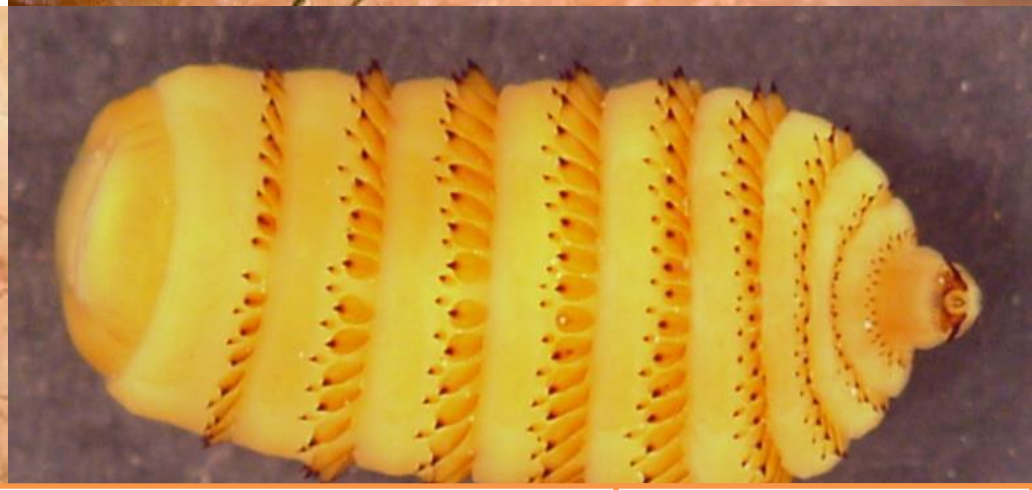
VETERINARY ENTHOMOLOGY



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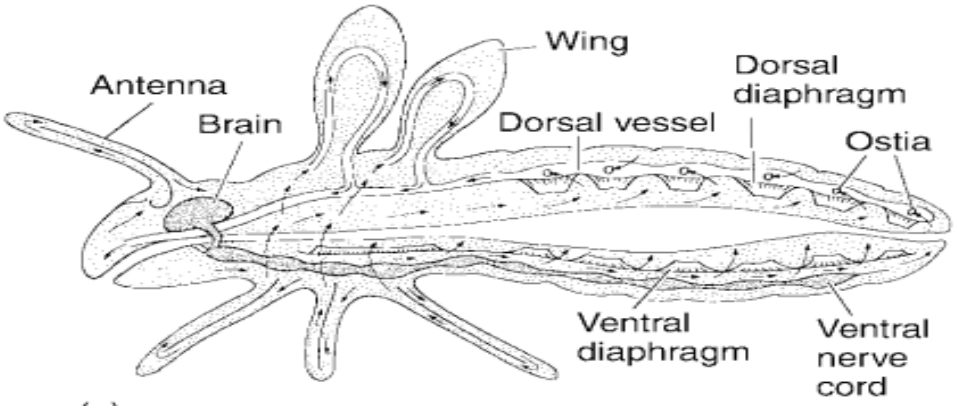
Introduction

- Veterinary Entomology: is a branch of science studying all parasitic arthropods of animals and arthropod-related problems.
- Phylum Arthropoda (Gk. Arthro-joint, podos-foot)is the Largest phylum in the animal kingdom (cointains over 80% of all known animal species) bearing jointed appendages,
- Arthropods are multicellular invertebrate animals having segmented body.
- Arthropods are coelomate, covered with an exoskeleton and are bilaterally symmetrical
- They display every type of life style including parasitism.
- Parasitic arthropods are generally described as ectoparasites/external parasites.
- Ectoparasites inhabit the skin or outgrowths of the skin of the host.
- They cause significant infestations in livestock, pets, laboratory animals, poultry, fish and bees and man

Introduction…

- Ectoparasites spend their entire/ parts of their life on the host or only occasionally visit it.
- Hosts may provide as source for food (i.e., blood, lymph, body secretions, skin debris, hair, feathers), shelter, transport….etc.
- Many of the ectoparasites are host specific (e.g. Lice) while others parasitize a wide range of hosts (e.g. ticks).
- Arthropods are involved in nearly every kind of parasitic relationship, either as
  - ✓parasites themselves or
  - ✓hosts/vectors for other micro-organisms (viruses, bacteria, protozoa and helminths).
- Many species are haematophagous (suck blood) while others are histophagous (tissue-feeders) and
  - ✓They bite or burrow in dermal tissues causing trauma, inflammation and hypersensitivity reactions.
- The impacts can be either:
  - ✓ direct : through tissue damage or blood loss or
  - ✓Indirect: through their role as vector of viral, bacterial, protozoa and helminth pathgens.

Structure and functions



The exoskeleton

- It provides:
  - ✓physical support and physiological protection to the underlying living tissues
  - ✓serves as a place for muscle attachment.
- It is usually hard, insoluble, virtually indigestible and often mineralized with coverage of calcium carbonate and wax.
  - ✓It is made out of chitin and it sheds throughout the growth process.
  - ✓chitin is a non-cellular material, a nitrogenous polysaccharide, secreted by the epidermis.
- The exoskeleton has fine pore canals which allow the passage of secretions from the epidermis to the surface.

Structure and functions….

- It has many outgrowths in the form of scales, spines, hairs and bristles/setae.
- The process of molting (shedding the skin) is technically called ecdysis.
- Moulting cycles run nearly continuously until an arthropod reaches full size.

❖**Body segmentation**

Segments grouped into **2 or 3** functional regions (e.g., head, thorax, abdomen).

- ✓**The Head** contains the **antennae, eyes** and **mouthparts**
- ✓**Thorax** consists of **three segments**, each with **a pair of legs**
- ✓**Abdomen** consists of **10 to 11 segments**, most of which have no paired appendages).

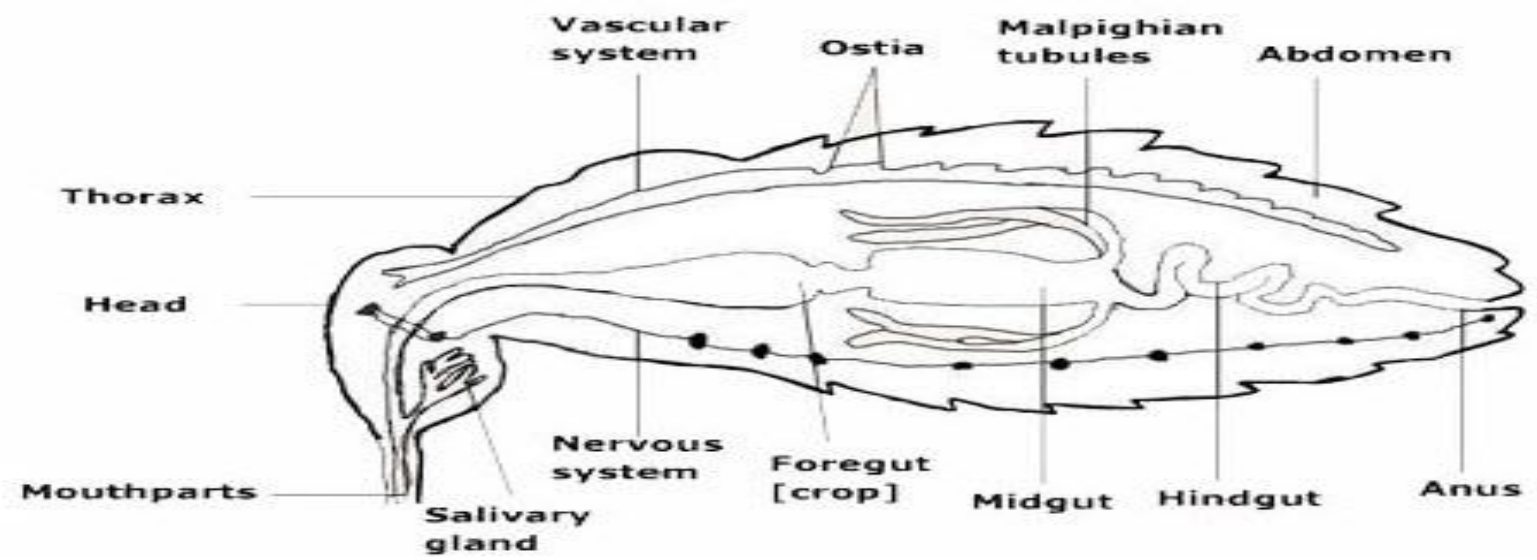
Structure and functions….

➢The legs are divided into **tube-like segments** connected to one other by **articular membranes** creating **joints** at each junction.

✓The legs are usually **hexa-segmented**

Excretory system:

In **insects** and **arachnids**, small structures called **malpighian tubules** remove **waste** from the blood, moving it into **excretory ducts** that open into the **intestine**. and pass with **feces**.



❖The nervous system of arthropods

- It consists of a dorsal brain in the head region, connected with a pair of ventrally situated ganglionated nerve cords.
- The sensory organs include: the eyes and various tactile and auditory organs (antennae, palps and various receptors).
  - ✓These organs respond to temperature, humidity, food stimuli and host odors.
- In some arthropods eyes are absent or reduced, (e.g. ticks and lice) while in others the eyes are well developed (some blood-sucking flies).

two types of eyes co-exist in the same animal:

- ✓compound eyes: adapted for the perception of movement.
- ✓Simple eyes (ocelli): present on the top of the head (with unknown function).

➢In the female of some species the eyes are distinctly separated (dichoptic) while in the males they may be very close together (holoptic).

❖Respiration (gas exchange) in arthropods:

- The process of getting oxygen to the tissues may be in different ways:
- In some of the smallest arthropods, the exoskeleton is thin and lacks a waxy layer and oxygen and carbon dioxide simply diffuse directly across the cuticle.
- In most terrestrial groups of arthropods, the cuticle is punctured by a number of respiratory openings known as spiracles.

➢Oxygen enters through the spiracles and pass down the trachea then to tracheoles and reach to parts of the body.

➢Carbon dioxide and water vapour move from the cells passes to the exterior in the opposite direction.

