TICKS

Ticks (Ixodida) are arachnids, typically 3 to 5 mm long, part of the superorder Parasitiformes. Along with mites, they constitute the subclass Acari. Ticks are external parasites, living by feeding on the blood of mammals, birds, and sometimes reptiles and amphibians. Ticks evolved by the Cretaceous period, the most common form of fossilisation being amber immersion. Ticks are widely distributed around the world, especially in warm, humid climates.

Almost all ticks belong to one of two major families, the Ixodidae or hard ticks, and the Argasidae or soft ticks. Adults have ovoid or pear-shaped bodies, which become engorged with blood when they feed, and eight legs. In addition to having a hard shield on their dorsal surfaces, hard ticks have a beak-like structure at the front containing the mouthparts, whereas soft ticks have their mouthparts on the underside of their bodies. Both families locate a potential host by odour or from changes in the environment.

Ticks have four stages to their lifecycle, namely egg, larva, nymph, and adult. Ixodid ticks have three hosts, taking at least a year to complete their lifecycle. Argasid ticks have up to seven nymphal stages (instars), each one requiring a blood meal. Because of their habit of ingesting blood, ticks are vectors of many diseases that affect humans and other animals.

Identification / General characteristics of tick genera (hard and soft ticks)

Although most people consider ticks to be either small and red or large and blue, on closer inspection many species are extremely colourful when examined under a stereoscopic microscope. The range of colours or ornamentation on the scutum, particularly of the males of certain species, is spectacular, from metallic mauve, shiny dark orange, bright yellow to iridescent green. The legs of certain species may also differ in colour from that of the scutum and the posterior edge of each segment of the legs may be encircled by an ivory-coloured band. Some of these features can readily be seen with the naked eye and the ticks have been given common names by farmers and researchers. Thus we have bont (brightly coloured) ticks, bont-legged ticks with ivory-coloured bands around their legs, red-legged ticks whose legs vary from light to dark orange, yellow dog ticks, and blue ticks, the last mentioned ticks acquiring their common name from the slaty blue colour of their engorged females.

Morphology

The Ixodidae are characterized by the presence of a tough sclerotised plate on the dorsal body surface, the scutum, covering the entire dorsal body surface in males (sometimes named conscutum), and limited to the anterior approximately one third of the dorsal body region in unfed females, nymphs and larvae. The folded cuticle posterior to the scutum constitutes the alloscutum. Both scutum and alloscutum are covered with numerous small setae. Sexual dimorphism is apparent only in the adult stage. The scutum is the site of attachment of various dorso-ventral body muscles, cheliceral retractor muscles, and many other muscle groups in the Ixodidae. Eyes, if present, are located on the lateral margins of the scutum.anterior to the scutum, the mouthparts protrude beyond the body and are readily visible dorsally. The mouthparts include the paired chelicerae dorsally and the segmented palps, and ventrally the denticulate hypostome, all mounted on the basis capituli. These structures constitute the capitulum. In all ixodid ticks, the palps consist of 4 segments (=articles), but the tiny sensilla-bearing terminal (4th) segment is recessed in a cavity on the ventral surface of segment III.
Females have a pair of porose areas (= *areae porosae*) on the dorsal surface of the basis capituli.
Ventrally, nymphs and adults bear a pair of spiracular plates (= stigmata) located immediately posterior to the fourth coxae, with the spiracle, a single opening, within each plate.
Pad-like pulvilli occur just proximal to the claws on the tips of the tarsus (last segment of the legs), enabling ticks to climb virtually any surface.
Nymphs and larvae resemble the adults, but lack the external genital pores and porose areas.The Argasidae are characterized by a tough leathery integument in all but the larval stage.

Kingdom:	Animalia
Phylum:	Arthropoda
Subphylum:	Chelicerata
Class:	Arachnida
Order:	Ixodida
Family:	Argasidae
Genus:	*Ornithodoros*
Species:	***O. herms***

The capitulum is recessed ventrally near the anterior end and is not visible dorsally (except in larvae).Eyes when present are on the lateral surface of the body. The spiracles or stigmata occur in the supracoxal folds between the coxae of legs III and IV.Nymphal and adult argasids also bear a pair of tiny pores, coxal pores, representing the openings of the coxal glands, located between the paired coxae of legs I and II. Excess fluid filtered from the bloodmeals they take is excreted via these pores.

Characteristics of the different genera of hard ticks
Ornithodoros hermsi

Amblyomma

- Mouthparts very long, elongate second segment of palps
- Conscutum and scutum ornate

Amblyomma (previously Aponomma)

- Mouthparts long
- Conscutum and scutum ornate or inornate. Conscutum circular to laterally oval

Rhipicephalus(previously Boophilus)

- Mouthparts very short, proximal margins of palpal segments II and III sclerotized and have the appearance of two protruding rings
- Conscutum often so poorly sclerotized that the dark pattern of the caeca can be *Dermacentor*

- Mouthparts medium-length and broad
- Basis capituli rectangular
- Scutum ornate

Haemaphysalis

- Mouthparts short and broad
- Basis capituli rectangular

Hyalomma

- Mouthparts long, second segment of palps elongate
- Scutum pale to dark brown

Ixodes

- Mouthparts long.
- Auriculae latero-ventrally on basis capituli
- No eyes
- No festoons
- No adanal plates on males
- Anal groove conspicuous and anterior to the anus
- Legs appear to be grouped anteriorly

Margaropus

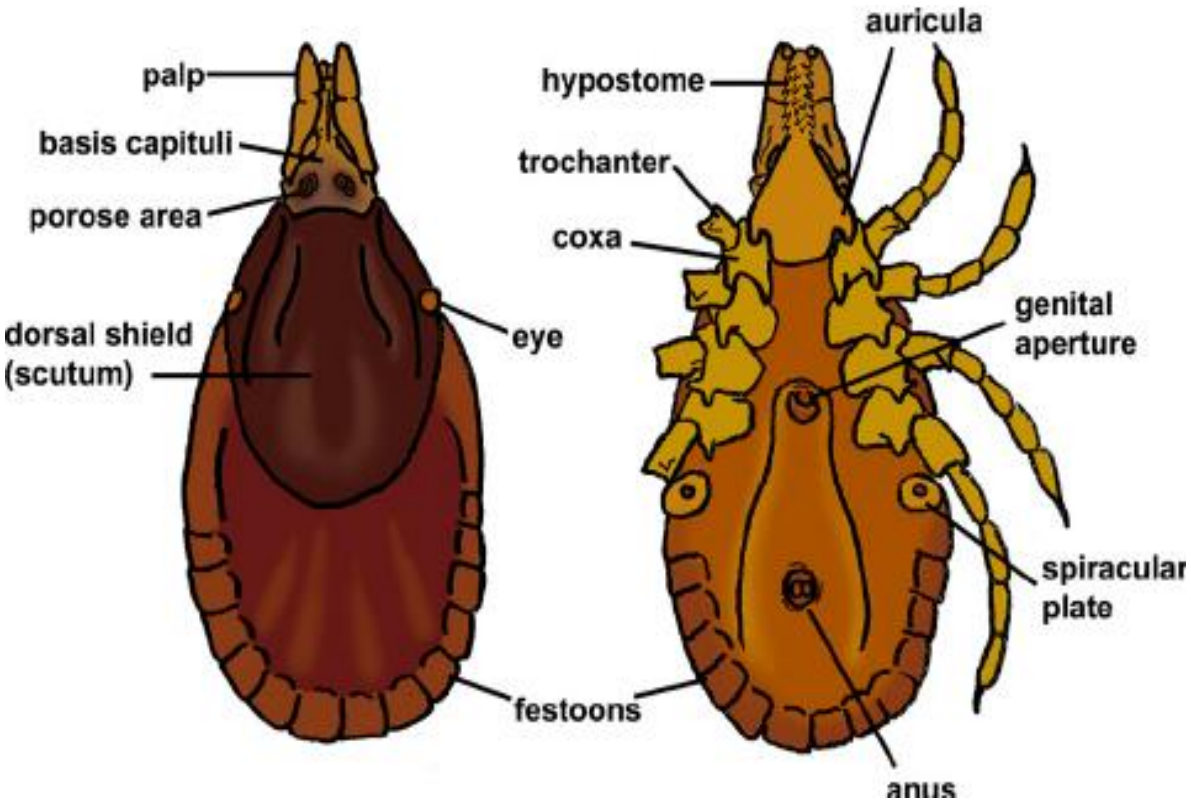
- Mouthparts very short
- Conscutum thin and transparent and the dark pattern of the caeca can be seen from above

