BIOSYSTEMATIC APPROACH: TO INVENTORIZATION OF UBIQUITOUS MYIASIS CAUSING FLIES OF VETERINARY IMPORTANCE IN INDIA

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Abstract. Dipterans are a diverse order of insect of which Calliphorids and Sarcophagids are the most ubiquitous, as several species of these families immature stages have been known to cause a deleterious condition of human and animal tissue, viz., collectively termed as myiasis. Therefore it is essential to gather information and to setup a biosystematic species inventory on the common and most ubiquitous myiasis causers along with their synonyms and notes on type localities to generate information about their distribution and substrate preferences for causing myiasis. The current study reveals, a total of 21 species of flies which are responsible for causing myiasis in India, out of which 17 species cause myiasis in animals, out of which 8 species belong to the family Calliphoridae and 9 species belong to the family Sarcophagidae, respectively. The present study provides a synopsis of the regional biosystematic and taxonomical work carried out until now, and can serve as a baseline data for future studies.

Keywords: medico-legal entomology, Myiasis, Calliphoridae, Sarcophagidae, India.

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1. Introduction

India is one of the world’s most biodiverse regions with a total area of about 3,287,263 km². The faunal diversity of India is rich and diversified because of a variety of ecozones ranging from deserts to high mountains and tropical to temperate forests. The Indian myiasis causers, especially the family Calliphoridae and Sarcophagidae has been poorly known as most species were described in the 19th century; apart from treatment by (Senior White et al, 1940) [77].

This taxonomically and medico legally important faunal group have been neglected till date. The study indicates that most of the species have been collected in selected regions of India, typically from West Bengal. The term "myiasis," was introduced by Hope in 1840, is now in general use to indicate the condition resulting from the invasion of tissues or organs of man or animals by dipterous larvae. Somewhat earlier; Kirby and Spence, had proposed the name "scolechiasis" for such invasions by insect larvae in general. Hope proposed to limit the term "scolechiasis" by proposing "myiasis" for dipteran larvae; "scolechiasis" for lepidopterous larvae and "canthariasis" for coleopteran larvae [17].

Patton in 1921 extended the use of the term myiasis to include all stages of Diptera including that eggs, pupae, and even adults may occasionally be found in the human or
animal body. Thus the need for a species inventory or a general guide to the subject became evident, only after the progress of World War II in Europe and America [42, 43]. But no such study was conducted in India.

The family Calliphoridae and Sarcophagidae flies are the most ubiquitous due to their trade mark appearance on wounds and dead bodies. The family Calliphoridae is represented currently in the world by 1,520 species and out of which 59 species has been recorded from India and the family Sarcophagidae is represented currently in the world by 3,079 species and out of which 126 species are recorded from India [33, 34].

The current interest in these flies is due to the fact that these flies wreck havoc on cattle health, by both in terms of product quality and quantity, viz., deteriorating cattle biomass there by tremendously reducing the quantity and quality of meat, milk, wool and leather in ungulates. Therefore the current study is important in the fact that it will provide a list of all the myiasis causing flies of the two most ubiquitous groups, which are taxonomically distinctly different but ecologically similar on basis of utilization of similar resources.

The current study focuses on the generation of base line data for India, which is so far not been attempted yet and this will seemingly be the pioneering study to generate a species inventory of myiasis causing Calliphorids and Sarcophagids in India of veterinary importance, also synonyms are given to avoid misidentification and distribution is given in this biosystematic checklist.

2. Materials and methods

2.1. Status survey
Taxonomic nomenclature used for the checklist follows (Evenhius, 2014). Indian distribution and elsewhere are also given; along with synonyms of the species. The study is based on the available literature rather than on extensive new taxonomic work. Most of the names of the described species presented are in accordance with the most recent Stratiomyidae classification following Systema Dipterorum (Woodley, 2001 and Pape and Evenhuis, 2013).

2.2. Museum survey
Dipterans collected from tissues of animals (adults and/or immature) and stored in the repository of National Zoological Collection in the Zoological Survey of India, Kolkata, were studied and utilized for the preparation of the checklist. The registration numbers of the flies are from 2080/H6 to 2364/H6, 2374/H6 to 4140/H6, 4321/H6 to 4647/H6 and 6935/H6 to 7836/H6.

