Cimex
(insect: bug)

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. Bugs (Hemiptera) are hemipterodeans that undergo gradual metamorphosis where nymphal stages gradually become more like the adults with each moult. All bugs have sucking mouthparts for feeding on the juices mainly of plants, but sometimes on other arthropods or blood from vertebrate hosts. Cimicids are small wingless bugs that feed on warm-blooded animals, primarily birds and bats, but including bed-bugs which feed on humans. Infestations by several *Cimex* spp. have been associated with irritation, inflammation and skin lesions in birds and mammals, including 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: Hemipterodea (Exopterygota) (young resemble adults, externally developing wings)
Order: Hemiptera (true bugs, mouthparts with stylet-like mandibles/maxillae, gradual metamorphosis)
Suborder: Heteroptera (some plant-feeders, some predatory on other arthropods, some blood-feeders on vertebrates)
Family: Cimicidae (small wingless bugs, incl. bed-bugs, blood feeders on animals)
Genus: *Cimex* (parasitic on skin of mammals/birds)
Species: various species cause skin lesions on humans

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). Various arthropods occur as ectoparasites on other animals, mostly feeding on the blood or skin of vertebrates. Arthropods have small segmented bodies encased in chitinous exoskeletons with articulated limbs. Three main subphyla are recognized: Chelicerata, Crustacea and Hexapoda. 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). Bugs are small winged hemipterodeans that undergo gradual (hemimetabolous) metamorphosis. They have stylet-like mouthparts and some prey on other arthropods while others feed on plants or blood from vertebrates.

Major parasitic hemipteran families	No. taxa	Hosts	Parasitic stages	Patho-genesis	Disease transmission
Family: Cimicidae (bed bugs, bat bugs, swallow bugs)	6 subfamilies, 24 genera, 110 species	birds, mammals (bats, humans)	adults	biting, blood-feeding	-
Family: Reduviidae (assassin bugs, conenose bugs)	23 subfamilies				
Subfamily: Triatominae (kissing bugs)	5-6 tribes, 16-19 genera, 132-149 species		adults	blood-feeding	protozoa (trypanosomes)

The family Cimicidae contains 24 genera in 6 subfamilies: namely; Cimicinae (*Cimex, Bertilia, Oeciacus, Paracimex, Propicimex*); Afrocimicinae (*Afrocimex*); Latrocimicinae (*Latrocimex*); Primicimicinae (*Bucimex*, *Primicimex*); Cacodminae (*Aphrania, Cacodmus, Crassicimex, Leptocimex, Loxaspis, Passicimex, Rusingeria, Stricticimex*); and Haematosiphonae (*Caminicimex, Cimexopsis, Haematosiphon, Hesperocimex, Ornithocoris, Psitticimex, Synxenoderus*). These bugs are temporary haematophagous ectoparasites as they only come into physical contact with warm-blooded hosts in order to suck blood. They spend most of their time free-living in the external environment hiding in refuges. Most species are nidicolous and remain close to enclosed spaces in which gregarious hosts rest and sleep (such as nests, roosts, caves, and buildings). The genus *Cimex* contains 23 species which traditionally may be allocated to three groups based on biological and geographical differences, including their apparent host preferences for humans, bats or birds. While two species (*C. lectularius* and *C. hemipterus*) feed primarily on humans, another six species usually feeding on birds or bats may also occasionally feed on humans (*C. columbarius, C. limai, C. pipistrelli, C. pilosellus, C. adjunctus* and *C. dissimilis*). More recent molecular characterization studies recognize four species groups: *C. lectularius* group (but including *C. columbarius* of birds and *C. emarginatus* of bats); *C. hemipterus* group (but including *C. insuetus* of bats); *C. pilosellus* group (Nearctic bat bugs); and *C. pipistrelli* group (Palaearctic bat bugs). Archaeological records show that bed bugs have been living with humans for thousands of years, both in tropical and temperate regions, and they have been given a variety of common names (including buk, chinche, ekukulan, fusfus, heavy dragoon, klop, kunguni, lude, nachtkrabbler, nankinmusi, perceveja, piq-seq, pishpesh, plostice, punaise, red coat, rep, tapetenflunder, tokozirami, uddamsa, vaeggelus, wagglus, and wandlaus). Infestations were generally associated with rural populations living in rudimentary buildings, but increasing travel and urbanization saw infestations spread to towns and cities, with outbreaks associated with unsanitary living conditions (slums and cheap hotels). Control programmes using residual insecticides have previously worked well, but the emergence of insecticidal resistance has seen a global resurgence of infestations. Bed bugs have not been implicated in the transmission of any infectious diseases to humans, but several species of bat bugs have been found to act as vectors for the transmission of some protozoal and viral infections in bats.