Rhipicentor

- Mouthparts of medium length
- Eyes present

Rhipicephalus

- Mouthparts short to medium length.
- Basis capituli generally hexagonal in shape.
- Scutum usually uniformly brown, but four species have ivory-coloured ornamentation.



Characteristics of the different genera of soft ticks

Phylum	Arthropoda
Subphylum	Chelicerata
Class	Arachnida
Subclass	Acari
Order	Parasitiformes
Suborder	Ixodida (=Metastigmata)
Family	Ixodidae

Argas

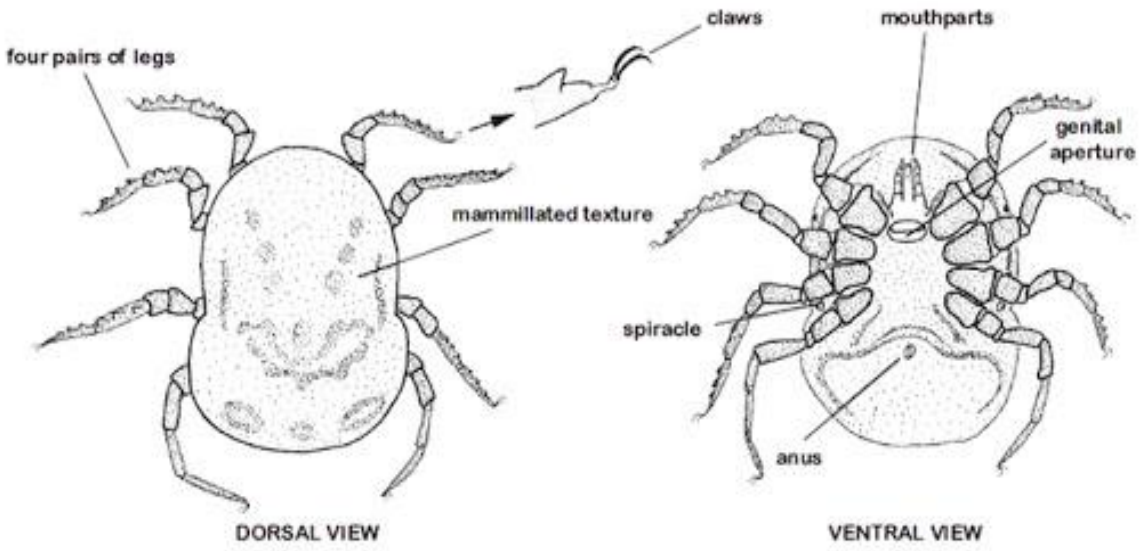
- Integument leathery
- Mouthparts recessed ventrally and not visible from above (except in larvae)

Otobius

- Dark, violin-shaped adults
- Mouthparts recessed ventrally and not visible from above (except in larvae)

Ornithodoros

- Leathery-mammillated integument
- Mouthparts recessed ventrally and not visible from above (except in larvae)
- Supra-coxal fold



Difference Between Hard Ticks and Soft Ticks

Hard ticks and soft ticks have many physical and biological dissimilarities. Among some of the more important differences are:

Appearance

- Hard tick adult males and females have different coloration and females are somewhat larger than males. Hard ticks have a “plate” on their back that is called a scutum. Also, hard ticks have mouthparts that are visible when the tick is viewed from above.
- Soft ticks appear to have a wrinkled body; lack a scutum; and the males and females are very close to the same size. Viewing a soft tick from above would give someone the impression that soft ticks do not have mouthparts. However, that is not the case; rather their mouthparts are located on the underside of the body so that the front portion of the tick’s body hides the mouthparts.

Diet

Although both hard and soft ticks are blood feeders and can transmit diseases, hard ticks typically search for and feed on hosts during the daytime, while soft ticks normally search for and feed on hosts during the nighttime.

Habitat

- Hard ticks thrive in habitats rich with vertebrate hosts, like mammals, lizards and ground-dwelling birds. Their preferred habitat is brushy, wooded or weedy areas, especially moist woodlands and vegetated areas at the edge of forests, along hiking trails and in overgrown weedy or grassy fields.
- Soft ticks are generally found in animal burrows, dens, caves or broken-down, simple human dwellings such as huts, cabins or sheds. In addition, soft ticks readily thrive in hot and dry conditions.

Life Cycle

Most hard ticks are either a one, two or three-host tick. After the tick’s egg stage hatches, one larval, one nymphal and an adult stage follows. Mature, blood-fed female adult ticks drop from the host, lay a large mass of a few to several thousand eggs and then die. Hard ticks usually mate while on host animals. Depending on the tick species and environmental conditions, the typical longevity of hard ticks ranges from about 2 months to 3 years.

- Adult female soft ticks feed and lay eggs several times during their lifetime. Most species of soft ticks do not bury themselves for a long stay on a host. Instead, they feed quickly, detach and then return later for another blood meal. Also, soft tick nymphs may feed several times and go through several nymphal stages. Female adults that take multiple blood meals will lay small batches of 20-50 eggs after taking each blood meal during their lifetime. Soft ticks can live up to 16 years.

Seasonal occurence/Life cycle

Seasonal occurrence

Most ticks show seasonality in their life cycles; in most species the adult ticks will become active and feed at the start of the rains. This has been noticed by livestock keepers and scientists for years. Because of the great

economic importance of certain ticks as vectors of diseases of domestic livestock and in particular cattle, the study of the seasonal occurrence of ticks is of major importance in the control of ticks and tick-borne diseases.
An increasing number of ticks have been studied during the last decennia and the seasonal responses and adaptations of their life cycles are much more complicated than expected previously. Seasonal activity is mainly determined by the activity or inactivity of the different life cycle stages.

Life cycle

All ticks have four stages: the embryonated egg and three active stages, namely the larva, one or more nymphal stages and the adult. Sexual dimorphism (phenotypic difference between males and females) is evident only in the adult stage. In the Argasidae (soft tick species), development is gradual, with multiple nymphal stages before reaching the adult form (multi-host life cycle), while in the Ixodidae (hard tick species), the development is accelerated, with only one nymphal stage. In most of the ixodid species, each active stage seeks a host, feeds, and drops off to develop further in the natural environment (three-host life cycle), but in few species, fed juveniles remain and develop on the host, shortening the life cycle (two-host and one-host ticks).

