al-Zahrani FS, Khater EI, Allam AM (2018) Prevalence and salient morphological features of myiasis causing Dipteran flies in Jeddah, Saudi Arabia. *Biosciences, Biotechnology Research Asia* 15: 101–9. <https://doi.org/10.13005/bbra/2612>
- Amin AR, Morsy TA, Shoukry A, Mazyad SA (1997) Oestrid head maggots in slaughtered sheep in Cairo abattoir. *Journal of the Egyptian Society of Parasitology* 27: 855–861.

- Attia MM, Khalifa MM, Mahdy OA (2018) The prevalence of *Gasterophilus intestinalis* (Diptera: Oestridae) in donkeys (*Equus asinus*) in Egypt with special reference to larvicidal effects of neem seed oil extract (*Azadirachta indica*) on third stage larvae. Open Veterinary Journal 8(4): 423–431. <https://doi.org/10.4314/ovj.v8i4.12>
- Austen EE (1931) A new species of warble-fly (Diptera – Family Tachinidae, Subfamily Hypoderminae, Genus Hypoderma), which attacks goats in Cyprus. Bulletin of Entomological Research 22: 423–429. <https://doi.org/10.1017/S0007485300029941>
- Bezzi M (1916) Un nuova specie di Estride dell'Eritrea. Bollettino del Laboratorio di zoologia generale e agraria della R. Scuola superiore d'agricoltura in Portici 10: 27–32.
- Bigot JMF (1884) Descriptions de Diptères nouveaux récoltés par M. le professeur Magretti dans le Soudan oriental. Annales de la Société entomologique de France, 6 4(2): 57–59.
- Bosly AH (2013) Seasonal prevalence of *Oestrus ovis* L. (Diptera: Oestridae) larvae in infested sheep in Jazan Region, Saudi Arabia. Journal of Parasitology and Vector Biology 5(5): 66–71.
- Boulard C (2002) Durably controlling bovine hypodermosis. Veterinary Research 33: 455–464. <https://doi.org/10.1051/vetres:2002032>
- Brauer F (1858a) Die Oestriden (Dasselfliegen) des Hochwildes, nebst einer Tabelle zur Bestimmung aller europäischen Arten dieser Familie. Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien 8: 385–414.
- Brauer F (1858b) Neue Beiträge zur Kenntniss der europäischen Oestriden. Verhandlungen der Kaiserlich-Königliche Zoologisch-Botanischen Gesellschaft in Wien 8: 449–470.
- Brauer F (1863) Monographie der Oestriden. C. Ueberreuter, Vienna, 291 pp. <https://doi.org/10.5962/bhl.title.57896>
- Brauer F (1875) Beschreibung neuer und ungenugend bekannter Phryganiden und Oestriden. Verhandlungen der Zoologisch - Botanische Gesellschaft in Wien 25: 69–78.
- Brauer F (1886) Nachträge zur Monographie der Oestriden. I. Ueber die von Frau A. Zugmayer und Herrn F. Wolf entdeckte Lebensweise des *Oestrus purpureus*. Wiener Entomologische Zeitung 5: 289–304. <https://doi.org/10.5962/bhl.part.20610>
- Brauer F (1897) Beiträge zur Kenntniss der Muscaria schizometopa und Beschreibung von zwei *Hypoderma*-Arten. I. Bemerkungen zu den Original Exemplaren der von Bigot, Macquart und Robineau-Desvoidy beschriebenen Muscaria schizometopa aus der Sammlung des Herrn G.H. Verrall. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Classe 106: 329–382.
- Brumpt E (1913) Précis de Parasitologie. 2nd ed., Masson et Cie, Paris, 1215 pp.
- Büttiker W, Zumpt F (1982) Veterinary and applied zoology in KSA: Myiasis in domestic animals. Fauna of Saudi Arabia 4: 520–524.
- Causar E (1940) Hypodermatids of goats in Azerbaidzhán. Publishing House of Azerbaijan branch of the USSR Academy of Sciences, Baku, 44 pp.
- Catts EP, Mullen GR (2002) Myiasis (Muscoidea, Oestroidea) In: Mullen G, Durden L (Eds) Medical and veterinary entomology. San Diego, Elsevier Science Academic Press, 317–348. <https://doi.org/10.1016/B978-012510451-7/50018-9>
- Clark B (1797) Observations on the genus *Oestrus*. Transactions of the Linnean Society of London 3: 289–329. <https://doi.org/10.1111/j.1096-3642.1797.tb00570.x>
- Clark B (1815) An essay on the bots of horses and other animals. Old Bailey, London, 72 pp. <https://doi.org/10.5962/bhl.title.159664>

- Clark B (1816) Supplementary sheet. Discovery of the fly of the white bot. Published by the author, London, 4 pp.