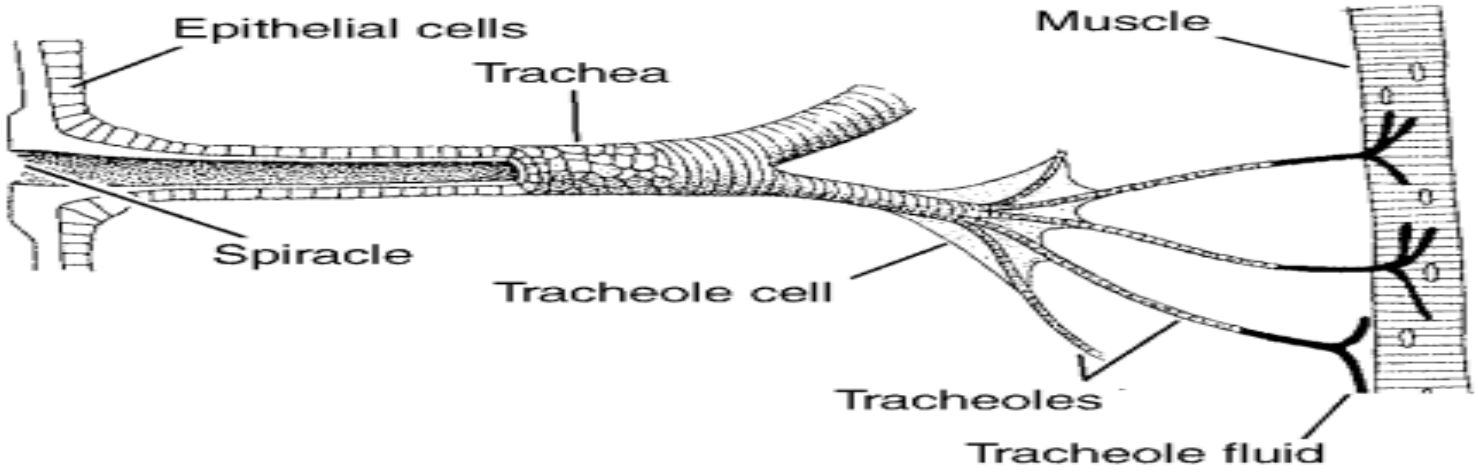


Fig. 1.6 A spiracle, trachea and tacheoles (after Snodgrass, 1935).

❖Digestion and absorption in arthropods

- Digestive system is well developed.
- The insect alimentary canal has 3 main interior parts:
  - ✓**Foregut:** for ingestion and storage (crop) of food
  - ✓**Midgut:** site of digestion and absorption (secretes **enzymes)**
  - ✓**Hindgut:** site of absorption of water and the formation of faeces
- **Malpighian tubules:** excretory tubules at the **junction of the mid- and hind-gut**
  - ✓It act as **filters**, **extracting waste products** from the haemolymph which are subsequently discharged into the gut.

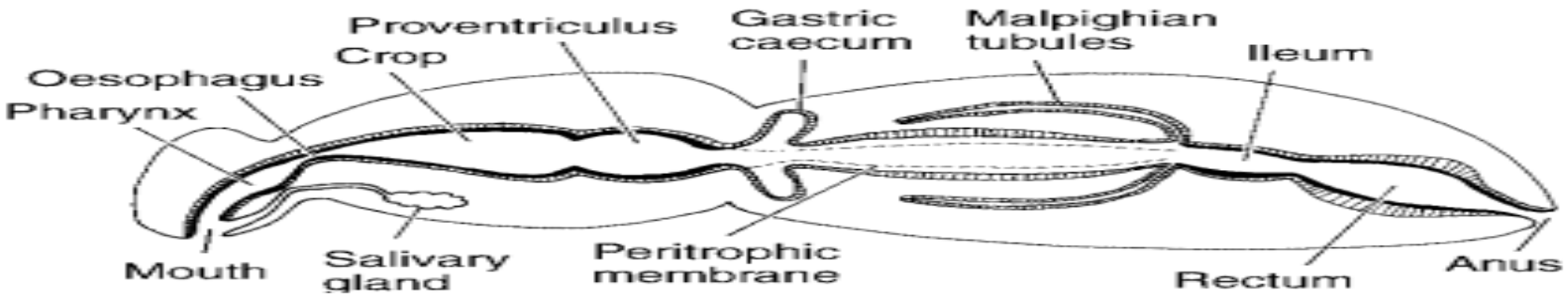


Fig. 1.8 Generalised digestive tract of an arthropod, showing the fore-, mid- and hindgut. The cuticular linings of the foregut and hindgut are indicated by thick lines.

Arthropod reproduction

- Fertilization is internal but eggs develop externally.
- As sexes are separate ,mating is usually required for the production of fertile eggs.
- Males have 2 testes, a vas deferens and seminal vesicle (stores sperm).
- Females have 2 ovaries, a common oviduct (uterus) and an ovipositor (vagina).
- Almost all arthropods lay eggs but some give birth to live young after the eggs have hatched inside the mother.
- Eggs passing into the vagina are fertilized by the sperm which remain viable in the ***spermatheca*** often throughout the female's life.
- In some species males may be absent and females reproduce by parthenogenesis (producing identical copies of themselves).

❖Egg laying habits of arthropods may be Oviparous, Ovoviviparous (e.g. flesh-flies) or Viviparous (e.g. sheep ked , tsetse fly):

❖**Life cycle in arthropods**

➢Development from egg to adult is usually of two types: **Simple** and **complex**

1. **Holometabolous metamorphosis:** complex life cycle with complete metamorphosis (e.g. flies, fleas)
   - ✓the entire body is reorganized and reconstructed.
   - ✓No physical resemblance to the adult.
   - ▪The transformation b/n the larva and the adult is through incorporation of the pupal stage which lies within the puparium or cocoon.

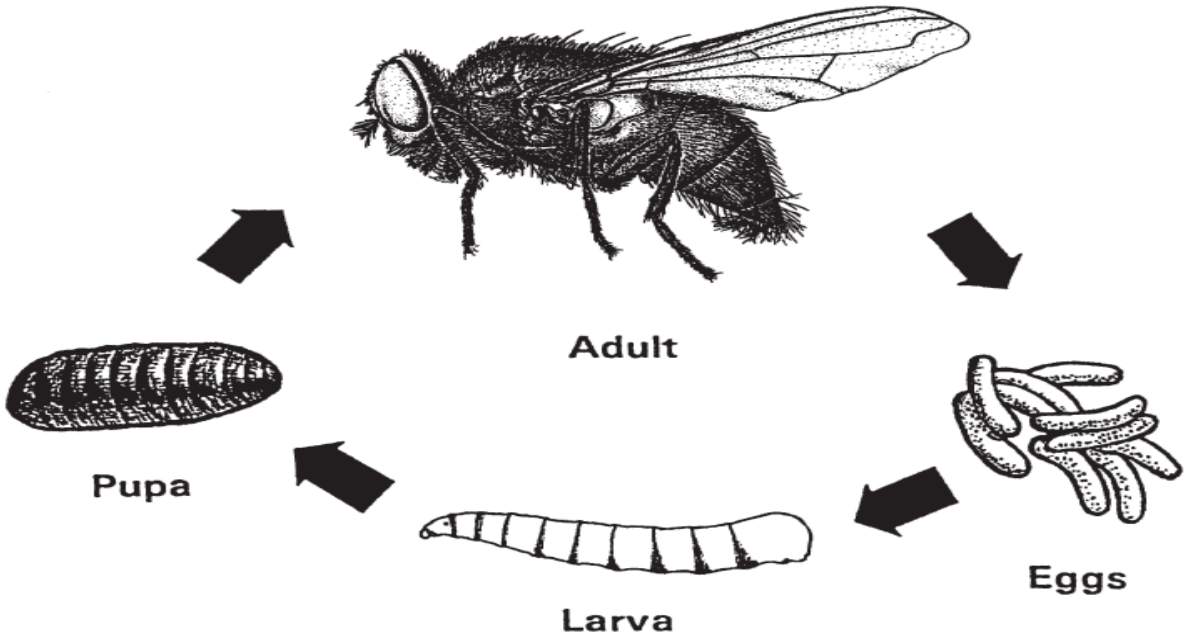


Fig. 1.3 House fly life cycle – example of complete metamorphosis (from USDA, ARS, Agri. Hndbk. No. 655, Feb. 1991)

2. Hemimetabolous metamorphosis :

- Simple life cycle with incomplete or partial metamorphosis
- Development occurs from the egg through several nymphal stages which resemble the adult in appearance, feeding habits and habitat (e.g. lice)
  - ✓except that the genitalia and wings are not developed.

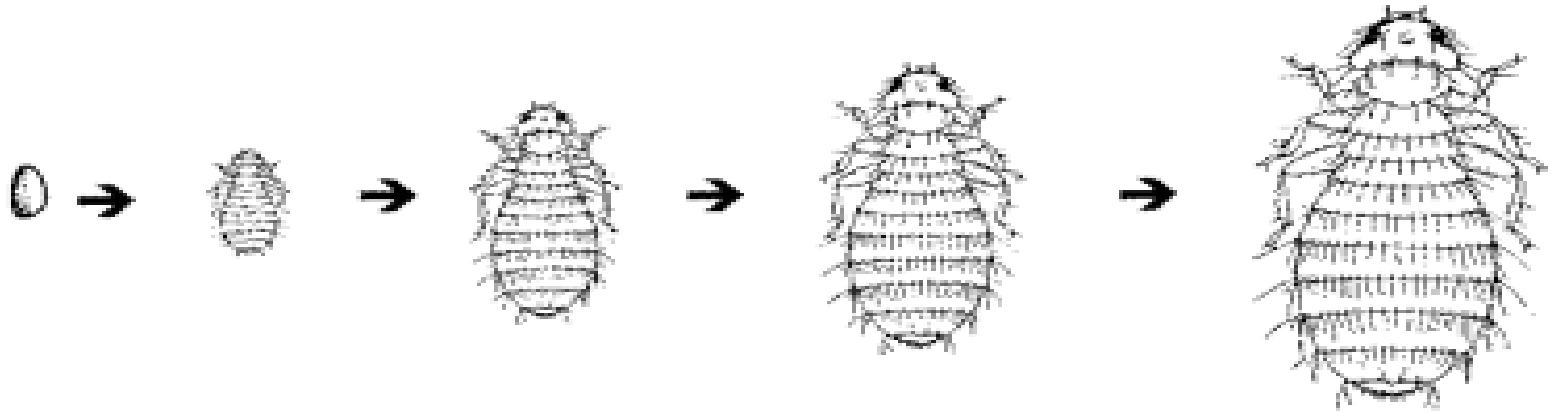


Fig. 1.11 Life-cycle of the louse, *Menopon gallinae*, displaying hemimetabolous metamorphosis and passing through three nymphal stages prior to emergence as a reproductive adult (modified from Herms & James, 1961).