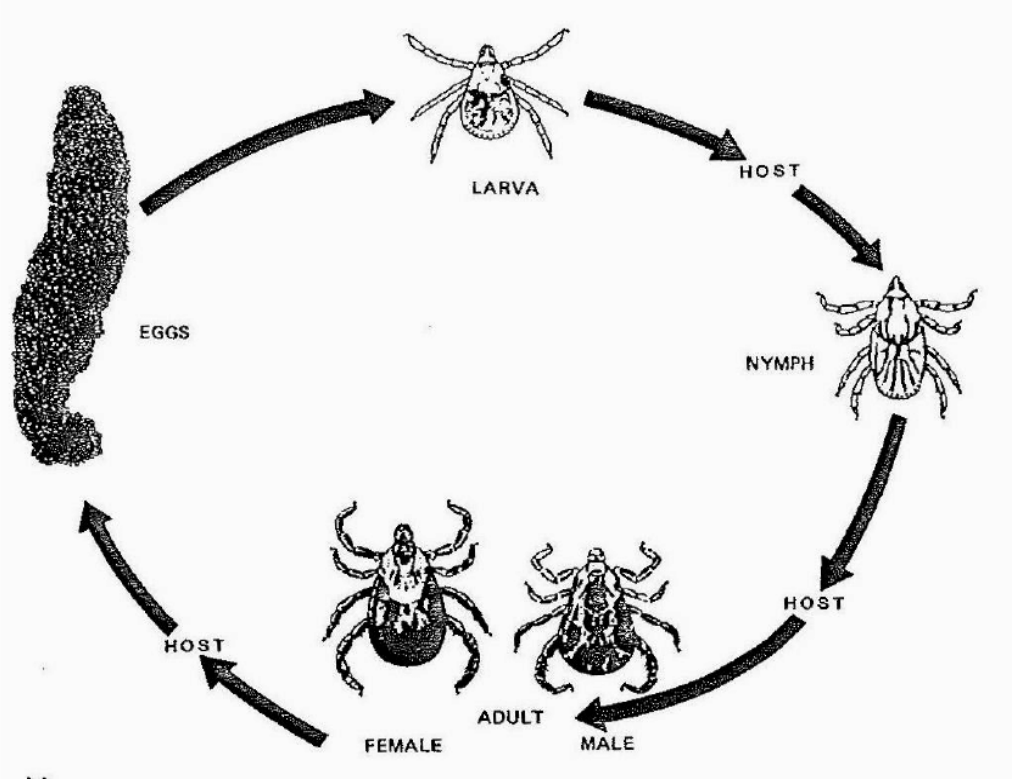
Life cycle of hard ticks

The fully fed female detaches and drops off the host and after a few days, known as the pre-oviposition period, lays a single large batch of several thousand eggs in a sheltered spot and then dies. After a period of weeks or even months minute six-legged larvae hatch from these eggs. These larvae are known as "seed" or "pepper" ticks because of their similar morphology to small seeds or crunched pepper corns. The larvae of some species climb up the stems of grasses or other plants and wait for a passing host to which they attach, while the larvae of other species wait for a host on the ground and then climb on and attach. Following attachment, they engorge and a period of quiescence follows while structural changes (partial metamorphosis) take place inside the skin of each larva. The larvae then moult into nymphs that require a few days for the integument to harden before they will attach. They engorge, go through a period of quiescence and moult to adults that also require a few days for the integument to harden before they will attach. The partially engorged female is attractive to the partially engorged male that migrates to where the female is attached, they mate, and the female engorges, detaches, drops to the ground and lays eggs. The male may remain on the host for months before finally dying. The integument of

the female undergoes physiological changes during the last 24 hours of engorgement. These changes make her less susceptible to desiccation and she also becomes less susceptible to the effects of acaricides.

One-host life cycle

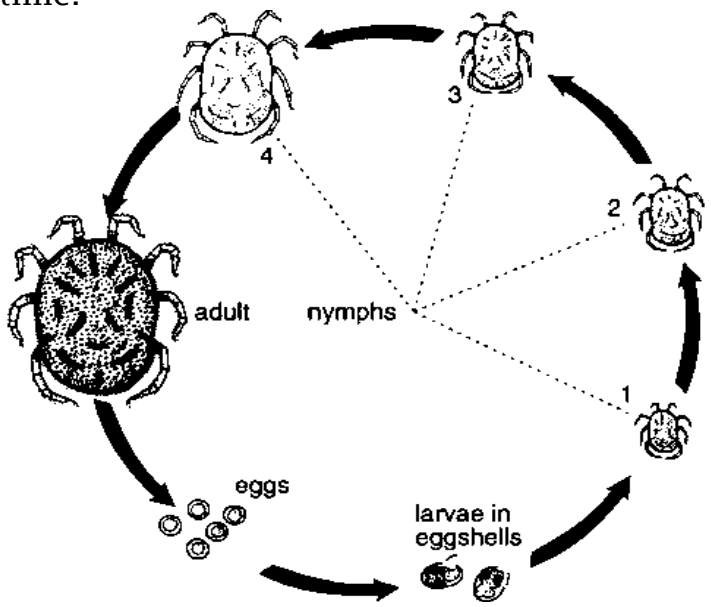
Eggs laid in the environment hatch into larvae, which immediately seek out a host in which to attach and feed. Fed larvae molt into unfed nymphs that remain on the host. After engorging on the host's blood, the nymphs molt into sexually mature adults that remain on the host in order to feed and mate. Once a female is both fed and ready to lay eggs, only then does she drop off the host in search of a suitable area to deposit her eggs. Ticks that follow this life cycle are called one-host ticks. The winter tick *Dermacentor albipictus* and the cattle tick *Boophilus microplus* are examples of one-host ticks.



Life cycle of soft ticks

The life cycle of the argasid tick species is more diverse than the much more uniform pattern found in the ixodid tick species. Some soft ticks seek hosts by questing on low-lying vegetation, but the vast majority are nest parasites, residing in sheltered environments such as burrows, caves, or nests. Certain biochemicals such as carbon dioxide as well as heat and movement serve as stimuli that guide host-seeking behaviour. The feeding behaviour of many soft ticks can be compared to that of fleas or bedbugs, as once established, they reside in the nest of the host, feeding rapidly when the host returns. The outside surface, or cuticle, of soft ticks expands, but does not grow to accommodate the large volume of blood ingested, which may be anywhere from 5-10 times their unfed body weight. Argasid ticks feed rapidly, females feed and oviposit

frequently (multiple gonotropic cycles) and deposit small egg masses (< 500 eggs/cycle). There are also 2 - 7 nymphal stages (moults) in the life cycle.
In the majority of species, larvae seek hosts, feed within 15 - 30 minutes and drop off to moult in the sand, duff or cracks and crevices of the natural habitat. *Ornithodoros* larvae don't feed and moult immediately to the nymphal stage. The first stage nymphs resemble the adults, but are smaller, lack the genital pore and any evidence of dimorphism. They in turn attack hosts, feed rapidly and moult again to another nymphal stage. The cycle of host seeking, feeding and moulting can be repeated up to 7 times in the nymphal stage. After the last nymphal moult, adult ticks become sexually active and they do not require a blood meal to initiate gametogenesis. Mating occurs before as well as after feeding, but rarely if ever on the host itself. *Otobius* adults do not feed at all.Following feeding, oviposition begins and once completed, the ticks remain vigorous.seek new hosts, feed and oviposit again.
This pattern of repeated gonotropic cycles enables argasid ticks to spread their progeny
gradually over time.



Tick Transmitted Diseases

Hard ticks are more likely to parasitize people and animals than soft ticks. Therefore, hard ticks transmit far more diseases in the United States than soft ticks. Some diseases transmitted by each group of ticks are:

- **Hard ticks**
  - Lyme disease
  - Rocky Mountain spotted fever

- Tularemia
- Colorado tick fever
- Human tick-borne ehrlichiosis
- American babesiosis
- Tick paralysis
- STARI (Southern tick-associated rash illness)
- Anaplasmosis

- **Soft Ticks**
  - Tick-borne relapsing fever
  - Q - fever

IMPORTANCE :

These blood-sucking ectoparasites cause considerable production losses especially to improved cattle breeds in the Afrotropical region. Each engorging female tick takes between 1 - 5 ml of blood depending on species and size.

