Sarcophaga
(insect: dipteran)

Overview

Arthropods are coelomate metameric invertebrate animals with a chitinous exoskeleton and jointed limbs. They undergo protostomial embryonic development and grow by cuticular moulting (ecdysis). Three main subphyla are recognized: Chelicerata, Crustacea and Hexapoda. Insects are hexapods with three pairs of uniramous legs, three tagmata (head, thorax, abdomen), ectognathous mouthparts with whole-limb mandibles, and one pair of antennae. Diptera (true flies) have two pairs of wings, but the hindwings are reduced to stabilizing halteres. All species are holometabolans and exhibit complete metamorphosis whereby vermiform larval stages undergo pupation and transform into free-flying adults. Several major parasitic groups are recognized: nematocerans (small slender bodies, long filamentous antennae, narrow wings) and brachycerans (larger bodies, short stout antennae, broad wings); the latter being divided into the Tabanomorpha (larval head capsule sclerotized) and the Muscomorpha (larval head not sclerotized, circular-seamed (cyclorrhaphous) pupae). Muscomorphans include the glossinids (tsetse flies), hippoboscids (louse flies), muscids (house flies), calliphorids (blow flies), sarcophagids (flesh flies) and oestrids (bot flies); all with sponging or biting mouthparts. These flies are either ectoparasitic with adults biting hosts (former three groups) or endoparasitic with vermiform larvae developing in host tissues (latter three groups). Sarcophagids (flesh flies) have large checkered bodies but are not parasitic as adults. Most species are larviparous and normally breed in carrion, but the female will deposit larvae on invertebrate and vertebrate hosts to become facultative parasites. Larvae of *Sarcophaga* spp. cause furuncular myiases in domestic animals and humans.

Classification:

Domain:	Eukaryota (membrane-bound nucleus)
Supergroup:	Amorphea (unikonts with single flagellum, or nonflagellated amoebae)
Kingdom:	Metazoa (multicellular eukaryotes, heterotrophs, notably animals)
Group:	Protostomia (triploblastic, spiral cleavage)
Subgroup:	Ecdysozoa (cuticle moulted = ecdysis)
Phylum:	Arthropoda (chitinous exoskeleton, segmented body, jointed limbs, haemocoel)
Subphylum:	Hexapoda (three tagmata, three pairs uniramous legs, whole-limb mandibles, Malpighian tubules)
Class:	Insecta (ectognathous mouthparts (bases lie outside head capsule), single pair antennae, many with wings)
Superorder:	Holometabola (Endopterygota) (young do not resemble adults, pupae, with internally developing wings)
Order:	Diptera (true flies, single pair of forewings, hindwings modified into halteres, vermiform larvae)
Suborder:	Brachycera (tabanid/March flies, short stout antennae often with aristae, telmophagy)
Infraorder:	Muscomorpha (Cyclorrhapha) (flies, cyclorrhaphous (circular-seamed) pupae, larval head not sclerotized)
Division:	Schizophora (head with frontal suture (lunule))
Section:	Calyptratae (calypters cover halteres)
Family:	Sarcophagidae (flesh flies, not metallic, breed in excrement/carrion/decomposing organic matter)
Genus:	*Sarcophaga* (parasitic on skin/subcutaneous tissues of mammals)
Species:	various species cause furuncular myiases

Parasite biodiversity and host range: Most Metazoa are multicellular triploblastic animals with differentiated tissues, many being bilaterally symmetrical with a body cavity. Most invertebrate animals are protostomes as their embryonic development involves spiral determinate cleavage. Those that moult their external cuticles during their life-cycles (process known as ecdysis) are grouped together in the unique clade Ecdysozoa, including the nematodes (roundworms), onychophorans (velvet worms), tardigrades (water bears) and arthropods (myriapods, chelicerates, crustaceans and hexapods). Arthropods have small segmented bodies encased in chitinous exoskeletons with articulated limbs. Most species are free-living in terrestrial and aquatic habitats, although a small range are ectoparasitic on other animals, some feeding on the blood or skin of vertebrates. Five subphyla are recognized: Chelicerata, Crustacea, Hexapoda, Myriapoda and Trilobita. Insects are hexapods with six legs, three distinct body parts, two antennae and mouthparts with whole-limb mandibles. Insects are the most biodiverse group on the planet, with millions of species described in numerous taxa. Notorious ectoparasitic species belong to four orders in two superorders: the Hemipterodea (Exopterygota) containing the orders Hemiptera (bugs) and Phthiraptera (lice); and the Holometabola (Endopterygota) containing the orders Siphonaptera (fleas) and Diptera ('true' flies). Flies are small winged holometabolans that undergo complete (holometabolous) metamorphosis with vermiform larvae undergoing pupation in silk cocoons. Thousands of dipteran species have been described throughout the world, most being free-living saprophages (detritivores) but some being parasitic either as adults biting and feeding on hosts (often haematophagous) or producing larvae that invade host tissues (condition known as myiasis). Two major suborders are recognized: the Nematocera (with small bodies, long filamentous antennae, narrow wings and aquatic larvae and pupae); and the Brachycera (with large bodies, short stout antennae often with aristae and broad wings).

Major parasitic dipteran families	Biodiversity	Parasitic stages	Status	Pathogenesis*	Disease transmission
Suborder: Nematocera (small midges/mosquitoes, thread-horned with long filamentous segmented antennae (= nemato-cera), aquatic life-cycles (larval/pupal stages associated with water), female adults require blood meal before they can lay eggs) (34 families)					
Culicidae (mosquitoes)	3 subfamilies, 70 genera, 3,500 species	adult ♀	obligate	blood-sucking	viral, protozoal, helminth
Psychodidae (moth flies, sand flies)	5 subfamilies, 150 genera, 3,000 species	adult ♀	obligate	blood-feeding	viral, bacterial, protozoal
Simuliidae (black flies)	3 subfamilies, 30 genera, 2,000 species	adult ♀	obligate	blood-feeding	protozoal, helminth
Ceratopogonidae (biting midges)	4 subfamilies, 110 genera, 6,000 species	adult ♀	obligate	blood-feeding	viral, protozoal, helminth
Suborder: Brachycera (large tabanid/March flies, with stout and fewer antennal segments (= brachy-cera), antennae often with aristae, females with slashing-sponging mouthparts to pierce skin and feed on pool of blood (telmophagy)) (120 families)					
Infraorder: Tabanomorpha (larval head capsule incomplete posteriorly (only anterior parts sclerotized))					
Tabanidae (horse flies, deer flies)	3-5 subfamilies, 133 genera, 4,300 species	adult ♀ [+ larvae]	obligate [accidental]	blood-feeding [GI, UG, TR myiasis]	viral, bacterial, protozoal, helminth
Infraorder: Muscomorpha (Cyclorrhapha) (aristate antennae, setose bodies, cyclorrhaphous pupa)					
Section: Calyptratae (calypters cover halteres)					
Superfamily: Muscoidea (synanthropic flies)					
Muscidae (house flies, stable flies)	9-10 subfamilies, 190 genera, 4,200 species	adult ♀, ♂ [+ larvae]	obligate [accidental]	biting, blood-feeding [CU, GI, TR myiasis]	bacterial, helminth
Superfamily: Oestroidea (cause larval myiases) (6 families)					
Calliphoridae (blow flies)	11 subfamilies, 75 genera, 1,100 species	larvae	facultative, obligate	CU, GI, NP, AU, UG TR, myiasis	-
Sarcophagidae (flesh flies)	3 subfamilies, 108 genera, 2,500 species	larvae	facultative, obligate	TR, GI, CU myiasis	-
Oestridae (bot flies, warble flies)	5 subfamilies, 25 genera, 150 species	larvae	obligate	CU, GI, NP, OC myiasis	-
Superfamily: Hippoboscoidea (pupa-bearers)					
Glossinidae (tsetse flies)	1 genus, 3 species-groups, 25 species	adult ♀, ♂	obligate	blood	protozoal
Hippoboscidae (louse flies, keds)	1-3 subfamilies, 21 genera, 212 species	adult ♀, ♂	obligate	blood	viral, protozoal, helminth

*type of myiasis: AU = auricular; CU = cutaneous; GI = gastro-intestinal; NP = naso-pharyngeal; OC = ocular; TR = traumatic; UG = uro-genital.