2.3. Literature survey
Taxonomic literatures were reviewed for extracting out Indian species of the medico-legally important dipteran from internet resources and other relevant literatures such as Catalog of Life (updated on September, 2016) [55], Systema Dipterorum (updated on June, 2013) [40], Oriental catalog [28], Fauna of British India [77] and Catalog of Diptera from Australasian and Oceania regions [10], Zoo records series (2011 to 2016) and State fauna series and Open search for papers on myiasis causing dipterans and allied disciplines from the Internet, were consulted for extraction of the
current taxonomic position of the myiasis causing species, for the preparation of biosystematic inventory and proper in-hand identification of the specimens as all the synonyms are clubbed under the current taxonomically accepted name, their biogeographic distribution and thereby ultimately curving all these data into the first of its kind checklist of Indian dipteran species of medico legal (veterinary) interest, the work, especially mentions the species from West Bengal. Besides this other major contributors of the field along with their contributions are cited and current status of the Indian variety is elucidated along with survey locations.

2.4. Descriptive statistics

Basic numerical taxonomy a classification system in biological systematics which deals with the grouping by numerical methods of taxonomic units based on their character. It aims to create a taxonomy using numeric algorithms like cluster analysis rather than using subjective evaluation of their properties. This is achieved by dividing on criteria basis and utilizing graphs to visualize data [69]. This will gave us an idea of the types of groups that are encountered due to substrate preference.

2.5. Biometric analysis and AHC

Previous collections (from National Zoological Collection, General Diptera Collection were taken) and microscopic measurements of the genital capsules of the various specimens of these myiasis causing flies were undertaken in Lecia M 205 and Lecia EZ4 HD microscopes. Based on the body biometrics (length of genital capsule of \( n = 10 \) individuals of each species) and current nomenclature AHC was done to see relation between the various levels of taxa to assess phylogenetic relationships between species, using the length of genital capsule. This method uses comparative statistical analyses that assumes the independence of data points and phylogenetically independent contrasts (Felsenstein, 1984), in Wards method [3, 12, 16, 14, 27, 30].

3. Results

The list is arranged systematically to subgenus and genus level and alphabetically thereafter, to make the search easier for a given taxon. Main references to the original distribution and host preference are listed. The acronyms used for collections follow the standard of the Systema Dipterorum (Woodley, 2001 and Pape and Evenhuis, 2013), and their equivalents are as follows; Calliphora (Calliphora) vicina Robineau-Desvoldy, 1830: CV; Lucilia cuprina (Wiedemann, 1830) : LC; Lucilia illistris (Meigen, 1826): LI; Lucilia sericata (Meigen, 1826) : LS ; Chrysomya albiceps (Wiedemann, 1819): CA; Chrysomya bezziana Villeneuve, 1914 : CB; Chrysomya megacephala (Fabricius, 1794): CM; Chrysomya rufifacies (Macquart, 1843): CR; Wohlfahrtia nuba (Wiedemann, 1830):WN; Sarcophaga (Bellieria) melanura Meigen, 1826: SBM; Sarcophaga (Liopygia) argyrostoma (Robineau-Desvoldy, 1830):SLA; Sarcophaga (Liopygia) ruficornis (Fabricius, 1794): SLR; Sarcophaga (Liosarcophaga) dux Thomson, 1869: SLD; Sarcophaga (Parasarcophaga) albiceps (Meigen, 1826) SPA; Sarcophaga (Parasarcophaga) hirtipes (Wiedemann, 1830): SPH; Sarcophaga (Parasarcophaga) macroauriculata (Ho,1932): SPM; Sarcophaga (Parasarcophaga) misera (Walker,1849): SP.
Checklist of myiasis causing flies of India (based on immature stage development model)

ORDER Diptera (Linnaeus, 1758)
 SUBORDER Brachycera (Macquart, 1834)
 INFRAORDER Muscomorpha (Woodley, 1989)
 SECTION Schizophora (Becher, 1882)
 SUB SECTION Calyptratae (Robineau-Desvoidy, 1830)
 SUPER FAMILY Oestroidea (Leach, 1815)
 FAMILY Calliphoridae (Brauer & Bergenstamm, 1889)
 TRIBE Calliphorini Lopes, 1968
 GENUS Calliphora Robineau-Desvoidy
 SUB GENUS Calliphora Robineau-Desvoidy, 1830