Scabies (*Sarcoptes scabiei* var. *hominis*)

Introduction

Scabies is a contagious ectoparasite skin condition caused by the mite *Sarcoptes scabiei* var. *hominis* (No relation to lice). In this condition, mites burrow into human skin and lay their eggs, which later hatch and grow into adults. The characteristic symptoms of this condition include superficial burrows, intense pruritus (itching) and secondary infection.

Agent

Classification: *Sarcoptes scabiei* var. *hominis* (CDC)
Taxonomy: (CDC)
Kingdom-Animalia
Phylum-Arthropoda
Class-Arachnida
Subclass-Acari
Family-Sarcoptidae
Genus and Species- Sarcoptes scabiei, variation hominis

Clinical Presentation in Humans

The characteristic symptoms of a scabies infection include superficial burrows, intense pruritus (itching), a generalized rash and secondary infection. Acropustulosis, or blisters and pustules on the palms and soles of the feet, are characteristic symptoms of scabies

Mode of Transmission

The majority of scabies cases are transmitted by skin-to-skin contact with persons carrying the scabies mite. Less often, scabies can be transmitted by sharing of clothes and bedding. Theoretically, touching an object that a mite is on is a third mode of transmission; however, this is not at all common.

Host Immune Response

When scabies mites burrow into the human skin, the eggs, mites and feces trigger a host immune response. Like an allergic reaction, this autonomic immune response results in a rash, itching, and occasionally a fever. However, this immune response does not occur until days to weeks after infection, due in large part to the fact that scabies mites are genetically encoded with immunological 'weapons' that prevent the host from responding to its presence (Burkhart).

Reservoir

Scabies has no non-human animal reservoir. However, mites can survive on fingernails, clothes, towels, bed linens and other household objects for up to three days.

Vector

There is no vector in the scabies lifecycle. Scabies is transmitted by human-to-human contact. Mites cannot survive longer than 3 days without a human host.

Incubation Period

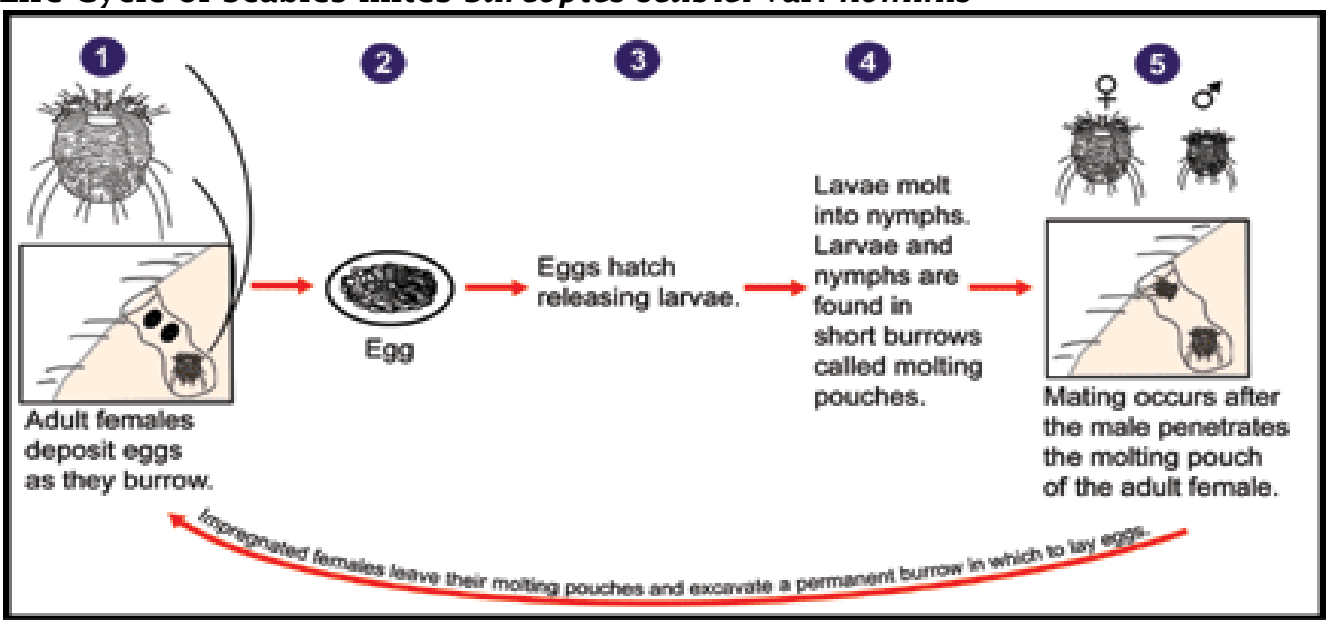
Upon infection, adult mites dig into the upper layers of human skin, creating burrows. Eggs are deposited into the burrows and hatch as larvae 3 to 4 days later. The larvae then excavate new burrows and mature in approximately 4 days (Markell & Voge). Once infected, the scabies lifecycle will continue until medication is used to treat the disease.

Morphology

Adult scabies mites are spherical, eyeless mites with four pairs of legs (CDC). They can be recognized by their oval, ventrally flattened and dorsally convex tortoise-like body and multiple cuticular spines (Arlian). Females are 0.30 to .45 mm long and 0.25 to 0.35 mm wide, and males are just over half that size (CDC).

Life Cycle

Life Cycle of Scabies mites *Sarcoptes scabiei* var. *hominis*



The scabies mite *Sarcoptes scabiei* var. *hominis* goes through four stages in its lifecycle: egg, larva, nymph and adult.

Upon infesting a human host, 1) the adult female burrows into the skin, where she deposits 2-3 eggs per day. These oval eggs are 0.10mm to 0.15mm long and 2) hatch as larvae in 3-4 days. Upon hatching, 3) the 6-legged larvae migrate to the skin surface and then burrow into molting pouches (these are shorter and smaller than the adult burrows). After 3-4 days, the larvae molt, turning into 4) 8-legged nymphs. This form molts a second time into slightly larger nymphs, before a final molt into adult mites. Adult mites then mate when the male penetrates the molting pouch of the female 5). Mating occurs only once, as that one event leaves the female fertile for the rest of her life (1-2months). The impregnated female then leaves the molting pouch in search of a suitable location for a permanent burrow. Once a site is found, the female creates her characteristic S-shaped burrow, laying eggs in the process. The female will continue lengthening her burrow and laying eggs for the duration of her life.

Management and Therapy

Scabies is not curable without prescription medication. The two medication options are a prescription cream or prescription pills; the cream is by far the most common treatment.

The topical medication is a 5% Permethrin cream, such as Elimite. 10% Crotamiton (Eurax) cream is suggested for infants less than 2 months of age .