The suborder Brachycera contains 6 infraorders: Asilomorpha (bee flies, robber flies, spider flies), Muscomorpha (previously suborder Cyclorrhapha) (house flies, blow flies, fruit flies), Stratiomyomorpha (soldier flies), Tabanomorpha (horse, deer and snipe flies), Vermileonomorpha (wormlions) and Xylophagomorpha (awl flies); all of which vary considerably in their morphological and biological characteristics. Members of the infraorder Muscomorpha differ from the others in that they form cyclorrhaphous (circular-seamed) pupae (adults eclose through a circular cap rather than a longitudinal slit), larvae without sclerotized heads, and adults with short pendulous 3-segmented antennae (the third segment often bearing feather-like aristae), palps with a single segment, and feet with 2 pads. Collectively, 15 superfamilies have been classified into 2 Divisions: the Schizophora (containing flies whose heads bear a frontal ptilinial suture and sclerotized lunule); and the Aschiza (hover flies lacking a frontal suture and lunule). Within the Schizophora, 2 sections are recognized: the Calypterae (comprising flies with calypters covering the halteres, large squamae, a strong thoracic suture and well-defined grooves on the antennal pedicels); and the Acalypterae (without

covering calypters, small squamae, a weak thoracic suture and no pedicel grooves). Calyptratae flies are divided into 3 superfamilies: Muscoidea (synanthropic flies with well-developed sponging mouthparts for feeding on decaying organic material or biting mouthparts for blood-feeding, most females being oviparous (egg-layers)); Hippoboscoidea (louse flies and tsetse flies with elongate biting mouthparts for blood-feeding, female flies formerly regarded as pupa-bearers and placed in group Pupipara (now defunct) as they have since been shown to birth mature larvae (considered to be prepupae)); and Oestroidea (blow flies, bot flies and flesh flies whose larvae are endoparasitic and cause myiases). Several superfamilies contain species whose larvae feed on the flesh of vertebrate hosts, mostly when dead (carrion) but sometimes when still living (causing fly-strike). Oestroid and muscoid larvae are well-adapted for living in moist organic substrates ranging from wet faeces to carrion to living flesh.

The superfamily Oestroidea is characterized by large flies that are not dorsoventrally flattened, their wing veins are not crowded, and the discal medial cell of the wings widens gradually. The superfamily contains 7 families: Calliphoridae (blow flies); Oestridae (bot flies); Polleniidae (cluster flies); Rhinophoridae (woodlouse flies); Sarcophagidae (flesh flies); Tachinidae (parasitic flies); and Ulurumyiidae (McAlpine's fly). The family Sarcophagidae contains over 2,500 species whose adults are not metallic in colour (like the blow flies) and whose larvae feed on decomposing organic matter (including excrement and carrion) and sometimes the dermal tissues of living vertebrates. Flesh flies have well-developed mouthparts, dull grey bodies with strong bristles and 3 black stripes on the scutum and spots on the abdomen. Around 108 genera have been described and classified into 3 subfamilies: Miltogramminae (parasitoids of arthropods), Paramacronychiinae (including *Wohlfahrtia*), and Sarcophaginae (including *Sarcophaga*).

Family	Genera	Hosts	Strike	Myiasis*
Sarcophagidae	*Sarcophaga*	mammals	secondary, primary	Facultative or accidental (AU, CU, GI, TR)
	Wohlfahrtia	mammals, birds	primary	Obligate, facultative (CU, TR)

*type of myiasis: AU = auricular; CU = cutaneous; GI = gastro-intestinal; TR = traumatic.

The genus *Sarcophaga* (syn. *Bulbostyla, Caledonicesa, Devriesia, Erichsonia, Heteronychia, Lehrera, Listeria, Pierretia*) contains well over 1,000 species classified into 157 subgenera (although some subgenera may subsequently prove to be distinct genera). Most species form adults with conspicuous red compound eyes that exhibit sexual dimorphism (eyes set further apart in females than in males). The larvae typically feed on decaying meat (including bacteria and other small organisms living on carrion), although some breed in dung and others are parasitoids of caterpillars (including pest species in forests and orchards). Although most *Sarcophaga* spp. are entirely free living, the larvae of several species have been found as facultative parasites of domestic animals and humans, causing temporary myiases, e.g. *S. haemorrhoidalis* is a typical carrion fly but its larvae may infest living animals.

***Sarcophaga* species (regional exemplars)**	Hosts	Location	Clinical signs (vectorial capacity)	Distribution
S. africa (syn. *S. geogina, nurus, Mesothryia madagascarensis*)	mammals (humans, livestock, carrion), gastropods (snails)	skin	facultative myiasis	worldwide
S. aldrichi (friendly fly, large flesh fly)	insects (forest tent caterpillars)	flesh	parasitoid	North America
S. bullata (grey flesh fly)	mammals (carrion)	flesh	necrophagous [forensic applications]	Nearctic
S. carnaria (syn. *S. variegata*) (cryptic worm flesh fly)	mammals (carrion, dung), gastropods (snails), annelids (earthworms)	flesh	necrophagous, parasitoid	Europe
S. crassipalpis	mammals (livestock)	skin wounds	facultative myiasis [laboratory applications]	worldwide
S. haemorrhoidalis (syn. *Bercaea cruentata*) (red-tailed flesh fly)	mammals (humans, livestock, wildlife)	skin, gut, rectum, nasal passages, ears	facultative myiases [forensic applications] (enteric bacteria, tapeworms, polio)	worldwide
S. subvicina (lesser worm flesh fly)	mammals (livestock, carrion)	flesh	facultative myiasis	Palearctic

Species list (compilation of several on-line data-bases)

***Sarcopohaga* species**	**Subgenus**
S. abramovi	*Heteronychia*
S. absurda	*Uroxanthisca*
S. acrophila	*Bercaeopsis*
S. adhamae	*Liosarcophaga*
S. adriatica	*Sarcophaga*
S. adusta	*Afrothyrsocnema*
S. adzharica	*Liosarcophaga*
S. aegyptica	*Liosarcophaga*
S. aenigma	*Aethiopisca*
S. aenigmoides	Unassigned
S. afra	*Aethiopisca*
S. africa	*Bercaea*
S. agnata	*Helicophagella*
S. agrestis	Unassigned
S. aheria	*Xanthopterisca*
S. airosalis	*Bulbostyla*
S. alba	*Leucomyia*
S. albiceps	*Parasarcophaga*
S. alcicornis	*Lioproctia*
S. aldabrae	*Afrothyrsocnema*
S. aldrichi	*Varirosellea*
S. alina	*Beziella*
S. allisoni	*Liosarcophaga*
S. alpha	*Sarcorohdendorfia*
S. alpina	*Sarcophaga*
S. altitudinis	*Helicophagella*
S. ambon	*Lioproctia*
S. amica	*Phallosphaera*
S. amicoides	*Phallosphaera*
S. amita	*Heteronychia*
S. amplicercus	*Liosarcophaga*
S. anaces	*Krameromyia*
S. anastrenua	*Heteronychia*
S. anatolica	*Heteronychia*
S. anchoriformis	*Robineauella*
S. ancilla	*Heteronychia*
S. ancilloides	*Heteronychia*
S. andaluciana	*Pandelleana*
S. andamanensis	*Sarcosolomonia*
S. angarosinica	*Liosarcophaga*
S. angelicae	*Heteronychia*
S. aniyai	*Sinonipponia*
S. annandalei	*Lioproctia*
S. antilope	*Sarcorohdendorfia*
S. apsuarum	*Sarcophaga*
S. aquila	Unassigned
S. arabari	*Sarcosolomonia*
S. arachnivora	*Baranovisca*
S. aratrix	*Rosellea*
S. arcipes	*Heteronychia*
S. argyrostoma	*Liopygia*
S. arizonica	Unassigned
S. armenica	*Heteronychia*
S. arnaudiella	*Kanoa*
S. arno	*Bercaea*
S. asahinai	*Myorhina*
S. assamensis	*Pandelleisca*
S. assimilis	*Sarcorohdendorfia*
S. atavina	*Heteronychia*
S. aureicrania	*Torgopampa*
S. aureifacies	*Sarcorohdendorfia*
S. aureolata	*Lioproctia*
S. aurescens	*Lioproctia*
S. auricauda	*Liosarcophaga*
S. auriecrania	*Torgopampa*
S. aurifrons	*Taylorimyia*
S. aurora	*Johnsonimima*
S. austenii	*Salemmyia*
S. australis	*Asceloctella*
S. bachmayeri	*Sarcophaga*
S. bainbriggei	*Pandelleisca*
S. bajkalensis	*Heteronychia*
S. balanina	*Heteronychia*
S. ballardi	*Pandelleisca*
S. bancroftorum	Unassigned
S. bangkokensis	*Kanomyia*
S. banksi	*Baranovisca*
S. baoxingensis	*Bellieriomima*
S. baranoffi	*Sarcophaga*
S. baranovi	*Sarcosolomonia*
S. barioensis	*Phallosphaera*
S. barracloughiana	*Nyikamyia*
S. baruai	Unassigned
S. basiseta	*Lioproctia*
S. basuto	*Cyclophalla*
S. batangomyia	*Philiphaga*
S. batissa	*Curranea*
S. batissoides	*Beziella*
S. baudeti	*Pandelleisca*
S. beameri	*Bercaeopsis*
S. bechuanae	*Liopygia*
S. beckiana	*Rosellea*
S. beeri	*Wohlfahrtiopsis*
S. beesoni	*Lioproctia*
S. belanovskyi	*Heteronychia*
S. belgiana	*Thyrsocnema*
S. bellae	*Boettcheriola*
S. bellowi	*Hyperacanthisca*
S. benaci	*Heteronychia*
S. benefactor	*Uroxanthisca*
S. bengalensis	*Boettcherisca*
S. beninella	Unassigned
S. benshiensis	*Pierretia*
S. berberina	Unassigned
S. bergi	*Sarcophaga*
S. beta	*Sarcorohdendorfia*
S. bezziana	*Heteronychia*
S. bezzii	*Johnstonimyia*
S. bicolor	*Bercaeopsis*
S. bidentata	*Sarcorohdendorfia*
S. bifrons	*Sarcorohdendorfia*
S. bihami	*Bellieriomima*
S. birganjensis	Unassigned