Effects of arthropods on the hosts

- The consequences to arthropod attack and annoyance may lead:
  - ✓ to reduced productivity, animal wellbeing, and profitability.
- The degree of damage caused by ectoparasites varies depending on the type of ectoparasites.

❖ Direct effects:

- Blood loss (anaemia)):by blood-feeding arthropods(e.g. blood-feeding ectoparasites).
  - ✓the blood removed by feeding may be directly debilitating and anemia is common in heavily infested hosts.
- Tissue damage:
  - ✓damage to carcasses or skin due to their feeding and moving habit through host tissue.
- **Myiasis,** the ecto infestation of tissue:
  - ✓larva of the some parasites cause direct damage to the carcasses and the skin by consuming or harming tissues of their hosts.
- **Direct causal agents** of **disease (e.g. mange).**
  - Causes toxic and allergic responses due to antigens and anticoagulants present in the saliva.

- **Bite irritation:** cause **skin inflammation** and **pruritus** (itching) by **feeding activities**.
  - ✓It can be accompanied by **hair or wool loss**, **skin thickening** and **secondary infections.**
- **Blockage of orifices** (ears, anus etc.)
- **Tick Paralysis:** Some ticks release toxins into the blood (e.g. *Ixodes* and *Dermacentor)*

❖Indirect effects:

- **Intermediate hosts** for various parasites: (tapeworms, roundworms)
- They act as the **vectors of pathogens :** transmit disease-producing pathogens (protozoa, bacteria, viruses, tapeworms, and nematodes).
  - By mechanical: the pathogen is usually adhering to the vector's mouthparts, body, or feet while feeding on an infected host or
  - biological maens.
- Annoyance (disturbance) causes irritation:
  - ✓ as they attempt to feed or oviposit (e.g. lice, fleas, ticks, flies),
  - ✓Livestock, in attempts to avoid or escape from arthropod attack, can be injured
  - ✓This may results in reduced growth and loss of condition due to the time spent in avoidance behavior losing grazing or resting period.

- Loss of productivity: through reduced growth and weight loss
  - the time for grazing or resting is lost in avoidance behavior or irritation.
- Secondary infections: through the damaged skin
- Self wounding: due to dramatic avoidance responses (gadding):
  - ✓collision with fences and other objects.

Host defense strategies against the activities of ectoparasites

➢Animals have developed elaborate means to defend themselves against:

✓ infestation by arthropods and infection by pathogens transmited by arthropods

➢Both behavioral and immunological responses are used to resist infestation.

❖Behavioral defenses include:

- Evasive, offensive, or defensive action against biting flies
- Grooming by animals (e.g., biting, scratching, or licking)
- Head shaking, foot stamping, skin twitching, tail switching or scratching and wing flapping
- seasonal mass migration to avoid areas of high parasite density.

Many blood-feeding arthropods partially or completely counteract the host immune response by inoculating *immunomodulators or immunosuppressive compounds into* the bite site.

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- A wide range of pharmacologically active compounds is known to be released at the bite site by various arthropods
- These compounds include:
  - ✓***anticoagulants*** *to prevent the blood* from clotting,
  - ✓**local *analgesics*** *to reduce host* ***pain***
  - ✓various **enzymes** and **other factors** for promoting **blood or tissue digestion**.
- Some of these compounds are perceived by the host as **antigens** and may elicit an **immune response**,
- whereas others can cause **localized or systemic toxic responses** and **itching**.

Ectoparasite-Host relationship

➢The association of Veterinary ectoparasites with their hosts can be classified based on:

1. The **body site** the ectoparasites occupy
2. The **rigour** of the host association,
3. The **duration** of the host association,

❖The body site :

➢Internal: burrowing into host tissues or living in body cavities (e.g. myiasis producing fly larvae), or

➢External: living on the host skin for various periods.

❖The rigor (strictness) of the host association

It falls into two primary categories:

1. **Obligatory association**:

When a parasite is **dependent on a host** for some resource for **continued life** or to **complete a portion of their lifecycle.**

- ✓ the parasite totally depend on the host.
- ✓ The host provides key elements required by the parasite
- ✓ the association is highly host specific with the parasite capable of developing only on one host species.

2. Faculitative association:

➢when the parasites feed or live only occasionally on the host and are not dependent on the host for survival.

✓Most often do not have a high degree of host specificity

✓The parasite can survive and develop in the absence of hosts, as free-living organism utilizing other food sources.

❖**The duration of the host association**

➢With obligatory parasitism, there can be considerable variation in the amount of time spent in or on the host.

1. Continuous association:

- Some parasites live with their host throughout their entire lifecycle.

in most cases, all lifecycle stages are dependent on their host .

- They are highly dependent on the host for survival.
- they can not usually survive any length of time away from the host.
- They are usually disseminated between individual hosts by direct contact.
  e.g. lice, sheep keds)
- In some cases, only specific lifecycle stages are dependent on their host (e.g. myiasis causing flies).

2. Intermittent association:

- Most parasitic arthropods are free living for a major portion of their lifecycle.
- Only certain life stages of these parasites depend on the host for resources.
  - ✓a proportion of the lifecycle stages being free-living (e.g. hard ticks, flea larvae)
  - ✓In these instances oviposition is generally away from the host and larval stages develop without dependence on the host.
  - ✓Some blood feeding adult flies (e.g. mosquitoes, tabanids) have a very short interaction with the host.

Some associations between arthropod parasites and skin:

a-blood-sucking(tick);

b-surface feeding on secretions and exudates(muscid fly);

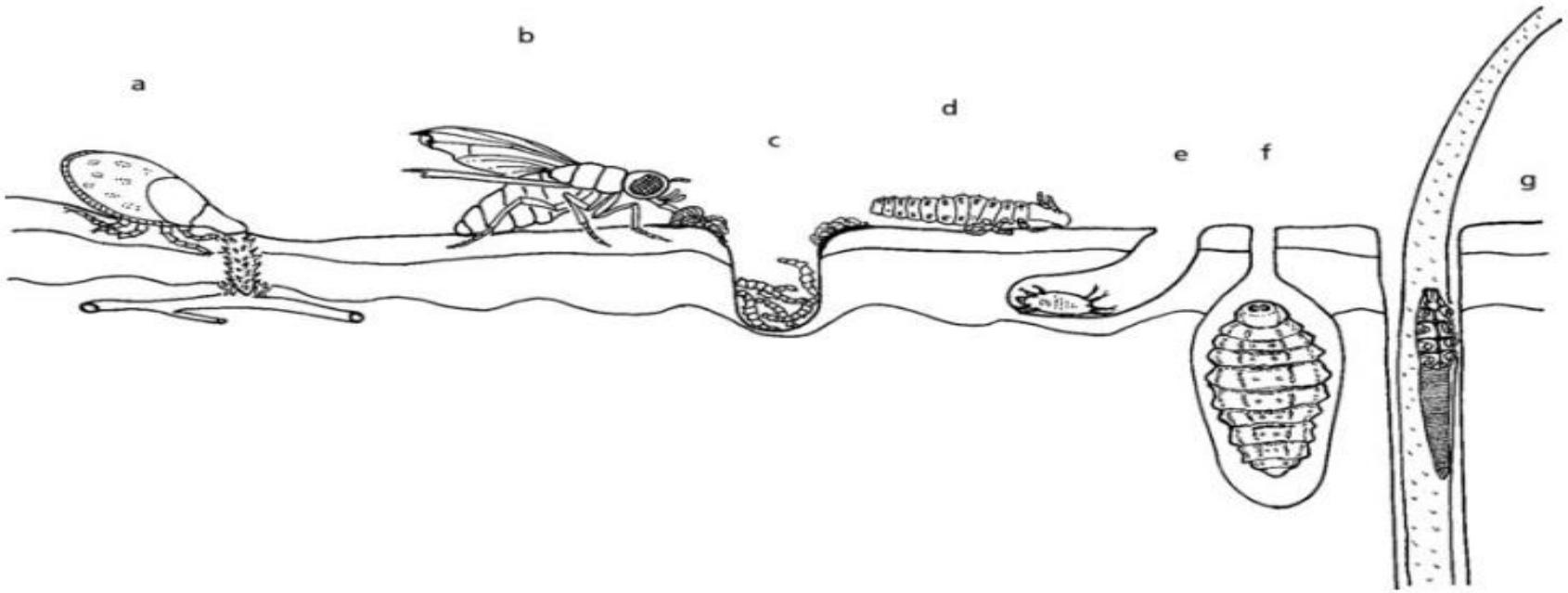
c-flesh-eating(cutaneous myiasis);

d-surface feeding on skin debris(chewing louse);

e-burrowing mite;

f-warble fly developing under skin;

g-miteinhairfollicle.



Control of Ectoparasites of animals:

- **Correct identification of** the **pest species** involved should be made.
- Basic understanding of the **biology, lifecycle**, and **habits of the pest** is neededto assess at which **vulnerable stage or stages** of the pest direct control efforts should be applied
- The **magnitude of damage** done by the pest should be assessed when control action should be taken.
- Determination then needs to be made on the **execution of the most efficient approach** to controlling the pest.
- In doing so, various **control components** (biological, cultural, chemical, mechanical) are utilized in harmony:
  - ✓ to **maximize profitability** and **minimize environmental impact**.
- There are various **tools** and **methods** that make up **integrated pest management programs** for animals.

These include:

1. Pest surveillance: for assessing pest population levels present and damage done.

❖Surveillance efforts are made to:

- ✓ identify species of arthropods present,
- ✓assess their distribution,

- establish host associations, anddetermine pest population densities at specific times and locations.

❖ Surveillance will range from:

- ✓ arthropod trapping methods,
- ✓use of insect nets,
- ✓ direct animal examinations, and
- ✓even observation of animal behavior in reaction to arthropod attack.

❖Surveillance techniques need to be established:

- ✓ specific to the pest group and
- ✓animal production system.

2. cultural methods

- waste management practices can effectively reduce fly breeding and fly activity
  - ✓regular waste removal and keeping moisture levels down can prevent major concerns for nuisance fly populations:
  - ✓preventing water leaks, designing proper floor grade to allow adequate moisture drainage,
  - ✓Providing adequate ventilation for waste drying and animal comfort,
  - ✓avoiding high temperatures to reduce animal need for excessive water intake,and
  - ✓using absorbent litter where feasible.
- Timely rotate pasture grazed livestock from one pasture to another.
- proper timing of such practices of dehorning, castration, and wool shearing to prevent fly attack of wounds.
- Proper outdoor water management practice to reduce breeding and the incidence of blood-feeding aquatic insects prevalent during warmer weather months.