1. Calliphora (Calliphora) vicina Robineau-Desvoidy, 1830.

Distribution in India: Chandīgarh (Singh & Sidhu, 2004), Haryāna (Singh & Sidhu, 2004), Himāchal Pradesh (Bharti & Singh B., 2017; Singh & Sidhu, 2004), [Shimla (Senior-White, Aubertin & Smart, 1940; Sinha & Nandi, 2004)], Punjab (Aggarwal, 2005; Bharti & Singh B., 2017; Bharti & Singh D., 2002; Singh & Bharti, 2000; Singh & Sidhu, 2004), Sikkim (Senior-White, Aubertin & Smart, 1940; Singh & Sidhu, 2004) [Mangan, Phensang (Sinha & Nandi, 2004)], Uttaranchal (Singh & Sidhu, 2004) [Dehra Dun (Senior-White, Aubertin & Smart, 1940); Nainital (Sinha & Nandi, 2004)], Uttar Pradesh [Mussooree (Senior-White, Aubertin & Smart, 1940)], Cherat? (Senior-White, Aubertin & Smart, 1940)] West Bengal (Singh & Sidhu, 2004) [Alipurduar, Birpara, Darjeeling, Ghoramara I., Kalimpong, Kuruseong, Rajabhatkhawa (Sinha & Nandi, 2004); Sundarbans Biosphere Reserve (Sinha, Ghosh & Nandi, 2002; Sinha & Nandi, 2004)].

Host: Sheep (14).

TRIBE Luciliini Shannon 1924
 GENUS Lucilia Robineau-Desvoidy, 1830

2. Lucilia cuprina (Wiedemann, 1830).

Synonyms
Lucilia amica Robineau-Desvoidy, 1830
Lucilia argyricephala Macquart, 1846
Lucilia dorsalis Robineau-Desvoidy, 1830
Lucilia elegans Robineau-Desvoidy, 1830
Lucilia leucodes Frauenfeld, 1867
Lucilia nigricornis Senior-White, 1924
Lucilia pseudosericata Gaminara, 1930
Lucilia pubens Macquart, 1843
Lucilia usta Robineau-Desvoidy, 1830
Musca fucina Walker, 1849
Musca serenissima Walker, 1853
Musca temperata Walker, 1853
Musca varians Wiedemann, 1830
Phaenicia pallescens Shannon, 1924
**Somomya pallifrons** Bigot, 1877  
**Strongyloneura nigricornis** Senior-White, 1924  

**Distribution in India:** Assam [Sadiya], Arunachal Pradesh [Pasighat], Chandīgarh (Singh & Sidhu, 2004), Haryāna (Singh & Sidhu, 2004), Himachal Pradesh [Shimla], Jammu & Kashmir [Gulmarg], Rajasthan (Singh & Sidhu, 2004; Singh & Singh, 2002), Sikkim [Jorethang] (Senior-White, Aubertin & Smart, 1940), Karnataka (Valandikar, 1982), West Bengal (Aloke, Roy & Dasgupta, 1989; Singh & Sidhu, 2004) [Burdwan, Coochbehar, Dhabalhat, Shibpur, Rajabhatkhawa, Ranaghat, Shibpur Botanical Garden (Sinha & Nandi, 2004)].  

**Host:** Sheep (22).  

**Distribution in India:** Haryāna (Singh & Sidhu, 2004), Himachal Pradesh (Senior-White, Aubertin & Smart, 1940; Singh & Sidhu, 2004), Punjab (Bharti, 2009; Shah & Sakhawat, 2004; Singh & Bharti, 2000; Singh & Sidhu, 2004), Uttaranchal (Singh & Sidhu, 2004; Singh & Singh, 2002).  