S. bishoppi	*Wohlfahrtiopsis*
S. bivittata	*Johnsonimima*
S. bodenheimeri	*Yerohama*
S. boettcheri	*Heteronychia*
S. booersiana	*Afrosarcophaga*
S. borneensis	*Pseudothyrsocnema*
S. borodorf	Unassigned
S. brachiata	Unassigned
S. braueri	*Sarcorohdendorfia*
S. braunsi	*Prionophalla*
S. brevicornis	*Liosarcophaga*
S. brevigaster	Unassigned
S. budapestana	*Heteronychia*
S. bulamatadi	*Uroxanthisca*
S. bulgarica	*Heteronychia*
S. bullata	*Neobellieria*
S. burungae	*Bercaea*
S. bushmenia	*Liosarcophaga*
S. buxtoni	*Sarcosolomonia*
S. cabrerai	*Boettcherisca*
S. cadyi	*Bulbostyla*
S. caerulescens	*Robineauella*
S. caledonia	Unassigned
S. calicifera	*Uroxanthisca*
S. canadensis	*Neosarcophaga*
S. cantrelli	*Baranovisca*
S. caraormana	*Pandelleola*
S. carinata	*Bercaeopsis*
S. carnaria	*Sarcophaga*
S. carolinensis	*Sarcosolomonia*
S. castellana	*Afrothyrsocnema*
S. catharosa	Unassigned
S. caudagalli	*Pseudothyrsocnema*
S. cavagnaroi	*Tolucamyia*
S. cavangarei	*Kozlovea*
S. cepelaki	*Heteronychia*
S. cetu	*Kozlovea*
S. chaetoneura	Unassigned
S. chalcura	*Sarcosolomonia*
S. chambaensis	*Sarcosolomonia*
S. chapini	*Heteronychia*
S. cheesmanae	*Sinonipponia*
S. choudhuryi	*Liosarcophaga*
S. choudhuryi	Unassigned
S. chrysotelus	Unassigned
S. cineria	Unassigned
S. circa	*Sarcosolomonia*
S. cirrhura	*Sarcorohdendorfia*
S. citellivora	*Neobellieria*
S. clarahenae	*Heteronychia*
S. claripalpis	Unassigned
S. claviger	Unassigned
S. clavus	*Sarcorohdendorfia*
S. cockerellae	*Mehria*
S. coei	*Robineauella*
S. cognata	*Liosarcophaga*
S. collessi	*Sarcosolomonia*
S. concreata	*Sinonipponia*
S. condona	*Xanthopterisca*
S. confusa	*Sarcosolomonia*

S. congesta	*Sarcophaga*
S. consanguinea	*Heteronychia*
S. conwayae	Unassigned
S. cooleyi	*Neobellieria*
S. corsicana	*Thyrsocnema*
S. crassimargo	*Helicophagella*
S. crassipalpis	*Liopygia*
S. crinita	*Sarcosolomonia*
S. crinitula	*Pseudothyrsocnema*
S. crispina	*Lipoptilocnema*
S. crispula	*Lipoptilocnema*
S. croatica	*Sarcophaga*
S. croca	*Heteronychia*
S. cruenata	*Bercaea*
S. cuautla	*Bulbostyla*
S. cucullans	*Discachaeta*
S. cultellata	*Liopygia*
S. currani	*Aethiopisca*
S. curva	*Liopygia*
S. curvicercus	Unassigned
S. curvifemoralis	*Heteronychia*
S. cuthbertsoni	*Phallosarcophaga*
S. cygnocercus	*Cornexcisia*
S. cyrtophorae	Unassigned
S. czernyi	*Macabiella*
S. daciana	Unassigned
S. dahliana	*Phalacrodiscus*
S. dambriensis	Unassigned
S. danxomeia	Unassigned
S. darwiniana	*Sarcorohdendorfia*
S. dasguptai	*Thyrsocnema*
S. daurica	*Robineauella*
S. davidsonii	*Arachnidomyia*
S. decisa	Unassigned
S. delicata	*Spatulapica*
S. demeilloni	*Afrothyrsocnema*
S. depressifrons	*Heteronychia*
S. desaii	*Sarcorohdendorfia*
S. desertorum	*Heteronychia*
S. destructor	*Phytosarcophaga*
S. dewulfi	*Paraethiopisca*
S. dimidiatipes	*Poecilometopa*
S. diminuta	*Bellieriomima*
S. dingaani	*Liopygia*
S. dinuzului	*Beziella*
S. discifera	Unassigned
S. disneyi	Unassigned
S. disputata	*Sarcophaga*
S. dissimilis	*Heteronychia*
S. distincta	Unassigned
S. diurpaneia	Unassigned
S. djakonovi	*Robineauella*
S. dreyfusi	*Ahavanella*
S. dromafricana	*Xanthopterisca*
S. dukoicus	*Leucomyia*
S. dumoga	Unassigned
S. dux	*Liosarcophaga*
S. dysderci	*Uroxanthisca*
S. edwardsi	Unassigned
S. edwardsiana	*Aethianella*

S. ehrlichi	*Zombanella*
S. einsteiniella	*Pterolobomyia*
S. elanis	*Bercaeopsis*
S. elegantipes	*Xanthopterisca*
S. elhawagryi	Unassigned
S. elongata	*Neosarcophaga*
S. emdeni	*Liosarcophaga*
S. emeishanensis	*Pterosarcophaga*
S. emmrichi	*Embulinkisa*
S. emmrichiana	*Liosarcophaga*
S. emuensis	*Sarcorohdendorfia*
S. enderleini	*Heteronychia*
S. eos	*Beziella*
S. erecta	*Beziella*
S. erlangeri	*Transvaalomyia*
S. esthera	*Discachaeta*
S. eta	*Liosarcophaga*
S. etoshana	*Nesbittia*
S. evagorata	*Heteronychia*
S. evelynae	*Liosarcophaga*
S. evenhuisi	*Liosarcophaga*
S. exuberans	*Liosarcophaga*
S. fabea	*Sarcosolomonia*
S. fani	*Myorhina*
S. fanigalia	*Pseudothyrsocnema*
S. fattigi	*Bercaeopsis*
S. fattigina	*Bulbostyla*
S. fatua	*Johnstonimyia*
S. fedtshenkoi	*Stackelbergeola*
S. fenchihuensis	Unassigned
S. feralis	*Liosarcophaga*
S. fergusonina	*Sarcorohdendorfia*
S. fernandae	Unassigned
S. ferox	*Heteronychia*
S. filia	*Heteronychia*
S. filiola	*Heteronychia*
S. fimbricauda	*Liosarcophaga*
S. flagellifera	*Rohdendorfisca*
S. flavibarbis	*Liopygia*
S. flavibasis	*Poecilometopa*
S. flavifemorata	*Parasarcophaga*
S. flexuosa	*Hoa*
S. footei	*Bercaeopsis*
S. forceps	*Liosarcophaga*
S. formosensis	*Boettcherisca*
S. fortisa	*Bercaeopsis*
S. freedmani	*Beziella*
S. freidbergi	*Xanthopterisca*
S. freyi	*Prionophalla*
S. froggatti	*Sarcorohdendorfia*
S. fulvipes	Unassigned
S. furcadorsalis	*Uroxanthisca*
S. furcata	*Sarcorohdendorfia*
S. furcoides	*Uroxanthisca*
S. furutonensis	*Nudicerca*
S. fuscipennis	*Scotathyrsia*
S. futilis	*Iranihindia*
S. gabrielei	*Heteronychia*
S. gadiriana	*Xanthopterisca*
S. galileana	*Stackelbergeola*

S. gallica	*Heteronychia*
S. galmuda	*Boettcherella*
S. gambiensis	*Liosarcophaga*
S. ganselene	Unassigned
S. ganura	*Fijimyia*
S. garbo	*Liosarcophaga*
S. geari	*Heteronychia*
S. genuforceps	*Bellieriomima*
S. georgiana	*Wohlfahrtiopsis*
S. germaini	*Uroxanthisca*
S. gertrudae	*Aethiopisca*
S. ghaiae	*Sarcorohdendorfia*
S. giganta	*Heteronychia*
S. gigas	*Rosellea*
S. globicauda	*Afrothyrsocnema*
S. globovesica	*Bellieriomima*
S. gnu	*Afrothyrsocnema*
S. gomezbustilloi	*Leclercqiomyia*
S. goodhopeia	*Liosarcophaga*
S. gorodkovi	*Helicophagella*
S. gorokaensis	*Johnstonimyia*
S. graciliforceps	*Bellieriomima*
S. gracilior	Unassigned
S. gracilis	*Neosarcophaga*
S. graeca	*Heteronychia*
S. granulata	*Mimarhopocnemis*
S. gravelyi	*Phallosphaera*
S. grenieri	*Heteronychia*
S. gresiventris	*Pandelleisca*
S. gressitti	*Alisarcophaga*
S. grueti	*Stackelbergeola*
S. grunini	*Robineauella*
S. guezoia	Unassigned
S. guillarmodi	*Heteronychia*
S. guyanensis	*Mehria*
S. haemorrhoa	*Heteronychia*
S. haemorrhoides	*Heteronychia*
S. hai	*Sarcosolomonia*
S. hainanensis	*Sinonipponia*
S. hainanna	*Rosellea*
S. hakusana	*Takanoa*
S. hamoni	*Liosarcophaga*
S. harinasutai	*Sarcosolomonia*
S. harpax	*Liosarcophaga*
S. hautieri	Unassigned
S. helanshanensis	*Heteronychia*
S. helenae	*Heteronychia*
S. helicivora	*Bercaeopsis*
S. hellenica	*Heteronychia*
S. henania	*Asiopierretia*
S. hennigi	*Sarcophaga*
S. henryi	*Sarcorohdendorfia*
S. heptapotamica	*Heteronychia*
S. hera	*Liopygia*
S. hervebazini	*Sinonipponia*
S. hesterna	*Bercaeopsis*
S. highlandica	*Boettcherisca*
S. hinei	*Mehria*
S. hinglungensis	*Liosarcophaga*
S. hiromui	*Sarcorohdendorfia*