Pediculosis

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Order:	Phthiraptera
Family:	Pediculidae
Genus:	*Pediculus*
Species:	*P. humanus*

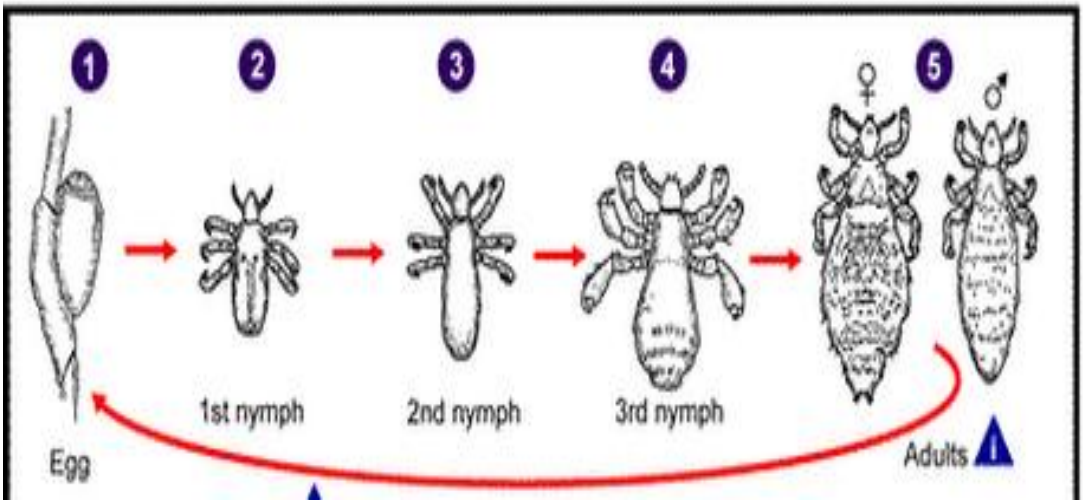
Pediculosis is an infestation of lice (blood-feeding ectoparasitic insects of the order Phthiraptera).The condition can occur in almost any species of warm-blooded animal (i.e. mammals and birds), including humans. Although *pediculosis* in

humans may properly refer to lice infestation of any part of the body, the term is sometimes used loosely to refer to *pediculosis capitis*, the infestation of the human head with the specific head louse.

Agents:
Pediculosis is caused by organisms of the phylum Arthropoda, class Insecta, order Anoplura (blood-sucking lice) and genus Pediculus. The three species that commonly infest humans are *Pediculus humanus capitus* or head lice, *Pediculus humanus humanus* or body lice, and *Phthirus pubis* or pubic lice, also known as crabs.

Morphology:
Lice are visible to the naked eye, with P. humanus 2-4 mm long and P.pubis 1mm long .The lice are flattened dorsoventrally, and are characterized by legs with claws adapted for clinging to hairs and fibers on the body of the host, as well as mouth parts used for piercing the skin of the host to attach to it to suck blood. Lice are wingless, so they can only be transmitted from host to host via direct contact. The eggs laid by the female louse are oval shaped and attached to the hair shaft of the host.

Transmission:
Transmission of Pediculosis can only occur through parasite transfer from host to host through direct body contact with lice or lice eggs (nits) on bodies, clothing or personal articles. *P. pubis* are transmitted through sexual contact or other contact with infested external genitalia. Lice are host specific, and can only survive on the host and briefly (up to one week) in the environment. Head and pubic lice deposit and cement nits onto the hair shaft on the scalp or pubic area, while the body louse deposits eggs primarily on the seams of clothing. Contact with these eggs can also spread the infestation.
·**Reservoir:** There is no reservoir for Pediculus other than humans because the lice are host-dependent (they cannot survive long in the environment) and host-specific (there are several types of animal lice as well but they do not typically affect humans).
·**Vector:** There is no vector for *Pediculus* because they are transmitted via direct contact. However, the body lice themselves are vectors of louse-borne relapsing fever (*Borrelia recurrentis*) and louse-borne typhus(*Rickettsia prowazeki, R. quintana*). Lice become infected when they feed off the blood of a person infected with either relapsing fever or typhus. The infected louse dislikes the intense heat of the fevered body, so leaves the infected person and movees to a new host, where it deposist the parasites on the body of the new hosts through fecal matter excreted as it feeds on the new host. This fecal matter is rubbed into the skin by scratching, and thus the *B. recurrentis* and *Rickettsia* parasites are able to enter the new host's body and infect him.



The **life cycle** of the head louse has three stages: egg, nymph, and adult.

Eggs: Nits are head lice eggs. They are hard to see and are often confused for dandruff or hair spray droplets. Nits are laid by the adult female and

are cemented at the base of the hair shaft nearest the scalp . **(1)**They are 0.8 mm by 0.3 mm, oval and usually yellow to white. Nits take about 1 week to hatch (range 6 to 9 days). Viable eggs are usually located within 6 mm of the scalp.
Nymphs: The egg hatches to release a nymph **(2).** The nit shell then becomes a more visible dull yellow and remains attached to the hair shaft. The nymph looks like an adult head louse, but is about the size of a pinhead. Nymphs mature after three molts **(3,4)** and become adults about 7 days after hatching.

Adults: The adult louse is about the size of a sesame seed, has 6 legs (each with claws), and is tan to grayish-white **(5).** In persons with dark hair, the adult louse will appear darker. Females are usually larger than males and can lay up to 8 nits per day. Adult lice can live up to 30 days on a person's head. To live, adult lice need to feed on blood several times daily. Without blood meals, the louse will die within 1 to 2 days off the host.

Body lice: Body lice are morphologically similar to head lice. They have a different life cycle, whereas body lice reside on and lay their eggs on the clothing and fomites of infected individuals and migrate to the human body to feed.

Treatment:

The methods include chemical treatments, natural products, combs, shaving, hot air, silicone-based lotions, and ethanol (ethyl alcohol).

Pediculosis is commonly treated with permethrin **lotion.**
Cattle infested with bovine pediculosis are generally treated chemically, by drugs like ivermectin **and** cypermethrin**.**

Xenopsylla cheopis (oriental rat flea)

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Order:	Siphonaptera
Family:	Pulicidae
Genus:	***Xenopsylla***

Flea, (order Siphonaptera), any of a group of bloodsucking insects that are important carriers of disease and can be serious pests. Fleas are parasites that live on the exterior of the host (i.e., are ectoparasitic). As the chief agent transmitting the Black Death (bubonic plague) in the Middle Ages, they were an essential link in the chain of events that resulted in the death of a quarter of the population of Europe.

General Features

Fleas are small, wingless insects with a tough cuticle bearing many bristles and frequently combs (ctenidia) of broad, flattened spines.

The adult flea varies from about 0.1 to 1 cm (0.039 to 0.39 inch) in length and feeds exclusively on the blood of mammals (including humans) and birds. With about 2,000 species and subspecies known, the order is still a small one compared with many other groups of insects.

However, it is widely distributed with some—such as the rat flea and the mouse flea—having been carried all over the world by humans. Native species of fleas are found in polar, temperate, and tropical regions.

Importance

Infestation by fleas may cause severe inflammation of the skin and intense itching. Although many animals acquire partial immunity after constant or repeated attacks, individuals (especially humans) can occasionally become sensitized after exposure and develop allergies. Species that attack people and livestock include the cat flea (*Ctenocephalides felis*), the so-called human flea (*Pulex irritans*), the dog flea (*Ctenocephalides canis*), the sticktight flea (*Echidnophaga gallinacea*), and the jigger, or chigoe, flea (*Tunga penetrans*). Poultry may be parasitized by the European chicken flea (*Ceratophyllus gallinae*) and, in the United States, by the western chicken flea (*Ceratophyllus niger*).

Certain fleas that feed primarily on rodents or birds sometimes attack people, particularly in the absence of their usual host. When rats are dying of bubonic plague, their hungry fleas, themselves infected with plague bacilli and seeking food elsewhere, can transmit the disease to humans, especially in buildings heavily infested with rats. The Oriental rat flea (*Xenopsylla cheopis*) is the most efficient carrier of plague, but other species of fleas (e.g., *Nosopsyllus fasciatus*, *Xenopsylla brasiliensis*, *Pulex irritans*) can also transmit the disease to people.

