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A biosystematic species inventory of Indian sarcophagidae (Insecta: Diptera: Sarcophagidae)

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Abstract

The Sarcophagids are one of the representative groups of the Cyclorrhaphan insects of the order Diptera and family Sarcophagidae. They are identified in-hand by their trademark three stripes checker board pattern in abdomen. The family is characterized and distinguished from other members of Cyclorrhaphan by the presence of more than 2 notopleural bristles. The family Sarcophagidae of India is presented by 3 subfamilies (Miltogrammatinae, Paramacronychiinae and Sarcophaginae), 17 genus and 126 species, which are known from India. The checklist is updated with the current nomenclatural changes of the Indian Sarcophagidae, according to available literatures, felid and museum specimens of National zoological collection of India.

Keywords: Diptera, biosystematic, species inventory, sarcophagidae, forensic dipterans, India

1. Introduction

The flesh flies belong to the family Sarcophagidae, currently in the world there are 133 genus (3079 species) [6]. Adult Flesh flies (Diptera: Sarcophagidae) are distinguished from other Calyptrate by the presence of an overall greyish appearance, three stripes running dorsal side and the presence of Hypopleural bristles. The family Sarcophagidae has been distinguished from family Calliphoridae on the basis of number of notopleural bristles present, since family Sarcophagidae (having 3-4), unlike the family Calliphoridae (having 2).

The family Sarcophagidae, previously were classified as a subfamily of Calliphoridae., viz subfamily Sarcophaginae (Senior-White, Aubertin and Smart, 1940), they divided subfamily Sarcophaginae into 4 genus (59 species), out of which 3 genus (32 species) are now found in India, this was precursor for Indian Sarcophagidae checklist [8], but due to occurrence of geopolitical division in 1947 and subsequent nomenclatural changes, made the checklist redundant as (Lehrer, 1970) split the family Calliphoridae, into 3 distinct families namely Calliphoridae, Rhiniidae and Sarcophagidae [20].

Later (Nandi, 2002) revised the checklist, and divided Sarcophagidae of Indian sub-continent into 50 genus (163 species), out of which 39 genus (119 species), are found in India [12]. Before this current study, a study was made by (Mitra & Sharma, 2010), they reduced the number of Indian Sarcophagidae, to 38 genus (117 species) [11]. The current study was designed due to the simple need to cull out differences and use currently accepted taxonomic nomenclature to find out what is the actual number of representatives of Indian Sarcophagidae and their current taxonomic status, which is found to be 18 genus (126 species), along with some notes in their distribution in India. In this paper, we update the list of flesh flies species known from India, based on examination of available collection, literature review and additional fieldwork by the authors.

2. Materials and Methods

2.1 Species inventory of Indian Sarcophagidae

Taxonomic literatures were reviewed for extracting out Indian species of the forensically important dipteran from internet resources and other relevant literatures such as Catalog of Life (updated on January, 2015) [6], Systema Dipterorum (updated on June, 2013) [7], Bionames [8], Catalog of fossil diptera (updated on January, 2015) [9], Oriental catalog [10, 11] and Catalog of Diptera from Australasian and Oceania regions [12], Zoo records series (2011 to 2016) and State fauna series and Open search for papers on forensic dipterans, the National Zoological collection and General diptera collection was also consulted from the Central entomological

labs of Zoological Survey of India, H.Q of registration numbers 5333/H6 to 8301/H6.

2.2 Species sampled and Phylogenetic relatedness

The flies employed in the present study were chosen based on availability specimens of National zoological collection and general diptera collection. The species represent 17 of the major genera and capture much of the range in size and sexual dimorphism seen in the family.

2.3 Biometric analysis

The specimens of National zoological collection and General diptera collection designated as NZC and GDC were utilized for the purpose of gathering the basic information, of length of males. Measurements were performed on the images using image analysis software Leica HD.

2.4 Statistical analysis

The National zoological collection and general diptera collection specimens were utilized, their 5th sternite was

dissected out and measured for all the species (n = 5). And the difference between the males and females for each genus and species was done.

2.5 Agglomerative Hierarchical Cluster (AHC) analysis

This was done to assess because phylogenetic relationships between species can bias comparative statistical analyses that assume the independence of data points, we used phylogenetically independent contrasts (Felsenstein, 1985). These analyses require an independently generated phylogenetic hypothesis. We developed a phylogenetic hypothesis for the 126 species based on the morphological features of taxonomy and AHC to create this dendrogram. The program that used the Agglomerative hierarchical clustering logic generated the dendrogram ^[1-5].

3. Results and Discussions

A table of species inventory was created, with family, sub family, tribe, sub tribe, genus, sub genus currently accepted name, distribution in India and references are provided.