- Clark B (1841) An appendix or supplement to a treatise on the Oestri and Cuterebrae of various animals. Proceedings of the Linnean Society of London 1: 99–100.
- Clark B (1843) An appendix or supplement to a treatise on the Oestri and Cuterebrae of various animals. Transactions of the Linnean Society of London (Zoology) 19(2): 81–94. <https://doi.org/10.1111/j.1096-3642.1842.tb00353.x>
- Colwell DD (2006) Life cycle strategies. In: Colwell DD, Hall MJR, Scholl PJ (Eds) The Oestrid flies: Biology, host-parasite relationships, impact and management. Wallingford, CABI, 67–77. <https://doi.org/10.1079/9780851996844.0067>
- Coquillett DW (1910) The type-species of the North American genera of Diptera. Proceedings of the United States National Museum, Washington 37: 499–647. <https://doi.org/10.5479/si.00963801.37-1719.499>
- Curtis J (1826) British entomology: being illustrations and descriptions of the genera of insects found in Great Britain and Ireland: Containing coloured figures from nature of the most rare and beautiful species, and in many instances of the plants upon which they are found. Printed for the author, London, 146 pp.
- De Geer C (1776) Mémoires pour servir à l'histoire des insectes. Tome sixième. P. Hesselberg, Stockholm, 523 pp.
- Dinulescu G (1932) Recherches sur la biologie des gastrophiles, anatomie, physiologie, cycle évolutif. Annales des Sciences Naturelles Zoologie 10: 1–183.
- Dinulescu G (1938) *Gastrophilus veterinus* var. *aureus*. Archives Roumaines de Pathologie Expérimentale et de Microbiologie (Bucuresti) 11: 315–335.
- El-Azzazy OME (1997) Goat warble fly, *Przhevalskiana silenus* (Brauer) (Diptera: Oestridae) in Saudi Arabia. Small Ruminant research 24(1): 65–67. [https://doi.org/10.1016/S0921-4488\(96\)00918-2](https://doi.org/10.1016/S0921-4488(96)00918-2)
- El-Bakry KM, Fadly S (2014) Differential identification of *Gasterophilus* larval spp. in donkeys by electron microscope. Assiut Veterinary Medical Journal 60(142): 144–155.
- El-Hawagry MS (2017) Catalogue of Egyptian Tephritoidea (Diptera: Schizophora: Acalypterae). Zootaxa 4299(2): 151–190. <https://doi.org/10.11646/zootaxa.4299.2.1>
- El-Hawagry MS (2018) Catalogue of the Tachinidae of Egypt (Diptera: Oestroidea). Egyptian Journal of Biological Pest Control 28: 46. <https://doi.org/10.1186/s41938-018-0042-3>
- El-Hawagry MS, Abdel-Dayem MS, Al Dhafer HM (2019) On the taxonomy of the genus *Thyridanthrax* Osten Sacken in Egypt and the Kingdom of Saudi Arabia, with description of a new species (Diptera: Bombyliidae). Zootaxa 4701(6): 501–519. <https://doi.org/10.11646/zootaxa.4701.6.1>
- El-Hawagry MS, Al Dhafer HM (2019) The family Bombyliidae in the Kingdom of Saudi Arabia (Diptera: Brachycera: Asiloidea). Zootaxa 4590(1): 059–094. <https://doi.org/10.11646/zootaxa.4590.1.3>
- El-Hawagry MS, El-Azab SA (2019) Catalog of the Calliphoridae, Rhiniidae, and Sarcophagidae of Egypt (Diptera: Oestroidea). Egyptian Journal of Biological Pest Control 29: 15. <https://doi.org/10.1186/s41938-019-0118-8>
- El-Hawagry MS, Abdel-Dayem MS, El-Sonbati SA, Al dhafer HM (2017) A preliminary account of the fly fauna in Garf Raydah Nature Reserve, Kingdom of Saudi Arabia, with new

- records and biogeographical remarks (Diptera: Insecta). *Journal of Natural History* 51: 1499–1530. <https://doi.org/10.1080/00222933.2017.1347299>
- El-Hawagry MS, El-Azab SE-DA, Abdel-Dayem MS, Al Dhafer HM (2020) Biting midges of Egypt (Diptera: Ceratopogonidae). *Biodiversity Data Journal* 8: e52357. <https://doi.org/10.3897/BDJ.8.e52357>
- El-Hawagry MS, Zatwarnicki T, Ebrahim AM (2018) Catalogue of the Egyptian Ephydroidea (Diptera: Schizophora: Acalyptratae). *Zootaxa* 4444(3): 201–246. <https://doi.org/10.11646/zootaxa.4444.3.1>
- Enderlein G (1934) *Dipterologica*. Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin 1933: 416–429.