3. Mechanical and physicaL methods:

In pastures, keeping brush and weeds cut down or burned may reduce the abundance of ticks.

Insect trapping is another form of mechanical/physical pest control to reduce fly populations.

the use of screens and barriers to prevent outdoor flying insect entry.

4. ChemicaL methods:

Application of insecticide/acaricides:

- ✓ to the animals,
- ✓to their houses or
- ✓to the environment in which the animals live.

Methods of chemical applications:

- **On animal** can be by:
  - ✓topical application,
  - ✓systemic application, or
  - ✓using feed additives or bolus treatments.
- **Off host animals can be:** sprays, baits, dusts, a larvicides.
  - ✓Residual sprays to surfaces where pest arthropods are frequent (e.g., fly resting places, crack and crevice arthropod harborage areas, etc.).

5. **Through manipulation of host responses,** in particular **host immune**:

✓ through proper management practices

✓Vaccination

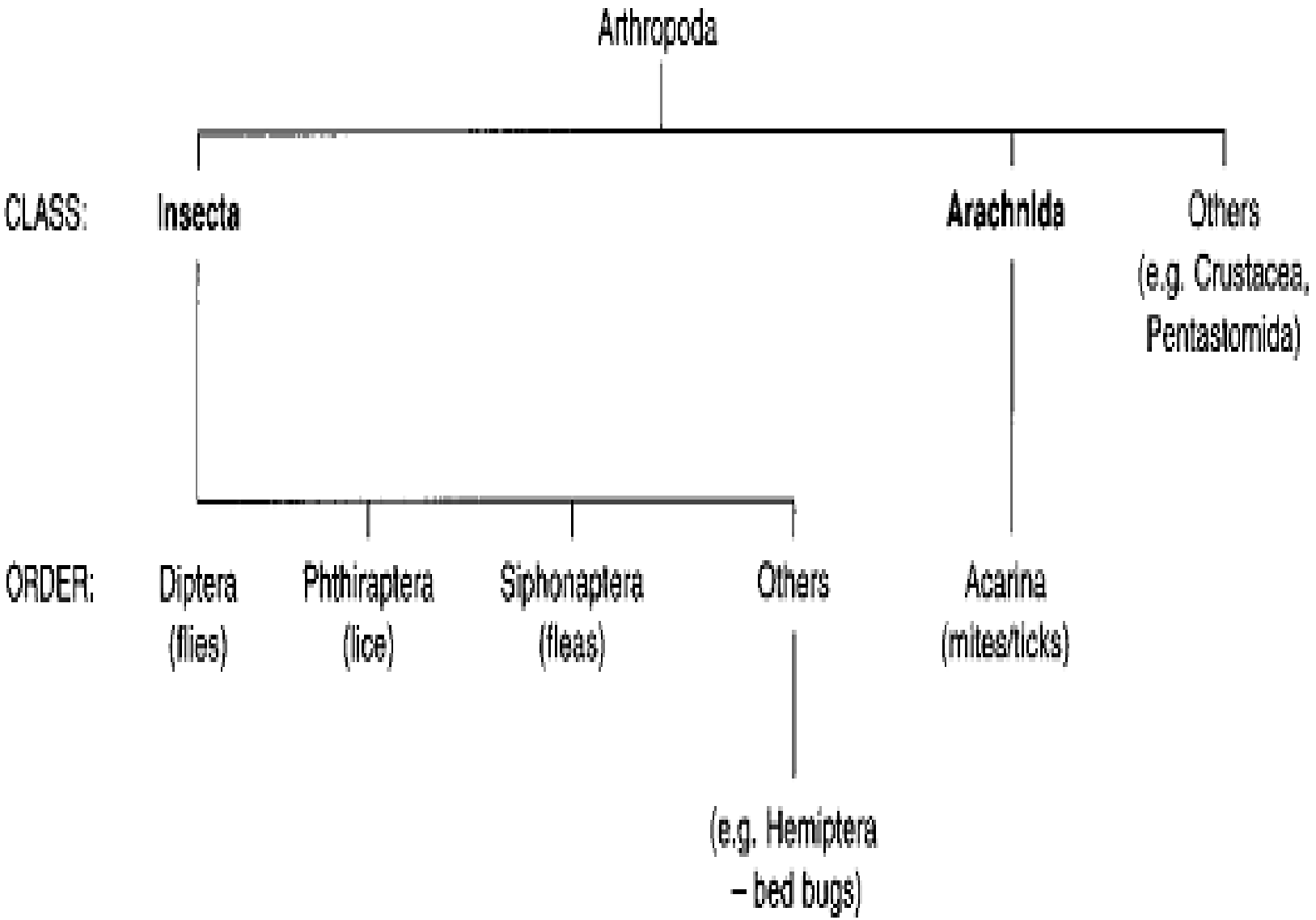
Classification of Arthropod ectoparasites

➢There are three **veterinary** important classes of Parasitic Arthropods:

1. Class **Insecta**- consists of mosquitoes, fleas, bugs, lice and flies,

2. Class **Arachnida** - consists of ticks and mites .

3. Class **Crustacea** - consists of cyclops.


Arthropoda
CLASS:
Insecta
Arachnida
Others
(e.g. Crustacea, Pentastomida)
ORDER:
Diptera (flies)
Phthiraptera (lice)
Siphonaptera (fleas)
Others
Acarina (mites/ticks)
(e.g. Hemiptera – bed bugs)

Class insecta

General features

- The adult insect body is divided into three functional regions: **head, thorax** and **abdomen**
- The Head: contains the mouth-parts with palpi, the compound eyes, and one pair of antennae.
- The mouth part is adapted for chewing-biting, sponging or piercing-sucking depending on feeding habits,.
- The thorax bears:
  - ✓three pairs of jointed legs and two (e.g. most flies), four (e.g Hemiptera) wings, or no wings (e.g. lice, fleas).
  - ✓The Legs are divided into segments: coxa, trochanter, femur, tibia and tarsus, ending in a pair of claws.
  - ✓On the thorax there are also a pair of respiratory openings called lateral spiracles.
- **Abdomen:** contains the food-digesting, food-assimilating, and reproductive organs and terminates with the anus.

The segments of leg

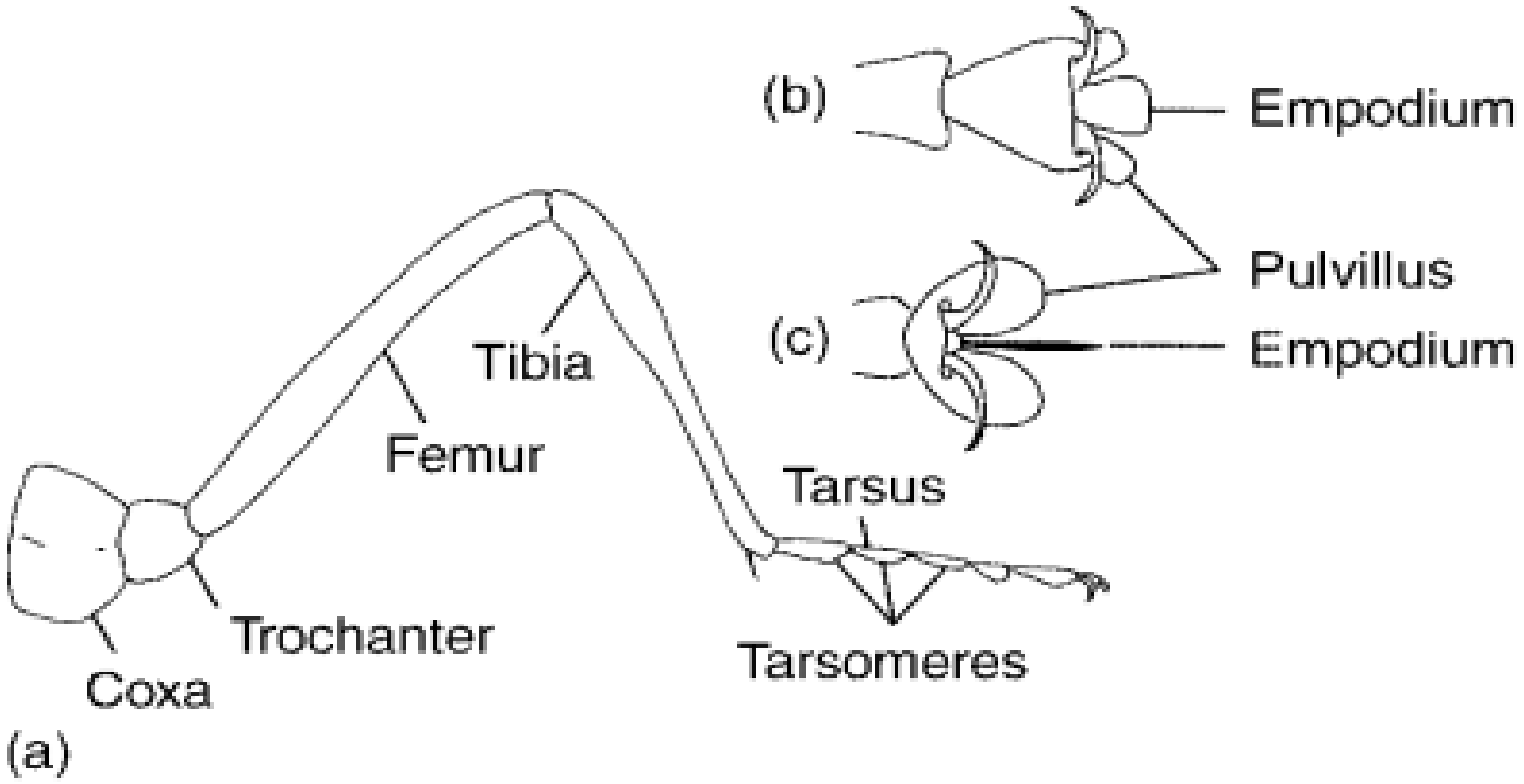


Fig. 4.4 The segments of the leg (a), and the empodium and pulvilli of adult brachycerran (b) and cyclorrhaphous (c) Diptera.