**Host:** Canine (foxes and dogs).  

**Synonyms**  
*Pyenosonia sericata* (Meigen, 1826).  
*Lucilia barberi* Townsend, 1908  
*Lucilia capensis* Robineau-Desvoidy, 1830  
*Lucilia flavipennis* Macquart, 1843  
*Lucilia frontalis* Brauer & Bergenstamm, 1891  
*Lucilia giraulti* Townsend, 1908  
*Lucilia laphyra* Walker, 1849  
*Lucilia latifrons* Schiner, 1861  
*Lucilia prunioida* Meigen, 1838  
*Lucilia sayi* Jaenicke, 1867  
*Musca lagyra* Walker, 1849  
*Musca nobilis* Meigen, 1826  
*Musca tegularia* Wiedemann, 1830  
*Phaenicia concinna* Robineau-Desvoidy, 1863  

**Distribution in India:** Almost throughout India” (Sinha, 2014), Himachal Pradesh (Bharti & Singh. B., 2017), Jharkhand (Sinha, 2014), Punjab (Senior-White, Aubertin & Smart, 1940; Singh & Singh, 2002), West Bengal [Bamankhali, Darjeeling, Ganga Sagar, Ghoramara I., Kalimpong, Malda, Siliguri, Sukna, Takvar (Sinha & Nandi, 2004)]  

**Host:** Sheep (22).  

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**SUB FAMILY Chrysomyinae Roback, 1951**  
**TRIBE Chrysomyini Shannon 1923**  
**GENUS Chrysomya Robineau-Desvoidy, 1830**  

5. *Chrysomya albiceps* (Wiedemann, 1819).  

**Synonyms**  
*Chrysomyia indica* Patton, 1934  
*Compsomyia flaviceps* Seguy, 1927
Compsomyia mascarenhasi Seguy, 1927
Lucilia arcuata Macquart, 1851
Lucilia testaceifacies Macquart, 1851
Musca bibula Wiedemann, 1830
Musca elara Walker, 1849
Musca emoda Walker, 1849
Musca felix Walker, 1853
Musca himella Walker, 1849
Paracompsomyia verticalis Adams, 1905
Somomyia annulata Brauer, 1899
Somomyia arussica Corti, 1895
Somomyia nubiana Bigot, 1877

**Distribution in India:** Kerala (Radhakrishnan et al., 2012), Punjab (Bharti, 2014), Uttaranchal (Singh & Singh, 2002), West Bengal (Sinha, Mondal & Mahato, 2016).

**Host:** Bovine (22).

6. **Chrysomya bezziana** Villeneuve, 1914.


**Host:** Bovine (16, 17, 18, 19).

7. **Chrysomya megacephala** (Fabricius, 1794).

**Synonyms**

Chrysomya megacephala (Fabricius, 1794).

Pyenosonia flaviceps (Berg)

Lucilia flaviceps Macquart, 1843

Chrysomya duvaucellii Robineau-Desvoidy, 1830

Chrysomya gratiosa Robineau-Desvoidy, 1830

Lucilia flaviceps Macquart, 1843
**Musca bata** Walker, 1849  
**Musca combrea** Walker, 1849  
**Musca dux** Eschscholtz, 1822  
**Musca remuria** Walker, 1849  
**Pollenia basalis** Smith, 1876  
**Somomyia cyaneocincta** Bigot, 1888  
**Somomyia pfefferi** Bigot, 1877  
**Somomyia cyaneocincta** Bigot, 1887  
**Somomyia dives** Bigot, 1887  
**Somomyia saffranea** Bigot, 1877


**Host:** Animal, generally canine (25).

8. *Chrysomya rufifacies* (Macquart, 1843).


**Host:** Sheep (22).

**SUBORDER Brachycera** (Macquart, 1834)  
**INFRAORDER Muscomorpha** (Woodley, 1989)
SECTION Schizophora (Becher, 1882)
SUB SECTION Calyptratae (Robineau-Desvoidy, 1830)
SUPER FAMILY Oestroidea (Leach, 1815)
FAMILY Sarcophagidae Haliday, 1853
GENUS Wohlfahrtia Brauer & Bergenstamm, 1889

9. Wohlfahrtia nuba (Wiedemann, 1830)

Synonyms

Tachina nuba Wiedemann, 1830
Wohlfahrtia volucris Seguy, 1941
Wohlfahrtia nuba Rohdendorf, 1956

Distribution India: Punjab (Chakraborty et al., 2017; Pape, 1996; Verves, 1985), Rajasthan (Chakraborty et al., 2017; Nandi, 2002).

Host: Bovine and Canine (29).