Although there are occasional cases of plague in tropical and some temperate regions, the disease in humans can be controlled by early diagnosis and antibiotics. Plague (sylvatic plague) is a widespread disease in hundreds of species of wild rodents throughout the world and is maintained in those populations by fleas that parasitize these animals. More than 100 species of fleas are known to be able to be infected by the plague bacillus, and an additional 10 species are implicated as carriers of the classic type of urban plague.
Xenopsylla cheopis, are thought to be the principal carriers of murine (endemic) typhus, a rickettsial disease of humans. As in plague, rats and mice are the sources of infection.

Fleas are considered important in the maintenance and spread of many locally restricted infections among rodents and other mammals, including tularemia and Russian spring-summer encephalitis. Fleas transmit myxomatosis, a viral disease of rabbits, which is used deliberately to control rabbits in areas where they are severe pests (e.g., in Australia). Fleas are probable carriers of a filarial worm of dogs and serve as the intermediate host of a common tapeworm (*Dipylidium caninum*) of dogs and cats and occasionally children. If heavily infested, animals can suffer severe damage or be killed by the effects of flea bites and the resultant loss of blood.

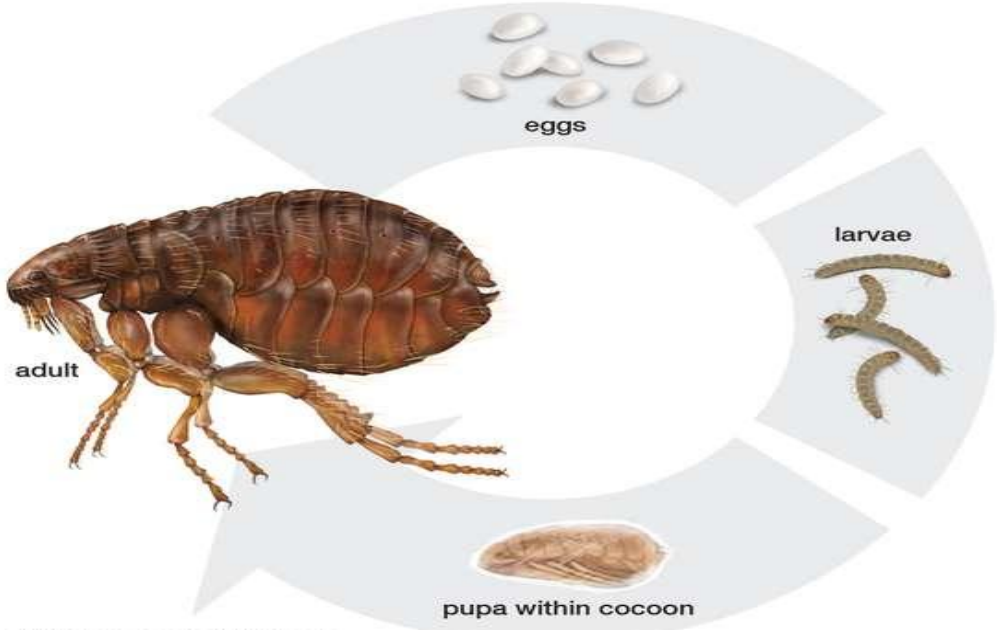
Life cycle

The four life stages are the egg, larva, pupa, and adult. Pearly white oval eggs are deposited on the body of, or in the nest or habitat of, the host animal. The larva is small and legless and feeds on organic debris, such as dried excrement, dried bits of skin, dead mites, or dried blood found in the host's nest.

The adult fleas pass freshly imbibed blood rapidly through their gut to produce fecal matter for the nourishment of their offspring, which is essential to the successful metamorphosis of certain species of flea larvae.

After three (exceptionally, two) molts, the larva spins a silk cocoon that includes debris from the nest and enters the pupal stage. The pupa emerges as an adult some days or months later.

Some species can enter an arrested state of development at the end of the pupal stage and will not emerge as an adult until a host is present. Depending upon the species or environmental conditions, the time required for a complete life cycle varies from two weeks to several months.



Control

In controlling fleas it is best to treat simultaneously both the host nest or bedding area, which is the breeding site of fleas, and the infested host, since the larval and pupal stages usually develop away from the host's body.

For infested animals a commercial dust, spray, dip, or aerosol containing an insecticide or growth regulator is used. However, in some regions, fleas have become resistant to some insecticides, and new materials are required.

For the control of larval and adult fleas away from the host, insecticides or growth regulators may be applied to the pens and haunts of the affected animals. Repellents may be effective in preventing attack by fleas.

Bedbugs(cimex sp.)

Cimex lectularis is cosmopolitan in distribution. Cimex hemipterus (formerly Cimex rotundas) is the Indian bedbug. It is limited to tropical and subtropical regions in distribution. Cimex boueti is the tropical species and is distributed in South America and Africa. All these three species of bedbug differ but very slightly from one another.

Cimex lectularis.

Cimex hemipterus.

Cimex.

CIMEX

SYSTEMATIC POSITION

Phylum	.....	**Arthropoda**
Subphylum	.....	**Mandibulata**
Class	.....	**Insecta**
Subclass	.....	**Pterygota**
Division	.....	**Exopterygota**
Order	.....	**Hemiptera**
Genus	.....	*Cimex*

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3. External Features of Bedbugs:

(i) Shape, Size and Colour:

The body of bedbug is small, oval and dorsoventrally flattened. It measures about 5.00 mm in length and about 3.00 mm in width. The colour of bedbug is reddish- brown which changes to deep purple or red after feeding. The body is profusely covered with bristles and hairs. The body consists of three parts the head, the thorax, and the abdomen.

(ii) Head:

The short and broad head fits inside lateral extensions of pro-thorax. Head bears a pair of compound eyes and two short antennae. Compound eyes are well developed but ocelli are absent. The antennae are four jointed. The clypeus is distinct. On the ventral side of the head, the mouth parts form a sucking apparatus known as proboscis, beak or rostrum.