Family		Sarcophagidae	
Sub family		Miltogrammatinae Enderlein 1928	
Tribe		Amobiini Townsend, 1916	
Subtribe		Amobiina Rohdendorf, 1918	
Genus		Amobia Robineau-Desvoidy, 1830	
Sub genus		Amobia Robineau-Desvoidy, 1830	
S. no.	Currently accepted species name	Distribution India	Reference
1	<i>Amobia (Amobia) auriceps</i> (Baranov, 1935)	Tamil Nadu (Coimbatore).	GDC, 12
2	<i>Amobia (Amobia) pelopei</i> (Rondani, 1859)	Tamil Nadu (Coimbatore).	GDC, 12
3	<i>Amobia (Amobia) signata</i> (Meigen, 1824)	Southern India, Jammu and Kashmir.	GDC, 12
Genus		Metopia Meigen, 1803	
4	<i>Metopia argentata</i> Macquart, 1851	Jammu and Kashmir (Gulmarg, 2,590m).	GDC
5	<i>Metopia campestris</i> (Fallen, 1810)	Jammu and Kashmir (Gulmarg, 2,590m).	GDC
6	<i>Metopia fastuosa</i> (Meigen, 1824)	Jammu and Kashmir Valley (Tangmarg, 671m).	10
7	<i>Metopia nudibasis</i> (Malloch, 1930)	Karnataka (Bannerghatta).	10
Genus		Sphenometopa Townsend, 1908	
8	<i>Sphenometopa jacobsoni</i> Rohdendorf, 1967	Jammu and Kashmir Valley (Tangmarg, 671m).	13
Genus		Wohlfahrtia Brauer & Bergenstamm, 1889	
9	<i>Wohlfahrtia nuba</i> (Wiedemann, 1830)	Rajasthan (Bikaner), Punjab.	GDC, NZC, 8
10	<i>Wohlfahrtia trina</i> (Wiedemann, 1830)	Rajasthan, Punjab.	GDC, 8
Genus		Miltogramma Meigen, 1830	
11	<i>Miltogramma angustifrons</i> (Townsend, 1933)	Assam; Doom Dooma (13m).	GDC, 10
12	<i>Miltogramma iberica</i> (Villeneuve, 1912)	Jammu and Kashmir; Dalchigam Rakh.	GDC
13	<i>Miltogramma macularis</i> (Wiedemann, 1824)	Bihar (Pusa).	GDC
14	<i>Miltogramma testaceifrons</i> (van Roser, 1840)	Jammu and Kashmir Valley (Tangmarg, 671m).	13
Genus		Phylloteles Loew, 1844	
15	<i>Phylloteles hyalipennis</i> (Baranov, 1934)	Assam (Cachar, Rashed).	10
Genus		Hoplocephalomima Verves, 1988	
16	<i>Hoplocephala indica</i> Verves, 1988	Tamil Nadu (Shevaroy Hills, Yercaud), 1372m.	GDC, NZC, 10
17	<i>Hoplocephala nathani</i> Verves, 1988	Tamil Nadu (Anamalai Hills, Cinchona).	GDC, 10
18	<i>Hoplocephala mirabilis</i> Verves, 1979	Jammu and Kashmir (Dal Lake), Karnataka.	GDC, 10
Genus		Taxigramma Perris, 1852	
19	<i>Taxigramma heteroneura</i> (Meigen, 1830)	Tamil Nadu (Anamalai Hills, Cinchona).	GDC
Genus		Phrosinella Robineau-Desvoidy, 1863	
20	<i>Phrosinella fedtshenkoi</i> (Rohdendorf, 1925)	Jammu and Kashmir Valley (Tangmarg, 671m).	13
Genus		Protomiltogramma Townsend, 1916	
21	<i>Protomiltogramma nandii</i> Verves, 1979	Tamil Nadu; Triunneveli, Dohnavur, 101m.	GDC, 13
22	<i>Protomiltogramma obscurior</i> (Villeneuve, 1916)	Kerala (Coast of Malabar)	10, 13
Genus		Senotainia Macquart, 1846	
23	<i>Senotainia albifrons</i> (Rondani, 1859)	Jammu and Kashmir (Tangmarg), Tamil Nadu.	GDC, 10, 12
24	<i>Senotainia navigatrix</i> (Meijere, 1910)	Assam (Silchar), Bihar (Pusa), Kerala (Midigare), Karnataka (Trivandrum), Tamil Nadu (Cinchona).	GDC, 12
Sub genus		<i>Sphixapata</i> Rondani, 1859	
25	<i>Senotainia (Sphixapata) anamalaica</i> Verves, 1988	Tamil Nadu (Anamalai Hills, Cinchona)	12
Subfamily		Sarcophaginae Townsend, 1917	
Genus		Blaesoxipha Loew, 1861	