SUB FAMILY Sarcophaginae Schiner 1861
GENUS Sarcophaga Meigen, 1826
SUB GENUS Bellieria Robineau-Desvoidy 1863

10. Sarcophaga (Bellieria) melanura Meigen, 1826

Synonyms

Sarcophaga melanura Meigen, 1826

Distribution India: Bihar (Chakraborty et al., 2017; Verves, 2001), Jammu & Kashmir (Chakraborty et al., 2017; Rohdendorf, 1937), Tamil Nadu (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001).

Host: Avian, Bovine and Canine (12, 13, 23).

SUB GENUS Liopygia Enderlein, 1928

11. Sarcophaga (Liopygia) argyrostopoma (Robineau-Desvoidy, 1830)

Synonyms

Sarcophaga barbata Thomson, 1869

Distribution India: Gujarat (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Haryana (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Maharashtra (Khan, L., Zambare & Fahd, 2016), Rajasthan (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Uttar Pradesh, Uttarakhand (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001).

Host: Sheep (12, 13).

12. Sarcophaga (Liopygia) ruficornis (Fabricius, 1794)

Synonyms

Parasarcophaga ruficornis (Fabricius, 1794)

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Host: Dog & Poultry, Bufo melanostictus (12, 13, 22, 29).

SUB GENUS Liosarcophaga Enderlein, 1928

13. Sarcophaga (Liosarcophaga) dux Thomson, 1869

Synonyms
Sarcophaga dux var. harpax Pandelle, 1896
Sarcophaga subtuberosa Parker, 1917

**Host:** Bovine (Cows, Camels and Bullocks) (12, 13, 22).

### SUB GENUS *Parasarcophaga* Johnston & Tiegs, 1921

**14. Sarcophaga (Parasarcophaga) albiceps** (Meigen, 1826)

**Distribution India:** Andaman Is. (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Andhra Pradesh (Chakraborty et al., 2017; Nandi, 2002; Senior-White, Aubertin & Smart, 1940; Verves, 2001), Arunachal Pradesh (Chakraborty et al., 2017; Nandi, 2002; Senior-White, Aubertin & Smart, 1940; Verves, 2001), Assam (Chakraborty et al., 2017; Nandi, 2002; Senior-White, Aubertin & Smart, 1940; Verves, 2001), Bihar (Chakraborty et al., 2017; Nandi, 2002; Senior-White, Aubertin & Smart, 1940; Verves, 2001), Chandigarh (Chakraborty et al., 2017; Nandi, 2002), Dādra & Nagar Haveli (Nandi, 2002), Damān and Diu (Chakraborty et al., 2017; Nandi, 2002), Delhi (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Goa (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Gujarāt (Chakraborty et al., 2017), Haryana (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Himachal Pradesh (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Jammu & Kashmir (Verves, 2001; Nandi, 2002), Jharkhand (Sinha, 2014), Karnataka (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Lāccadive Is. (Parui & Datta, 1991; Verves, 2001; Nandi, 2002), Madhya Pradesh (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Maharashtra (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Manipur (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Meghalaya (Verves, 2001; Nandi, 2002), Mizoram (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Nagaland (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Nicobar Is. (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Orissa (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Pondicherry (Chakraborty et al., 2017; Nandi, 2002), Punjab (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Rajasthan (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Sikkim (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Tamil Nadu (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Tripura (Chakraborty et al., 2017; Datta & Parui, 2000; Nandi, 2002; Verves, 2001), Uttar Pradesh (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), West Bengal (Aloke, Roy & Dasgupta, 1989; Chakraborty et al., 2017; Nandi, 1982a, b, Verves, 2001) [Sundarbans Biosphere Reserve (Sinha, Ghosh & Nandi, 2002)]

