Culicoides
(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). Nematocerans include the culicids (mosquitoes), ceratopogonids (midges); simuliids (black flies) and psychodids (sand flies): only the females are parasitic and have piercing-sucking mouthparts. Ceratopogonids are very small but fierce flies known as biting midges. They have thoracic humps and narrow spotted wings. Many are daytime feeders, some crepuscular and others nocturnal, but all prefer still conditions as they do not cope well with winds. Most species feed on insects or cold-blooded animals, and only a few on mammals. Larvae develop in a range of conditions, mangroves, swamps, freshwater bodies, moist soils and animal dung. Female *Culicoides* spp. feed on humans and animals and are known to transmit viruses (bluetongue), protozoa (haemosporidia) and helminths (filarial nematodes).

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:	Nematocera (midges/mosquitoes, long filamentous antennae, aquatic larvae/pupae)
Family:	Ceratopogonidae (midges/sand flies, narrow spotted wings)
Genus:	*Culicoides* (parasitic on skin of mammals/birds)
Species:	various species cause pruritus, hypersensitivity

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 Nematocera comprises small slender flies that are 'thread-horned' i.e. they possess long filamentous antennae composed of many articulating segments (= nemato-cera). Adults have long narrow wings (with many branching veins) and specialized mouthparts (short or long) with a protective sheath (labium and labellae) protecting feeding stylets (labrum, mandibles, maxillae and hypopharynx) and flanked by 4-5 segmented palps (usually pendulous but slender in mosquitoes). Many species have aquatic life-cycles (larval/pupal stages associated with water) and all undergo complete metamorphosis whereby adults eclose from puparia through longitudinal slits (rather than circular caps like Cyclorrapha). The suborder contains 7 infraorders: Axymyiomorpha (larvae in decomposing wood); Bibionomorpha (gnats, lovebugs); Blephariceromorpha (mountain midges); Culicomorpha (mosquitoes, midges, black flies); Psychodomorpha (moth flies); Ptychopteromorpha (primitive crane flies); and Tipulomorpha (crane flies). While small 'midges' have been further classified into several different groups, most are saprophages or detritivores, but several groups do contain representatives that bite vertebrate hosts in order to feed on blood. The infraorder Culicomorpha contains 2 superfamilies: Chironomoidea (biting, non-biting and trickle midges, black flies); and Culicoidea (meniscus midges, phantom midges, frog-biting midges, and mosquitoes).

The superfamily Chironomoidea contains 4 families: Ceratopogonidae (biting midges), Chironomidae (non-biting midges), Simuliidae (black flies), and Thaumaleidae (trickle midges). Members of the family Ceratopogonidae are readily distinguished by their small size, humped thorax, small head with long filamentous hairy antennae with 14-15 visible segments, short mouthparts, 5-segmented palps, short stout legs, and mottled hairy wings with forked medial veins and less than 8 veins reaching the wing margin. Over 6,000 ceratopogonid species have been described in over 100 genera in 4 subfamilies: Dasyheleinae with 1 genus; Leptoconopinae with 2 genera; Forcipomyiinae with 2 genera; and Ceratopogoninae with 6 tribes and 101 genera (including *Culicoides*); as well as several unplaced genera and over 20 fossil genera. In particular, the latter 3 subfamilies contain species that feed on vertebrate blood, with those belonging to 4 genera (*Austroconops, Leptoconops, Forcipomyia* and *Culicoides*) being notorious as annoying pests of humans and domestic animals, as well as acting as vectors for several infectious diseases (viruses, protozoa and helminths). Members of the genus *Culicoides* (syn. *Conopoides, Marksomyia, Padrosia, Remmia, Sensiculicoides*) are characterized by small biting midges with humped bodies and narrow spotted wings. Over 1,300 species have been described in 27 subgenera, many of them reported to feed on birds and mammals. Biting midges have been attributed many common names around the world attesting to their minute size and aggravating bites; including no-see-ums, punkies, five-o's, no-no's, brulot, knotts, kuiki, jejenes, maruins, makunagi, nukaka, nyung noi, agas, merutu, merotoe as well as moose flies and sand flies (but distinct from phlebotomine sand flies).

***Culicoides* species (regional exemplars)**	**Host preferences**	**Clinical signs (+ vectorial capacity)**	**Distribution**
C. bolitinos, brevitarsis, fulvus, gulbenkiani, histrio, imicola, impunctatus, insignis, milnei, nebeculosus, obsoletus, pulicaris, pungens, sibirica, sonorensis, variipennis, victoriae	domestic and wild mammals, some birds	annoyance, pruritus, hypersensitivity (equine dermatitis, bunyaviruses, reoviruses, rhabdoviruses, onchocerciasis, avian haemoproteid infection)	cosmopolitan
C. adersi, austeni, grahamii, inornatipennis	primates, incl. humans	annoyance, pruritus, hypersensitivity (hepatocystosis, mansonellosis)	Africa
C. denningi, furens, melanura, occidentalis, stelifer, venustus	domestic and wild mammals, incl. horses	annoyance, pruritus, hypersensitivity (eastern equine encephalitis)	North America
C. arboricola, crepuscularis, edeni, , haematopus, hinmani, knowltoni, sphagnemensis, stilobezzioides	birds, esp. passeriforms and galliforms	annoyance (avian haemoproteid infection)	North America
C. barbosai, diabolicus, paraensis, phlebotomus	primates, incl. humans	annoyance, hypersensitivity (mansonellosis, bunyaviruses)	South America
C. dycei, marksi, oxystoma, peregrinus, robertsi, wadai	domestic and wild mammals, and marsupials	annoyance, pruritus, hypersensitivity (bluetongue virus, onchocerciasis, reoviruses)	Australia
C. arakawae, circumscriptus, guttifer, schultzei	birds, esp. chickens	annoyance (avian leucocytozoonosis)	Asia

Full species list (compilation of several on-line data-bases)

***Culicoides* species**	**Subgenus**
C. abbreviatipennis (fossil)	Unassigned
C. abchazicus	*Avaritia*
C. acanthostoma	*Trithecoides*
C. accraensis	Unassigned
C. achkamalicus	*Oecacta*
C. achrayi	*Oecacta*
C. acotylus	*Oecacta*
C. actoni	*Avaritia*
C. adamskii	Unassigned
C. adersi	Unassigned
C. africanus	Unassigned
C. agamus (fossil)	Unassigned
C. agas	Unassigned
C. aitkeni	*Glaphiromyia*
C. alachua	*Avaritia*
C. alahialinus	*Oecacta*
C. alaskensis	*Beltranmyia*
C. alatavicus	*Oecacta*
C. alazanicus	*Oecacta*
C. albibasis	*Trithecoides*
C. albicans	*Oecacta*
C. albifascia	Unassigned
C. albipennis	Unassigned
C. albomacula	*Selfia*
C. albomotatus	Unassigned
C. albopunctatus	Unassigned
C. alboscutatus	*Trithecoides*
C. albosparsus	Unassigned
C. albovenosus	Unassigned
C. alexanderi	Unassigned
C. alexandrae	*Oecacta*
C. algecirensis	Unassigned
C. algeriensis	*Oecacta*
C. alishenensis	Unassigned
C. allantothecus	*Trithecoides*
C. almeidae	*Culicoides*
C. almirantei	*Oecacta*
C. alpicola	Unassigned
C. alpigenus	*Fastus*
C. altaicus	*Oecacta*
C. alticola	Unassigned
C. alvarezi	*Selfia*
C. amamiensis	*Culicoides*
C. amaniensis	Unassigned
C. amazonicus	Unassigned
C. ambericus (fossil)	*Oecacta*
C. ameliae	Unassigned
C. amossovae	*Oecacta*
C. anadyriensis	Unassigned
C. analis	Unassigned
C. andicola	*Avaritia*
C. andinus	*Oecacta*
C. andrewsi	*Culicoides*
C. angkaensis	*Culicoides*
C. angolensis	Unassigned
C. annandalei	*Avaritia*
C. annettae	*Hoffmania*
C. annosus (fossil)	Unassigned
C. annuliductus	Unassigned
C. anophelis	*Trithecoides*
C. antefurcatus	*Selfia*
C. antennalis	Unassigned
C. anthropophygas	*Sinocoides*
C. antilleanus (fossil)	*Oecacta*
C. antunesi	*Selfia*
C. aomoriensis	Unassigned
C. aquilinus	*Oecacta*
C. aquilonius (fossil)	Unassigned
C. arabiensis	Unassigned
C. aragaoi	Unassigned
C. arakanae	*Beltranmyia*
C. arboreus	*Oecacta*
C. arboricola	*Amossovia*
C. archboldi	*Oecacta*
C. ardentissimus	Unassigned
C. ardleyi	Unassigned
C. arenarius	Unassigned
C. arenicola	*Oecacta*
C. aricola	Unassigned
C. arizonensis	*Drymodesmyia*
C. arnaudi	*Oecacta*
C. arschanicus	Unassigned
C. arubae	Unassigned
C. asiaticus	*Oecacta*
C. atchleyi	Unassigned
C. atelis	Unassigned
C. aterinervis	*Culicoides*
C. atratus (fossil)	Unassigned
C. atripennis	*Oecacta*
C. aureus	*Oecacta*
C. austeni	Unassigned
C. austerus (fossil)	Unassigned
C. australiensis	Unassigned
C. austropalpalis	*Oecacta*
C. austroparaensis	Unassigned
C. autumnalis	*Culicoides*
C. avilaensis	*Oecacta*
C. azerbajdzhanicus	*Oecacta*
C. azureus	*Oecacta*
C. bachmanni	Unassigned
C. bahrainensis	Unassigned
C. baisasi	*Trithecoides*
C. bajensis	Unassigned
C. bakeri	*Drymodesmyia*
C. balsapambensis	*Oecacta*
C. balticus (fossil)	*Oecacta*
C. bambusicola	*Oecacta*
C. bancrofti	Unassigned
C. barbosai	*Oecacta*
C. barnetti	*Trithecoides*
C. barrosmachadoi	Unassigned
C. barthi	*Oecacta*
C. bassetorum	Unassigned