Sub genus		Blaesoxipha Loew, 1861	
26	<i>Blaesoxipha (Blaesoxipha) agrestis</i> (Robineau-Desvoidy, 1863)	Jammu and Kashmir (Gulmarg).	GDC
27	<i>Blaesoxipha (Blaesoxipha) aldrichi</i> Nandi, 1992	Karnataka (Kaimara, 1,480m) and Maharashtra (Nagpur).	13
28	<i>Blaesoxipha (Blaesoxipha) bhutanensis</i> Nandi, 1993	Sikkim (Gangtok Hospital Campus, 1677m).	13
29	<i>Blaesoxipha (Blaesoxipha) karnataka</i> Pape, 1994	Karnataka (Kemmanundi).	13
30	<i>Blaesoxipha (Blaesoxipha) nathani</i> Lopes, 1990	Karnataka (Kemmanundi), Kerala.	13
31	<i>Blaesoxipha (Blaesoxipha) pygmaea</i> (Zetterstedt, 1844)	Tamil Nadu (Madras, Coimbatore), Mizoram (Luglei Circuit house campus), Madhya Pradesh, Mizoram	GDC, NZC, 13, 12
32	<i>Blaesoxipha (Blaesoxipha) rishikeshi</i> Nandi, 1990	Uttar Pradesh (Rishikesh, Panichar, 335m).	13
33	<i>Blaesoxipha (Blaesoxipha) rufipes</i> (Macquart, 1839)	Mehalaya: Shilong, Tamil Nadu: Thekkedi; Periyar Dam, Trivancore.	13
34	<i>Blaesoxipha (Blaesoxipha) valangae</i> (Aldrich, 1932)	Karnataka (Banglaore).	13
Genus		Ravinia Robineau-Desvoidy, 1863	
35	<i>Ravinia (Squamatodes) pernix</i> (Harris, 1780)	Andhra Pradesh, Arunachal Pradesh (Dunn Bridge), Bihar (Postoita), Himachal Pradesh (Chamba, Dalhousie, Kufri, Manali, Manikaran, Shimla), Jammu and Kashmir (Jhelum valley, Kogyar, Tangmarg), Uttarakhand (Badrinath, Mussoorie, Naini Tal, Sahastradhara, Tehri).	GDC, NZC, 13
Genus		Heteronychia Brauer & Bergenstamm, 1889	
Sub genus		Uroxanthisca Rohdendorf 1963	
36	<i>Heteronychia (Uroxanthisca) calicifera</i> (Bottcher, 1912)	Bihar; Pusa, Harayana; Kalka, Himachal Pradesh; Solan, Karnataka (Bangalore, Hebbal), Maharashtra; Nagpur, Nagaland; Mokokchung, Tamil Nadu; Coonoor, West Bengal (Calcutta, Sal Bankura, Sukna forest), Uttar Pradesh, and Union territories of Andaman and Nicobar island (Netaji nagar).	10
Genus		Sarcophaga Meigen, 1826	
Sub genus		Alisarcophaga Fan & Chen, 1981	
37	<i>Sarcophaga (Alisarcophaga) sawainensis</i> (Nandi, 1989)	Andaman and Nicobar ; Car Nicobar Isl.	10
Sub genus		Asceloctella Enderlein, 1928	
38	<i>Sarcophaga (Asceloctella) calicifera</i> Bottcher, 1912	Bihar, Delhi, Harayana, Himachal Pradesh, Karnataka, Maharashtra, Manipur, Nagaland, Tamil Nadu, West Bengal and Andaman and Nicobar isl.	GDC, 13, 21
Sub genus		Bellieria Robineau-Desvoidy 1863	
39	<i>Sarcophaga (Bellieria) melanura</i> Meigen, 1826	Bihar, Jammu and Kashmir, Tamil Nadu.	13
Sub genus		Curranea Rohdendorf, 1937	
40	<i>Sarcophaga (Curranea) kalimpongensis</i> Nandi, 1979	West Bengal (Kalingpong 1,038m), Sikkim (Mangan, 1189m), Tamil Nadu (Anamalai hills).	GDC, NZC, 21, 10
Sub genus		Baranovisca Lopes, 1985	
41	<i>Sarcophaga (Baranovisca) cantrelli</i> Verves, 1992	Tamil Nadu (Pami).	10
Sub genus		Bercaea Robineau-Desvoidy, 1863	
42	<i>Sarcophaga (Bercaea) africa</i> (Wiedemann, 1824)	Assam, Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Uttar Pradesh, West Bengal, Bihar (Several localities), Punjab.	GDC, 21
Sub genus		Boettcherisca Rohdendorf, 1937	
43	<i>Sarcophaga (Boettcherisca) karnyi</i> (Hardy, 1927)	South Andaman; Mini Zoo; Little Andaman; Netaji Nagar Palm oil extraction center area; Little Andaman; Vivekanandapur.	NZC, 9
44	<i>Sarcophaga (Boettcherisca) nathani</i> (Lopes, 1961)	Gujrat (Ahmedabad, Dwarka, Gir Wild Life Sanctuary: 680m, Girnar hills, Sasan Gir: 680m), Maharashtra (Khandala: 960m), Tamil Nadu (Karikal, Korumbagram) and West Bengal (Gooke).	10
Sub genus		Fengia Rohdendorf, 1964	
45	<i>Sarcophaga (Fengia) ostindicae</i> (Senior-White, 1924)	Assam, Mizoram: Aizawal P.U. College campus, 1,100m, Aizwal, Bonkon, 1050m, Kolasib, 800m and Uttar Pradesh (Dera dun).	NZC, 9
46	<i>Sarcophaga (Fengia) kaimaraensis</i> (Nandi, 1992)	Karnataka; Kaimara, 1,480m.	10
Sub genus		Harpagophalla Rohdendorf, 1937	
47	<i>Sarcophaga (Harpagophalla) kempfi</i> (Senior-White, 1924)	Arunachal Pradesh (Tipi), Assam (Barpathar, Dibrugarh, Jorhat), Bihar (Deoghar, Giridih, Mahaudanga, Pusa), Himachal Pradesh (Dharmasala), Sikkim (Gangtok), Kerala (Trivancore), Manipur (D.M. College campus), Meghalaya (Shilong, Singimari), Mizoram Aizwal, Kolasib, Lunglei), Tripura (Kanchanpur, Sipahijala), Nagaland (Dimapur) and West Bengal (Arabari forest, Bhatpur, Calcutta, Chandrapur forest, Gorumara forest, Kenduah, Ketka, Susunia forest), Karnataka, Madhya Pradesh, Uttar Pradesh.	NZC, 21
48	<i>Sarcophaga (Harpagophalla) panchganiensis</i> Nandi, 1993	Maharashtra (Panchgani).	7
Sub genus		Helicophagella Enderlein, 1928	