***Cimex* species**	**Hosts**	**Clinical signs**	**Distribution**
C. adjunctus (Eastern bat bug)	Chiroptera: vespertilionid (big brown bat, little brown bat, silver haired bat, California bat, Indiana bat, northern long-eared bat, evening bat, Rafinesque's big-eared bat); Galliformes: phasianid (chicken); occasionally Primates: hominid (humans)		North America
C. antennatus	Chiroptera: vespertilionid (pallid bat, little brown bat), molossid (Mexican free-tailed bat)		North America
C. brevis	Chiroptera: vespertilionid (little brown bat)	experimental vector for *Trypanosoma hedricki* of bats	North America
C. burmanus	Chiroptera: vespertilionid (pipistrelle)		Asia
C. cavernicola	Chiroptera: rhinolophid (horseshoe bat), miniopterid (bent-winged bat), vespertilionid (mouse-eared bat)		Russia
C. columbarius	Columbiformes: columbid (pigeon); Passeriformes: muscicapid (pied flycatcher); Lagomorpha: leporid (rabbit); occasionally Primates: hominid (humans)		Europe
C. dissimilis	Chiroptera: vespertilionid (greater mouse-eared bat, common noctule); occasionally Primates: hominid (humans)		Eurasia
C. emarginatus	Chiroptera: vespertilionid (Geoffroy's bat)		Eurasia
C. flavifuscus	Chiroptera: vespertilionid (yellow bats); Rodentia: cricetid (Chinese striped hamster)	natural vector for *Trypanosoma scotophili* of bats	China
C. hemipterus (syn. *C. rotundatus*) (tropical bedbug)	Primates: hominid (humans); Chiroptera: vespertilionid (greater Asiatic yellow bat, lesser Asiatic yellow bat, Temminck's bat); Lagomorpha: leporid (rabbit); Rodentia: murid (rats); Galliformes (chickens); Apodiformes: apodid (common swift)	sleeplessness, sores, iron & haemoglobin deficiencies	Southeast Asia, Africa, Europe, South America
C. himalayanus	Chiroptera: vespertilionid (Himalayan whickered bat)		India
C. incrassatus	Chiroptera: vespertilionid (pallid bat, big brown bat, fringed myotis, cave myotis, Yuma myotis, canyon bat, Rafinesque's big-eared bat), molossid (Mexican free-tailed bat)		North America
C. insuetus	Chiroptera: molossid (wrinkle-lipped free-tailed bat)	vector for Kaeng Khoi virus of bats	Indochina
C. japonicus	Chiroptera: vespertilionid (greater noctule bat)		Asia
C. latipennis	Chiroptera: vespertilionid (fringed myotis)		North America