- Fabricius JC (1787) *Mantissa insectorum sistens eorum species nuper detectas adiectis characteribus genericis, differentiis specificis, emendationibus, observationibus*. Impensis Christian Gottlob Proft, Copenhagen, 382 pp. <https://doi.org/10.5962/bhl.title.36471>
- Fabricius JC (1794) *Entomologia systematica emendata et aucta*, Vol. 4: Secundum classes, ordines, genera, species. Impensis Christ Gottl Proft, Copenhagen, 472 pp.
- Fatani A, Hilali M (1994) Prevalence and monthly variations of the second and third instars of *Cephalopina titillator* (Diptera: Oestridae) infesting camels (*Camelus dromedarius*) in the Eastern Province of Saudi Arabia. *Veterinary Parasitology* 53: 145–151. [https://doi.org/10.1016/0304-4017\(94\)90026-4](https://doi.org/10.1016/0304-4017(94)90026-4)
- Fitzinger LJFJ (1873) Die Gattungen der europäischen Cyprinen nach ihren äusseren Merkmalen. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe 68: 145–170.
- Gadallah NS, Bosly HA (2006) Diptera associated with camels in the Jeddah region, western Saudi Arabia. *Fauna of Arabia* 21: 339–350.
- Gedoelst LM (1916) Notes sur les Oestrides. *Revue Zoologique Africaine* 4: 259–264.
- Gedoelst LM (1923) Note sur la larve du *Gasterophilus haemorrhoidalis* et description de la larve d'une nouvelle espèce africaine. *Annales de Parasitologie* 1: 269–275. <https://doi.org/10.1051/parasite/1923013269>
- Ghazanfar SA, Fisher M (1998) Vegetation of the Arabian peninsula. *Geobotany* 25: 1–362. https://doi.org/10.1007/978-94-017-3637-4_1
- Gistel J (1848) *Naturgeschichte des Thierreichs für höheren Schulen*. R. Hoffmann, Stuttgart, 216 pp.
- Grunberg K (1904) Ueber eine neue Oestridenlarve (*Rhinoestrus hippopotami* n. sp.) aus der Stirnhöhle des Nilpferdes. *Der Gesellschaft Naturforschender Freunde zu Berlin* 1904: 35–39.
- Grunin KJ (1948) A new species of botfly from under the skin of the *Orongo antelope* (*Pantholops hodgsoni* Abel). *Doklady Akademii Nauk SSSR* 63(4): 469–472.
- Grunin KJ (1956) Ueber die in *Gazella subgutterosa* Gueld. schmarotzenden Dasselfliegen (Diptera, Hypodermatidae). *Revue d'Entomologie de l'URSS* 35: 716–723.
- Grunin KJ (1965) 64b. Hypodermatidae. In: Lindner E (Ed.) *Die Fliegen der Paläarktischen Region* 8. Schweizerbart'sche, Stuttgart, 153 pp.
- Guérin-Méneville FÉ (1827) *Dictionnaire classique d'histoire naturelle*. Paris, Rey et Gravier, Libraires-Editeurs, Auai des Augustins, no. 55; Baudouin FrèreS, Libraires-Editeurs, Imprimeurs de la société D'Histoire Naturelle, Rue de Vaugirard, no. 36, Paris, 634 pp.

- Hall M, Wall R (1995) Myiasis of humans and domestic animals. *Advances in Parasitology* 35: 257–334. [https://doi.org/10.1016/S0065-308X\(08\)60073-1](https://doi.org/10.1016/S0065-308X(08)60073-1)
- Hendawy SHM, Allam NAT, Kandil OM, Zayed AA, Desouky ARAY, El-Rafey MA (2012) Partial COI and 16S rRNA genes sequences of *Cephalopina titillator* mitochondrial DNA: Evidence for variation in evolutionary rates within myiasis-causing species. *Global Veterinaria* 9(6): 769–778.