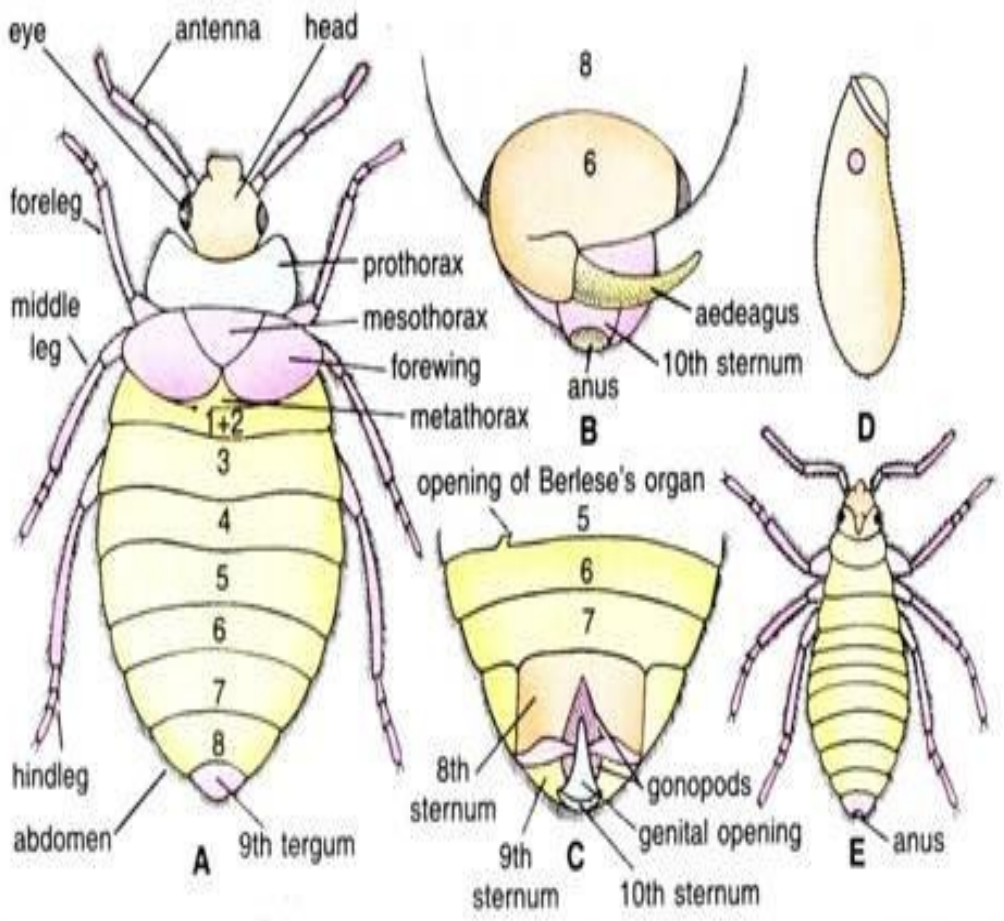

Fig. 79.1. *Cimex*. A—Adult male (Dorsal view); B—Genitalia of male; C—Posterior end of abdomen of adult female (Ventral view); D—Egg, E—Young nymph.

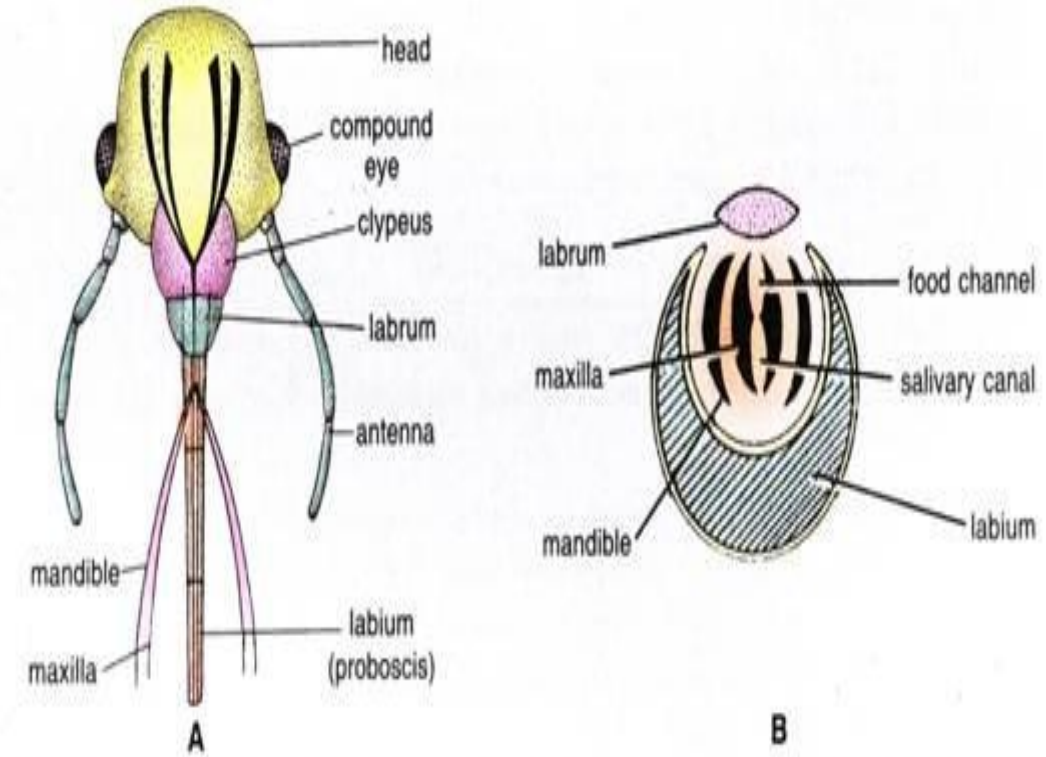

Fig. 79.2. *Cimex*. Mouth parts. A—Head and mouth parts in front view; B—T.S. of mouth parts.

Mouth Parts:

Mouth parts form a pointed beak or rostrum that lies bent under the head in a ventral groove up to the first pair of legs. The mouth parts are

modified for piercing the skin and sucking the blood. They consist of a labrum, labium, a pair of mandibles and a pair of maxillae.

The labrum is short and it covers the mid-dorsal groove of the rostrum. The labium forms an elongated incomplete hollow tube or sheath called the rostrum. It is three-jointed and mid-dorsally grooved to enclose the four needle-shaped stylets, two mandibles and two maxillae.

The mandibles are flattened and sharply pointed. The maxillae are slightly shorter and possess serrated edges. The mandibles, worked by muscles in the head, slide independently on either side of the two maxillae which do not move independently of each other.

The inner maxillary surfaces are grooved so as to form two exceedingly fine channels running along their entire length. One of these is the feeding channel and is connected to the pharynx. Blood is sucked through it. Feeding channel is bigger and dorsal in position.

The other is the salivary channel joined by its ducts to the salivary glands, and is connected to a small pump beneath the pharynx. The salivary channel is smaller and ventral in position, it is used for injecting saliva into the puncture. All these are enclosed in the trough-like beak.

The beak is grooved in such a way that the sides of the groove are almost close together, thus, forming a protective sheath for the stylets inside. The maxillary and labial palps are absent.

At rest, the rostrum is bent beneath the thorax. For feeding, the rostrum is directed downwards or forwards, the blade-like mandibular stylets make a puncture in the skin of the host. The jointed rostrum bends and the maxillary stylets enter the wound. The saliva runs down into the puncture and prevents the clotting of the blood which is subsequently sucked up.

(iii) Thorax:

The thorax is divisible into a large pro-thorax, a very small mesothorax and metathorax. The pro-notum of pro-thorax is notched anteriorly to receive the head. The mesothorax is very small. The metathorax is generally covered by a pair of stub-like vestigial forewings or hemielytra that arise from the mesothorax.

The hind wings are completely absent so that flight is impossible. Each thoracic segment bears ventrally a pair of short, stout legs. The legs have three- jointed tarsi with two strong claws each. Stink glands open on the ventral side of metathorax.

(iv) Abdomen:

The abdomen is flat and consists of ten segments, tenth segment is tiny with an anus. In the male, the abdomen is narrower and pointed than in the female and terminates into a curved hook-like clasper, which serves as a sheath for the aedeagus or penis for transferring spermatozoa to female.

In the female, the abdomen is broad, rounded apically and possesses a prominent notch or cleft ventrally on the posterior margin of the fourth segment, slightly to the right of the middle line. This notch or cleft is the opening of a particular blind copulatory pouch known as the organ of Berlese, from which there is no opening to any other organ of the body.

In the female, the eight and ninth sterna are cleft into two parts. There are no cerci. The spermatozoa are introduced into organ of Berlese by the aedeagus or penis of the male. The spermatozoa bore through the organ of Berlese and reach the ovary.

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4. Life History of Bedbugs:

Before laying eggs, the female bug feeds on blood-meal and mates with the male bug. Life history of bedbug exhibits gradual metamorphosis and comprises three stages: egg, nymph and adult.

(i) Mating:

In bedbugs, the mating or copulation is quite interesting. While mating or copulating, the male bug takes up a position diagonally across the body of female bug and introduces its penis into the notch or cleft of the organ of Berlese to transfer the spermatophores. The spermatozoa bore through the wall of organ of Berlese and reach the ovary to fertilize the eggs. Thus, fertilisation is internal.