C. lectularius (common bedbug)	Primates: hominid (humans); Rodentia: murid (rats, mice); Chiroptera: vespertilionid (eastern red bat, greater mouse-eared bat, lesser mouse-eared bat, whiskered bat), rhinolophid (Mediterranean horseshoe bat); Lagomorpha: leporid (rabbit); Rodentia: murid (mouse); Galliformes: phasianid (chicken); Columbiformes: columbid (pigeon)	sleeplessness, sores, iron & haemoglobin deficiencies	Americas, Eurasia, Africa, Australasia
C. limai (syn. *Propicimex*)	Chiroptera: molossid (velvety free-tailed bat); occasionally Primates: hominid (humans)		Brazil
C. pilosellus (bat bug, Western bat bug)	Chiroptera: vespertilionid (big brown bat, silver haired bat, California myotis, long-legged myotis, Yuma myotis, pallid bat, canyon bat); Galliformes (chickens); occasionally Primates: hominid (humans)	experimentally supports *Trypanosoma cruzi*	North America
C. pipistrelli	Chiroptera: vespertilionid (common noctule, lesser noctule, common pipistrelle); occasionally Primates: hominid (humans)	natural vector for *Trypanosoma incertum* of bats	Eurasia
C. pulveratus	Chiroptera: vespertilionid (Chinese pipistrelle)		Vietnam
C. singeri	Chiroptera: vespertilionid (greater mouse-eared bat), rhinolophid (greater horseshoe bat)		Eurasia
C. stadleri	Chiroptera: rhinolophid (greater horseshoe bat), vespertilionid (greater mouse-eared bat, Geoffroy's bat)		Europe
C. usingeri	Chiroptera: rhinolophid (rufous horseshoe bat)		India

Parasite morphology: Cimicid bugs form three different types of developmental stages: eggs; nymphs (5 stages (instars) often designated N1-N5); and adults. The eggs are oval-elliptical in shape but slightly asymmetrical (bowed longitudinally). They are elongate and measure 0.9-1.1 x 0.3-0.4 mm and have a prominent operculum (anterior cap) that is bent obliquely. They are coated with a thin layer of transparent cement and appear milky-pearly white in colour. Eggs hatch to release first stage nymphs (N1) which undergo gradual (incomplete) metamorphosis whereby nymphs resembling adults moult after bloodmeals to form another four nymphal stages (N2-N5) and then adults. Successive stages gradually increase in size (from 1.5 mm long as N1 to 4.5 mm as N5 and 5-7 mm as adults) and their cuticle gradually darkens in colour (from pale yellow as N1 to dark brown as N5 and adults). All feeding stages are roughly oval and conspicuously dorsoventrally flattened. After a bloodmeal, they become swollen, and the gut turns reddish black (most obvious in the abdomen). The alimentary tract consists of a foregut (stomatodeum) with a buccal capsule, cybarium and oesophagus connected to salivary glands, a midgut (mesenteron) with a globular stomach and tubular ventricles connected to excretory Malpighian tubules and a mycetome (harbouring symbionts), and a hindgut (proctodeum) with a vesicular colon and short rectum terminating in a posterior anus. Nymphs and adults have three conspicuous body parts: a short stout head; a shield-like thorax; and an oval abdomen. The integument is densely covered with fine hairs (setae) which are most evident on adults, particularly on the margins of abdominal segments and on the legs. The head often appears triangular with a blunt tip, a pair of long slender antennae (each composed of four segments, with the distal three segments long and slender) and a pair of widely-separated lateral compound eyes. The mouthparts are located on a long slender ventral proboscis which is folded under the head when not in use for feeding. The mouthparts are of the piercing and sucking type with a basal labrum, a long slender labium forming a three-segmented rostellum (rostrum), and lateral maxillary and mandibular stylets that form two canals used for feeding and salivation. The thorax has a pronounced canoe-shaped pronotum (dorsal plate-like structure) with an anterior concavity where the head is joined). On adults, the pronotum contains numerous bristles that project outwards laterally along the margins. The thorax does not possess wings, but the forewings have been reduced to oval hemelytral pads that cover the dorsolateral mesonotum (pads absent on nymphs). The thorax possesses three bilateral pairs of slender well-developed legs inserted ventrally, and each ending in small paired claws. Bugs also possess an odorific apparatus comprising a pair of stink-glands which are located on the ventral thorax of adults but on the dorsal abdomen of later-stage nymphs. The abdomen has eleven segments that expand during feeding, exposing intersegmental membranes, and there are seven pairs of respiratory spiracles located laterally. Male bugs are slightly smaller than females, and their abdomen is narrower and the posterior tip is curved and more pointed than in females. The male reproductive system comprises globular testes, tubular vas deferens, a saccular seminal vesicle with accessory glands and a mesadenial reservoir, and then an elongate copulatory organ (aedeagus with basal paramere and terminal ejaculator bulb). The female reproductive system comprises ovoid ovaries, lateral tubular oviducts converging to a common duct and genital chamber (vagina). Females also possess a paragenital system comprising globose spermalege for sperm storage (alternatively known as the Ribaga or Berlese organ) near a narrow cleft or fissure (also known as the paragenital sinus) on the posterior margin of the fifth abdominal sternite. This system is involved in a unique form of copulation practiced by these bugs (called extra-genital, traumatic or integumentary insemination) whereby males use their lance-shaped external genitalia to pierce the female abdomen near the cleft to inject spermatozoa directly into her spermalege. A range of morphological features have been used to differentiate species, notably pronotal structure and paragenital sinus armature. For example, *C. lectularius* has broad lateral pronotal lobes while those of *C. hemipterus* are narrow. Both have a narrowly-clefted and bristled paragenital sinus (apparently an Old World feature). The bird bug *C. columbarius* is similar to *C. lectularius* but smaller, while bat bugs of the *C. pilosellus* and *C. pipistrelli* groups have narrow lateral pronotal lobes and a rounded paragenital sinus (with bristles in the *C. pilosellus* group, but naked in the *C. pipistrelli* group).