- Hilali M, Derhali FS, Baraka A (1987) Incidence and monthly prevalence of *Gasterophilus* spp. larvae (Diptera: Gastrophilidae) in the stomach of donkeys (*Equus asinus*) in Egypt. *Veterinary Parasitology* 23: 297–30. [https://doi.org/10.1016/0304-4017\(87\)90015-X](https://doi.org/10.1016/0304-4017(87)90015-X)
- Hilali MA, Mahdy OA, Attia MM (2015) Monthly variations of *Rhinoestrus* spp. (Diptera: Oestridae) larvae infesting donkeys in Egypt: Morphological and molecular identification of third stage larvae. *Journal of Advanced Research* 6(6): 1015–1021. <https://doi.org/10.1016/j.jare.2014.12.003>
- Hölzel H (1998) Zoogeographical features of Neuroptera of the Arabian Peninsula. *Acta Zoologica Fennica* 209: 129–140.
- Hoseini SM, Zaheri BA, Adibi MA, Ronaghi H, Moshrefi AH (2017) Histopathological study of esophageal infection with *Gasterophilus pecorum* (Diptera: Oestridae) in Persian onager (*Equus hemionus onager*). *Journal of Arthropod-Borne Diseases* 11(3): 441–445.
- Hudson GV (1892) An elementary manual of New Zealand entomology. Being an introduction of our native insects. West, Newman, & Co., London, 128 pp. <https://doi.org/10.5962/bhl.title.8441>
- Hussein MF, El-Amin FM, El-Taib NT, Basmaeil SM (1982) The pathology of nasopharyngeal myiasis in Saudi Arabian camels (*Camelus dromedarius*). *Veterinary Parasitology* 9: 253–160. [https://doi.org/10.1016/0304-4017\(82\)90060-7](https://doi.org/10.1016/0304-4017(82)90060-7)
- Kenawy MA, Al Ashry HA, Shobrak M (2014) Synanthropic flies of Asir Province, southwest of Saudi Arabia. *Journal of Entomological and Acarological Research* 46: 4623. <https://doi.org/10.4081/jear.2014.4623>
- Kettle DS (1995). *Medical and Veterinary Entomology*. 2nd ed., C.A.B. international, U.K. at the University press, Cambridge, 725 pp.
- Kirk-Spriggs AH, Sinclair BJ (2017) *Manual of Afrotropical Diptera*. Vol. 1. Introductory chapters and keys to Diptera families. South African National Biodiversity Institute, Pretoria, 425 pp.
- Latreille PA (1818) *Oestre*, Nouveau dictionnaire d'histoire naturelle, appliquée aux arts, à l'agriculture, à l'économie rurale et domestique, à la médecine, etc. Par une société de naturalistes et d'agriculteurs. Nouvelle Edition 23, 264–274.
- Leach WE (1817) On the arrangement of oestrideous insects. In *On the genera and species of epoboscideous insects, and on the arrangement of oestrideous insects*. Neill & Co., Edinburg, 1–20.
- Li X-Y, Pape T, Zhang D (2019a) *Gasterophilus flavipes* (Oestridae: Gasterophilinae): A horse stomach bot fly brought back from oblivion with morphological and molecular evidence. *PLoS ONE* 14 (8): e0220820. <https://doi.org/10.1371/journal.pone.0220820>
- Li X-Y, Pape T, Zhang D (2019b) Taxonomic review of *Gasterophilus* (Oestridae, Gasterophilinae) of the world, with updated nomenclature, keys, biological notes, and distributions. *ZooKeys* 891: 119–156. <https://doi.org/10.3897/zookeys.891.38560>

- Liakos BD (1986) Effect of hypodermatosis on the body weight of young goats. *Bulletin of the Hellenic Veterinary Medical Society* 37: 8–12.
- Linnaeus C (1758) *Systema naturae per regna tria naturae :secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Salvii, Stockholm, 824 pp. <https://doi.org/10.5962/bhl.title.542>
- Loew H (1863) Zwei neue europäische Dipterengattungen. *Wiener Entomologische Monatschrift* 7: 38–40.
- Macquart PJM (1843) *Diptères exotiques nouveaux ou peu connus*. Tome deuxième, 3eme partie. Roret, Paris, 460 pp.
- Marshall SA, Kirk-Spriggs AH, Muller BS, Paiero SM, Yau T, Jackson MD (2017) [Chapter] 12. key to Diptera families. In: Kirk-Spriggs AH, Sinclair BJ (Eds) *Manual of Afrotropical Diptera*. Volume 1. Introductory chapters and keys to Diptera families. *Suricata* 4, South African National Biodiversity Institute, Pretoria, 267–355.