S. hirsuta	Unassigned
S. hirticrus	*Helicophagella*
S. hirtipes	*Parasarcophaga*
S. hokurikuensis	*Nihonea*
S. hollandia	*Sarcorohdendorfia*
S. hongheensis	*Sarcosolomonia*
S. horii	*Bellieriomima*
S. horti	*Sarcorohdendorfia*
S. hortobagyensis	*Helicophagella*
S. houghi	*Mehria*
S. howensis	*Sarcorohdendorfia*
S. hozawai	*Horiisca*
S. huangshanensis	*Robineauella*
S. hugoi	Unassigned
S. hui	*Pandelleisca*
S. hunti	*Liosarcophaga*
S. idmais	*Liosarcophaga*
S. idonea	*Bercaeopsis*
S. ikat	*Sarcorohdendorfia*
S. ikedai	*Sarcorohdendorfia*
S. imbecilla	*Pseudodiscachaeta*
S. imita	*Lioproctia*
S. imitatrix	*Sarcorohdendorfia*
S. immaculata	Unassigned
S. impatiens	*Sarcorohdendorfia*
S. inaequalis	*Bercaea*
S. incisilobata	*Thyrsocnema*
S. indica	*Pseudothyrsocnema*
S. inducta	*Uroxanthisca*
S. indusa	*Sarcorohdendorfia*
S. inextricata	*Sarcorohdendorfia*
S. ingwavumae	*Afrothyrsocnema*
S. inhacaensis	*Liosarcophaga*
S. inopinata	*Helicophagella*
S. insula	*Pandelleisca*
S. insularis	*Pandelleana*
S. invaria	*Boettcherisca*
S. inzi	*Liosarcophaga*
S. inzoides	*Liosarcophaga*
S. ironalis	*Bulbostyla*
S. irrequieta	*Sarcorohdendorfia*
S. ismailiana	*Liosarcophaga*
S. isorokui	Unassigned
S. israeliana	*Golania*
S. iulicida	*Pierretia*
S. iwuensis	*Pandelleisca*
S. jacobi	*Liosarcophaga*
S. jacobsoni	*Liosarcophaga*
S. jamesi	*Iranihindia*
S. jamila	*Sokotriella*
S. japonica	*Robineauella*
S. jaroschevskyi	*Liosarcophaga*
S. javana	*Robineauella*
S. javanica	*Boettcherisca*
S. javi	*Sinonipponia*
S. jeanleclercqi	*Sarcophaga*
S. johnsoni	*Wohlfahrtiopsis*
S. josephi	*Bellieriomima*
S. juliaetta	*Neosarcophaga*
S. juncta	*Liosarcophaga*

S. jupalnica	*Sarcophaga*
S. kadeisi	*Beziella*
S. kagaensis	*Bellieriomima*
S. kaimaraensis	*Fengia*
S. kairatuensis	*Pseudothyrsocnema*
S. kalabariana	*Pterolobomyia*
S. kanekoi	*Amamia*
S. kanoi	*Liosarcophaga*
S. kanoiana	*Liosarcophaga*
S. kaplani	*Sarcophaga*
S. kappa	*Johnstonimyia*
S. karachiensis	Unassigned
S. karakoncolos	*Hadroxena*
S. karna	Unassigned
S. karnyi	*Boettcherisca*
S. kataphygionis	*Heteronychia*
S. kaushanensis	*Sarcosolomonia*
S. kawayuensis	*Pandelleisca*
S. kayaensis	*Asiopierretia*
S. keegani	*Phallantha*
S. keiseri	*Prionophalla*
S. kempi	*Harpagophalla*
S. kentejana	*Thyrsocnema*
S. keresophalla	*Yerohama*
S. kericho	*Poecilometopa*
S. kerteszi	*Heteronychia*
S. kesseli	*Wohlfahrtiopsis*
S. keziviana	*Myorhina*
S. khasiensis	*Rosellea*
S. kikuyana	*Mauritiella*
S. kirgizica	*Liosarcophaga*
S. kisangani	*Uroxanthisca*
S. kitaharai	*Liosarcophaga*
S. kiyokoae	Unassigned
S. kladosoides	Unassigned
S. klinzigi	*Anthostilophalla*
S. klinzigiana	*Hochiella*
S. kobachidzei	*Heteronychia*
S. kobayashii	*Liosarcophaga*
S. koehleri	Unassigned
S. kohla	*Liosarcophaga*
S. koimani	*Boettcherisca*
S. komi	*Sinonipponia*
S. konakovi	*Phallosphaera*
S. kopetdaghica	*Robineauella*
S. kovatschevitchi	*Liosarcophaga*
S. kozlovi	*Heteronychia*
S. krathonmai	*Boettcherisca*
S. kugleri	*Pandelleana*
S. kunonis	*Heteronychia*
S. kupangensis	*Sarcosolomonia*
S. kurahashii	*Phallosphaera*
S. lacrymans	*Heteronychia*
S. lageniharpes	*Pierretia*
S. lanei	*Lipoptilocnema*
S. langi	*Prionophalla*
S. lanna	*Mehria*
S. lasiostyla	Unassigned
S. lederbergi	*Heteronychia*
S. lednicensis	*Heteronychia*

S. leechi	*Prionophalla*
S. lehmanni	Unassigned
S. lejlekensis	*Heteronychia*
S. lekebai	*Parasarcophaga*
S. lhasae	*Pseudothyrsocnema*
S. libera	*Neobellieria*
S. liberia	*Scotathyrsia*
S. liberiphaga	*Sarconimba*
S. limbata	*Heteronychia*
S. limbatella	Unassigned
S. limela	*Callostuckenbergia*
S. limpopoensis	*Liopygia*
S. lincta	*Johnstonimyia*
S. lindae	*Arachnidomyia*
S. lindneriana	*Uroxanthisca*
S. lingulata	*Bellieriomima*
S. lini	*Bellieriomima*
S. litsingeri	*Mehria*
S. littoralis	*Hardyella*
S. liukiuensis	*Liosarcophaga*
S. lomagundica	*Prionophalla*
S. lombokensis	*Sarcosolomonia*
S. londti	*Nuzzaciella*
S. londtiana	*Liosarcophaga*
S. longanota	*Dasysceloctis*
S. longestylata	*Notoecus*
S. longicornuta	*Cornexcisia*
S. longifilia	*Sarcorohdendorfia*
S. longisterna	*Neobellieria*
S. longistylata	*Pseudothyrsocnema*
S. lopesi	*Baliisca*
S. lorengauensis	*Pandelleisca*
S. lorosa	*Mehria*
S. lothianensis	*Kozlovea*
S. louisianensis	*Bercaeopsis*
S. luabae	*Liosarcophaga*
S. lubaia	*Mitumbana*
S. lucentina	*Spatulapica*
S. lunigera	*Myorhina*
S. lushainensis	*Thyrsocnema*
S. luzonensis	*Liosarcophaga*
S. lypai	*Liosarcophaga*
S. maai	*Sarcosolomonia*
S. mababiensis	*Liosarcophaga*
S. macroauriculata	*Parasarcophaga*
S. macromembrana	*Heteronychia*
S. macrura	*Helicophagella*
S. maculata	*Helicophagella*
S. maculigaster	*Amharomyia*
S. maculipennis	*Dasysceloctis*
S. maculosa	Unassigned
S. madeirensis	*Liosarcophaga*
S. madrasiola	*Sarconandia*
S. magensi	*Phallanthisca*
S. magnifica	*Sarcorohdendorfia*
S. major	Unassigned
S. malaitensis	Unassigned
S. malgache	*Uroxanthisca*
S. mandelania	*Sabiella*
S. mantiae	*Seniorwhitea*