(ii) Eggs:

The female lays about 200 to 500 eggs, singly or in batches, 2 or 3 eggs per day, in cracks and crevices of cots and furniture, in holes, under mattresses and similar other places. The eggs of bedbugs are pearly white oval or cylindrical objects, furnished with a little cap-like lid at one end which is slightly curved to one side.

The end possessing the cap-like lid bears a micropyle. The eggs are about 1.00 mm in length and are laid singly or in small batches. The eggs are laid throughout the year in warm countries.

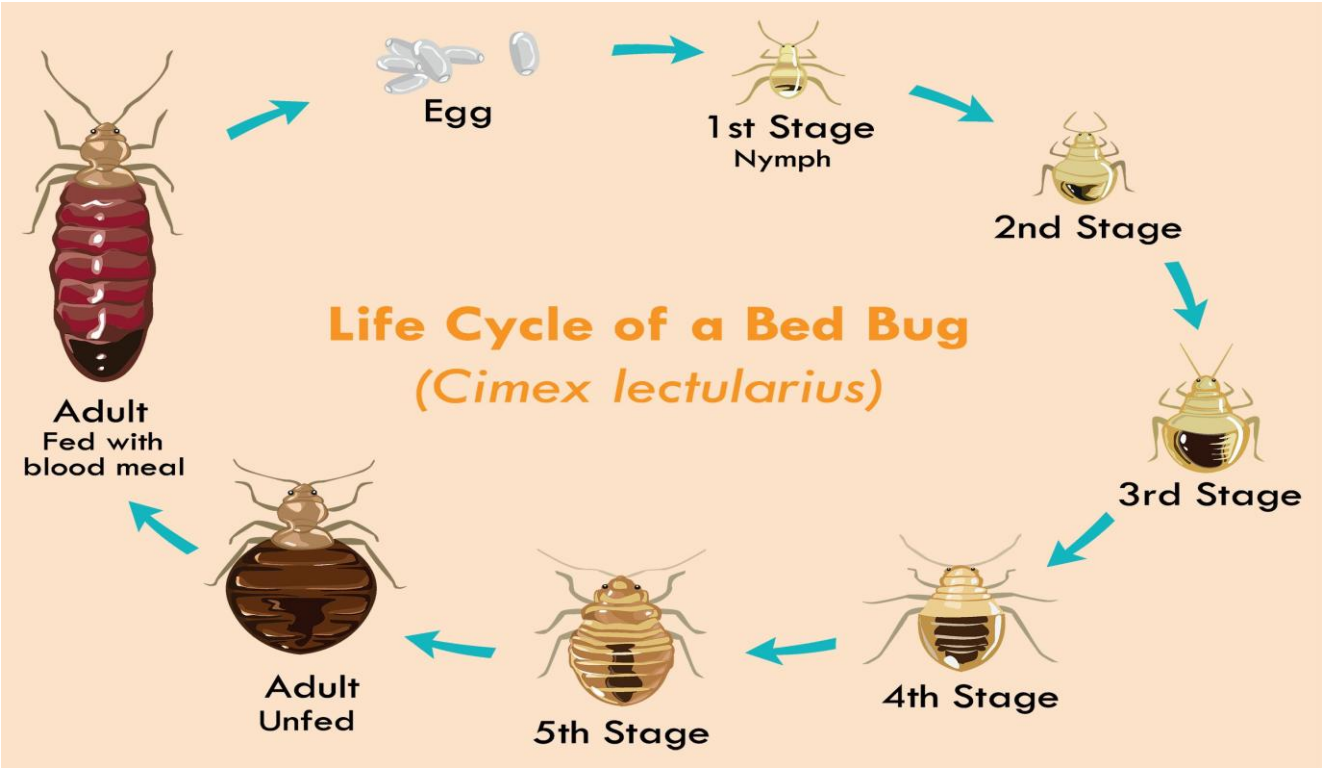
(iii) Nymph:

The eggs hatch in from 6 to 10 days during warm weather but take a longer period during cold weather as their development is retarded by cold. The young bugs or nymphs come out by pushing off the lids of the eggs. The nymphs are very small, about 1.00 to 1.50 mm long, flat, active, delicate, semitransparent creatures and are pale in colour.

They resemble the parents in general appearance except being smaller and paler and possessing comparatively thicker antennae and stouter legs. After a few hours, the nymphs are able to pierce the skin of man and suck the blood, and if undisturbed they feed to repletion in about 3 or 4 minutes.

They may take a meal three or four times of their body weight and become globular and bright red. They need shelter but no more food till they moult into the second stage. After their first hearty meal they have a much more robust appearance, and grow rapidly. They feed on human blood and moult five times to become the adult.

After each moult, the nymphs become slightly larger and darker. If man is not available for feeding, they feed on blood from the older bugs. The nymphs can survive without feeding for 3 or 4 months during which period they do not moult. After five moults they become adult taking about 7 to 24 weeks in all. The entire life history takes about 2 months in warm weather and about 6 months during winter in cold regions.



5. Economic Importance of Bedbugs:

The bedbugs are the most annoying and disgusting household pests. They feed on human blood by piercing the skin, causing in some cases only, pain and inflammation.

The economic importance of bed bug can be better studied under the following heads:

1. Nuisance:

The bedbugs emit foul and stinking smell due to the secretion of the stinking glands. This peculiar odour is unbearable to the human beings. When their number increases sufficiently, the sleep becomes almost impossible. Their bite causes inflammation, irritation and disturbance in sleep.

Sleepless nights with constant irritation due to the introduction of saliva of bedbug in the human blood during feeding are likely responsible to contribute greatly to the ill- health of children and even of certain adult persons.

2. Diseases:

The bedbugs have been suspected of transmitting many diseases from man to man. They are supposed to transfer the micro-organisms or germs of kala-azar, bubonic plague, relapsing fever, typhoid and even tuberculosis.

It is doubtful, however, if they are active or chief vectors of any major disease, but they appear to possess the micro-organism of kala-azar, plague, typhoid, relapsing fever and tuberculosis and under exceptional circumstances they may become means of their dissemination and transmission. It is generally accepted now that bed bugs are not responsible for large outbreaks of epidemic diseases.

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6. Control of Bedbugs:

The following measures are suggested to control the bedbugs:

1. The houses should be well-ventilated, damp-free, and clean. This can be done by cleaning the rooms, beds, mattresses and furniture, etc.

2. Necessary precautions to prevent entrance of bedbugs from infested beddings or luggage brought after journey, should be taken.

3. Badly infested rooms and furniture may be made bug-free by washing with insecticides which will penetrate the cracks and crevices in the walls of rooms and the furniture.

4. Sprinkling of boiling water, spraying of petrol or an emulsion of kerosene, benzene and petrol and fumigation with sulphur are generally used to exterminate the bedbugs.

5. Bedbugs can be killed by the fumigation of rooms and furniture with HCN gas but this should be done with extreme precaution as the HCN gas is poisonous to man also.

6. The best method to exterminate the bedbugs is the spray of DDT (dichloro-diphenyl- trichloroethane). It can be sprayed on the indoor surface and on the furniture so as to leave residue which is lethal to bedbugs which crawl over it for many months.

For small infested bed rooms all that is required is about 1.5 litres of 5 per cent DDT in kerosene. This can be sprayed on all the walls and furniture where bugs may crawl or rest. In case of irritation and inflammation of skin by bed bug bite, a little of hydrogen peroxide or ammonia may be rubbed on the skin. This acts almost as an immediate cure.