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The **membranous wings** have **species-specific** supportive arrangement of **hollow**, rod-like structures, called **veins.**

Six primary veins are recognized:

Costa (C), subcosta (Sc)

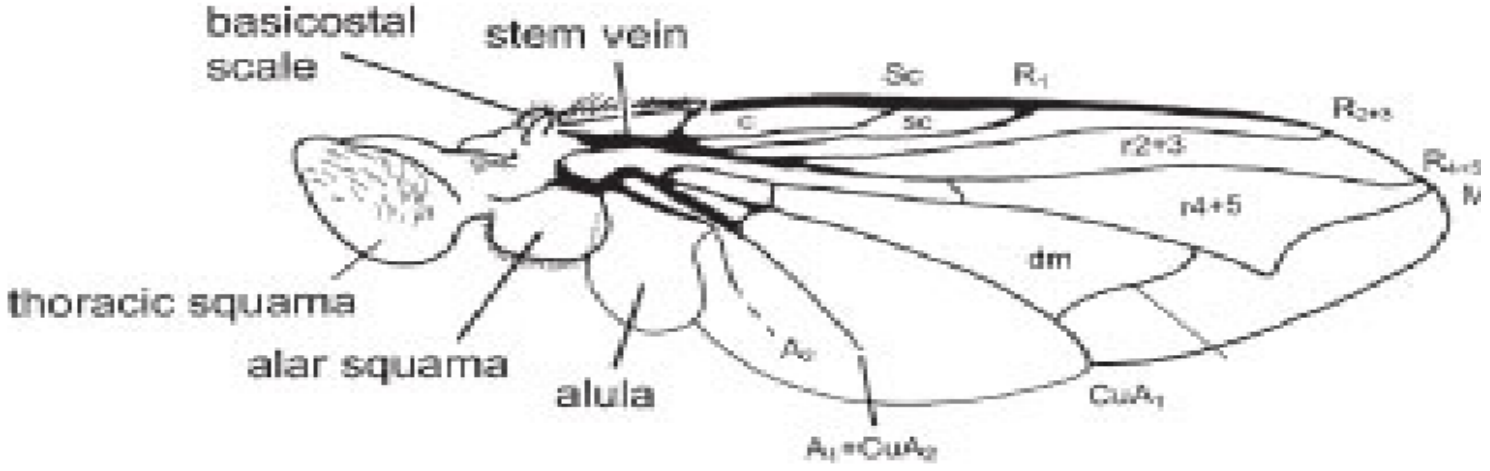
Radius (R), Media (M)

Cubitus (Cu) and anal vein (A)

These veins may be **branched** and are connected by **cross veins** framing areas of wing called **cells.**

Cells are described as **open** if they reach the **wing margin** and **closed** if they do not.

The veins and cells are designated by **letters** and **numbers.**



❖**Life cycle of insects**

- sexes are **separate**
- lay either **eggs** or **larvae** in **water**, on **plants** or on the **ground,**
- Development often involves three or more **larval stages** followed by **pupa** and emergence of **adults**.
- The life cycles may be with **incomplete** or **complete metamorphosis.**
- There are two main types of metamorphosis in insects:

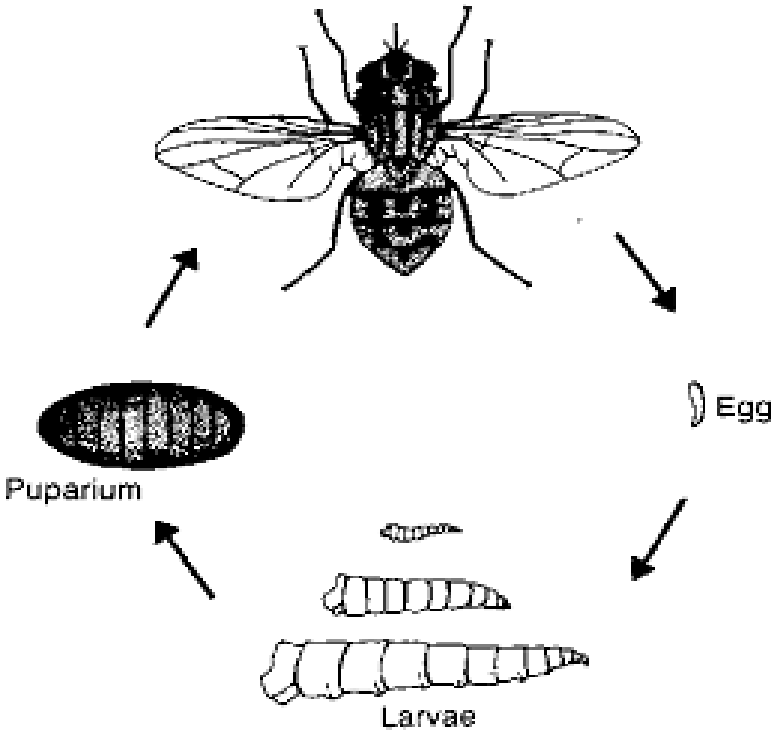
1. **Incomplete metamorphosis (hemimetabolous)**:
   - ✓ insects hatch from their eggs as **nymphs** with **very similar body structure** to the adult,
   - ✓ there are often **color** and **size differences**.
   - ✓ The reproductive systems are **immature**.

2. Complete metamorphosis (holometabolous):

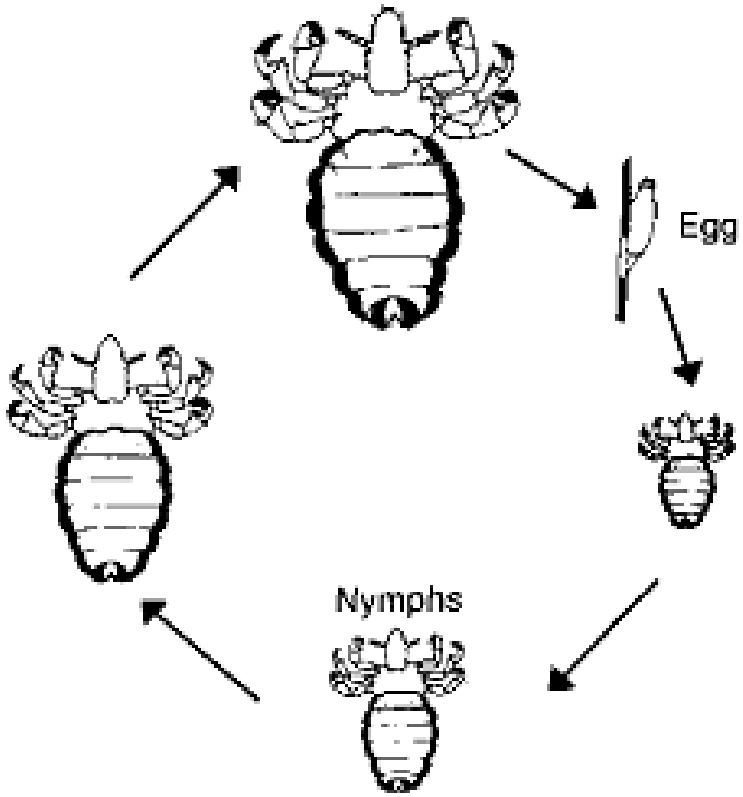
- ✓ involves the transition from **egg** to **larva, pupa** and then to a **adult,** with **dissimilar body structure**.
- ✓ The **pupal stage** does **not feed or move,** surrounded by a protective covering**, cocoon.**
- ✓ The **pupa stage** only occurs for insects who undergo **complete metamorphosis.**
- ✓ A holometabolous life cycle is typical of **many flies**.

Holometabolous (Left)and **Hemimetabolous** (Right) life cycles

e.g. **Fly**



e.g. Louse



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➢There are four orders of insects that are of primary importance as pests of domestic animals.

These include:

- Diptera (true flies),
- Phthiraptera (lice),
- Siphonaptera (fleas),
- Hemptera(bed bugs)

➢All species of Phthiraptera and Siphonaptera are parasites of vertebrate animals.

Order Diptera

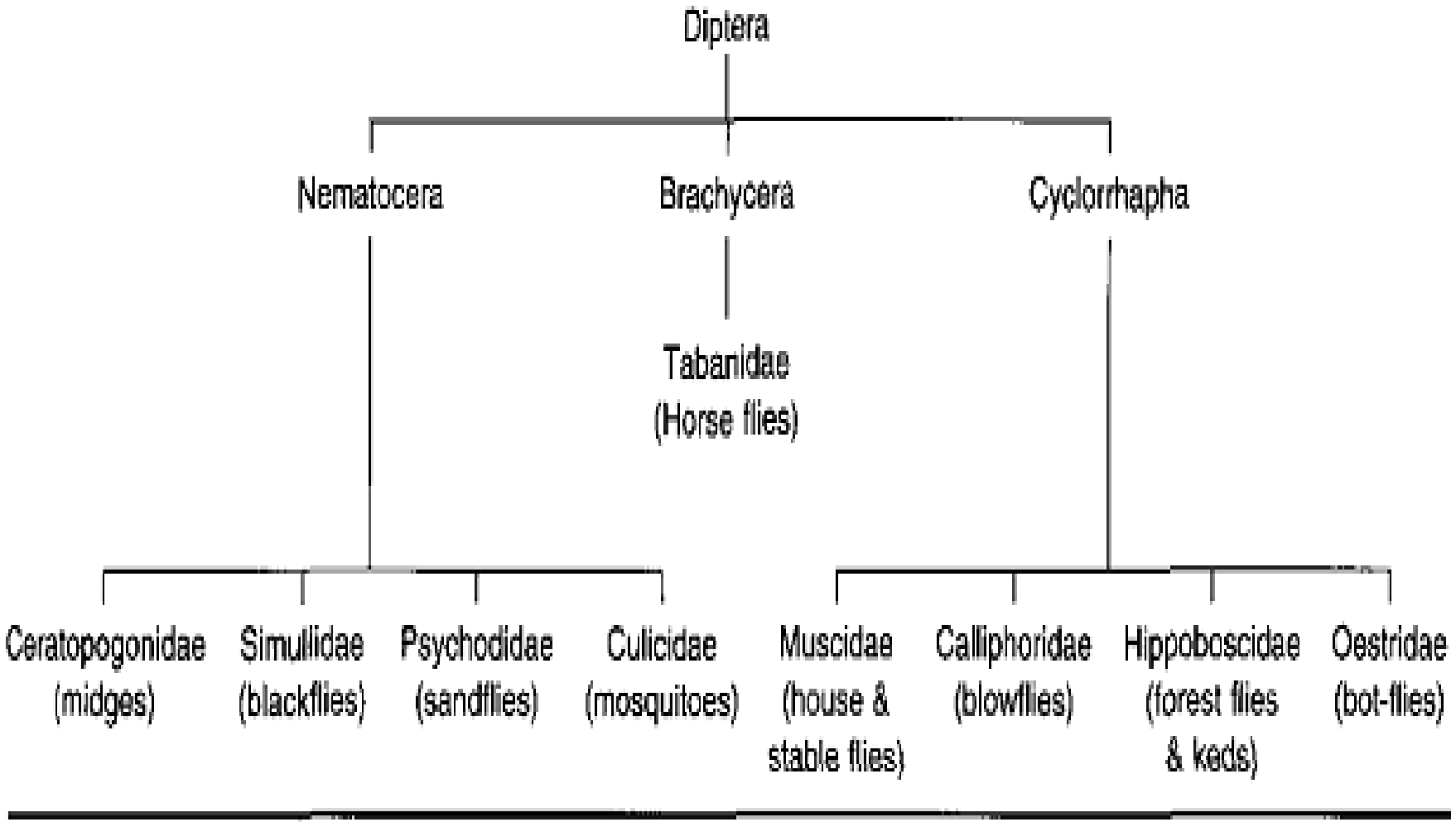
- The Diptera are the true flies
- Contains all of the flies of veterinary importance.
- Have only one pair of membranous wings (except keds, wingless)
- The hind pair of wings have been reduced to become small club-like organs called "halteres“, help to maintain stable flight.
- Hence, the word Diptera is derived from the Greek, " *di pteron*“, meaning two winged