C. baueri	*Diphaomyia*
C. bayano	Unassigned
C. beaveri	Unassigned
C. beckae	*Amossovia*
C. bedfordi	Unassigned
C. begueti	*Oecacta*
C. belgicus	Unassigned
C. belkini	Unassigned
C. benarrochi	*Selfia*
C. bergi	*Diphaomyia*
C. bermudensis	*Beltranmyia*
C. bernardae	Unassigned
C. beybienkoi	*Oecacta*
C. biarcuatus	Unassigned
C. bickleyi	Unassigned
C. bicolor (fossil)	Unassigned
C. bicornus	Unassigned
C. biestroi	Unassigned
C. bifasciatus	Unassigned
C. bifidus (fossil)	Unassigned
C. bigeminus	*Avaritia*
C. biguttatus	*Silvaticulicoides*
C. bilobatus	Unassigned
C. bimaculatus	*Glaphiromyia*
C. birabeni	*Oecacta*
C. biscapus	Unassigned
C. bisignatus	Unassigned
C. bisolis	Unassigned
C. blantoni	*Diphaomyia*
C. bodemensis	Unassigned
C. bodemheimeri	Unassigned
C. bolitinos	*Avaritia*
C. boliviensis	Unassigned
C. boophagus	*Avaritia*
C. boormani	Unassigned
C. borinqueni	*Drymodesmyia*
C. bottimeri	*Wirthomyia*
C. bougainvillae	Unassigned
C. boydi	*Avaritia*
C. brachcordylus	Unassigned
C. brasilianus	*Glaphiromyia*
C. bredini	*Selfia*
C. brevifrontis	*Beltranmyia*
C. brevipalpis	*Avaritia*
C. brevitarsis	Unassigned
C. bricenoi	*Selfia*
C. brinchangensis	*Hoffmania*
C. brodzinskyi (fossil)	*Oecacta*
C. bromophilus	Unassigned
C. brookmani	*Selfia*
C. brosseti	Unassigned
C. brownei	*Hoffmania*
C. brucei	Unassigned
C. brunnicans	*Oecacta*
C. bubalus	*Culicoides*
C. buettikeri	Unassigned
C. buhetoensis	*Monoculicoides*
C. bulbostylus	*Oecacta*
C. bullus (fossil)	Unassigned
C. bundyensis	Unassigned
C. bunrooensis	*Oecacta*

C. burylovi	*Oecacta*
C. butleri	*Drymodesmyia*
C. bwambanus	Unassigned
C. bychowskyi	*Oecacta*
C. byersi	*Drymodesmyia*
C. cacticolus	*Drymodesmyia*
C. calcaratus	*Haemophoructus*
C. caldasi	Unassigned
C. calexicanus	Unassigned
C. californiensis	*Amossovia*
C. caliginosus	*Oecacta*
C. calloti	Unassigned
C. cambodiensis	*Culicoides*
C. cameronensis	Unassigned
C. cameroni	*Groganomyia*
C. camicasi	Unassigned
C. camposi	*Oecacta*
C. canadensis (fossil)	Unassigned
C. cancer	*Oecacta*
C. cancrisocius	Unassigned
C. capillosus	Unassigned
C. capricorniae	Unassigned
C. caprilesi	*Oecacta*
C. carbonelli	Unassigned
C. caridei	*Oecacta*
C. carpenteri	*Oecacta*
C. carpophilus	*Hoffmania*
C. carri (fossil)	Unassigned
C. carsiomelas	*Oecacta*
C. casei (fossil)	Unassigned
C. castillae	*Oecacta*
C. cataneii	*Oecacta*
C. catharinae	*Pontoculicoides*
C. caucaensis	*Oecacta*
C. caucoliberensis	*Oecacta*
C. causeyi	*Oecacta*
C. cavaticus	Unassigned
C. ceranowiczi (fossil)	Unassigned
C. certus	*Avaritia*
C. ceylanicus	Unassigned
C. chacoensis	Unassigned
C. chagyabensis	Unassigned
C. changbaiensis	Unassigned
C. charadraeus	*Oecacta*
C. charrua	Unassigned
C. chateaui	Unassigned
C. chaverrii	*Anilomyia*
C. chazeaui	Unassigned
C. cheahi	Unassigned
C. chengduensis	Unassigned
C. cheni	Unassigned
C. chewaclae	Unassigned
C. chiopterus	*Avaritia*
C. chitinosus	*Oecacta*
C. choochotei	*Culicoides*
C. chrysonotus	*Anilomyia*
C. cilipes	Unassigned
C. cinereus	Unassigned
C. circumbasalis	Unassigned
C. circumscriptus	*Beltranmyia*
C. citroneus	Unassigned

C. claggi	Unassigned
C. clarkei	Unassigned
C. clastrier	*Oecacta*
C. clavipalpis	Unassigned
C. cleaves	Unassigned
C. clintoni	Unassigned
C. coarctatus	Unassigned
C. cochisensis	*Amossovia*
C. cockerellii	*Culicoides*
C. combinothecus	Unassigned
C. commatis	*Selfia*
C. comosioculatus	*Oecacta*
C. comparis	*Avaritia*
C. concatervans	*Trithecoides*
C. confusus	Unassigned
C. congolensis	Unassigned
C. copiosus	*Drymodesmyia*
C. coracinus	Unassigned
C. cordiformis	Unassigned
C. cordiger	Unassigned
C. corneti	Unassigned
C. corniculus	Unassigned
C. cornutus	Unassigned
C. coronalis	Unassigned
C. corsis	*Oecacta*
C. corsoni	Unassigned
C. corti	Unassigned
C. costalis	Unassigned
C. coutinhoi	*Glaphiromyia*
C. covagarciai	*Anilomyia*
C. crassipilosus	*Oecacta*
C. crassus	Unassigned
C. crepuscularis	*Beltranmyia*
C. crescentris	*Selfia*
C. crucifer	*Oecacta*
C. cuiabai	Unassigned
C. culiciphagus	Unassigned
C. cummingi	Unassigned
C. cunctans	Unassigned
C. cuniculus	Unassigned
C. cylindratus	*Culicoides*
C. daedaloides	*Selfia*
C. daedalus	Unassigned
C. dalessandroi	Unassigned
C. damnosus	Unassigned
C. dampfi	*Selfia*
C. darlingtonae	*Oecacta*
C. dasyheleiformis (fossil)	*Oecacta*
C. dasyophus	*Oecacta*
C. dasyops	Unassigned
C. davidi	*Hoffmania*
C. daviesi	*Selfia*
C. davisi	Unassigned
C. deanei	Unassigned
C. debilipalpis	*Haematomyidium*
C. décor	*Anilomyia*
C. definitus	*Avaritia*
C. defoliarti	*Diphaomyia*
C. dekeyseri	Unassigned
C. delfinadoae	*Avaritia*
C. dellapei	*Haematomyidium*