- Meigen JW (1824) *Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten*. Vierter Theil. Schulz-Wundermann'sche Buchhandlung, Hamm, 428 pp.
- Morsy TA, Shoukry A, Mazyad SA, Abou Gamra MM (1998) The goat warble fly, *Przhevalskiana silenus* Brauer) in north Sinai, Egypt. *Journal of the Egyptian Society of Parasitology* 28: 373–378.
- Mote DC (1928) The ox warble flies. *Ohio Agricultural Experiment Station Bulletin*, 428, 45 pp.
- Omar MS, Das AB, Osman NI (1988) External ophthalmomyiasis due to the sheep nostril botfly larva *Oestrus ovis* in Saudi Arabia, *Annals of Tropical Medicine and Parasitology* 82(2) 221–223. <https://doi.org/10.1080/00034983.1988.11812235>
- Otranto D, Traversa D, Guida B, Tarsitano E, Fiorente P, Stevens J (2003) Molecular characterization of the mitochondrial cytochrome oxidase I gene of Oestridae species causing obligate myiasis. *Medical and Veterinary Entomology* 17(3): 307–315. <https://doi.org/10.1046/j.1365-2915.2003.00442.x>
- Otranto D, Colwell D, Milillo P, Di Marco V, Paradies P, Napoli C (2004) Report in Europe of nasal myiasis by *Rhinoestrus* spp. in horses and donkeys: seasonal patterns and taxonomical consideration. *Veterinary Entomology* 122: 79–88. <https://doi.org/10.1016/j.vetpar.2004.03.015>
- Pallas PS (1776) *Spicilegia zoologica quibus novae imprimis et obscurae animalium species iconibus, descriptionibus atque commentariis illustrantur*. Fasciculus undecimus, Berlin, 86 pp.
- Papavero N (1977) *The world Oestridae (Diptera), mammals and continental drift*. Dr. W.Junk bv Publishers-The Hague, 240 pp. <https://doi.org/10.1007/978-94-010-1306-2>
- Pape T (1992) Phylogeny of the Tachinidae family-group (Diptera: Calypttratae). *Tijdschrift voor Entomologie* 135: 43–86.
- Pape T (2001) Phylogeny of Oestridae (Insecta: Diptera). *Systematic Entomology* 26: 133–171. <https://doi.org/10.1046/j.1365-3113.2001.00143.x>
- Pape T, Blagoderov V, Mostovski MB (2011) Order Diptera Linnaeus, 1758. In: Zhang ZQ (Ed.) *Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness*. *Zootaxa* 3148: 222–229. <https://doi.org/10.11646/zootaxa.3148.1.42>

- Paramonov SJ (1940) *Gastrophilidae und ihre Bekämpfungen*. Kiew-Lwow, 128 pp.
- Patton WS (1922) *Hypoderma crossii* sp. n. parasitic in its larval stages in cattle and goats in the Punjab. *Indian Journal of Medical Research* 10: 573–578.
- Patton WS (1924) *Gasterophilus crossi* sp. nov., parasitic in its larval stage in the stomach of the horse in the Punjab. *Indian Journal of Medical Research* 11: 963.
- Pleske T (1926) *Revue des espèces paléarctiques des Oestrides et catalogue raisonné de leur collection au Musée Zoologique de l'Académie des Sciences. Annuaire du Musée Zoologique de l'Académie Impériale des Sciences de Saint Pétersbourg* 26: 215–230.
- Rodhain J, Bequaert J (1920) Oestrides d'antilopes et de zèbres recueillis en Afrique orientale avec un conspectus du genre *Gasterophilus*. *Revue Zoologique Africaine* 8: 169–228. <https://doi.org/10.5962/bhl.part.22396>
- Rondani C (1857) *Dipterologiae Italicae prodromus. Vol. 2. Species Italicae ordinis diptero-rum in genera characteribus definita, ordinatim collectae, methodo analitica distinctae, et novis vel minus cognitis descriptis. Pars prima: Oestridae, Syrphidae, Conopidae*. Stocchi, Parmae, 264 pp. <https://doi.org/10.5962/bhl.title.8160>
- Royce LA, Rossignol PA, Kubitz ML, Burton FR (1999) Recovery of a second instar *Gasterophilus* larva in a human infant: A case report. *The American Journal of Tropical Medicine and Hygiene* 60(3): 403–404. <https://doi.org/10.4269/ajtmh.1999.60.403>
- Saini RK, Sankhala LN (2015) A case report of bovine hypodermosis. *International Journal of Science, Environment and Technology* 4(3): 725–726.