Ectoparasite flies are grouped into those :

- whose Larval stage are parasitic in the living tissues vertebrate hosts, causing myiasis (e.g., cattle grubs, horse bots, sheep nose bot, screwworms);
- Whose dult stages are blood feeders and
- Who have indirect impacts through a variety activities with animals or humans
- Many of them serve as vectors of disease agents.
- Other Diptera contribute to nuisance and annoyance to livestock and humans (e.g., house flies).

- Diptera go through a complete metamorphosis.
  - the larvae are completely different from the adults
- life cycle has four life stages: egg, larva, pupa and adult.
- The adult female may produce eggs or mature larvae.
- Adult Diptera are usually highly active and mobile.
- The order Diptera is divided into three suborders:
  - ✓Nematocera,
  - ✓Brachycera and
  - ✓Cyclorrhapha.
- In the Nematocera and Brachycera, only the females take blood meals.
- Adults of these suborders can be distinguished morphologically by:
  - ✓ wing venation and
  - ✓antennal structure

Classification of the Diptera



Characteristics Antennae of Dipterans

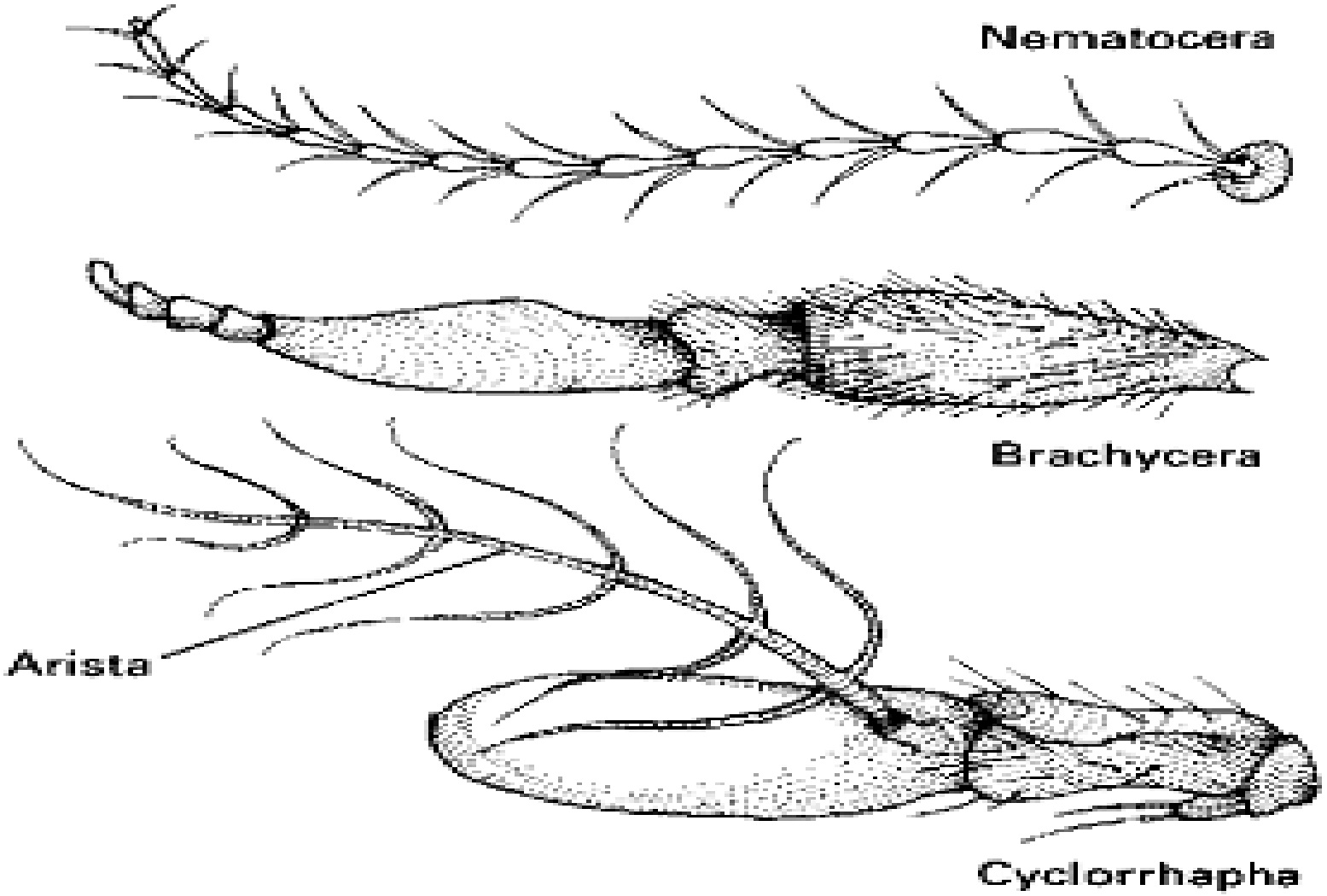
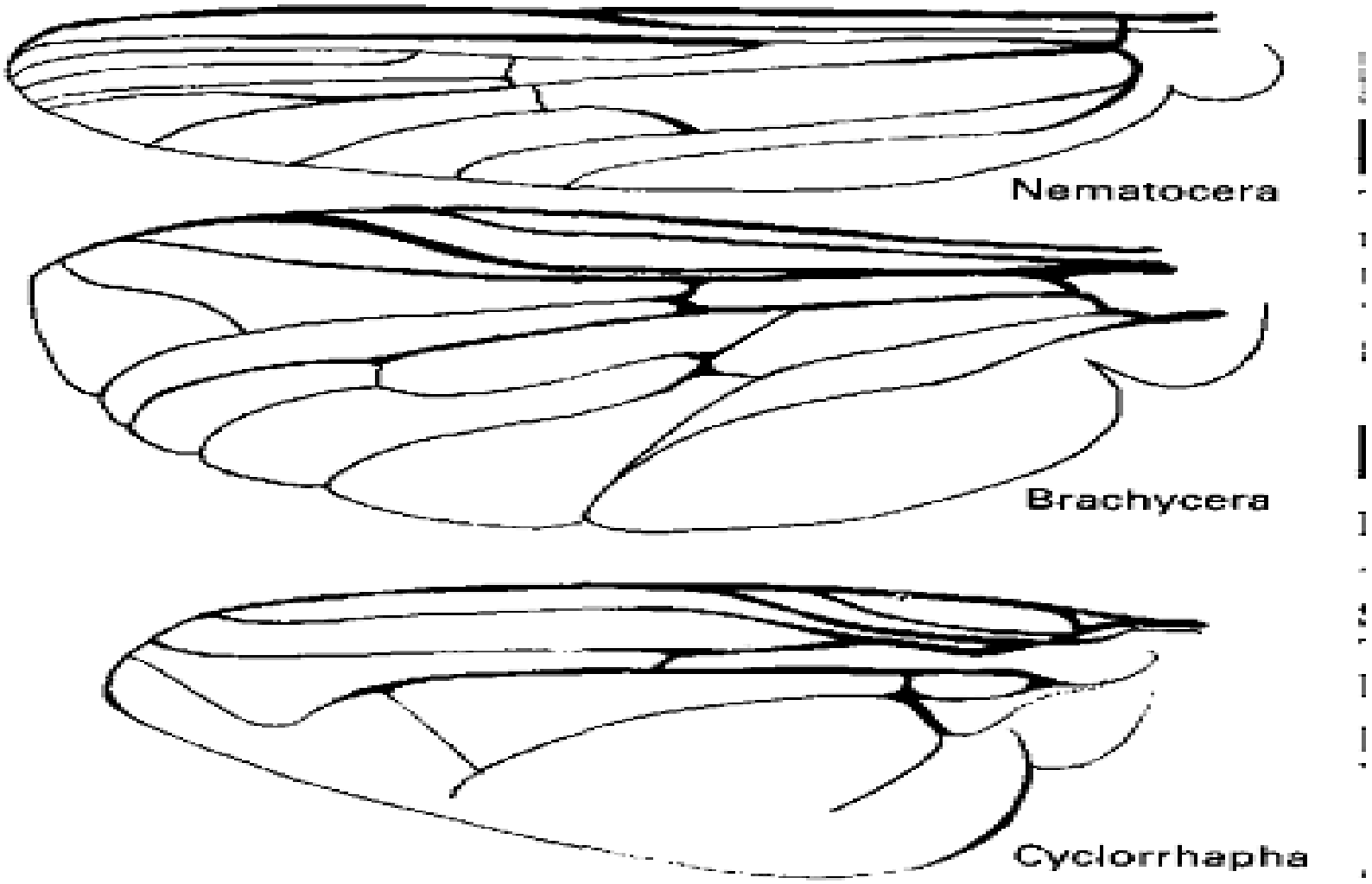


Fig. 111 The three suborders of the Diptera each possess characteristic antennae.