C. delta	*Culicoides*
C. dendriticus	*Oecacta*
C. dendrophilus	*Oecacta*
C. denisae	*Oecacta*
C. denisoni	Unassigned
C. denningi	*Selfia*
C. dentatus	Unassigned
C. denticulatus	Unassigned
C. derisor	*Oecacta*
C. desertorum	*Beltranmyia*
C. desytoculus	Unassigned
C. dewulfi	*Avaritia*
C. diabolicus	*Glaphiromyia*
C. diamouanganai	Unassigned
C. dicrourus	*Oecacta*
C. diffusus	*Hoffmania*
C. digitalis	*Monoculicoides*
C. dikhros	Unassigned
C. dingriensis	*Oecacta*
C. diplus	Unassigned
C. discrepans	*Oecacta*
C. dispar	Unassigned
C. dispersus	*Oecacta*
C. distinctipennis	Unassigned
C. distinctus	Unassigned
C. diversus	Unassigned
C. divisus	*Hoffmania*
C. doeringae	Unassigned
C. dominicanus	*Anilomyia*
C. donajil	*Oecacta*
C. downesi	Unassigned
C. duartei	Unassigned
C. dubiosum	Unassigned
C. dubitatus	Unassigned
C. dubius	*Culicoides*
C. duddingstoni	*Oecacta*
C. dukinensis	Unassigned
C. dumdumi	*Culicoides*
C. dungunensis	*Trithecoides*
C. dunhuaensis	*Jilinocoides*
C. dunni	*Selfia*
C. duodenarius	*Meijerehelea*
C. dureti	Unassigned
C. dutoiti	Unassigned
C. dycei	Unassigned
C. dzhafarovi	*Oecacta*
C. eadsi	*Haematomyidium*
C. edeni	*Diphaomyia*
C. efferus	*Anilomyia*
C. effusus	*Culicoides*
C. elbeli	*Trithecoides*
C. eldridgei	Unassigned
C. elemae	*Amossovia*
C. elizabethae	Unassigned
C. elongatulus (fossil)	Unassigned
C. elongatus	Unassigned
C. elutus	*Culicoides*
C. enderleini	Unassigned
C. engubandei	Unassigned
C. eoselficus (fossil)	Unassigned
C. equatoriensis	*Oecacta*

C. erairai	*Oecacta*
C. eremicus	Unassigned
C. erikae	*Diphaomyia*
C. eriodendroni	Unassigned
C. esakii	Unassigned
C. espinolai	Unassigned
C. estevezae	Unassigned
C. eublepharus	*Oecacta*
C. eupurus	Unassigned
C. evansi	*Diphaomyia*
C. excavatus	Unassigned
C. expalleus	*Monoculicoides*
C. exspectator	Unassigned
C. fadzili	Unassigned
C. faghihi	*Oecacta*
C. fagineus	*Culicoides*
C. farri	*Anilomyia*
C. fascipennis	*Oecacta*
C. felippebauerae	*Mataemyia*
C. fernandezi	*Oecacta*
C. fernandoi	*Hoffmania*
C. ferreyrai	Unassigned
C. festivipenis	*Oecacta*
C. fieldi	*Oecacta*
C. filamentis	Unassigned
C. filarifer	*Glaphiromyia*
C. filicinus	*Avaritia*
C. filiductus	Unassigned
C. filipalpis (fossil)	Unassigned
C. firuzae	*Oecacta*
C. flavescens	*Trithecoides*
C. flavidorsalis	Unassigned
C. flavimaculinotalis	Unassigned
C. flavipes	Unassigned
C. flavipulicaris	*Culicoides*
C. flavirostris	Unassigned
C. flaviscriptus	Unassigned
C. flaviscutatus	*Trithecoides*
C. flaviscutellaris	*Trithecoides*
C. flavisomum	Unassigned
C. flavitibialis	*Trithecoides*
C. flavivenula	*Glaphiromyia*
C. flavus	Unassigned
C. flinti	Unassigned
C. flochabonnenci	*Oecacta*
C. florenciae	*Oecacta*
C. floridensis	Unassigned
C. flukei	*Amossovia*
C. fluminensis	Unassigned
C. flumineus	Unassigned
C. fluvialis	*Oecacta*
C. fluviatilis	*Selfia*
C. foleyi	*Oecacta*
C. footei	*Diphaomyia*
C. forattinii	*Oecacta*
C. fordae	*Trithecoides*
C. fossicola	Unassigned
C. fossilis (fossil)	Unassigned
C. foxi	*Glaphiromyia*
C. fragmentum	Unassigned
C. franclemonti	Unassigned

C. franklini	*Hoffmania*
C. freeborni	*Culicoides*
C. frohnei	*Culicoides*
C. fukienensis	Unassigned
C. fukudai	Unassigned
C. fulbrighti	Unassigned
C. fulvithorax	Unassigned
C. fulvus	Unassigned
C. furcillatus	*Oecacta*
C. furens	*Oecacta*
C. furensoides	*Oecacta*
C. fuscicaudae	Unassigned
C. fuscus	Unassigned
C. gabaldoni	*Oecacta*
C. galindoi	*Oecacta*
C. galliardi	Unassigned
C. gambiae	Unassigned
C. garciai	*Avaritia*
C. gedanensis (fossil)	Unassigned
C. gejgelensis	*Oecacta*
C. gemellus	*Haemophoructus*
C. geminus	Unassigned
C. gentilis	*Haemophoructus*
C. gentiloides	*Haemophoructus*
C. geocheloneoides	*Tokunagahelea*
C. germanus	*Oecacta*
C. gewertzi	*Trithecoides*
C. giganteus	Unassigned
C. gigas	*Monoculicoides*
C. ginesi	*Oecacta*
C. glabellus	*Oecacta*
C. glabrior	*Oecacta*
C. gladysae	Unassigned
C. gluchovae	*Beltranmyia*
C. glushchenkoae	*Avaritia*
C. gorgasi	*Oecacta*
C. gornostaevae	Unassigned
C. gouldi	*Trithecoides*
C. gracilior (fossil)	Unassigned
C. gracilipes	*Oecacta*
C. grahamii	Unassigned
C. grandensis	*Monoculicoides*
C. grandibocus (fossil)	Unassigned
C. gregsoni	*Culicoides*
C. grenieri	Unassigned
C. griffithi	*Avaritia*
C. griseidorsum	*Oecacta*
C. griseolus	Unassigned
C. grisescens	*Culicoides*
C. guadeloupensis	*Oecacta*
C. guangxiensis	*Jilinocoides*
C. guarani	Unassigned
C. guerrai	*Oecacta*
C. guineensis	Unassigned
C. gulbenkiani	Unassigned
C. gutsevichi	*Oecacta*
C. guttatus	*Glaphiromyia*
C. guttifer	*Meijerehelea*
C. guttipennis	*Amossovia*
C. guyanensis	*Oecacta*
C. gymnopterus	*Haemophoructus*

C. haematopotus	*Diphaomyia*
C. haitiensis	Unassigned
C. halonostictus	*Beltranmyia*
C. hamiensis	Unassigned
C. hanae	*Oecacta*
C. haranti	*Oecacta*
C. hasegawai	*Avaritia*
C. hawsi	Unassigned
C. hayakawai	*Avaritia*
C. hayesi	*Anilomyia*
C. hegneri	*Meijerehelea*
C. heliconiae	*Glaphiromyia*
C. heliophilus	*Oecacta*
C. helveticus	*Monoculicoides*
C. hengduanshanensis	Unassigned
C. henryi	Unassigned
C. herero	Unassigned
C. hermani	*Avaritia*
C. heteroclits	*Oecacta*
C. hewitti	Unassigned
C. hieroglyphicus	*Selfia*
C. hildae	Unassigned
C. hildebrandoi	Unassigned
C. himalayae	Unassigned
C. hinmani	*Drymodesmyia*
C. hinnoi	*Trithecoides*
C. hirstus	Unassigned
C. hirsutus	Unassigned
C. hirtipennis	*Culicoides*
C. hirtulus	*Avaritia*
C. hispanicolus (fossil)	*Oecacta*
C. histrio	*Meijerehelea*
C. hitchcocki	Unassigned
C. hoffmani	*Oecacta*
C. hoffmanioides	*Haemophoructus*
C. hoguei	Unassigned
C. hokkaidoensis	Unassigned
C. holcus	Unassigned
C. hollandiensis	Unassigned
C. hollensis	*Beltranmyia*
C. homochorus	*Beltranmyia*
C. homotomus	*Monoculicoides*
C. hondurensis	*Culicoides*
C. hornsbyensis	Unassigned
C. hortensis	Unassigned
C. horticola	*Oecacta*
C. huambensis	Unassigned
C. huayingensis	Unassigned
C. huberti	*Trithecoides*
C. huffi	Unassigned
C. hui	*Avaritia*
C. hulinensis	Unassigned
C. humeralis	*Trithecoides*
C. husseyi	Unassigned
C. hyalinus	Unassigned
C. hylas	*Glaphiromyia*
C. hypsipyles	Unassigned
C. ibericus	*Pontoculicoides*
C. ibriensis	Unassigned
C. ichesi	Unassigned
C. ignacioi	*Glaphiromyia*