49	<i>Sarcophaga (Helicophagella) gimarensis</i> Nandi, 1992	Gujrat; Girnar hills, 820m.	7
Sub genus		Iranihindia Rohdendorf, 1961	
50	<i>Sarcophaga (Iranihindia) futilis</i> (Senior-White, 1924)	Arunachal Pradesh (Mangalagiri), Assam (Silchar.), Bihar (Chapra, Pusa, Chota Nagpur, Deoghar, Dumraon, Giridhi water falls, Hazaribagh, Patna, Raja Rappa water falls, Rajgir), Jharkhand (Ranchi, Titalgarh), Gujrat (Ahmedabad, Bet Dwarka, Dwarka, Gir sanctuary), Karnataka (Bannerghata National park, Banglore, Kellar, Mysore), Kerala (Calicut, Wilingdonisl.), Maharashtra (Lonavale, Nagpur), Madhya Pradesh (Artham, Jonk river), Nagaland (Dimapur), Mizoram (Aizwal, Bonkon), Orissa (Ashanput, Balugaon, Hiraakund), Tamil Nadu (Coimbatore, Chennai, Parvatipuram), Tripura (Matabari, Pratia forest), Uttar Pradesh (Dera dun), West Bengal (Bhatpur, Bishnupur, Calcutta, Dulmi West, Kachujur, Sahebbundh, Sasankali, Purulia), Andhra Pradesh, Karnataka, Orissa; Barkuda isl., Tripura.	GDC, NZC, 21, 7
51	<i>Sarcophaga (Iranihindia) indica</i> Nandi, 1979	Andra Pradesh, Assam, Kerala, Karnataka, Maharashtra, Tamil Nadu West Bengal (Birbhum; Panchubaga, Midnapore; Salboni), Bihar (Hazaribagh National Park: 300m, Palamau National Park: 320m, Madhudanga, Netarhat).	NZC, 7
52	<i>Sarcophaga (Iranihindia) jamesi</i> Nandi, 1979	West Bengal; Birbhum (Ganpur forest), Purulia: Ketka, Salboni, Panchubaga, Bihar; Hazaribagh National Park, 300m, Palamau Forest rest house, 320m, Mahaudanga, 880m and Netarhat, Karnataka (Bangalore).	NZC, 7
53	<i>Sarcophaga (Iranihindia) martellata</i> (Senior-White, 1924)	Andhra Pradesh, Arunachal Pradesh (Manalagiri), Assam (Silchar), Bihar (Chota Nagpur, Deoghar, Dumraon, Giridhi water falls, Hazaribagh, Patna, Raja Rappa water falls, Rajgir), Jharkhand (Titalgarh), Gujrat (Ahmedabad, Bet Dwarka, Dwarka, Gir Sanctuary), Karnataka (Bannerghata National Park, Bangalore, Kellar, Mysore), Kerala (Calicut, Willingdon isl.), Maharashtra (Lonavale, Nagpur), Madhya Pradesh (Artham, Jonk river), Nagaland (Dimapur), Mizoram (Aizwal, Bonkon), Orissa (Ashanput, Balugaon, Hiraakund), Tamil Nadu (Coimbatore, Chennai, Parvatipuram), Tripura (Matabari, Pratia forest), Uttar Pradesh (Dera dun), West Bengal (Bhatpur, Bishnupur, Calcutta, Dulmi West, Kachujur, Sahebbundh, Sasankali).	NZC, 21, 7
54	<i>Sarcophaga (Iranihindia) martellatoides</i> (Baranov, 1931)	Bihar (Hazaribagh, Palamau, Pusa), Karnataka (Bangalore, Mysore, Srirangapatana), Madhya Pradesh (Bilaspur, Jabalpur, Khajuraho), Maharashtra (Aurangabad, Daulatbad, Ellora), Orissa (Balugaon, Sundargarh), Tripura (Agartala, Santibazar, Trishna), Uttar Pradesh (Dera dun), West Bengal (Calcutta, Dulmi West, Hijul forest, Panchubaga, Sahebbundh).	GDC, NZC, 21, 7
Sub genus		Kozlovea Rohdendorf, 1937	
55	<i>Sarcophaga (Kozlovea) cavangarei</i> (Nandi, 1988)	Tamil Nadu (Kodaikanal)	7
56	<i>Sarcophaga (Kozlovea) peshelicis</i> (Senior-White, 1930)	Himachal Pradesh (Chatru, Spiti valley), Haryana, West Bengal (Darjeeling).	NZC, 7, 9
57	<i>Sarcophaga (Kozlovea) vervesi</i> Nandi, 1993	Maharashtra; Nagpur Seminay hills, 350m, Khandala, 950m.	7
58	<i>Sarcophaga (Kozlovea) lothianensis</i> (Sinha & Nandi, 2002)	West Bengal: Sundarbans Biosphere Reserve, Lothian Isl.	7
Sub genus		Leucomyia Brauer & Bergenstamm, 1891	
59	<i>Sarcophaga (Leucomyia) alba</i> (Schiner, 1868)	Andhra Pradesh, Karnataka, Kerala, Orissa, Uttar Pradesh	16
Sub genus		Lioproctia Enderlein, 1928	
60	<i>Sarcophaga (Lioproctia) annandalei</i> (Senior-White, 1924)	West Bengal; Midnapore (Digha), Bihar; (Deoghar, 245m Pusa, Chota Nagpur), Gujrat; Saputara, 875m, Tamil Nadu (Nilgiri hills, Coonor, Coimbatore), Uttar Pradesh (Dera dun), Orissa.	NZC, 9
61	<i>Sarcophaga (Lioproctia) beesoni</i> (Senior-White, 1924)	West Bengal: Darjeeling (Sukna Forest), 200m.	7
62	<i>Sarcophaga (Lioproctia) midnaporensis</i> Nandi, 1978	Bihar, Gujarat, Uttar Pradesh, West Bengal.	NZC, 7
63	<i>Sarcophaga (Lioproctia) pattoni</i> (Senior-White, 1924)	Tamil Nadu; Nilgiri hills, Coonoor, Mizoram: Aizwal: Assam rifles.	GDC, NZC, 21, 7
Sub genus		Liopygia Enderlein, 1928	
64	<i>Sarcophaga (Liopygia) argyrostoma</i> (Robineau-Desvoidy, 1830)	Gujrat (Girner hills, Junagadh), Harayana (Ambala), Rajasthan (Jaipur) and Uttar Pradesh (Mussoorie), Punjab (Kalash Valley, Ambala).	9
65	<i>Sarcophaga (Liopygia) ruficornis</i> (Fabricius, 1794)	Andhra Pradesh, Assam, Bihar, Delhi, Meghalaya, Mizoram, Goa, Gujrat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Union territories of Andaman and Nicobar Isl. Dadra and Nagar Haveli, Delhi, Lakshdweep and Pondicherry.	GDC, NZC, 21, 7