S. maramureshana	Unassigned
S. marcelleclercqi	*Sarcophaga*
S. marcosgarciae	*Liosarcophaga*
S. mariobezzii	*Sarcosolomonia*
S. maritima	*Liosarcophaga*
S. marshalli	*Liosarcophaga*
S. martellata	*Iranihindia*
S. martellatoides	*Iranihindia*
S. masaiana	*Curranea*
S. matilei	*Sarcophaga*
S. mauritiana	*Lioplacella*
S. maxima	*Sarcorohdendorfia*
S. mazaliana	*Xanthopterisca*
S. mazuella	*Liosarcophaga*
S. mazurmovitshi	*Heteronychia*
S. mcgoughi	*Heteronychia*
S. mediterranea	*Heteronychia*
S. mefouensis	*Beziella*
S. megafilosia	*Sarcorohdendorfia*
S. mehadiensis	*Stackelbergeola*
S. meiofilosia	*Sarcorohdendorfia*
S. melania	*Pierretia*
S. melanura	*Helicophagella*
S. membranijuxta	*Hoa*
S. membranocorporis	*Pterosarcophaga*
S. menadensis	Unassigned
S. menelika	*Anthostilophalla*
S. mersinensis	Unassigned
S. metopina	*Heteronychia*
S. metzgeri	*Phallosphaera*
S. midnaporensis	*Lioproctia*
S. mimobasalis	*Sarcorohdendorfia*
S. mimobrevicornis	Unassigned
S. mimoris	*Bercaeopsis*
S. minima	*Heteronychia*
S. minor	*Phallocheira*
S. minutissima	*Mehria*
S. misera	*Parasarcophaga*
S. mishnania	*Yerohama*
S. moldavica	*Sarcophaga*
S. momba	*Liopygia*
S. monodia	*Liosarcophaga*
S. monospila	*Liosarcophaga*
S. monserrati	*Liosarcophaga*
S. monspellensia	*Heteronychia*
S. mont	*Sarcorohdendorfia*
S. montana	*Sarcorohdendorfia*
S. montiblensis	Unassigned
S. monticola	*Bercaeopsis*
S. montivaga	*Afrothyrsocnema*
S. moravica	*Sarcophaga*
S. morenita	*Heteronychia*
S. morosa	*Bercaeopsis*
S. mossambica	*Heteronychia*
S. mouchajosefi	*Sarcophaga*
S. moucheti	*Liosarcophaga*
S. mulaba	*Liosarcophaga*
S. multicolor	*Lioproctia*
S. multivillosa	*Sarcorohdendorfia*
S. munroi	*Xanthopterisca*

S. munronis	*Nesbittia*
S. musashinensis	*Sinonipponia*
S. musitali	*Afrothyrsocnema*
S. mutesa	Unassigned
S. mutila	*Heteronychia*
S. namaquensis	*Prionophalla*
S. namibia	*Liosarcophaga*
S. nanpingensis	*Liosarcophaga*
S. nanula	*Heteronychia*
S. natalensis	*Liosarcophaga*
S. nathani	*Boettcherisca*
S. naumanni	*Rosellea*
S. nearctica	*Robineauella*
S. neglecta	*Phallosarcophaga*
S. nemoralis	*Mehria*
S. nepalensis	*Boettcherisca*
S. neuweileri	*Liosarcophaga*
S. nevoi	*Pseudothyrsocnema*
S. nicobarensis	*Pseudothyrsocnema*
S. niculescui	*Thyrsocnema*
S. nigribasicosta	*Dinemomyia*
S. nigricaudata	*Heteronychia*
S. nigridorsalis	Unassigned
S. nigriventris	*Myorhina*
S. nihbadella	*Xanthopterisca*
S. nipponensis	*Heteronychia*
S. nitidiventris	*Poecilophalloides*
S. nodosa	*Liosarcophaga*
S. nomita	*Curranea*
S. noonganensis	*Bellieriomima*
S. nostalgica	*Spatulapica*
S. notabilis	*Lioproctia*
S. notatipennis	*Scotathyrsia*
S. novella	*Helicophagella*
S. noverca	*Helicophagella*
S. novercoides	*Helicophagella*
S. nubica	*Afrothyrsocnema*
S. nuzzacii	Unassigned
S. obvia	*Heteronychia*
S. occidentalis	*Neosarcophaga*
S. occulta	*Sarcosolomonia*
S. octomaculata	*Poecilometopa*
S. offecta	*Neobellieria*
S. oharai	*Malawithyrsia*
S. oitana	*Pterophalla*
S. okaliana	*Helicophagella*
S. okazakii	*Kanoa*
S. olsoufjevi	*Mehria*
S. omari	Unassigned
S. omikron	*Sarcorohdendorfia*
S. ontariensis	*Bercaeopsis*
S. opata	*Harpagophylloides*
S. optata	*Malliophalla*
S. ora	*Helicophagella*
S. orientalis	*Seniorwhitea*
S. ornatijuxta	Unassigned
S. oshimensis	*Phallonychia*
S. ostindicae	*Fengia*
S. otiophalla	*Kalshovenella*
S. owadai	Unassigned

S. pachyura	*Helicophagella*
S. pagensis	*Sarcophaga*
S. paineiana	*Lioproctia*
S. palavae	Unassigned
S. palestinensis	*Liosarcophaga*
S. panaya	*Pseudothyrsocnema*
S. panchganiensis	*Harpagophalla*
S. pandellei	*Heteronychia*
S. pandifera	Unassigned
S. panormi	Unassigned
S. papaii	*Sinonipponia*
S. papuensis	*Sarcosolomonia*
S. par	*Liopygia*
S. paralina	*Beziella*
S. parallela	*Bercaeopsis*
S. paramonovi	*Stackelbergeola*
S. paramulaba	*Liosarcophaga*
S. parasurcoufi	*Bercaea*
S. pattoni	*Lioproctia*
S. pauciseta	*Heteronychia*
S. paularnaudi	*Macabiella*
S. paulina	*Bercaeopsis*
S. peckae	*Heteronychia*
S. penicillata	*Heteronychia*
S. pennopluma	*Liosarcophaga*
S. peregrina	*Boettcherisca*
S. perisi	*Perisimyia*
S. perissa	*Neosarcophaga*
S. persica	*Iranihindia*
S. perspicax	*Neosarcophaga*
S. peshelicis	*Kozlovea*
S. petrovae	*Heteronychia*
S. phallosoma	*Liosarcophaga*
S. pharaonis	*Liosarcophaga*
S. phoenicopterus	*Seniorwhitea*
S. picibasicosta	*Robineauella*
S. piciventris	*Sarcorohdendorfia*
S. pingi	*Pandelleisca*
S. piva	*Sarcorohdendorfia*
S. platariae	*Thyrsocnema*
S. pleomenda	*Bercaeopsis*
S. pleskei	*Liosarcophaga*
S. plotnikovi	*Heteronychia*
S. plutus	*Uroxanthisca*
S. polistensis	*Neobellieria*
S. polita	Unassigned
S. polystylata	*Pandelleisca*
S. pomeroyi	*Beziella*
S. pongola	*Hochiella*
S. pontica	*Heteronychia*
S. porrecta	*Heteronychia*
S. portschinskyi	*Liosarcophaga*
S. praedatrix	*Sarcorohdendorfia*
S. praedo	Unassigned
S. praelibera	*Baranovisca*
S. praerupta	*Kermalia*
S. pratti	*Bercaeopsis*
S. preussi	*Cercosarcophaga*
S. princeps	*Seniorwhitea*
S. promiscua	*Liosarcophaga*

S. propinqua	*Lioplacella*
S. prosballiina	*Lioproctia*
S. protuberans	*Pandelleana*
S. proxima	*Heteronychia*
S. pseudobenaci	*Heteronychia*
S. pseudoscoparia	*Robineauella*
S. pseudosubulata	*Bellieriomima*
S. pterygota	*Bellieriomima*
S. pubicornis	*Neosarcophaga*
S. pudongensis	*Beziella*
S. pulla	*Thyrsocnema*
S. pumila	*Heteronychia*
S. punctipennis	*Poecilometopa*
S. purpurascens	Unassigned
S. pusana	*Sarcorohdendorfia*
S. pyrenaica	*Sarcophaga*
S. quinqueramosa	Unassigned
S. quinquestrigata	*Heteronychia*
S. quoi	*Heteronychia*
S. rabunensis	*Bercaeopsis*
S. rageaui	*Beziella*
S. rayssae	*Drakensbergiana*
S. recta	*Heteronychia*
S. recurvata	*Myorhina*
S. redux	*Liosarcophaga*
S. reedi	*Anthostilophalla*
S. regularis	*Xanthopterisca*
S. reicostae	*Helicophagella*
S. reposita	*Baranovisca*
S. resnikae	*Pandelleola*
S. retrostylata	*Rossikenya*
S. rhynchura	*Sarcorohdendorfia*
S. robustispinosa	Unassigned
S. rohdendorfi	*Liosarcophaga*
S. rohdendorfia	*Sarcosolomonia*
S. rohdendorfiana	*Robineauella*
S. romanica	*Sarcophaga*
S. rondaniana	*Heteronychia*
S. rosellei	*Helicophagella*
S. rosellensis	*Heteronychia*
S. rozkosnyi	Unassigned
S. ruficornis	*Liopygia*
S. rufipes	Unassigned
S. ruticilla	Unassigned
S. sabae	*Liosarcophaga*
S. sabiensis	*Liopygia*
S. sabroskyi	*Bercaeopsis*
S. sachsae	*Drakensbergiana*
S. safaria	Unassigned
S. sakharovae	*Afrothyrsocnema*
S. salemiana	*Liosarcophaga*
S. salerensis	*Heteronychia*
S. salkhit	*Liosarcophaga*
S. samia	*Scotathyrsia*
S. santosdiasi	*Liopygia*
S. santospintosi	*Mediterranisca*
S. sapitwana	*Malawixia*
S. saprianovae	*Lioproctia*
S. saputaraensis	*Ziminisca*
S. sarezia	*Helicophagella*