C. iliensis	*Oecacta*
C. imicola	*Avaritia*
C. imitador	*Oecacta*
C. imperceptus	*Avaritia*
C. impunctatus	*Culicoides*
C. impusilloides	Unassigned
C. indecorus	Unassigned
C. indianus	*Culicoides*
C. inexploratus	Unassigned
C. inflatipalpalis	Unassigned
C. infulatus	Unassigned
C. innoxius	*Culicoides*
C. inornatithorax	*Trithecoides*
C. insignipennis	*Culicoides*
C. insignis	*Hoffmania*
C. insinuatus	*Oecacta*
C. insolatus	*Drymodesmyia*
C. insulanus	Unassigned
C. insularis	*Oecacta*
C. interrogatus	Unassigned
C. inthanonensis	*Oecacta*
C. inyoensis	*Diphaomyia*
C. iphthimus	Unassigned
C. iranicus	*Oecacta*
C. iriartei	*Culicoides*
C. irregularis	Unassigned
C. irwini	Unassigned
C. isechnoensis	*Meijerehelea*
C. isioloensis	Unassigned
C. jacksoni	*Selfia*
C. jacobsoni	*Avaritia*
C. jamaicensis	*Drymodesmyia*
C. jamesi	*Selfia*
C. jamnbacki	Unassigned
C. japonicus	*Beltranmyia*
C. javae	Unassigned
C. javanicus	Unassigned
C. jefferyi	Unassigned
C. jianfenglingensis	Unassigned
C. jimmiensis	*Culicoides*
C. jonesi	*Drymodesmyia*
C. jouberti	Unassigned
C. jucundus (fossil)	Unassigned
C. juddi	*Avaritia*
C. jumineri	*Oecacta*
C. jurbergi	*Diphaomyia*
C. jurensis	*Oecacta*
C. jurutiensis	*Haematomyidium*
C. kaimosiensis	Unassigned
C. kaluginae (fossil)	Unassigned
C. kampa	*Haematomyidium*
C. kamrupi	*Pontoculicoides*
C. kanagai	Unassigned
C. kangdingewnsis	*Fastus*
C. karagiensis	*Oecacta*
C. karajevi	*Oecacta*
C. karakumensis	*Oecacta*
C. karenensis	Unassigned
C. kasimi	*Oecacta*
C. kayi	*Marksomyia*
C. kelantanensis	*Avaritia*

C. kelinensis	Unassigned
C. kepongensis	*Avaritia*
C. kerichoensis	Unassigned
C. kettlei	*Haematomyidium*
C. kibatiensis	Unassigned
C. kibunensis	Unassigned
C. kinabaluensis	*Hoffmania*
C. kinari	*Haemophoructus*
C. kingi	*Oecacta*
C. kirbyi	Unassigned
C. kirgizicus	*Oecacta*
C. kirinensis	*Culicoides*
C. kisangkini	*Haemophoructus*
C. klossi	*Culicoides*
C. knowltoni	*Beltranmyia*
C. kobae	Unassigned
C. kolymbiensis	Unassigned
C. komarovi	Unassigned
C. konmiaoensis	*Sinocoides*
C. koreensis	*Beltranmyia*
C. korossoensis	Unassigned
C. kotonkan	Unassigned
C. krameri	Unassigned
C. kribiensis	Unassigned
C. krombeini	Unassigned
C. kucheensis	Unassigned
C. kugitangi	*Oecacta*
C. kumbaensis	Unassigned
C. kurensis	*Oecacta*
C. kusaiensis	Unassigned
C. kuscheli	Unassigned
C. kyotoensis	*Avaritia*
C. kyushuensis	Unassigned
C. labis	Unassigned
C. lacustris	Unassigned
C. lahontan	*Culicoides*
C. laimargus	Unassigned
C. lamborni	Unassigned
C. landauae	*Oecacta*
C. lanei	*Oecacta*
C. langeroni	*Oecacta*
C. lansangensis	*Culicoides*
C. lanyuensis	*Culicoides*
C. laoensis	*Trithecoides*
C. lasaensis	Unassigned
C. latifrons	Unassigned
C. latifrontis	*Oecacta*
C. latipennis	Unassigned
C. laurae (fossil)	Unassigned
C. leanderensis	Unassigned
C. leechi	Unassigned
C. leei	Unassigned
C. lenae	*Oecacta*
C. lenti	Unassigned
C. leoni	*Oecacta*
C. leopoldoi	*Oecacta*
C. leucostictus	Unassigned
C. lichyi	*Oecacta*
C. lieni	*Oecacta*
C. liliputanus (fossil)	Unassigned
C. limai	*Oecacta*
C. limonensis	*Oecacta*
C. lini	Unassigned
C. linleyi	Unassigned
C. lisicarruni	Unassigned
C. liubaensis	*Beltranmyia*
C. liui	*Culicoides*
C. liukueiensis	Unassigned
C. lobatoi	Unassigned
C. loisae	*Silvaticulicoides*
C. longicercus	*Trithecoides*
C. longicollis	*Monoculicoides*
C. longior	Unassigned
C. longipalpis	*Culicoides*
C. longipennis	*Oecacta*
C. longiporus	Unassigned
C. longiradialis	Unassigned
C. longirostris	Unassigned
C. lopesi	*Oecacta*
C. lophortygis	Unassigned
C. loughnani	*Drymodesmyia*
C. loxodontis	*Avaritia*
C. luganicus	*Oecacta*
C. luglani	Unassigned
C. lulianchengi	Unassigned
C. lutealaris	*Anilomyia*
C. luteolus	*Trithecoides*
C. luteoventus	*Culicoides*
C. lutzi	*Glaphiromyia*
C. lyrinotatus	*Oecacta*
C. maai	*Avaritia*
C. macclurei	*Avaritia*
C. macfiei	*Trithecoides*
C. macieli	*Oecacta*
C. macintoshi	Unassigned
C. mackerrasi	Unassigned
C. macrostigma	*Oecacta*
C. maculatus	*Avaritia*
C. maculipennis	*Haemophoructus*
C. maculiscutellaris	Unassigned
C. maculitibialis	*Trithecoides*
C. madagascarensis	Unassigned
C. magnificus	*Beltranmyia*
C. magnipalpis	*Oecacta*
C. magnipictus	Unassigned
C. magnithecalis	*Meijerehelea*
C. magnus	Unassigned
C. majorinus	Unassigned
C. malariologiensis	Unassigned
C. malayae	*Culicoides*
C. malevillei	*Oecacta*
C. mamaensis	Unassigned
C. mammalicolus (fossil)	Unassigned
C. manchuriensis	*Beltranmyia*
C. manikumari	*Trithecoides*
C. marcleti	*Oecacta*
C. marginalis	Unassigned
C. marginatus	Unassigned
C. marginus	Unassigned
C. margipictus	Unassigned
C. marinkellei	*Culicoides*
C. maritime	*Oecacta*

C. marksi	Unassigned
C. marmoratus	Unassigned
C. marshi	*Anilomyia*
C. martinezi	*Oecacta*
C. martyrius	*Haematomyidium*
C. maruim	*Glaphiromyia*
C. mathisi	Unassigned
C. matsuzawai	*Trithecoides*
C. mayeri	Unassigned
C. mcdonaldi	Unassigned
C. mcdowelli	Unassigned
C. mckeeveri	*Diphaomyia*
C. mcmillani	Unassigned
C. megacanthus (fossil)	Unassigned
C. meijerei	Unassigned
C. melanesiae	Unassigned
C. melleus	Unassigned
C. mellipes	*Haemophoructus*
C. menghaiensis	Unassigned
C. menglaensis	Unassigned
C. meridionalis	Unassigned
C. mesghalii	*Oecacta*
C. metagonatus	*Anilomyia*
C. micheli	Unassigned
C. micromaculatus	Unassigned
C. midorensis	*Oecacta*
C. miharai	*Oecacta*
C. mihunensis	*Jilinocoides*
C. mikros	*Tokunagahelea*
C. milnei	Unassigned
C. minasensis	Unassigned
C. minimaporus	*Jilinocoides*
C. minimus	*Avaritia*
C. minipalpis	*Avaritia*
C. minutunculus	Unassigned
C. minutus	Unassigned
C. miocenicus (fossil)	Unassigned
C. miombo	*Avaritia*
C. mirsae	*Oecacta*
C. mirzaevi	*Pontoculicoides*
C. mississippiensis	*Beltranmyia*
C. miuntissimus	*Oecacta*
C. mohave	Unassigned
C. mojingaensis	*Oecacta*
C. molestior	Unassigned
C. molestus	Unassigned
C. mollis	Unassigned
C. molotovae	Unassigned
C. mongolensis	*Oecacta*
C. monicae	*Anilomyia*
C. monocylichnus	*Trithecoides*
C. monoensis	Unassigned
C. monothecalis	Unassigned
C. montanus	*Avaritia*
C. monticola	*Oecacta*
C. moreensis	Unassigned
C. moreli	Unassigned
C. morisitai	*Oecacta*
C. mortivallis	Unassigned
C. motoensis	Unassigned
C. moucheti	Unassigned