- Schwab KC (1840) *Die Oestraciden – Bremsen – der Pferde, Rinder und Schafe*. Matthäus Pössenbacher, München, 83 pp.
- Slater PL (1858) On the general geographical distribution of the members of the class Aves. *Journal of the Proceedings of the Linnean Society of London. Zoology* 2: 130–145. <https://doi.org/10.1111/j.1096-3642.1858.tb02549.x>
- Soós A, Minar J (1986a) Family *Gastrophilidae*. In: Soos A, Papp L (Eds) *Catalogue of Palaearctic Diptera. Volume 11. Scathophagidae–Hypodermatidae*. Akadémiai Kiado, Budapest, 237–240.
- Soós A, Minar J (1986b) Family *Oestridae*. In: Soos A, Papp L (Eds) *Catalogue of Palaearctic Diptera. Volume 11. Scathophagidae–Hypodermatidae*. Akadémiai Kiado, Budapest, 240–244.
- Steel JH (1887) On bots (Larval Oestridae) of the horse and camel. *Journal of the Bombay Natural History Society* 2: 27–30.
- Steyskal GC, El-Bialy S (1967) A list of Egyptian Diptera with a bibliography and key to families. *Ministry of Agriculture Technical Bulletin* 3: 32–37.
- Strand E (1928) *Miscellaneae nomenclaturica zoologica et palaeontologica*. *Archiv für Naturgeschichte* 92A(8): 30–75.
- Sultanov MA (1951) A new species of botflies from horse – *Gastrophilus viridis* sultanov sp. nov. *Doklady Akademii Nauk Uzbekskoi SSR* 1951: 41–44.
- Szilády Z (1935) Die ungarischen Dasselfliegen. *Állattani Közlemények* 32: 136–140.
- Townsend CHT (1912) A readjustment of muscoid names. *Proceedings of the Entomological Society of Washington* 14: 45–53.

- Townsend CHT (1916) Diagnoses of new genera of muscoid flies founded on old species. Proceedings of the United States National Museum 49: 617–633. <https://doi.org/10.5479/si.00963801.2128.617>
- Townsend CHT (1918) New muscoid genera, species and synonymy (Diptera). Insecutor Inscitiae Menstruus 6: 157–182.
- Townsend CHT (1933) New genera and species of Old World oestromuscoid flies. Journal of the New York Entomological Society 40: 439–479.
- Townsend CHT (1934) New Neotropical oestromuscoid flies. Revista de Entomologia 4: 201–212.
- Villers CJ (1789) Caroli Linnaei entomologia, faunae Suecicae descriptionibus aucta; DD. Scopoli, Geoffroy, de Geer, Fabricii, Schrank, &c. speciebus vel in systemate non enumeratis, vel nuperrime detectis, vel speciebus Galliae australis locupletata, generum specierumque rariorum iconibus ornata; curante & augente Carolo de Villers, Acad. Lugd. Massil. Villa-Fr. Rhotom. necnon Geometriae Regio Professore. Tomus tertius. Piestre et Delamolliere, Lyon, xxiv + 657 pp.
- Walker F (1849) List of the specimens of dipterous insects in the collection of the British Museum. Part III. British Museum (Natural History), London, 485–687.
- Wallace AR (1876) The geographical distribution of animals, vVols 1, 2. Macmillan, London, 574 pp + 650 pp.
- Wiedemann CRW (1830) Aussereuropäische zweiflügelige Insekten. Als Fortsetzung des Meigenschen Werkes, zweiter Theil. Schulz, Hamm, xii + 684 pp.
- Wood DM (1987) Chapter 107. Oestridae. In: McAlpine JF, et al. (Eds) Manual of Nearctic Diptera, vol. 2. Agriculture Canada Monograph, 1147–1158.
- Zayed AA (1998) Localization and migration route of *Cephalopina titillator* (Diptera: Oestridae) larvae in the head of infested camels (*Camelus dromedarius*). Veterinary Parasitology 80(1): 65–70. [https://doi.org/10.1016/S0304-4017\(98\)00182-4](https://doi.org/10.1016/S0304-4017(98)00182-4)
- Zetterstedt JW (1844) Diptera Scandinaviæ disposita et descripta. Tomus 3. Officina Lundbergiana, Lundae [= Lund], 895–1280.
- Zumpt F (1965) Myiasis of Man and Animals in the Old World. Butterworths, London, 267 pp.