S. sarraceniae	*Bercaeopsis*
S. sarracenioides	*Liosarcophaga*
S. sarupi	*Liosarcophaga*
S. sawainensis	*Alisarcophaga*
S. sayersi	*Liosarcophaga*
S. schineri	*Heteronychia*
S. schnabli	*Heteronychia*
S. schoemani	*Seniorwhitea*
S. schrameli	*Tolucamyia*
S. schuetzei	*Kramerea*
S. schusteri	*Sarcophaga*
S. scopariiformis	*Liosarcophaga*
S. seagoi	*Bercaeopsis*
S. sedlaceki	*Sarcosolomonia*
S. selene	*Uroxanthisca*
S. semenovi	*Ziminisca*
S. semimarginalis	*Liosarcophaga*
S. seniorwhitei	*Sarcorohdendorfia*
S. separata	*Sarcorohdendorfia*
S. septentrionalis	*Boettcherisca*
S. serbica	*Sarcophaga*
S. serrata	*Hosarcophaga*
S. serratocudo	*Sarcorohdendorfia*
S. setifacies	*Sarcosolomonia*
S. setinervis	*Heteronychia*
S. sexpunctata	*Mehria*
S. seychellica	*Afrothyrsocnema*
S. shermani	*Liosarcophaga*
S. shimbana	*Liosarcophaga*
S. shinolopia	*Pseudothyrsocnema*
S. shinonagai	*Sarcosolomonia*
S. shirakii	*Phallanthisca*
S. shiritakaensis	*Liosarcophaga*
S. shnitnikovi	*Heteronychia*
S. shoniella	*Liosarcophaga*
S. shresthai	*Sarcosolomonia*
S. shuxia	*Bellieriomima*
S. sichotealini	*Phallantha*
S. sicilia	*Heteronychia*
S. siciliae	*Pandelleana*
S. siciliana	*Heteronychia*
S. siciliensis	*Heteronychia*
S. siganella	*Batissophalla*
S. sigilla	*Tolucamyia*
S. sigma	*Liosarcophaga*
S. silbergliedi	*Mehria*
S. silvai	*Prionophalla*
S. sima	*Bercaeopsis*
S. similis	*Pandelleisca*
S. simplex	*Poseidonimyia*
S. simulatrix	*Liosarcophaga*
S. simultaneousa	Unassigned
S. sinuata	*Sarcotachinella*
S. sisyphus	*Sisyhelicobia*
S. situliformis	*Bellieriomima*
S. slameckovae	*Kramerella*
S. slovaca	*Heteronychia*
S. smarti	*Sinonipponia*
S. smirnovi	*Heteronychia*
S. smithi	*Pierretia*

S. smithiana	*Heteronychia*
S. snyderi	*Bercaeopsis*
S. socrus	*Myorhina*
S. solitaria	*Thyrsocnema*
S. solomonica	*Liosarcophaga*
S. sororcula	*Myorhina*
S. sororia	*Salemea*
S. sorror	Unassigned
S. souzalopesi	*Baliisca*
S. spangleri	*Beziella*
S. spatulifera	*Heteronychia*
S. spatuliformis	*Bellieriomima*
S. spilargyra	*Liosarcophaga*
S. spilogaster	*Poecilometopa*
S. spinifera	*Lioproctia*
S. spinigera	*Sarcorohdendorfia*
S. spinipenis	Unassigned
S. spinosa	*Pseudothyrsocnema*
S. stackelbergi	*Bellieriomima*
S. stanleyiana	Unassigned
S. statuta	*Neosarcophaga*
S. sternalis	*Liosarcophaga*
S. strenua	*Heteronychia*
S. stricklandi	*Sarcosolomonia*
S. strumiana	*Liosarcophaga*
S. struthioides	*Pandelleana*
S. stuckenbergi	*Seniorwhitea*
S. stuckenbergiana	*Petuniophalla*
S. stygia	*Beziella*
S. stylata	*Sarcorohdendorfia*
S. subaenescens	*Mehria*
S. subdiscalis	*Liosarcophaga*
S. subdistinguenda	*Afrothyrsocnema*
S. subharpax	*Liosarcophaga*
S. subulata	*Bellieriomima*
S. subvicina	*Sarcophaga*
S. sudanica	*Dolichophalla*
S. sudiai	*Bercaeopsis*
S. suffa	Unassigned
S. suffusa	*Liopygia*
S. suhaylia	*Yemeniella*
S. sumbaensis	*Lioproctia*
S. sumunensis	*Sarcosolomonia*
S. sundaensis	*Sarcorohdendorfia*
S. superba	*Chrysosarcophaga*
S. surcoufi	*Liopygia*
S. surda	*Zumptiopsis*
S. susainathani	*Sarcosolomonia*
S. sushkini	*Stackelbergeola*
S. susteriana	Unassigned
S. suthep	*Rosellea*
S. sutilis	*Bercaeopsis*
S. sympaestria	*Liosarcophaga*
S. synia	*Sarcosolomonia*
S. taenionota	*Parasarcophaga*
S. tainanensis	Unassigned
S. taiwanensis	*Lioproctia*
S. taka	*Pandelleisca*
S. takahasii	*Bellieriomima*
S. talomoensis	*Boettcherisca*

S. talonata	*Harpagophalla*
S. tangerensis	*Heteronychia*
S. tanzaniae	*Liopygia*
S. tanzaniella	*Sabakia*
S. tarsata	*Bercaeopsis*
S. taurica	*Heteronychia*
S. telengai	*Heteronychia*
S. tenuicornis	*Bellieriomima*
S. tenuiforceps	*Heteronychia*
S. tephroides	Unassigned
S. tephrura	*Fijimyia*
S. teretirostris	*Liosarcophaga*
S. teskeyi	*Mandalania*
S. tetona	*Bercaeopsis*
S. tetra	*Bercaeopsis*
S. tetrix	*Heteronychia*
S. tewfiki	*Seniorwhitea*
S. thailandica	*Robineauella*
S. thalhammeri	*Heteronychia*
S. thatuna	*Neosarcophaga*
S. theodori	*Pandelleisca*
S. theseus	*Harpagophylloides*
S. thinhi	*Pierretia*
S. thirionae	*Heteronychia*
S. tibialis	*Liosarcophaga*
S. timorensis	*Boettcherisca*
S. todiscoae	Unassigned
S. torvida	*Lioproctia*
S. trabzonensis	*Sarcophaga*
S. transpyrenaica	*Thyrsocnema*
S. transvaalensis	*Curranea*
S. travassosi	*Arachnidomyia*
S. tricolor	*Heteronychia*
S. trifulcata	*Sarcosolomonia*
S. triplasia	*Neobellieria*
S. triplex	*Sarcorohdendorfia*
S. tristylata	*Pandelleisca*
S. tsengi	*Sugiyamamyia*
S. tshernovi	*Kozlovea*
S. tshernovi	*Sarcosolomonia*
S. tsinanensis	*Heteronychia*
S. tsintaoensis	*Mehria*
S. tsushimae	*Liosarcophaga*
S. tuberosa	*Liosarcophaga*
S. tulagiensis	*Sarcosolomonia*
S. tunisiae	*Heteronychia*
S. tupada	Unassigned
S. turana	*Heteronychia*
S. turkanella	*Pterolobomyia*
S. uamensis	*Curranea*
S. uemotoi	*Robineauella*
S. ugamskii	*Asiopierretia*
S. ukrainica	*Sarcophaga*
S. uliginosa	*Liosarcophaga*
S. uncicurva	*Heteronychia*
S. uncus	*Sarcorohdendorfia*
S. unguitigris	*Parasarcophaga*
S. uniseta	*Bellieriomima*
S. urceola	*Sarcorohdendorfia*
S. ussuriensis	*Liosarcophaga*