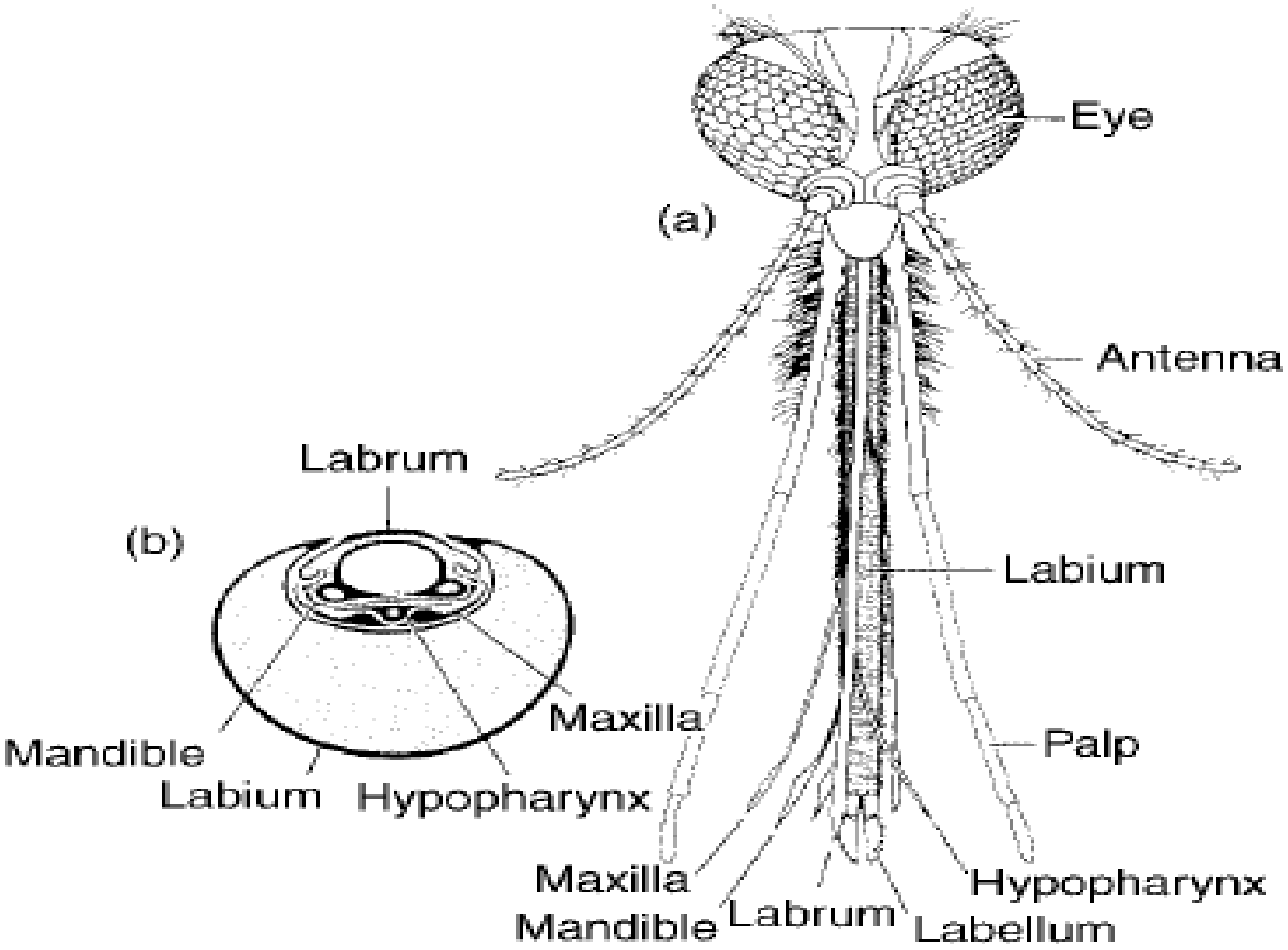
Variations in wing venation found in the three suborders of Diptera



Suborder Nematocera

- Nematocera are considered to be the more primitive Diptera
- include smaller flies with long narrow wings and long antennae composed of several segments.
- Generally, breed in aquatic habitats.
- Females lay eggs in or near water and develop into aquatic larvae and pupae
- Only the females are parasitic (feed on blood) and have piercing-sucking mouthparts (e.g. Mosquitoes, sand flies, black flies),
- Most nematocerans males do not feed on blood and have either poorly developed or non-functional mouthparts
- Families of veterinary importance as blood feeding ectoparasites and disease vectors:
  - ✓Ceratopogonidae(biting midges)
  - ✓ Simulidae(black flies)
  - ✓Culicidae(mosquitoes)
  - ✓Psychodidae(sand flies)

Mouthparts of Nematocerans



Family Ceratopogonidae

- This family consists of very small flies
- The flies are commonly known as "biting midges " or "gnats".
- The thorax is strongly arched
- The proboscis is short
- The antennae are long, consisting of 13-15 segments
- The antennae are pilose (short hairs) in the female and pulmose (feathery) in the male
- The wings are hairy, but bear no scales
- The larvae develop in moist places: mud, sand at the edge of streams, in tree holes or in moist rubbish heaps
- The females feed on man and animals
- known to transmit various viruses, protozoa and helminths.
- have a forked media vein(M1, M2)
- The only important genus is Culicoides.

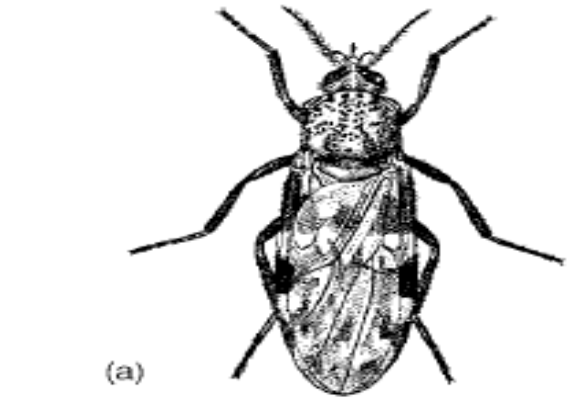
Genus *Culicoides*

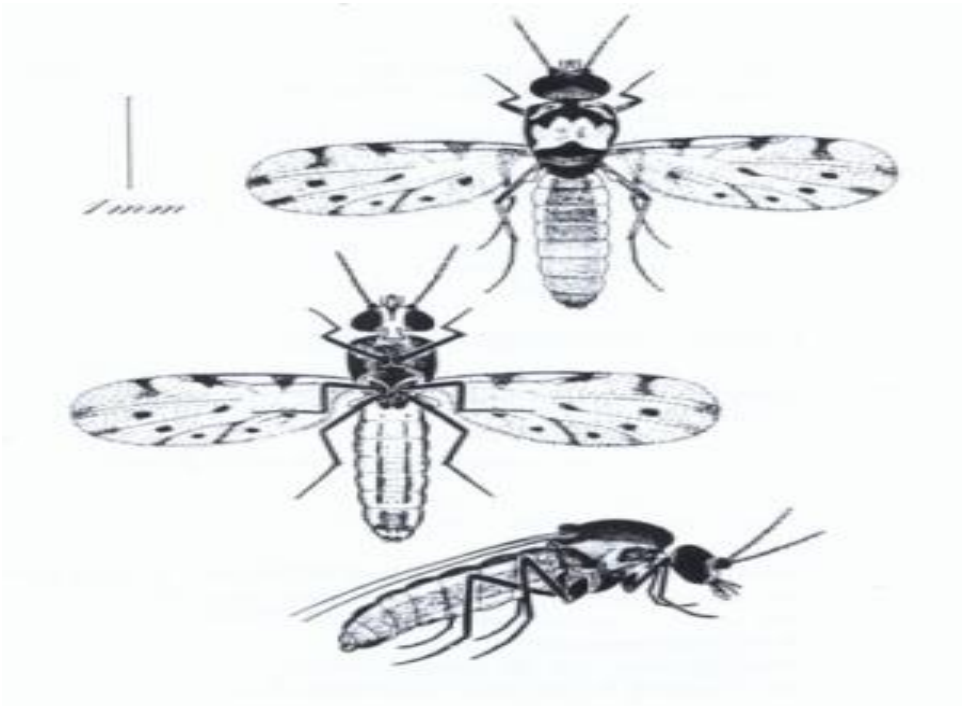
- **Hosts:** All domestic animals and man.
- **Species:** over 800
- **Distribution:** Worldwide.
- **Morphology**
- Tiny flies,1–3 mm long
- the thorax humped over a small head
- wings, generally mottled,
- The antennae are prominent, the legs relatively short, and
- the small mouthparts hang vertically.
- The **short piercing proboscis/** mouthparts consists of a **sharp labrum**, **two maxillae**, **two mandibles**, a hypopharynx
- and a fleshy labium which does not enter the skin during feeding by the adult female.
- In the male, the long antennae are feathery or plumose whereas in female short hairs or pilose, and are
- Legs: are very short and stout, particularly the forelegs
- **Wings: covered by microscopic hairs**.

….

- *Culicoides* usually have a distinct pattern of radial cells and an RM cross-vein on their wings
- At rest the wings are folded over each other like a closed pair of scissors and held flat over the abdomen
- **Active** at dusk or dawn, Bites are very painful;

- **Adult females at rest(a) and wing venation showing the two elongated radial cells(b)**





Life cycle

- The eggs, which are brown or black, are cylindrical or hanana-shaped;
- eggs are laid in damp marshy ground or in decaying vegetable matter near water.
- Hatching of eggs occurs in 2-9 days depending on the species and temperature
- There are four larval stages characterized by having small dark heads, segmented bodies and terminal anal gills.
- Larvae feed on decaying vegetation
- Larval development is complete in warm countries in 14-25 days,
- The pupae are found at the surface or edges of water and are characterized by a pair of respiratory trumpets on the ceohalothorax and a pair of terminal horns which enable the pupa to move.
- Adult flies emerge from the pupae in 3-10 days and the females suck blood

Pathogenic significance

- In large numbers bites cause irritation and annoyance in livestock
- favored feeding sites are either on dorsal or ventral aspect of host,
- TransmitLife cyclearouse disease agents: bluetongue virus, *Onchocerca* spp*,* *Haemo-proteus*, and *Leucocytozoon* spp. (hemoparasites of birds) and African horse sickness
- In horses cause intensely pruritic, skin disease called 'sweet itch' , mainly on the withers and base of the tail
- Control
- difficult because of the usually extensive breeding habitat
- It depends on the destruction of breeding sites by drainage or spraying with insecticides
- However, wind dispersion of these small flies may be important in the spread of some virus diseases.
- Repellents or screens may be used
- For 'sweet itch', antihistamine treatment may give immediate relief
- Housing of animals when fly activity is maximal usually in late afternoon and early morning is also important

Family Simuliidae

- **Dark-coloured** and are Commonly known as " black flies“
- Tiny flies (1–6 mm long) that tend to swarm
- The thorax is high and legs are short
- The antennae are short and consist 11 segments
- Serrated, scissor-like mouthparts
- they have a wide rage of host, (a variety of mammals and birds)
- Cause annoyance and irritation due to their painful bites.
- Ears, neck, abdomen and legs are favored feeding sites
- Swarming and biting can cause annoyance, resulting in decreased production in livestock.