Site of infection: All cimicid bugs are obligate haematophagous ectoparasites, with nymphs required bloodmeals to moult and adults requiring blood to mature and reproduce. However, the bugs are temporary parasites as they only come into physical contact with their hosts when feeding. Several species feed on humans, biting exposed skin (face, neck, shoulders, back, limbs) often with three bites in a row (sometimes nicknamed as 'breakfast, lunch and dinner'). Bat bugs bite their hosts mostly on body surfaces with sparse hairs (particularly the wings and ears) while bird bugs often feed around sites with small downy feathers (face and vent). Most hosts are bitten at night whilst in small enclosed spaces routinely used for resting or sleeping, such as beds, buildings, caves or nests.

Pathogenesis: Bed bug infestations have been associated with a wide variety of dermatological manifestations in humans, ranging from erythematous macules or papules to bullous (blister) eruptions, and occasionally systemic and psychological disorders. Infestations of domestic poultry can be debilitating, causing significant irritability and sometimes anaemia, especially in young birds. Nymphs and adults (both sexes) feed on host blood, using their mouthparts to pierce the skin, inject saliva containing a variety of glyco- and lipo-proteins (many with anticoagulant and vasodilatory activity), and then sucking up blood. They do not remain on the host after feeding and the bites are generally painless and initially go unnoticed. However, host immunological reactions to the injected substances subsequently cause the feeding sites to become inflamed, thickened and painful. The most common local reaction is the development of pruritic (itchy) erythematous (red) maculopapular lesions (2-5 mm flat or raised bumps or wheals), which can take up to 9 days to appear but resolve within a week (often with temporary residual hyperpigmentation). The lesions may coalesce to form rashes when bites are clustered due to repeated probing by bugs to find capillary beds upon which to feed. In some cases, bullous lesions (blisters) may occur days after being bitten, and scratching may result in pruritic papules, wheals or nodules which can last for weeks. Individuals vary considerably in their immune reactions to bites, with previous exposure sometimes leading to desensitization but more frequently resulting in hypersensitivity with quicker onset and more severe lesions. On occasion, repeated infestations may lead to severe systemic allergic reactions including asthma, generalized urticaria and anaphylaxis. In heavy or protracted infestations, patients may also demonstrate varying degrees of pallor, anaemia, iron deficiency, diarrhoea, malnourishment, lethargy, malaise, sleeplessness, nervousness, irritability, anxiety, emotional and psychological distress (sometimes misdiagnosed as neurosis). Patients are also predisposed to secondary bacterial infections causing folliculitis, cellulitis and eczematoid dermatitis, with bruising and scar formation due to scratching. Infested people and premises may also develop a distinctive pungent sweet odour due to chemicals (pheromones) secreted from stink-glands in nymphal and adult bugs. Despite their reputation as one of the most common and annoying pests in human history, bed bugs have not been found to act as vectors for any infectious diseases, even though there are anecdotal reports they may harbour a range of bacteria and viruses but are unable to transmit them. Experimental studies have shown that *C. pilosellus* may support the limited development of *Trypanosoma cruzi* but there is no evidence that they are involved in the transmission of Chagas' disease. In contrast, studies involving bats have shown that *C. pipistrelli, C. flavifuscus, C. brevis* and *C. lectularius* may act as a vector for *Trypanosoma incertum, T. scotophili, T. hedricki* and *T. myoti* of bats, respectively, and that *C. insuetus* may act as a vector for Kaeng Khoi virus of bats.