C. mukerjii	*Diphaomyia*
C. mulrennani	*Silvaticulicoides*
C. multifarious	Unassigned
C. multifidous	*Beltranmyia*
C. multimaculatus	Unassigned
C. multinotatae	Unassigned
C. multipunctatus	*Selfia*
C. murphyi	Unassigned
C. murrayi	*Avaritia*
C. murtalai	Unassigned
C. musajevi	*Beltranmyia*
C. muscicola	Unassigned
C. mykytowyczi	Unassigned
C. mystacinus	Unassigned
C. nagarzensis	Unassigned
C. nairobiensis	Unassigned
C. nampui	*Trithecoides*
C. namulus	Unassigned
C. nanellus	Unassigned
C. nanpingensis	Unassigned
C. nanus	Unassigned
C. narrabeenensis	Unassigned
C. nasuensis	Unassigned
C. nattaiensis	Unassigned
C. navaiae	*Beltranmyia*
C. nayabazari	*Avaritia*
C. neavei	Unassigned
C. neghmei	*Oecacta*
C. neoangolensis	Unassigned
C. neofagineus	*Culicoides*
C. neomelanesiae	Unassigned
C. neomontanus	*Culicoides*
C. neopalpalis	Unassigned
C. neoparaensis	*Oecacta*
C. neopulicaris	*Culicoides*
C. neoschultzei	Unassigned
C. nevilli	Unassigned
C. newsteadi	*Culicoides*
C. nibleyi	*Oecacta*
C. nielamensis	Unassigned
C. niger	*Oecacta*
C. nigeriae	Unassigned
C. nigrigenus	*Anilomyia*
C. nigripennis	Unassigned
C. nigripes	*Avaritia*
C. nigritus	Unassigned
C. nigroannulatus	*Culicoides*
C. nigrosignatus	Unassigned
C. nigrus	Unassigned
C. nilogenus	Unassigned
C. nilophilus	Unassigned
C. niphanae	*Avaritia*
C. nipponensis	*Culicoides*
C. nitens	*Haemophoructus*
C. nivosus	Unassigned
C. nobrei	Unassigned
C. nocivus	Unassigned
C. noshaquensis	*Oecacta*
C. notatus	Unassigned
C. novaguineanus	Unassigned
C. novairelandi	Unassigned

C. novamexicanus	Unassigned
C. nubeculosus	*Monoculicoides*
C. nudipalpis	*Avaritia*
C. nudipennis	*Oecacta*
C. nukabirensis	Unassigned
C. nunomemoguri	*Oecacta*
C. nuntius	Unassigned
C. nupurius	*Avaritia*
C. nyakini	*Haemophoructus*
C. nyungnoi	*Trithecoides*
C. obesus (fossil)	Unassigned
C. obnoxius	*Oecacta*
C. obscuratus (fossil)	Unassigned
C. obsoletus	*Avaritia*
C. obuncus (fossil)	Unassigned
C. occidentalis	*Monoculicoides*
C. ochraceimaculatus	*Beltranmyia*
C. ochraceipennis	*Beltranmyia*
C. ochrothorax	Unassigned
C. octosignatus	Unassigned
C. oculatus	Unassigned
C. ocumarensis	*Glaphiromyia*
C. odai	Unassigned
C. odiatus	*Oecacta*
C. odiosus	Unassigned
C. okazawai	Unassigned
C. oklahomensis	*Amossovia*
C. olyslageri	Unassigned
C. omogensis	*Oecacta*
C. onderstepoortensis	Unassigned
C. onoi	*Oecacta*
C. oregonensis	Unassigned
C. orescius	*Oecacta*
C. orestes	*Hoffmania*
C. orientalis	*Avaritia*
C. orjuelai	*Avaritia*
C. ornatus	Unassigned
C. ostroushkoae	*Silvaticulicoides*
C. ousairani	*Amossovia*
C. ovalis	Unassigned
C. owyheensis	Unassigned
C. oxianus	*Beltranmyia*
C. pabloi	Unassigned
C. pachymerus	*Oecacta*
C. padusae	*Culicoides*
C. paksongi	*Trithecoides*
C. palauensis	Unassigned
C. palawanensis	Unassigned
C. pallidicornis	*Oecacta*
C. pallidimaculosus	Unassigned
C. pallidizonatus	Unassigned
C. pallidothorax	Unassigned
C. pallidus	*Oecacta*
C. palmerae	Unassigned
C. palpalis	*Hoffmania*
C. palpifer	*Trithecoides*
C. palpisimilis	*Avaritia*
C. pamiricus	*Oecacta*
C. pampaensis	Unassigned
C. pampangensis	Unassigned
C. pampoikilus	Unassigned

C. panamensis	*Drymodesmyia*
C. pancensis	Unassigned
C. pangkorensis	*Avaritia*
C. papillatus	Unassigned
C. papilliger	Unassigned
C. papuensis	Unassigned
C. parabarnetti	*Trithecoides*
C. parabubalus	*Hoffmania*
C. paradisionensis	Unassigned
C. paraensis	Unassigned
C. paraflavescens	*Trithecoides*
C. paragarciai	Unassigned
C. parahumeralis	*Trithecoides*
C. paraignacioi	*Hoffmania*
C. paraimpunctatus (fossil)	Unassigned
C. paraliui	*Culicoides*
C. paramalayae	*Hoffmania*
C. parapiliferus	Unassigned
C. parararipalpis	*Trithecoides*
C. parascopus	Unassigned
C. parauapebensis	Unassigned
C. parroti	*Monoculicoides*
C. parvimaculatus	Unassigned
C. parviscriptus	Unassigned
C. parvulus	Unassigned
C. pastus	*Avaritia*
C. patulipalpis	*Oecacta*
C. paucienfuscatus	*Oecacta*
C. paulipictus	Unassigned
C. pechumani	*Avaritia*
C. pecosensis	*Amossovia*
C. peculiaris	*Diphaomyia*
C. peliliouensis	Unassigned
C. pellucidus	Unassigned
C. pendleburyi	*Trithecoides*
C. pentamaculatus	*Oecacta*
C. perakensis	Unassigned
C. peregrinus	*Culicoides*
C. perettii	Unassigned
C. perornatus	Unassigned
C. peruvianus	Unassigned
C. petersi	Unassigned
C. petronius	*Oecacta*
C. phaeonotus	*Oecacta*
C. phlebotomus	*Macfiella*
C. photophilus	Unassigned
C. picadoae	Unassigned
C. pichindensis	Unassigned
C. pictellum	Unassigned
C. pictilis	*Avaritia*
C. pictipennis	*Oecacta*
C. picturatus	*Oecacta*
C. pifanoi	*Oecacta*
C. pikongkoi	*Haemophoructus*
C. piliferus	Unassigned
C. pilosipennis	Unassigned
C. pilosus	*Drymodesmyia*
C. platiradius	Unassigned
C. plaumanni	*Hoffmania*
C. poikilonotus	*Drymodesmyia*
C. polynesiae	Unassigned

C. polypori	*Hoffmania*
C. polystictus	*Selfia*
C. pongsomiensis	*Oecacta*
C. popayanensis	*Anilomyia*
C. poperonghensis	*Oecacta*
C. posoensis	Unassigned
C. praesignis	Unassigned
C. pretoriensis	Unassigned
C. profundus	Unassigned
C. prolixipalpis	*Meijerehelea*
C. propinquus	*Oecacta*
C. propriipennis	*Oecacta*
C. prussicus (fossil)	Unassigned
C. pseudocordiger	Unassigned
C. pseudocrescentis	Unassigned
C. pseudodiabolicus	*Hoffmania*
C. pseudoheliconiae	Unassigned
C. pseudoheliophilus	*Oecacta*
C. pseudolangeroni	Unassigned
C. pseudopallidipennis	Unassigned
C. pseudopallidus	*Oecacta*
C. pseudopalpalis	*Avaritia*
C. pseudoreticulatus	Unassigned
C. pseudosalinarius	Unassigned
C. pseudostigmatus	Unassigned
C. pseudoturgidus	*Avaritia*
C. pulchellus	Unassigned
C. pulchripennis	*Oecacta*
C. pulicaris	Unassigned
C. pumilus	Unassigned
C. puncticeps	Unassigned
C. puncticollis	*Monoculicoides*
C. punctithorax	Unassigned
C. pungens	*Avaritia*
C. pungobovis	Unassigned
C. puracensis	*Avaritia*
C. puripennis	*Oecacta*
C. purus	Unassigned
C. pusilloides	*Avaritia*
C. pusillus	*Avaritia*
C. pycnostictus	Unassigned
C. pygmaeus	Unassigned
C. qabdoensis	Unassigned
C. qinghaiensis	Unassigned
C. qiongzhongensis	Unassigned
C. quadratus	*Culicoides*
C. quadrisignatus	Unassigned
C. quadrivittatus	Unassigned
C. quaiparaensis	*Oecacta*
C. quatei	*Avaritia*
C. quaterifasciatus	Unassigned
C. queenslandae	Unassigned
C. quinquelineatus	Unassigned
C. quinquermaculatus	Unassigned
C. rabauli	Unassigned
C. rachoui	*Oecacta*
C. radicitus	*Avaritia*
C. radiomaculatus	Unassigned
C. rageaui	Unassigned
C. rangeli	*Oecacta*
C. raposoensis	Unassigned