S. utilis	*Wohlfahrtiopsis*
S. vachai	*Heteronychia*
S. vadoni	*Liosarcophaga*
S. vagans	*Heteronychia*
S. vancouverensis	*Neosarcophaga*
S. vanrienbeecki	*Beziella*
S. vansoni	*Afrothyrsocnema*
S. vanuatu	Unassigned
S. variabilis	*Sarcorohdendorfia*
S. variegata	*Sarcophaga*
S. versatilis	*Sarcosolomonia*
S. vervesi	*Kozlovea*
S. vicaria	*Beziella*
S. vicina	*Heteronychia*
S. vietnamensis	Unassigned
S. vietnamica	*Liosarcophaga*
S. villa	*Chaetophalla*
S. villeneuveana	*Heteronychia*
S. villeneuvei	*Myorhina*
S. villipes	*Mindanaoa*
S. villisterna	*Sarcorohdendorfia*
S. violovitshi	*Heteronychia*
S. vitilevensis	Unassigned
S. vockerothi	*Durbanella*
S. voluptus	*Liosarcophaga*
S. vorax	Unassigned
S. wagneri	*Liosarcophaga*
S. wahisi	*Heteronychia*
S. walayari	*Robineauella*
S. wallenbergi	*Sarcophaga*
S. walshi	*Liosarcophaga*
S. weberi	*Devriesia*
S. wetzeli	*Liosarcophaga*
S. weyeri	*Prionophalla*
S. whitneyi	*Sarcorohdendorfia*
S. wiesenthali	Unassigned
S. wrangeliensis	*Neosarcophaga*
S. wujiangiana	*Sarcorohdendorfia*
S. wumengia	*Sarcorohdendorfia*
S. wyatti	*Pierretia*
S. xizangensis	*Tuberomembrana*
S. yaanensis	*Bellieriomima*
S. yadvashemia	*Braunsiella*
S. yelangiops	*Phallosphaera*
S. yonahaensis	*Takaraia*
S. yorkii	*Liosarcophaga*
S. yuwanensis	Unassigned
S. yvorei	*Liosarcophaga*
S. zaitzevi	*Iranihindia*
S. zarudnyi	*Stackelbergeola*
S. zeta	*Sarcorohdendorfia*
S. zhelochovtzevi	*Heteronychia*
S. zhouquensis	*Bellieriomima*
S. ziegleri	*Xanthopterisca*
S. zimba	Unassigned
S. zuli	*Boettcherisca*
S. zuluensis	*Afrothyrsocnema*
S. zulunata	*Xanthopterisca*
S. zumpti	*Hyperacanthisca*
S. zumptiana	*Sarcophaga*

Parasite morphology: *Sarcophaga* spp. form 4 different types of morphological stages during their developmental cycles: eggs (in utero); larvae (3 instars); pupae (in puparia); and adult flies (male and female). The eggs are retained by female flies within uterine pouches where they embryonate and grow to 0.5-3.5 x 0.1-0.8 mm. They hatch within the uterus releasing larvae which are deposited (larviposited) in the external environment. Larvae have elongated cylindrical white-yellow bodies that are stout in the middle (more robust than blow fly larvae), taper anteriorly to a narrow mouth and are truncated posteriorly. They develop through 3 instars (L1-3) growing from 1-5 mm long up to 20 mm depending on the species. They lack a sclerotized head capsule (although the first segment may sometimes be sclerotized dorsally) and they have an internal cephalopharyngeal skeleton with paired mandibles that are strong and curved like a hook. Sarcophaginae larvae usually lack a labral sclerite, but in some cases, a small triangular plate may be located between the mandibles. The body segments have conspicuous bands of small spines (absent in muscoid larvae), and the hindmost segment has an anal opening located on a posteroventral lobe with lateral tubercles. Larvae breathe using 2 pairs of respiratory spiracles: a small anterior pair, each consisting of a short branched stalk resembling a fan (absent in L1); and a larger caudal pair, each forming a plate recessed in a deep cavity (unique to flesh flies) surrounded by 8-12 tubercles (dorsal ones often sclerotized with toothed processes, ventral ones often covered in nipple-like projections). The spiracular plates are bound by an incomplete sclerotized peripheral ring (peritreme) and have 3 straight vertical slits (2 slits in L1) slanted away from the midline (slits in muscid larvae slant towards the midline, while oestrid larvae have porous plates often without slits). Mature L3 form cylindrical-oval (barrel-shaped) puparia measuring 5-10 mm long that are initially creamy brown in colour but darken to red-brown with age. The enclosed pupa undergoes metamorphic transformation into a winged adult fly which ecloses through a circular cap (like all Cyclorrhapha) rather than longitudinal slits (like Brachycera and Nematocera). Adult sarcophagids are medium-large in size ranging from 4-23 mm in length depending on the species (e.g. *S. haemorrhoidalis* adults are 7-14 mm long, while those of *S. bullata* are 8-17 mm long). *Sarcophaga* spp. do resemble blow flies but are not metallic in colour, and have dull grey-black bodies with 3 longitudinal thoracic stripes and a checkered (tessellated) pattern of dark rectangles on the abdomen. Their bodies have long thick bristle-like setae as well as shorter finer setae. Adults have 3 conspicuous tagma: an oval head; a narrow thorax; and a robust abdomen. The head is often pale ashen grey in colour and has 2 well-developed red compound eyes (set further apart in females than males). Both a ptilinal suture and facial lunule are present (similar to other Oestroidea and Muscoidea, but unlike other calyptrates). The head is adorned with long bristles on the genae (cheeks) and females have 2 orbital bristles (absent in males). There are 2 anterior antennae, each composed of 3 dissimilar segments: a short basal scape; a club-like pedicel with a complete dorsal seam; and an anterior flagellum comprising a large dorsal bristle (arista) that is plumose (feather-like) only at its base (unlike calliphorids whose arista are plumose their entire lengths). Adult flies have sponging

mouthparts that lack piercing elements (adults are not blood-feeders). The mouthparts are contained within a short ventral proboscis flanked by small club-like palps. The proboscis consists of a short rostrum, a tubular haustellum (with a labial sheath holding an anterior labrum and a slender hypopharynx), and a flattened terminal sponging labellum. Ingested foods are routed through a tubular oesophagus to the globular proventriculus (with saccular diverticula) and then on to the midgut (for digestion), hindgut (with excretory Malpighian tubules), rectum and terminal anus. The thorax is covered by a shield-like scutum but lacks a post-scutellum (hind lobe). A prominent row of black bristles occurs on the hypopleuron to either side of the thorax, and another row is found just under the wing base (these presence of these 2 sets of bristles distinguishes sarcophagids from muscids). *Sarcophaga* spp. also have 4 (rather than 2-3) notopleural bristles, 3 sternopleural bristles, and vertical row of bristles on meron (lacking on muscoid flies). The mesothorax gives rise to a pair of narrow clear wings whose wing membranes are supported by 6 primary veins [costa (C), subcosta (Sc), radius (R), media (M), cubitus (Cu), and anal (A)] with the M vein bending towards the leading edge. Like all dipterans, the hindwings have been reduced to small club-like halteres used to stabilize flight. Like all calyptrates, the halteres are covered by posterobasal wing lobes (calypters). Flesh flies also have bulbous swellings (greater ampullae) below their wing bases. The ventral thorax bears 3 pairs of long black legs, each composed of 5 segment (coxa, trochanter, femur, tibia, and tarsus) and terminating in a pair of claws with large pad-like pulvilli. The middle tibia is bare while the hind-tibia is setate with a fringe of short setae or irregularly-placed long setae. The abdomen is ovoid with dorsal segments displaying unique tessellated colour patterns and lateral spiracles. The terminal segments are modified by genital structures which provide key features used to identify sarcophagid genera. Males have 2 testes connected by vas deferens to a seminal vesicle (with lateral accessory glands) leading to a tubular ejaculatory duct and copulatory aedeagus and claspers that are often bright red in colour. Females have 2 ovaries with oviducts leading to a globular uterus (with associated spermatheca and accessory glands). Eggs are retained in expanded bilobed uterine pouches until they hatch and the larvae are birthed through a terminal larvipositor.

Site of infection: Adult flesh flies are free-living and attracted to decomposing organic matter where females deposit larvae. Many species breed in carrion, thus deserving their genus name (*Sarcophaga* literally meaning 'meat-eater') as well as their common name (flesh fly). Some species may also breed in dung, and others are internal parasites (parasitoids) of other insects (especially caterpillars). Several carrion-feeding species may also opportunistically cause facultative cutaneous myiases in live animals when larvae invade wounds or soiled pelage (coat), notably *S. haemorrhoidalis*. Some animals may also acquire gastro-intestinal infestations when they accidentally ingest fly-blown food. Larval myiases have been found in domestic animals, pets, and wildlife as well as in humans, with some fly species adapting well to human habitations and being attracted indoors by faecal odours.