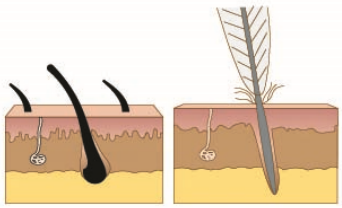
Developmental cycle and mode of transmission: The entire life-cycle of cimicid bugs is completed in the external environment, but each developmental instar requires at least one blood meal from a warm-blooded host in order to develop and moult, and adult females require larger blood meals for egg production. The bugs are therefore regarded as transient or temporary ectoparasites only coming into contact with hosts in order to feed. Indeed, the bugs lack appendages to enable them to cling to hair, fur or feathers. They are not transmitted between hosts via physical contact but spend most of their time hiding and resting within refuges. Bugs are generally nocturnal parasites and tend to feed in darkness when hosts are resting or sleeping. Nymphs and adults seek hosts within 24 hours of hatching or moulting and they are attracted by carbon dioxide, warmth, and possibly other chemicals. Having found a host, they probe exposed skin for suitable capillary beds and feed on host blood for several (3-15) minutes before leaving and seeking refuge. When prevailing temperatures exceed 10°C, they may feed several (1-3) times a week (less frequently in cooler conditions). Most cimicids are nidicolous, and well adapted to living in resting or sleeping areas of their hosts (beds, hides, nests, caves). Several species have become accustomed to invading, or even colonizing, man-made structures (buildings, pens, coops), particularly those made of poor quality materials (rough dry substrates) with numerous cracks or crevices in which to hide away from light. In refuges, mature females lay several eggs per day for 5-7 weeks, attaching the eggs to substrates in clusters using a secreted adhesive cement (sites sometimes called brood centres). The eggs hatch within 4-12 days depending on ambient temperature (longer in cooler conditions). Cimicids develop by gradual (incomplete) metamorphosis (hemimetabolous) whereby nymphs resembling adults undertake five successive moults to reach adulthood, each instar requiring a bloodmeal to develop further. Each instar develops over 2.5-10 days and adults may be formed within 6-8 weeks. Bug development, life-cycle duration and fecundity depends primarily on temperature and humidity (all being reduced in colder conditions). With regular blood meals, *C. lectularius* may complete its life-cycle in as little as 24 days at 30°C and as long as 128 days at 18°C, while *C. hemipterus* may take 25 days at 30°C and 265 days at 18°C. Without blood, adults may survive for one year in warm conditions, and even up to two years in cooler environments (bugs have been found to assimilate moisture from water vapor in the surrounding air). Different bug species vary in their climatic and geographic distributions as well as in their preferences for particular hosts. Nonetheless, they are widespread in tropical and temperate regions where human dwellings, bat caves and bird nests provide suitable habitats offering sheltered refuges, warmth and regular access to resident hosts. In human habitations, they prefer dark dry places in beds, bed frames,

mattresses (seams and stuffing), cracks/crevices in the walls and floors, behind wallpaper and wood panelling, under rugs and carpets, in furniture (particularly upholstered items), and amongst stacks or accumulations of papers and books. In severe infestations, bed bugs can be carried in the clothing and may be carried to public facilities such as theatres, office waiting rooms and upholstered seats on buses. Bed bugs may also be transported over large distances by vehicles (cars, planes, trains and ships) concealed in infested bedding, luggage, furniture and packing materials. Indeed, international travellers have been linked to the spread of infestations principally in lodging establishments around the world.