C. raripalpis	*Trithecoides*
C. rariradialis	*Haemophoructus*
C. rarus	*Meijerehelea*
C. ravus	Unassigned
C. reconditus	*Oecacta*
C. recurvus	*Culicoides*
C. reevesi	*Haematomyidium*
C. remerki	Unassigned
C. remotus	Unassigned
C. reticulatus	*Oecacta*
C. rhizophorensis	Unassigned
C. rhombus	Unassigned
C. ribeiroi	Unassigned
C. riebi	Unassigned
C. riethi	*Monoculicoides*
C. riggsi	Unassigned
C. riouxi	*Oecacta*
C. ritzei	*Oecacta*
C. robini	Unassigned
C. rochemus	Unassigned
C. rodriguezi	*Oecacta*
C. ronderosae	*Diphaomyia*
C. rostratus	*Anilomyia*
C. roswelli	Unassigned
C. rugulithecus	*Trithecoides*
C. ruiliensis	Unassigned
C. ruizi	*Hoffmania*
C. rutilis	Unassigned
C. ryckmani	*Drymodesmyia*
C. saboyae	Unassigned
C. sabroskyi	Unassigned
C. saevanicus	*Oecacta*
C. saevus	*Pontoculicoides*
C. sahariensis	*Oecacta*
C. saintjusti	*Hoffmania*
C. sajanicus	*Oecacta*
C. salebrosus	Unassigned
C. salihi	Unassigned
C. salinarius	*Beltranmyia*
C. saltaensis	Unassigned
C. saltonensis	*Culicoides*
C. samoensis	Unassigned
C. sanguisuga	*Avaritia*
C. saninensis	*Oecacta*
C. sanmartini	Unassigned
C. santanderi	Unassigned
C. santonicus	*Oecacta*
C. sarawakensis	*Trithecoides*
C. saundersi	Unassigned
C. scanloni	Unassigned
C. schramae	Unassigned
C. schultzei	Unassigned
C. scopus	*Glaphiromyia*
C. scoticus	*Avaritia*
C. segnis	*Oecacta*
C. seimi	*Avaritia*
C. sejfadinei	*Pontoculicoides*
C. selangorensis	*Avaritia*
C. sellersi	Unassigned
C. semicircum	Unassigned
C. semimaculatus	*Oecacta*

C. sensillatus	*Oecacta*
C. septemmaculatus	Unassigned
C. sergenti	*Oecacta*
C. shahgudiani	*Oecacta*
C. shaklawensis	*Oecacta*
C. shermani	Unassigned
C. shimoniensis	Unassigned
C. shortti	*Oecacta*
C. siamensis	*Avaritia*
C. sibiricus	*Beltranmyia*
C. sibiricus (fossil)	Unassigned
C. sierrensis	*Culicoides*
C. sigaensis	*Avaritia*
C. sigmoidus	Unassigned
C. signatus	Unassigned
C. sikkimensis	*Avaritia*
C. silverstrii	Unassigned
C. similis	Unassigned
C. simulans	Unassigned
C. simulator	*Oecacta*
C. sinanoensis	*Avaritia*
C. sitiens	*Drymodesmyia*
C. slovacus	*Pontoculicoides*
C. smeei	Unassigned
C. snowi	Unassigned
C. sogdianus	*Oecacta*
C. sommermanae	*Culicoides*
C. sonorensis	*Monoculicoides*
C. sordidellus	*Culicoides*
C. sousadiasi	Unassigned
C. speciosus (fossil)	*Oecacta*
C. sphagnumensis	*Beltranmyia*
C. sphenostylus (fossil)	Unassigned
C. spiculae	*Haemophoructus*
C. spinifer	Unassigned
C. spinosus	*Silvaticulicoides*
C. spinoverbosus	Unassigned
C. spinulosus	Unassigned
C. spurius	*Oecacta*
C. stagetus	Unassigned
C. stanicicus	*Oecacta*
C. stellifer	*Oecacta*
C. stepicola	*Oecacta*
C. stercorarius	Unassigned
C. stigma	*Monoculicoides*
C. stigmalis	*Selfia*
C. stigmaticus	Unassigned
C. stilobezzioides	*Wirthomyia*
C. stonei	Unassigned
C. suarezi	*Avaritia*
C. subfagineus	Unassigned
C. subfasciipennis	*Oecacta*
C. subflavescens	*Trithecoides*
C. subgedanensis (fossil)	Unassigned
C. subgedanicus (fossil)	Unassigned
C. subimmaculatus	Unassigned
C. sublettei	*Silvaticulicoides*
C. subltifrontis	*Oecacta*
C. submagnesianus	Unassigned
C. subneglectus	*Oecacta*
C. suborientalis	*Avaritia*

C. subpalpifer	*Trithecoides*
C. subpunctatus	Unassigned
C. subravus	Unassigned
C. subschultzei	Unassigned
C. subsylvarum	*Oecacta*
C. succineus (fossil)	*Oecacta*
C. succivarius (fossil)	*Oecacta*
C. suiyangensis	*Avaritia*
C. sumatrae	*Culicoides*
C. superfluthecus	Unassigned
C. superfulvus	Unassigned
C. suspectus	Unassigned
C. swaminathi	*Oecacta*
C. sylvarum	*Oecacta*
C. sylvicola	Unassigned
C. tadzhikistanicus	*Oecacta*
C. tahemanensis	*Culicoides*
C. taimyricus (fossil)	Unassigned
C. taiwanensis	Unassigned
C. talgariensis	*Oecacta*
C. tamada	*Trithecoides*
C. tamaensis	Unassigned
C. tamboensis	*Oecacta*
C. taonanensis	*Monoculicoides*
C. tarapaca	Unassigned
C. tatebeae	Unassigned
C. tauffiebi	Unassigned
C. tauricus	*Pontoculicoides*
C. tavaresi	Unassigned
C. tawauensis	*Haemophoructus*
C. tayulingensis	Unassigned
C. tbilisicus	*Oecacta*
C. tentorius	*Oecacta*
C. tenuifasciatus	*Hoffmania*
C. tenuilosus	*Oecacta*
C. tenuipalpis	*Trithecoides*
C. tenuipennis (fossil)	Unassigned
C. tenuistylus	*Selfia*
C. teretipalpis	Unassigned
C. testudinalis	Unassigned
C. tetrathyris	*Oecacta*
C. thurmanae	*Avaritia*
C. tianmushanensis	Unassigned
C. tiaratus	*Oecacta*
C. tibetensis	*Avaritia*
C. tidwelli	*Hoffmania*
C. tienhsiangensis	Unassigned
C. tissoti	Unassigned
C. tobaensis	*Avaritia*
C. tohokuensis	*Oecacta*
C. tokunagai	*Oecacta*
C. tonmai	*Trithecoides*
C. tororensis	Unassigned
C. tororoensis	Unassigned
C. torreyae	*Haematomyidium*
C. torridus	*Drymodesmyia*
C. towadaensis	*Culicoides*
C. toyamaruae	*Beltranmyia*
C. transferrans	*Oecacta*
C. translucens	Unassigned
C. translucens	Unassigned

C. trapidoi	Unassigned
C. travassosi	*Hoffmania*
C. travisi	Unassigned
C. triallantionis	*Trithecoides*
C. triangulatus	*Oecacta*
C. trichopis	Unassigned
C. trifasciellus	Unassigned
C. trifidus	Unassigned
C. trilineatus	*Oecacta*
C. trimaculipennis	*Hoffmania*
C. trinidadensis	*Hoffmania*
C. tripallidus	Unassigned
C. trisignatus	Unassigned
C. tristanii	Unassigned
C. tristriatulus	*Culicoides*
C. tritenuifasciatus	Unassigned
C. trivittatus	*Oecacta*
C. trizonatus	Unassigned
C. tropicalis	Unassigned
C. trouilleti	Unassigned
C. truncatus (fossil)	Unassigned
C. truncorum	*Oecacta*
C. tsutaensis	Unassigned
C. tuamsombooni	*Oecacta*
C. tugaicus	*Oecacta*
C. tunkinensis	Unassigned
C. turanicus	*Oecacta*
C. turgidus	*Avaritia*
C. tuttifrutti	*Avaritia*
C. tyrrelli (fossil)	Unassigned
C. ukrainensis	*Oecacta*
C. uncistylus	Unassigned
C. undentaris	*Oecacta*
C. unetensis	Unassigned
C. unicolor	Unassigned
C. unicus	*Haemophoructus*
C. uniradialis	*Oecacta*
C. univittatus	*Oecacta*
C. uruguayensis	Unassigned
C. usingeri	*Silvaticulicoides*
C. ustinovi	*Oecacta*
C. utahensis	Unassigned
C. utowana	Unassigned
C. vagus	Unassigned
C. variatus	Unassigned
C. variifrons	*Oecacta*
C. variipennis	*Monoculicoides*
C. venezulensis	*Oecacta*
C. ventralis (fossil)	Unassigned
C. venustus	*Hoffmania*
C. verbosus	Unassigned
C. verecundus	*Hoffmania*
C. vetustus	Unassigned
C. vexans	*Oecacta*
C. vicinus	Unassigned
C. victoriae	Unassigned
C. vidourlensis	*Oecacta*
C. villosipennis	*Amossovia*
C. vitreipennis	*Oecacta*
C. vitshumbiensis	Unassigned
C. vomensis	Unassigned
C. wadai	*Avaritia*
C. walkeri	Unassigned
C. wandashanensis	Unassigned
C. wansoni	Unassigned
C. wardi	Unassigned
C. waringi	Unassigned
C. wenzeli	Unassigned
C. werneri	Unassigned
C. williamsi	Unassigned
C. willistoni	*Macfiella*
C. williwilli	Unassigned
C. wirthi	Unassigned
C. wirthomyia	*Drymodesmyia*
C. wisconsiensis	Unassigned
C. wisconsinensis	*Beltranmyia*
C. wokei	*Oecacta*
C. wuyiensis	Unassigned
C. xanifer	*Hoffmania*
C. xanthoceras	Unassigned
C. xanthogaster	Unassigned
C. xinjiangensis	Unassigned
C. xuguitensis	Unassigned
C. yamii	*Culicoides*
C. yanbianensis	Unassigned
C. yankari	Unassigned
C. yasumatsui	Unassigned
C. yemenensis	Unassigned
C. yoosti (fossil)	Unassigned
C. yoshimurai	Unassigned
C. youngi	Unassigned
C. yuchihensis	*Culicoides*
C. yui	*Oecacta*
C. yukonensis	*Culicoides*
C. yunanensis	Unassigned
C. zentae	*Marksomyia*
C. zhogolevi	*Oecacta*
C. zikaensis	Unassigned
C. zuluensis	Unassigned
C. zumbadoi	Unassigned