Sub genus		Liosarcophaga Enderlein, 1928	
66	<i>Sarcophaga (Liosarcophaga) amplicercus</i> Shinonaga & Tumrasvin, 1979	Tamil Nadu (Marudamali Forests), Madhya Pradesh (Jabalpur), Karnataka (Bandipur), Tripura.	GDC
67	<i>Sarcophaga (Liosarcophaga) brevicornis</i> Ho, 1934	Assam, Andhra Pradesh, Arunachal Pradesh, Bihar, Gujrat, Himachal Pradesh, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Rajasthan, Tripura and West Bengal	NZC, 6, 7
68	<i>Sarcophaga (Liosarcophaga) choudhuryi</i> (Sinha & Nandi, 2002)	West Bengal	6, 7, 11
69	<i>Sarcophaga (Liosarcophaga) dux</i> Thomson, 1869	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Jammu and Kashmir, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal and the union territories of Andaman and Nicobar Isl. and Lakshadweep.	GDC, NZC, 9, 21
70	<i>Sarcophaga (Liosarcophaga) geetai</i> Algalil and Zambare, 2016	Maharashtra (Aurangabad city)	19
71	<i>Sarcophaga (Liosarcophaga) jaipurensis</i> Nandi, 1990	Rajasthan: Nahargarh Fort area, Haryana; Kalka, Meghalaya; Singirmari, Gujarat, Himachal Pradesh, Manipur, Nagaland.	GDC, 7, 21
72	<i>Sarcophaga (Liosarcophaga) josephi</i> Nandi, 2002	Rajasthan (Nahargarh Fort area), Haryana (Kalka), Meghalaya (Singirmari).	9
73	<i>Sarcophaga (Liosarcophaga) rohdendorfi</i> Salem, 1936	West Bengal; Ranaghat Hijuli forest, Andhra Pradesh; Araku, 918m, Orissa; Taptapani.	GDC
74	<i>Sarcophaga (Liosarcophaga) saputaraensis</i> Nandi, 1992	Gujrat (Saputara, 875m).	7
75	<i>Sarcophaga (Liosarcophaga) sarupi</i> Nandi, 1979	Uttar Pradesh; Nainital, 1230m, Uttar Pradesh; Kaushani, 1890m, Mizoram; Champhai, P.W.D. Campus, 1600m, Champhai Assam rifle area, 1615m and Meghalaya (Barapani).	GDC, 21, 7
76	<i>Sarcophaga (Liosarcophaga) scopariiformis</i> Senior-White, 1927	Assam (Dibrugarh, Nowgong), Karnataka (Chikmagalore), Kerala (Walayar forest), Manipur (Imphal), Mizoram (Aizwal), Nagaland (Dimapur), Tripura (Kanchanpur, Matabari), Tamil Nadu (Tranquebar) and West Bengal (Diamond harbour, Gour, Rudranagar, Sankrail).	GDC, NZC, 21
Sub genus		Pandelleisca Rohdendorf, 1937	
77	<i>Sarcophaga (Pandelleisca) assamensis</i> Nandi & Ray, 1982	Assam; Jorhat, Manipur; D.M.College campus.	GDC, 21, 7
78	<i>Sarcophaga (Pandelleisca) bainbriggei</i> (Senior-White, 1925)	Assam (Silchar), Bihar (Deoghar, Pusa), Himachal Pradesh (Solan), Kerala (Kurumbagram), Orissa (Balugaon, Nandankanan, Taptapani), Tripura (Trishna), Tamil Nadu (Coimbatore, Chennai, Tranquebar) and West Bengal (Baharampur, Bishnupur, Calcutta, Gour Suri)	9
79	<i>Sarcophaga (Pandelleisca) ballardi</i> (Senior-White, 1924)	Tamil Nadu; Coimbatore, Karnataka; Mysore zoo, 757m, Maharashtra; Daulatabad, 340 m.	NZC, 7, 9
80	<i>Sarcophaga (Pandelleisca) curvata</i> Nandi, 1989	Himachal Pradesh; Manali, 1,926m, Harayana.	7
81	<i>Sarcophaga (Pandelleisca) taka</i> Pape, 1996	Karnataka, Maharashtra.	7
Sub genus		Parasarcophaga Johnston & Tiegs, 1921	
82	<i>Sarcophaga (Parasarcophaga) albiceps</i> (Meigen, 1826)	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Delhi, Goa, Gujrat, Harayana, Himachal Pradesh; Kullu; 6,000ft, Mizoram, Nagaland, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Andaman and Nicobar, Delhi, Karnataka, Kerala, Madhya Pradesh, Manipur, Maharashtra, Orissa, Panjab, Chandighar, Daman Diu, Pondicherry.	GDC, NZC, 21, 9
83	<i>Sarcophaga (Parasarcophaga) hirtipes</i> (Wiedemann, 1830)	Andhra Pradesh, Bihar, Delhi, Gujrat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Andaman isl.	GDC, NZC, 21, 9
84	<i>Sarcophaga (Parasarcophaga) macroauriculata</i> (Ho, 1932)	Manipur (Churachandpur, Imphal, Mao), Meghalaya (Cherapunji), Nagaland (Dimapur), Sikkim (Dentam, Gangtok, Kabi, Chulung, Phensang, Swistik camp), Uttar Pradesh (Kaushani) and West Bengal (Darjeeling).	GDC, 21
85	<i>Sarcophaga (Parasarcophaga) misera</i> (Walker, 1849)	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Delhi, Goa, Gujrat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.	GDC, NZC, 21, 9
86	<i>Sarcophaga (Parasarcophaga) taenionota</i> Wiedemann, 1819	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar; Banhar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.	GDC, NZC, 21, 9
Sub genus		Phallosphaera Rohdendorf, 1938	
87	<i>Sarcophaga (Phallosphaera) gravelyi</i> (Senior-	Tamil Nadu; Nilgiri hills. (Kallar), Andhra Pradesh (Godavari	NZC, 7, 9