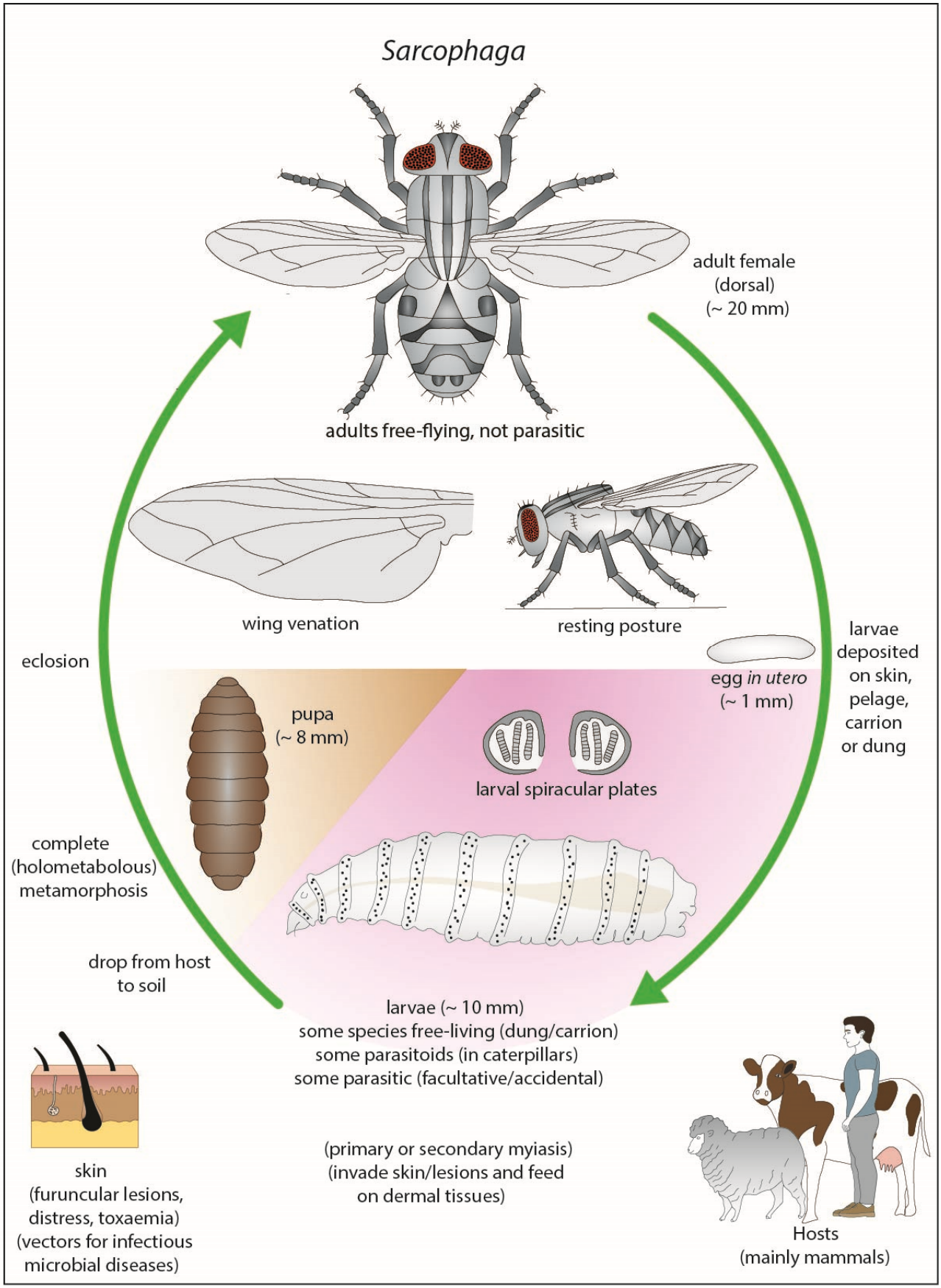
Pathogenesis: Vertebrate hosts may acquire larval infestations when gravid female flies deposit larvae near wounds or soiled coats. The larvae feed on necrotic or dead flesh using their rasping and tearing mandibles, mostly being confined to superficial regions. Most infestations result in furuncular (boil-like) dermal lesions containing a few larvae which breathe through a common central punctum (puncture point or pore). Furuncles develop over several days as larvae feed and are evident as pustules surrounded by inflamed tissue with variable pruritus. Infestations are often considered self-limiting as mature larvae leave the hosts and drop to the ground to pupate. Some hosts do not seem bothered by a few small lesions, but multiple and more severe lesions may cause marked distress. Animals often attempt to relieve clinical signs by biting, scratching or rubbing affected areas which can result in self-trauma and open wounds to secondary bacterial infections. Other sites of infestation have been reported in companion animals, including auricular myiasis (on the outer ear), and aural myiasis (with ear discharge, otalgia and itching). A growing number of cases have also been reported involving gastro-intestinal myiasis in carnivores, and humans, when larvae have been ingested with contaminated meat although they resolve quickly when larvae are excreted with faeces. Because adult flesh flies come into contact with carrion and faeces (some species being particularly attracted to human food and filth), they may act as mechanical vectors for the transmission of various infectious diseases, particularly enteric bacteria which may be carried on the fly body, legs or mouthparts to animal or human food or open sores. *S. haemorrhoidalis* has also been found to carry polio virus.

Developmental cycle and mode of transmission: Flesh flies exhibit holometabolous development whereby grub-like larvae transform in pupae into winged adult flies. Female flies are not oviparous and do not lay eggs. Instead, they retain fertilized eggs in uterine pouches until they produce larvae. Females are viviparous as they give birth to live larvae. Females use their larvipositors to deposit several larvae at a time head-first on decaying organic material (carrion and dung) and sometimes near wounds or soiled coats on live animals. The larvae burrow into the substrate to feed and grow through 3 instars (L1-3) over 3-7 days. They are voracious and will eat almost anything of animal origin that they encounter, including the larvae of other insects (caterpillars, grasshoppers, beetles, other flies) and even snails. Indeed, sarcophagid larvae are larger than those of most other wound-colonizing flies, and often out-compete other species. When replete, mature L3 cease feeding and exit the wound dropping to the ground. They burrow into the soil and form puparia by contraction and hardening of their tegument. The enclosed pupae undergo pupation over 1-2 weeks, but this can be extended in cooler climatic conditions in temperate regions (some species hibernating or over-wintering as pupae). Adult flies emerge and after a short resting period to harden their cuticles and wings, they fly in search of food, mates and larviposition sites. Female flies live for 15-21 days and may produce 30-200 larvae in that time. The whole life-cycle may be completed in as little as 23 days, but is often takes up to 34 days or longer in cooler conditions. While adults may feed on plant sugars (flower nectar, sap), many species are strongly attracted to animal remains in both early and late stages of decomposition, even flying through extreme weather conditions to reach carrion (sarcophagids are often the first flies to colonize cadavers). Some may also opportunistically invade wounds and soiled coats on live animals. Other species are attracted to dung and are routinely

found around compost piles and latrine pits. Even other species invade the tissues of insect larvae (notably caterpillars) as parasitoids or cleptoparasitoids where they complete their larval development by consuming the host. Adult flies prefer sunlight over shaded conditions and are more abundant worldwide in regions with warm climates and during warmer months.

Differential diagnosis: The diagnosis of myiases due to flesh fly larvae is difficult on clinical grounds as many aetiological agents (including other fly species) may cause similar cutaneous lesions. Diagnoses are therefore made by the direct detection, collection and identification of sarcophagid larvae from wounds. Species-specific identification is difficult and recourse is sometimes made to the cultivation of larvae on meat or synthetic media until they pupate and release adult flies for examination. More recently, molecular biological techniques have been used to identify species and examine their phylogenetic relationships by polymerase chain reaction (PCR) amplification of nuclear (ribosomal DNA) and mitochondrial (cytochrome oxidase I and II) gene sequences.

Treatment and control: Fly strike wounds should be treated as soon as practicable to minimize their impact on the host and prevent secondary infections. Wounds should be cleansed with antiseptics and attempts made to remove the maggots, either using tweezers, flushing with lidnocaine and/or epinephrine, or by surgical incision, debridement and extraction under local anaesthesia. Larvae may be made more compliant to extraction by smothering them with occlusive dressings that are oil-based (petroleum jelly, mineral or vegetable oils, liquid paraffin, butter, beeswax, and even nail polish, adhesive tape, or chewing gum) or contain insecticidal chemicals (organochlorines, organophosphates, or pyrethroids). Care should be taken not to damage larvae to prevent inflammation, and patients should be given supportive therapy in the form of analgesics, anti-inflammatories, antibiotics and rehydration solutions. The prevention of fly strike revolves around prophylactic insecticidal treatments, establishing barriers between hosts and gravid female flies, and reducing fly populations by eliminating breeding sites. Insecticides with good residual activity may be used on livestock, particularly after management procedures that involve inflicting wounds (branding, dehorning, castration, tailing). Housing facilities may be improved to separate livestock from humans, with window and door screens used to exclude adult flies. Every effort should be made eliminate potential breeding sites for flies by proper disposal of carcases (burn, bury) and improving sanitation (remove faeces). Flesh flies have also been used for forensic applications, as they are usually the first flies to locate and colonize human corpses. Determining the duration of larval developmental stages under different environmental conditions has allowed forensic investigators to calculate the approximate time of infestation (and thereby infer the approximate time of death).


Sarcophaga
adult female
(dorsal)
(~ 20 mm)
adults free-flying, not parasitic
wing venation
resting posture
larvae
deposited
on skin,
pelage,
carrion
or dung
egg in utero
(~ 1 mm)
eclosion
pupa
(~ 8 mm)
larval spiracular plates
complete
(holometabolous)
metamorphosis
drop from host
to soil
larvae (~ 10 mm)
some species free-living (dung/carrion)
some parasitoids (in caterpillars)
some parasitic (facultative/accidental)
(primary or secondary myiasis)
(invade skin/lesions and feed
on dermal tissues)
skin
(furuncular lesions,
distress, toxaemia)
(vectors for infectious
microbial diseases)
Hosts
(mainly mammals)

Sarcophaga adult

Sarcophaga eggs

Sarcophaga larvae

Sarcophaga pupae