Parasite morphology: Ceratopogonid midges form 4 different types of developmental stages: eggs; larvae; pupae; and adults. The eggs are small (250-500 μm long), cylindrical to crescent-shaped, initially white in colour but gradually darkening to brown, and covered with minute projections. The larvae and long and slender with tubular segmented bodies ranging up to 2-5 mm in length. They have a small dark yellow to brown head capsule possessing mouthparts with non-opposable mandibles that move vertically or partially rotate to scrape, tear and seize items. The buccal cavity has a complex sclerotized epipharynx with pharyngeal combs. The cylindrical body is translucent white with 12 segments and no appendages except for 4 pairs of caudal setae. There are 4 larval instars which depend on cutaneous respiration (most lack spiracles) and osmoregulation via narrow bifid anal papillae (everted sporadically through the anus when alive but usually retracted in preserved specimens). Pupae are light brown in colour and have elongate conical bodies up to 2-3 mm long. The broader anterior end has a pair of short prothoracic respiratory horns with numerous tiny spiracular openings at their tips. The long body appears segmented as details of the internal developmental stages are visible, including developing adult appendages and cuticular features such as tubercles, spines and setae. Adult midges are small winged insects usually 1.0-2.5 mm long (some up to 4 mm) with grey to brown (sometimes black) bodies with an iridescent sheen. They have 3 distinct body parts: a small conical head, a humped thorax and an ovoid abdomen. The head has 2 large well-developed compound eyes, 2 elongate filamentous antennae (basal scape, enlarged pedicel containing Johnston's organ, and 13 flagellomeres) and forward-projecting biting/piercing mouthparts (well developed in females, particularly in blood-sucking species, but reduced in males). The stylet-like mouthparts are contained in a short proboscis (sheath formed by labium with terminal labella) and consist of an upper labrum-epipharynx, a pair of blade-like mandibles (with teeth along the inner edges), a pair of curved lacinae (maxillae) and a ventral hypopharynx (with a longitudinal groove along which saliva flows during feeding). The mouthparts are flanked by maxillary palps each with 5 segments, the third segment being enlarged and bearing specialized sensilla in a sensory pit. The alimentary tract consists of a tubular oesophagus leading to a globular proventriculus where dilute fluids (e.g. plant sugars) may be shunted for storage into a saccular diverticulum (crop) whereas nutrient-rich foods (e.g. blood) are routed to the tubular midgut (for digestion) with waste passing through the hindgut (connected to Malpighian excretory tubules), rectum (with expandable ampulla) and terminal anus. The globular thorax is often black spotted and the dorsal scutum appears humped over the head with a distinct set of small humeral pits along the anterior edge. The thorax bears 2 pairs of respiratory spiracles (anterior mesothoracic pair and posterior metathoracic pair) and often contains small bristles. The dorsal thorax gives rise to a pair of elongate narrow wings which appear hairy and mottled (spotted) due to distinct patterns of tiny setae (macro- and micro-trichia) on the wing surface (rather than pigment). The wing membranes are supported by 6 primary veins [costa (C), subcosta (Sc), radius (R), media (M), cubitus (Cu), anal (A)] with distinct patterns (notably forked M veins, R-M cross-veins present, and 2 radial cells present). At rest, the wings are folded over each other and held flat on abdomen. The second pair of wings in all dipteran flies are highly reduced to a pair of posterior knob-like halteres used to stabilize flight. The ventral thorax gives rise to 3 pairs of short stout legs, each with 5 segments (coxa, trochanter, femur, tibia, and tarsus), the latter carrying a pair of claws surrounding a central empodium. The ovoid abdomen has 11 segments and 7 pairs of dorso-lateral spiracles. The terminal segments are modified by the presence of ventral genital plates and ducts and external genital appendages (female ovipositor, male claspers). Males have 2 testes connected by tubular vas deferens to a seminal vesicle (with lateral accessory glands) leading to an ejaculatory duct with a terminal bulb located beneath the genital plate housing the retractable copulatory aedeagus. Females have 2 ovaries (with polytrophic ovarioles) connected by oviducts to a globular uterus, often with associated spermatheca and accessory glands, leading to the vulva.

Site of infection: Only adult female midges of some *Culicoides* spp. are transient blood-feeders on vertebrate hosts. They typically have a narrow range of preferred hosts in tropical regions, but will feed on other available hosts in cooler temperate regions. Many species appear to feed primarily on mammals, whereas others feed preferentially on birds, reptiles or amphibians. A small range of species have been found to bite humans, domestic animals (esp. cattle, sheep and horses), smaller ground-dwelling mammals, poultry and aviary birds. Some species have also been found to exhibit site preferences, some (such as *C. brevitarsis*) feeding along the dorsal mid-line, while others (such as *C. marksi*) feed on the legs and belly. All other developmental stages (eggs, larvae and pupae) are free-living in aquatic or semi-aquatic habitats (ranging from ponds to bogs to decaying organic material).

Pathogenesis: Although midges have shorter mouthparts than mosquitoes, they inflict more painful bites by using their cutting mandibles to puncture/lacerate the host skin causing blood to seep into surrounding tissues. Female midges are pool feeders and imbibe this blood through a food canal formed by the other mouthparts and the pumping action of strong pharyngeal muscles. During feeding, they inject saliva containing vasoactive compounds with anti-coagulant, anti-platelet and vasodilatory properties. Midge bites may cause significant fly worry to their hosts, especially when conditions favour population explosions leading to dense swarms. Animals become stressed, irritated and annoyed and may exhibit extravagant avoidance behaviours resulting in energy expenditure, biting stress and reduced grazing leading to decreased productivity and self-trauma predisposing to secondary infections. Lesions may develop at bite sites with papule formation, inflammation and pruritus. Many individuals may also develop hypersensitivity reactions (both immediate and delayed) after repeated exposure to midge salivary components. Some humans develop reactive papules with intense pruritus which may last for days, whereas some animals may develop severe papular dermatitis which lasts for weeks. Horses may develop a condition known as 'sweet itch' or 'Queensland itch' with intense irritation, papules, ulceration, crusting, scaling, severe pruritus, lichenification, hyperpigmentation, excoriation and alopecia, exacerbated by self-trauma (rubbing, scratching). Lesions may be present dorsally or ventrally, particularly along the back, withers and base of the

tail. Horses of all breeds and sexes may be affected, usually annually when conditions favour midge swarms. Biting midges have been shown to act as both biological and mechanical vectors for various infectious diseases, particularly arthropod-borne (arbo-) viruses, including bunyaviruses (causing Crimean-Congo haemorrhagic fever, Oropouche, Shuni and Dugbe in humans and cattle, and a range of conditions in wildlife), reoviruses (causing African horse sickness, bluetongue in livestock, epizootic haemorrhagic fever in deer, and a number of regional specific conditions in livestock), and rhabdoviruses (causing bovine ephemeral fever). Biting midges also transmit filarial nematodes (causing mansonellosis in humans and onchocerciasis in animals), and haemosporidia (causing leucocytozoonosis and haemoproteid lesions in birds).