**Host:** Bovine (Bull) (12, 13, 22).

**15. Sarcophaga (Parasarcophaga) hirtipes** (Wiedemann, 1830)

**Synonyms**

*Sarcophaga hirtipes.var orchidea* Bottcher, 1913

**Distribution India:** Andaman Is. (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Andhra Pradesh (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Bihar (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Delhi (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Gujarat (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Haryana (Nandi, 2002; Pape, 1996; Verves, 2001), Jharkhand (Sinha, 2014), Karnataka (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Kerala (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Madhya Pradesh (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Maharashtra (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Mizoram (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Nagaland (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Orissa (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Pondicherry (Chakraborty et al., 2017; Nandi, 2002), Punjab (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Rajasthan (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Sikkim (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Tamil Nadu (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Tripura (Chakraborty et al., 2017; Datta & Parui, 2000; Nandi, 2002; Verves, 2001), Uttar Pradesh (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), West Bengal (Aloke, Roy & Dasgupta, 1989; Chakraborty et al., 2017; Nandi, 1982a, b, Verves, 2001) [Sundarbans Biosphere Reserve (Sinha, Ghosh & Nandi, 2002)]

**Host:** Sheep (12, 13).

16. *Sarcophaga (Parasarcophaga) macroauriculata* (Ho, 1932)

**Distribution India:** Manipur (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Meghalaya (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Nagaland (Chakraborty et al., 2017; Nandi, 2002; Verves, 2001), Sikkim (Chakraborty et al., 2017; Nandi, 1990, 2002; Verves, 2001), Uttar Pradesh (Chakraborty et al., 2017; Nandi, 1990, 2002; Verves, 2001), West Bengal (Chakraborty et al., 2017; Dasgupta, Roy & Guin, 1972; Nandi, 2002; Senior-White, Aubertin & Smart, 1940; Verves, 2001).

**Host:** Feline (12, 13).

17. *Sarcophaga (Parasarcophaga) misera* (Walker, 1849)


**Host:** Domesticated & Poultry animals, sheep (12, 13).
Biometric analysis and AHC

The biometric data was run through AHC which yielded 5 distinctly different groups, as specific biometric lengths points to specific substrate preference. As shown below. The bovine sub group consisting of CV, LC, CS, CB, WN, SBM, SLD, SPA and the feline sub group SPM, seems to have diverged from a common stock and the canine sub group consist of LI, CM; the caprine and ovine sub group consist of LS,CR,SLA,SPH and lastly the non specific sub group consists of SLR, SP.

![AHC Diagram]

Fig. 1. AHC of the Sarcophagids and Calliphorids of Veterinary importance in India

3. Conclusion

The current study shows that the genus Sarcophaga is the major contributor to myiasis in India, as per previous literatures, as they amount for 44% (8 species) of the myiasis cases in India. The genus Chrysomya and Lucilia seems to be 22% (4 species) of the myiasis cases in India, as is the second largest contributor. The genus Wohlfahrtia and Calliphora amounts for 6% (1 species) of the myiasis cases in India, as is the third largest contributors, each cases of myiasis each in India (Fig. 2, 3).

We show that the taxonomically less studied species designated as NMF (No mention found) on sub genus is the largest contributor to myiasis in India, with an astounding 44% (8 species), which re establishes the belief that taxonomic study along with biosystematic studies are needed for generation of base line data for these myiasis causing flies on the sub genus level. The sub genus Parasarcophaga amounts for 17% (3 species) of the myiasis cases in India, as is the second largest contributor. The sub genus Liopygia amounts for 11% (2 species) each of the myiasis cases in India, as is the third largest contributor. The sub genus Bellieria, Bercaea, Liosarcophaga and Prionophalla amounts for 6% (1 species) each. The sub genus Squamatodes and Calliphora amounts for 5% (1 species) each. (Fig. 4, 5).
**Fig. 2.** The % of Genus of various flies in their contribution to myiasis cases in India

**Fig. 3.** The number of species of Genus of various flies in their contribution to myiasis cases in India
**Fig. 4.** The % of Genus of various flies in their contribution to myiasis cases in India

**Fig. 5.** The number of species of Sub genus of various flies in their contribution to myiasis cases in India
Fig. 6.a. Show the hosts and family of myiasis causers and their hosts in myiasis cases.

Fig. 6.b. The types of hosts and their substrate preference of the two families.

It seems bovine is equally preferred for both families at 45% each, while ovine and caprine is more preferred by Calliphoridae at 33%, than Sarcophagidae at 22%, canine is specifically preferred by Calliphoridae at 22% and feline is specifically preferred by Sarcophagidae at 11%, also Sarcophagidae at 22% of sometimes tend to be non specific also, thereby showing flexibility in substrate utilization.
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