	White, 1924)	dist.).	
	Sub genus	Pierretia Robineau-Desvoidy, 1863	
88	<i>Sarcophaga (Pierretia) wyatti</i> Nandi, 1994	Jammu and Kashmir (Dal Lake).	7
	Sub genus	Prionophalla Rohdendorf, 1963	
89	<i>Sarcophaga (Prionophalla) peregrina</i> (Robineau-Desvoidy, 1830)	Assam, Bihar, Himachal Pradesh, Kerala, Maharashtra, Madhya Pradesh, Manipur, Mizoram, Nagaland, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Andaman and Nicobar Isl. Dadra and Nagar Haveli and Pondicherry.	GDC, 21, 9
	Sub genus	Pseudothyrsocnema Rohdendorf, 1937	
90	<i>Sarcophaga (Pseudothyrsocnema) caudagalli</i> Bottcher, 1912	Nilgiris, Kotagiri; Jeypore hills, Ambadola	9
91	<i>Sarcophaga (Pseudothyrsocnema) indica</i> (Shinonaga & Lopes, 1975)	West Bengal (Midnapore: Arabari forest).	7
92	<i>Sarcophaga (Pseudothyrsocnema) nicobarensis</i> (Nandi, 1989)	Nicobar isl (Car Nicobar; Agricultural farm area), Tripura (Jamerdhapa).	7
93	<i>Sarcophaga (Pseudothyrsocnema) longistylata</i> (Shinonaga & Lopes, 1975)	West Bengal (Daimond Harbour, Midnapore: Digha, Arabari forest, Calcutta,),Kerala (Palghat; 82m, Cinchona, Karikal) and Bihar (Netarhat; 1250m, Chapra, Chota Nagpur, Pusa).	NZC, 7
	Sub genus	Robineauella Enderlein, 1928	
94	<i>Sarcophaga (Robineauella) coei</i> (Rohdendorf, 1966)	Andhra Pradesh, Arunachal Pradesh, Madhya Pradesh, Manipur, Mizoram, Nagaland, Sikkim, West Bengal.	GDC, 21, 7
95	<i>Sarcophaga (Robineauella) djakonovi</i> (Rohdendorf, 1937)	Kashmir (Gulmarg, 2,600-3,000m).	13
96	<i>Sarcophaga (Robineauella) javana</i> Macquart, 1851	Arunachal Pradesh, Nagaland, Mizoram.	GDC, 21
97	<i>Sarcophaga (Robineauella) walayari</i> (Senior-White, 1924)	Bihar (Chota nagpur, Pasoita hills), Karnataka (Nandi hills; 1,330m), Kerala (Karikal, Palghat, Walayar forest).	NZC, 9, 7
	Sub genus	Rosellea Rohdendorf, 1937	
98	<i>Sarcophaga (Rosellea) khasiensis</i> (Senior-White, 1924)	J&K (Kashmir), Manipur (Churachandpur, Imphal, Mao), Meghalaya (Cherrapunji, Singimari), Nagaland (Kohima) and Sikkim (Gangtok, Kabi, Chulung, Swistik Camp).	GDC, NZC, 21, 9, 7
	Sub genus	Sarcorohdendorfia Baranov, 1938	
99	<i>Sarcophaga (Sarcorohdendorfia) antilope</i> Bottcher, 1913	Assam; Margherita and Sadiya.	NZC, 9
100	<i>Sarcophaga (Sarcorohdendorfia) froggatti</i> Taylor, 1917	Assam.	20
101	<i>Sarcophaga (Sarcorohdendorfia) inextricata</i> Walker, 1859	Andaman isl.(Margherita, Sadiya).	13
102	<i>Sarcophaga (Sarcorohdendorfia) mysorensis</i> Nandi, 1988	Karnataka; Mysore, 10 miles North of Belur, 1025m, Tripura; Melaghar.	13
103	<i>Sarcophaga (Sarcorohdendorfia) pusana</i> Senior-White, 1924	West Bengal; Ranaghat; Hijuli forest, Calcutta zoo. Garden, Bihar; Rajgir; Joy Prakash Narayan Park, Nagaland; Kohima war cemetery campus, 1,490m.	GDC, NZC, 21, 7, 9
104	<i>Sarcophaga (Sarcorohdendorfia) seniorwhitei</i> Ho, 1938	Arunachal Pradesh.	21, 7
	Sub genus	Sarcosolomonina Baranov, 1938	
105	<i>Sarcophaga (Sarcosolomonina) arabari</i> Pape, 1996	West Bengal (Midnapore: Arabari forest).	7
106	<i>Sarcophaga (Sarcosolomonina) andamanensis</i> Nandi, 1989	Karnataka (Kaimara) and Andaman (Mini zoo, Netaji Nagar, Ramkrishnapur, Sabani Plantation area, Siphighat, Vivekanadapur).	7
107	<i>Sarcophaga (Sarcosolomonina) chambaensis</i> Nandi, 1989	Himachal Pradesh; Chamba.	7
108	<i>Sarcophaga (Sarcosolomonina) crinita</i> Parker, 1917	West Bengal (Kolkata, Baruipur), Bihar; Pusa, Chapra, Chota Nagpur and Tamil Nadu; Kodaikanal, Kazanthum.	NZC
109	<i>Sarcophaga (Sarcosolomonina) kaushanensis</i> Nandi, 1990	Uttar Pradesh; Kaushani.	7
110	<i>Sarcophaga (Sarcosolomonina) rohdendorfia</i> Pape, 1996	Arunachal Pradesh; Araku, Orissa; Taptapani, West Bengal; Ranaghat Hijuli forest.	7, 13
111	<i>Sarcophaga (Sarcosolomonina) susainathani</i> Pape, 1996	Tamil Nadu; Anamalai Hills (Cinchona).	NZC, 7
	Sub genus	Seniorwhitea Rohdendorf, 1937	
112	<i>Sarcophaga (Seniorwhitea) mantiae</i> Nandi, 2002	West Bengal; Chilapata forest.	6, 7
113	<i>Sarcophaga (Seniorwhitea) princeps</i> Wiedemann, 1830	Arunachal Pradesh, Andhra Pradesh, Assam; several localities, Bihar; Chapra, Gujrat, Harayana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra; Mumbai, Manipur, Mizoram, Nagaland, Orissa; Barkuda isl., Pondicherry, Sikkim, Tamil Nadu; several localities, Tripura, Uttar Pradesh; Dera dun, West Bengal and Andaman.	GDC, NZC, 21, 6, 7, 9
	Sub genus	Sinonipponia Rohdendorf, 1965	
114	<i>Sarcophaga (Sinonipponia) bengalensis</i> (Nandi, 1977)	West Bengal; Midnapore Arabari Forest, Bankura; Bhatpur, Birbhum; Charicha Forest, Birbhum; Suri D.F.O	6, 7

		Campus, Gujrat (Dwarka, Gir Santuary, Sasangir),Maharashtra (Aurangabad, Nagpur).	
115	<i>Sarcophaga (Sinonipponia) hainanensis</i> Ho,1936	Indian	13
116	<i>Sarcophaga (Sinonipponia) smarti</i> Nandi,1991	Tripura; Sipahjala, Paratia forest.	6, 7
Sub genus		Stackelbergeola Rohdendorf, 1937	
117	<i>Sarcophaga (Stackelbergeola) papei</i> Nandi, 1994	West Bengal.	6, 7
Sub genus		Tricholioproctia Baranov, 1938	
118	<i>Sarcophaga (Tricholioproctia) desaii</i> Nandi, 1978	Manipur; Ukhrul circuit house, 2, 000m.	6
119	<i>Sarcophaga (Tricholioproctia) ghaiiae</i> Nandi, 1979	Mizorm; Kolasib, 800m.	GDC, 21, 6, 7
Sub genus		Thyrsocnema Enderlein, 1928	
120	<i>Sarcophaga (Thyrsocnema) dasguptai</i> Nandi, 1979	Rajasthan; Bharatpur Bird santuary.	6, 7, 13
121	<i>Sarcophaga (Thyrsocnema) kentejana</i> Rohdendorf, 1937	Jammu and Kashmir (Tangmarg), Punjab (Saiful-Muluk lake, Naltar).	13
122	<i>Sarcophaga (Thyrsocnema) lushainensis</i> Nandi,1992	Mizoram; Champai Zote village, 1, 500m, Manipur (Chrachandpur).	GDC
Sub genus		<i>Heteronychia</i> Brauer & Bergenstamm 1889	
123	<i>Sarcophaga (Heteronychia) filia</i> Rondani,1860	Indian.	GDC
124	<i>Sarcophaga (Heteronychia) smithiana</i> Pape, 1996	Bihar; Nalakha.	GDC
Unplaced Genus		Microcerella Macquart 1851	
125	<i>Microcerella cinerea</i> Lopes, 1982	Indian.	GDC
Unplaced Genus		Spirobolomyia Townsend 1917	
126	<i>Spirobolomyia basalis</i> (Walker, 1853)	N.E. frontier provience, Sadiya, Chota Nagpur, Sarandah forest.	9

3.1 Agglomerative Hiearchial Cluster (AHC) analysis

The AHC is done as per the taxonomic criteria of the length difference of 5th sternite are give below (Fig.2).