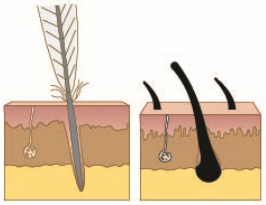
Developmental cycle and mode of transmission: Biting midges are free-living insects for their entire life-cycles, but the female adult stages of some species are transient ectoparasites biting vertebrate hosts and feeding on their blood to obtain nutrients for egg production. Like all dipteran insects, midges undergo complete metamorphosis whereby grub-like larvae undergo pupation and transform into winged adults. Gravid females are oviparous and oviposit eggs in batches in a wide range of aquatic and semi-aquatic habitats extending from the tropics to subpolar regions. The eggs hatch in 2-7 days releasing vermiform segmented larvae which live, feed and develop in their moist environments. Larvae have been found in open waters (including standing or slow-flowing saline and freshwater ponds, streams and river margins), water-logged or damp earth (freshwater and tidal marshes, mangroves, swamps, bogs, peats, mud holes and wet soil) and decaying organic material (tree holes and other cavities in wood, rotting cacti, decaying vegetation, and animal dung). The species *C. brevitarsis* develops mainly in cattle dung. The larvae of some species are good swimmers with a distinctive serpentine side-to-side thrashing motion in water, some browse over wet or submerged substrates, while others burrow into moist semi-solid substrates. *Culicoides* larvae prefer organically-enriched substrates where they feed opportunistically on detritus and particulate material, including micro-organisms (bacteria, fungi, algae, diatoms, protozoa) and small invertebrates (rotifers, oligochaetes, nematodes, insect larvae). The larvae grow and moult through 4 instars over 2-6 weeks, although many species may extend that period for up to a year when they overwinter as larvae for several months, or when larvae become dormant during hot summer months. Pupation usually occurs in spring or early summer, when fourth larval instars form pupal cases in which to undergo metamorphosis to adults over 3-10 days. Pupae occur near the surface of water bodies or moist substrates so they can respire through their anterior prothoracic horns. Male midges often emerge just before females and mating usually occurs in swarms (coincident with synchronous/seasonal development). Both males and females may feed on nectar from flowering plants, but the females of some species are anautogenous and require a bloodmeal from a vertebrate hosts before they can lay eggs (although some species are autogenous and emerge with enough nutrients to undergo at least the first gonotrophic cycle). Females seek hosts using chemical and thermal cues (odours and warmth) and they usually feed at 3-4 day intervals on mammals, birds, reptiles and even other invertebrates. Different *Culicoides* spp. may exhibit some degree of host specificity or at least host preferences (e.g. *C. brevitarsis* feeds primarily on cattle, while *C. imicola* feeds mainly on horses). Most female midges only undergo 2-3 gonotrophic cycles after feeding, with egg development taking 3-10 days before oviposition in moist environments. Females may lay from 25-450 eggs over their life-spans, which may be as brief as 2-7 weeks but may be extended for several months (possibly 2 years?) in colder subpolar regions. The females of most species feed in the early morning or late afternoon (crepuscular activity) although some may feed overnight (nocturnal). Feeding is also more prevalent and frequent during overcast or dull humid weather. Many environmental factors have been found to influence midge flight activity, including temperature, humidity, light intensity, lunar cycles, barometric pressure and wind velocity, but adult midges are generally not strong fliers and are found close to aquatic/semi-aquatic habitats suitable for larvae. Geographic and ecological factors have been used to recognize regionally-specific species-groups, with ‘maritime’ species being significant pests to humans and coastal developments (many having painful bites, even through standard mosquito nets), and several ‘peri-urban’ and ‘rural’ species negatively impacting livestock industries.

Differential diagnosis: Clinical signs observed in vertebrates are not sufficiently characteristic to facilitate diagnosis as dermal lesions and inflammation may be attributed to many ectoparasites. Likewise, the assessment of clinical parameters is non-specific, with haematological examination often revealing peripheral eosinophilia, and histopathological examination of skin biopsies generally demonstrating eosinophilic perivascular dermatitis. While the development of papular dermatitis in hosts exhibiting seasonal or protracted irritation around twilight hours may be suggestive of feeding activity, diagnosis depends on direct observation of biting midges which is often difficult due to their small size, cryptic behaviour and extreme host avoidance behaviours. Differential diagnosis relies on the capture of feeding midges using baits or nets for subsequent microscopic examination and identification. Immunodiagnostic techniques have been used to detect host reactions to midge antigens in intradermal skin tests, and molecular biological techniques have been used to detect gene sequences from various *Culicoides* spp. following polymerase chain reaction (PCR) amplification (notably those midge species implicated in the transmission of viral diseases).

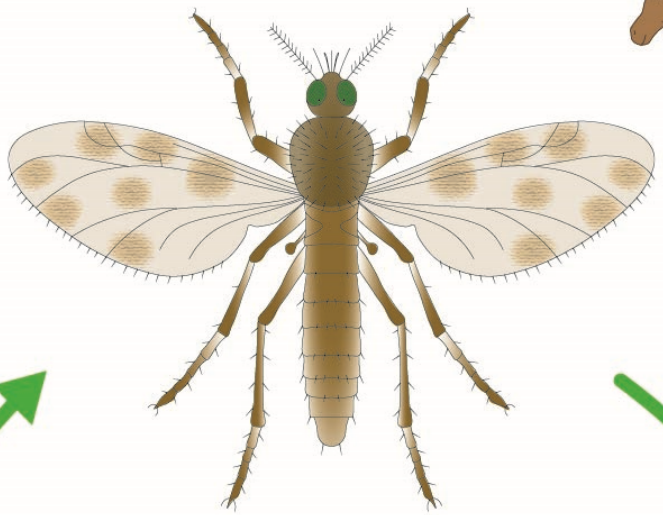
Treatment and control: Hosts exhibiting clinical signs of biting midge infestations may be treated with insecticides to discourage and suppress biting activity (topical formulations such as sprays, pour-ons, creams, dusts, or impregnated eartags applied to ears, collars or halters). Many conventional insecticides have proven effective against biting midges; including organophosphates (coumaphos, chlorfenvinphos, diazinon, dioxathion, fenchlorvos, malathion, phosmet, stirofos, trichlorfon) and pyrethroids (permethrin, cyfluthrin, cypermethrin). Severely affected hosts may also require supportive therapy in the form of systemic glucocorticoids and antihistamines to alleviate inflammation and hypersensitivity reactions. A range of management practices have been adopted to avoid biting midges, notably by moving people or livestock indoors at twilight, closing or screening doors and windows, and covering bare skin preferably with cloth treated with insect repellents (such as diethyltoluamide, DEET). However, such efforts are not always appropriate or effective, given that some midge species follow hosts indoors, others are small enough to move through conventional screen meshes, and some are able to bite through thin clothing. The application of insecticides with good residual activity to indoor areas (particularly midge resting places) has met with limited success as has the use of traps or baits containing attractants and insecticides, often simply due to the huge numbers of midges occurring in seasonal swarms. Similarly, attempts to treat breeding or congregation sites with insecticides have met with limited success. Adulticides delivered in mists or fogs often require regular (weekly) applications as they disperse unevenly and are unsuitable in windy conditions. Larvicides applied to water sources, wet grounds and manure simply lack coverage over the numerous and diverse habitats utilized by midge larvae (aquatic and semi-aquatic) and may also have undesirable ecological impacts (killing non-target species, upsetting natural cycles). Nonetheless, every effort should be made where possible to eliminate midge breeding sites by removing dung, rotting vegetable matter, maintaining water reticulation systems, regularly flushing ponds and irrigation channels, draining standing waters, and even discing wet soils.

Culicoides

adult female
(dorsal) (~ 2 mm)

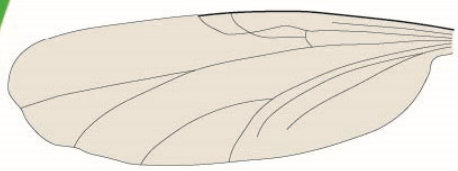


skin
(annoyance, pruritus,
inflammation, allergy)
(vectors for infectious
microbial diseases)

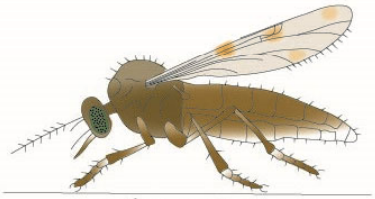


Definitive Hosts
(mammals, birds)

adults free-flying, females transient ectoparasites
(require bloodmeal for reproduction)



wing venation

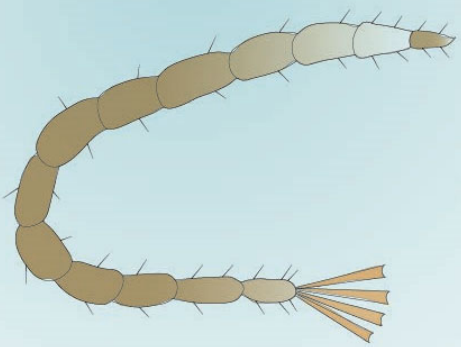


resting posture

eggs laid
in moist
areas

eclosion

pupa
(~ 2.5 mm)



egg
(~ 350 µm)

complete
(holometabolous)
metamorphosis

hatch

free-living feeding larva
(~ 3 mm)

development in semi-aquatic to aquatic habitats,
incl. mangroves, swamps, moist soils, animal dung, freshwater bodies

Culicoides adult

Culicoides eggs

Culicoides larva

Culicoides pupa