Differential diagnosis: Bed bug infestations are generally suspected following the detection of linear arrays of bites on the skin, bite sites later becoming inflamed and itchy. Visual examination of sheets and mattresses may reveal reddish-brown bloodstains as well as speckles of bug excrement. Careful examination of the immediate surroundings, particularly dark crevices which serve as hiding places, may reveal egg cases, shed skins and excrement around points of entry and exit. Infested areas may also acquire an unpleasant sickly-sweet or raspberry-like odour due to secretions from bug stink-glands. Despite such indications, infestations are best definitively confirmed by the capture and identification of bugs during or after feeding (nymphs and adults range from pale yellow to reddish-brown depending on stage and gut content). Molecular characterization studies have recently been used to examine cimicid phylogeny following the polymerase chain reaction (PCR) amplification of nuclear (ribosomal RNA) or mitochondrial (cytochrome oxidase) genes.

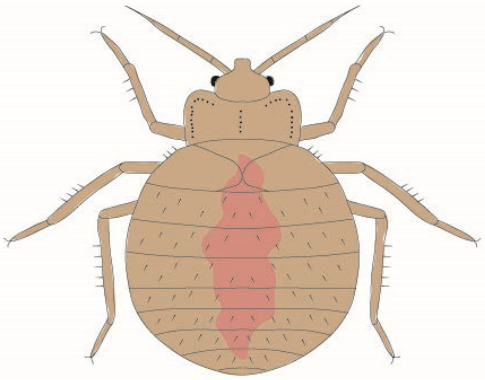
Treatment and control: Most bed bug bites resolve spontaneously in 3-10 days without treatment, but heavy or recurrent infestations may lead to persistent lesions, and even hypersensitivity. Inflammation and pruritus at the bite site may be temporarily relieved by the application of heat or ice, topical anti-pruritic agents, and topical or systemic corticosteroids or antihistamines, but they generally do not improve the appearance or duration of any dermatitis. Topical or systemic antibiotics may also be used to treat secondary bacterial infections, particularly those involving bullous lesions. In rare cases of hypersensitivity involving anaphylaxis, emergency intervention may be required with intramuscular adrenaline, antihistamines and corticosteroids. Infestations are generally controlled at source by improved hygiene and environmental disinfection using a range of chemical and non-chemical methods, which can be costly and prolonged as bugs are hardy and may survive for months. Every effort should be made to improve hygienic practices, especially with respect to sleeping quarters. Sheets and clothes should be laundered by washing in hot water with detergent or steam cleaning, and then thoroughly dried either in a hot clothes dryer for at least 20 minutes or by air-drying exposed to the sun. Bedding materials (mattresses, pillows, bedframes) should be regularly aired in the sun or cleansed by steam cleaning. Some agencies have used plastic zippered mattress covers with some success as bugs become trapped inside and die. Furniture, walls and floors should be cleaned thoroughly with commercial products, and hard-to-reach places may be dowsed with rubbing alcohol (although heavily infested upholstered furniture may have to be discarded and burned). Rugs and carpets should be regularly vacuumed and collections of papers, books or wood should be removed. Anecdotal reports suggest that sleeping under mosquito nets and keeping the lights on at night tend to reduce the frequency of being bitten. The most effective control programmes, however, also employ insecticidal chemicals to disinfect the surroundings and restrict bug populations. A range of insecticides with good residual activity are sprayed onto substrates around sites of infestations: including organochlorines (dichlorodiphenyltrichloroethane (DDT), dichlorovos, lindane, dieldrin, aldrin); organophosphates (malathion, diazinon, phosalon (on chicken farms)); pyrethrin and synthetic pyrethroids (permethrin, cypermethrin), diethyltoluamide (DEET) and some insect growth regulators (benzoylphenylureas). It may be difficult to treat all bug refuges in a single application, so a second treatment is often used 10 days later to kill any newly-emergent bugs. Given toxicity concerns associated with many of these insecticides, it is often best to employ professional pest exterminators. It is also advisable to treat luggage before and after travel to prevent the inadvertent translocation of bugs. Many successes have been recorded in controlling infestations around the world, but the emergence of insecticidal resistance and increasing globalization has seen a recent resurgence of infestations in many countries.