3.2 Statistical analysis

The data from the checklist were run through basic statistical analysis [1] to see comparative differences between Indian Sarcophagidae and rest of the world. In India we presently

have a total of 126 species, which accounts for 4% of total species present in the world. Out of which 69 species is exclusively Indian, this accounts for 54.75% of the total species that are indigenous to India. In India we presently have a total of 18 genus. This accounts for 14% of the total genera present in the world (Fig.1).

Fig.1) Number of genus and species in world and India in number and %

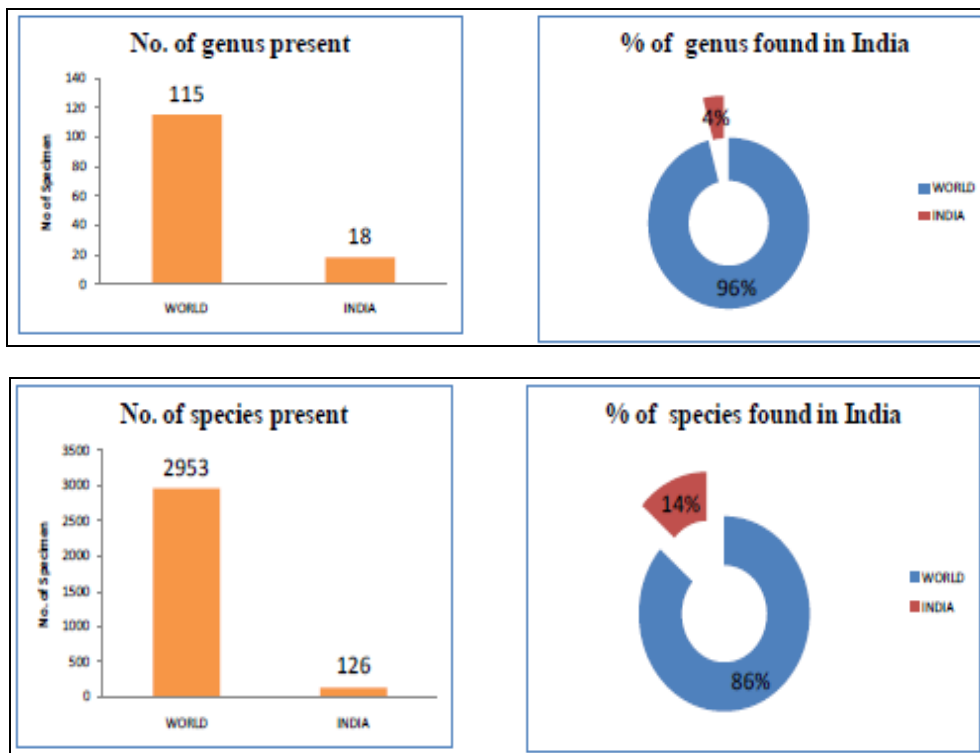


Fig 2: Shows the dendrogram for the family Sarcophagidae based on Wards method and Numerical taxonomy.