Cimex

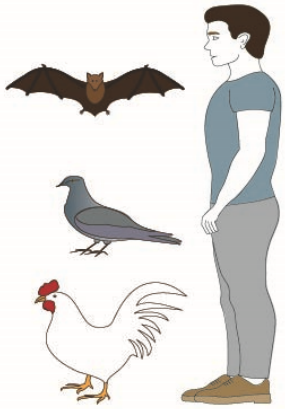


skin, pelage/plumage
(irritation,
inflammation,
skin lesions)

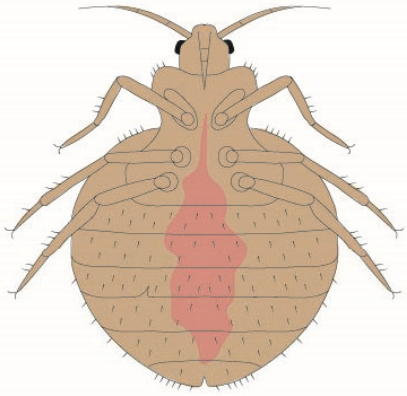
adults (~ 6 mm)



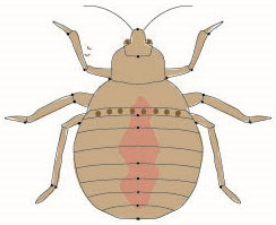
dorsal



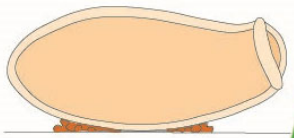
Definitive Hosts
(mammals, birds)



ventral



nymph (dorsal)
(~ 2.5 mm)

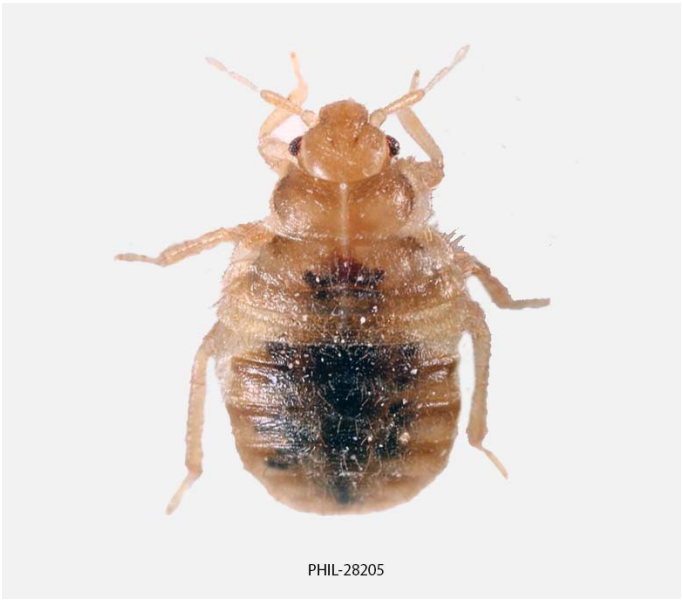


egg
(~ 1 mm)

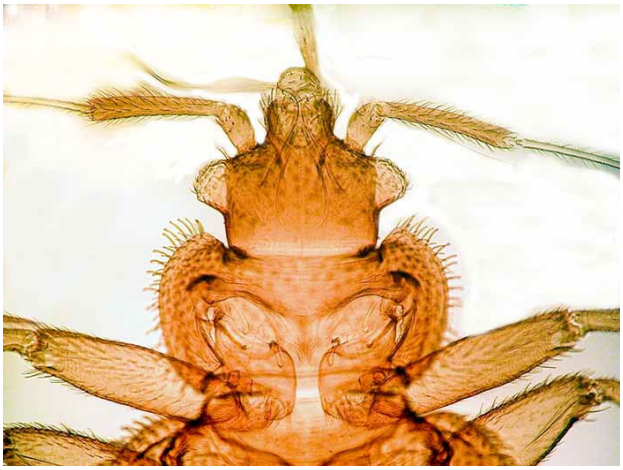
all stages occur in external environment
(but motile stages are temporary
ectoparasites that feed on blood)

motile stages are nidiculous and
emerge nocturnally to feed on resting hosts

Cimex adult



Cimex adult



Cimex adult head

Cimex egg