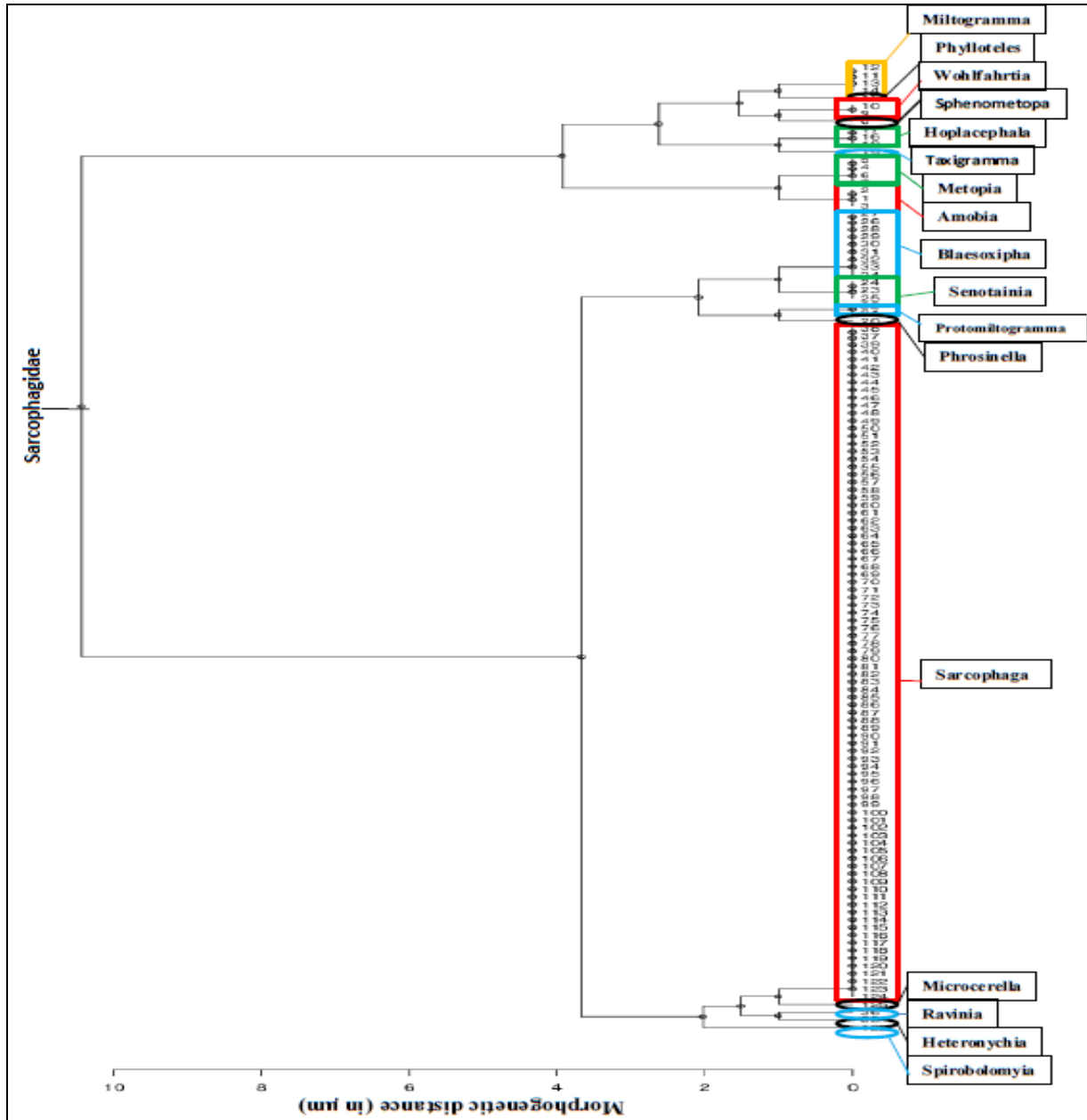
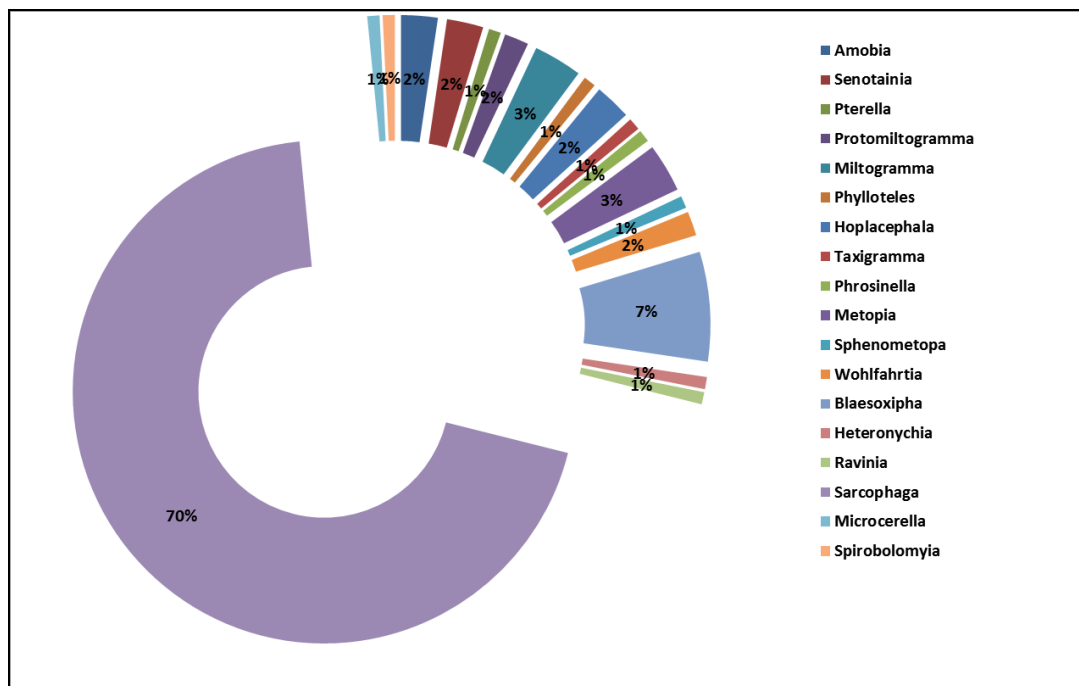
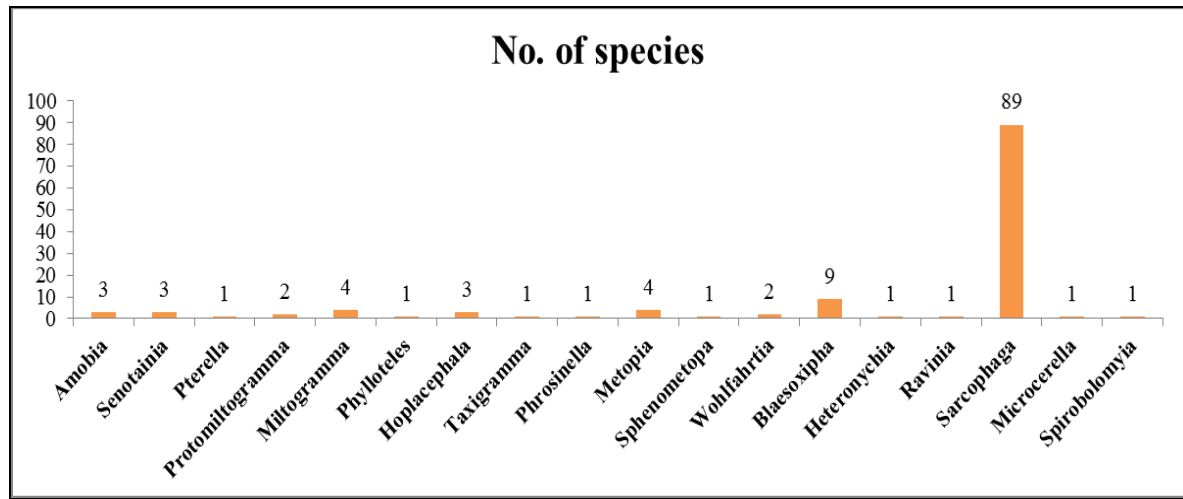


Fig 3: Number of species in % and number





4. Conclusion

The Indian family of Sarcophagidae consists of 126 species, out of which 89 species are from the genus *Sarcophaga* which amounts for 70% of the Indian Sarcophagidae family. The genus *Blaesoxipha* consist of 9 species which amounts for 7% of the Indian Sarcophagidae family. The genus *Metopia* and *Miltogramma* consist of 4 species each which amounts for 2% each of the Indian Sarcophagidae family. The genus *Amobia*, *Senotainia* and *Hoplacephala* consist of 3 species each which amounts for 2% each of the Indian Sarcophagidae family. *Protomiltogramma* and *Wohlfahrtia* consist of 2 species each which amounts for 2% each of the Indian Sarcophagidae family; *Pterella*, *Phylloteles*, *Taxigramma*, *Phrosinella*, *Sphenometopa*, *Heteronychia*, *Ravinia*, *Microcerella* consist for only 1% of the Indian Sarcophagidae family. Out of this 126 species found in India almost 55% are not found in anywhere else in the world and are indigenous to India.

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