Transmit: *Leucocytozoon* spp. *Onchocerca gutterosa* .

- ✓In man: ***Onchocerca volvulus*** whlch causes 'river blindness' in Africa and Central and South America.

❖**Genus *Simulium***

Hosts: All domestic animals and man

Species: Numerous

Distribution: Worldwide except New Zealand, Hawaii and some minor island groups

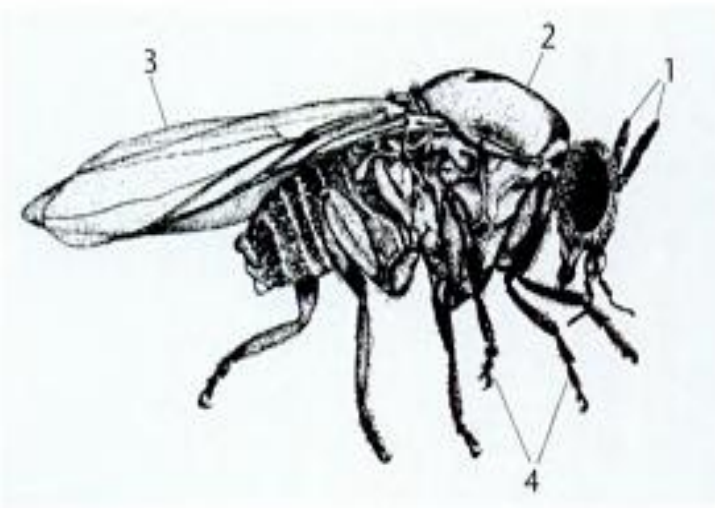
Simulium---

Morphology

- Flies are usually black with a humped thorax
- The adults are 1.5-5.0mm long, relatively stout bodied
- Wings: colourless and show distinct venation
- Morphologically, adult male and female flies are similar, but in female the eyes are distinctly separated (dichoptic)
- Antennae: relatively short , stout and horn-like, do not bear hairs.
- The mouthparts bears conspicuous segmented maxillary palps.

***Simulium* species**:

1. antennae: short, horn-like;
2. humped thorax;
3. wings: broad and clear;
4. legs: short



Simulium---

- Life cycle
- Eggs are laid in sticky masses on partially submerged stones or vegetation in flowing water
- Hatching takes only a few days in warm conditions
- There may be up to eight larval instars,
- the mature larvae are light-coloured and poorly segmented,
  - distinguished by a blackish head with a prominent pair of feeding brushes.
  - The body is swollen posteriorly
- just below the head is an appendage called the proleg which bears hooks.
- Mature larvae pupate in slipper-shaped brownish cocoon fixed to submerged objects
- the pupa has prominent respiratory gills projecting from the cocoon
- The pupal period is normally 2-6 days

Simulium---

- **Pathogenic significance**
- Only the adult females suck blood
- Feeding sites: legs, abdomen, head and ears,
- active during the morning and evening in cloudy warm weather (rainy season).
- The painful bites of swarms interfere with grazing and cause production loss
- Poultry may become anaemic from blood loss when attacked.
- Transmit: the viruses causing Eastern equine encephalitis and vesicular stomatitis, the avian protozoan Leucocytozoon and filarioid helminths such as *Onchocerca gutturosa* of cattle.
- **Control**
- application of insecticides to breeding sites to kill larvae.
- Bush clearing will remove adult resting sites
- In horses, insecticides or repellents may be applied topically
- poultry can be provided with insecticidal dust baths.

➢Family Psychodidae

- The flies are commonly known as " sandfies“
- *Phlebotomus* is the only genus of veterinary importance.
- These flies are important as vectors of *Leishmania.*
- Genus *Phlebotomus*
- Hosts: Many mammals, reptiles, birds and man.
- Species: over 600 species.
- Distribution: Widely distributed in the tropics, subtropics
  - Most species prefer semi-arid and savannah regions to forests
- Morphology
- small flies, up to 5.0mm long
- characterized by their densely hairy wings which give them a moth-like appearance.
- Have large black eyes and long still-like legs.
- Mouthparts: short to medium length, hang downwards, and are adapted for piercing and sucking.
- In both sexes the very long antennae of up to 16 segments bears many short hairs
- Wings: lanceolate in outline, covered in hairs and are held erect over the body at rest.
- Phlebotomines are distinguished from other members of the family by the way they hold their wings above the body in a vertical V shape

Phlebotomus---

- Life cycle
- Ovoid, brown or black eggs may be laid in small cracks or holes in the ground, the floors of animal houses or in leaf litter.
- the eggs can hatch in 1-2 weeks,
- There are four larval instars, maturation taking 3 weeks to several months
- The larvae are characterized by a black head and a segmented grayish body covered in bristles.
- The adults emerge from pupation after 1-2 weeks.
- The whole life cycle takes 30-100 days, or even longer in cool weather

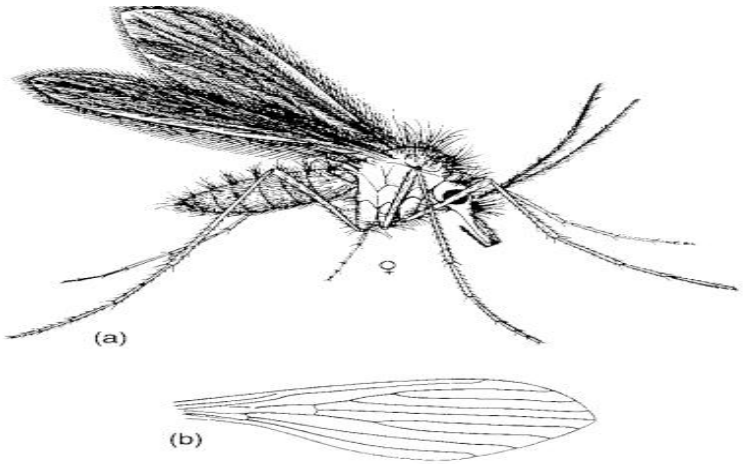
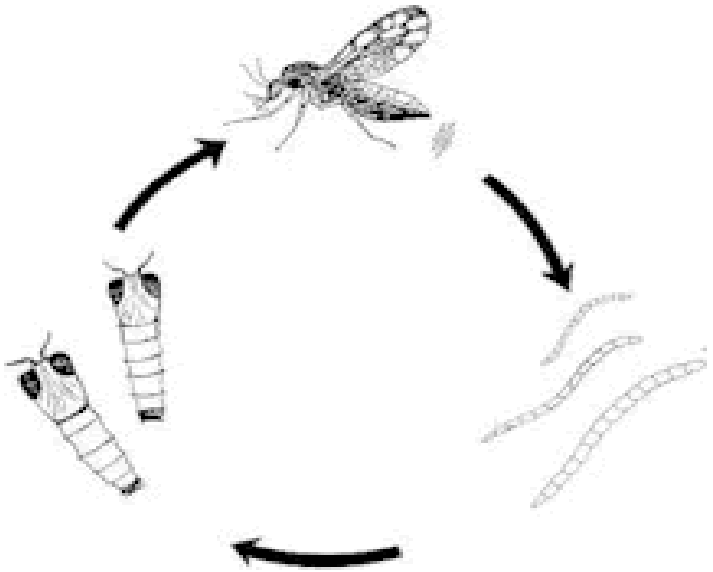


Fig. 4.25 (a) Adult female sand fly, *Phlebotomus papatasi*. (b) Wing venation typical of species of *Phlebotomus* (Psychodidae) (reproduced from Smart, 1943).



Phlebotomus---

- **Pathogenic significance**
- only the **females** suck blood**.**
- They prefer to feed **at night**, resting in **shaded areas** during the day.
- Cause **biting nuisance** in localized areas
- the sole known vectors of ***Leishmania tropica*** and ***L.donovani***, which cause cutaneous and visceral leishmaniosis in **man, dogs.**
- **Control**
- The **adults** are susceptible to most insecticides
- **Man** has protected himself from the bites of these flies by using residual **house-sprays, repellents** and **very fine mesh** fly screens.

Family Culicidae: Mosquitoes

- vectors of malaria (*Plasmodium* spp.)
- the family is of limited veterinary significance
- Hosts: A wide variety of mammals, including man; reptiles and birds.
- Species: over 3000 species belonging to 34 genera,
  - ✓important genera: *Anophele,, Culex* and *Aedes*.
- Habitats: large swampy areas, ponds, lakes, holes, hoof tracks, discarded cans, and water barrels.
- Distribution: Found wherever temperature and moisture are suitable.

Morphology:

- Adults, 3-6 mm. in length, are slender.
- have small spherical heads and long legs.
- Have prominent eyes
- Antennae: in both sexes, long filamentous and segmented (14-15), pilose in females and plumose in males.
- Mouthparts: long, forward-projecting, adapted for piercing and sucking.
- Wings: long and narrow.
- The wing veins, body, head, and legs bear scales.
- Both sexes have an abdomen with a pointed tip
- Mosquitoes are identified on the basis of wing venation
- Adult males can be distinguished from females by their “bushy” antennae.

Mosquitoes---

➢**Anopheline** can be distinguished from
➢**Culicines** and ***Aedes*** mosquitoes based on:

1. their resting/landing behavior on flat surface:

✓**Anopheles**: The adult mosquito rests and feeds at **an angle** with the skin surface;

✓rest with the **proboscis, head, thorax and abdomen** in **one line** at an angle to the surface

✓The **proboscis** extends from the mosquito's body in a **straight line**.

✓ **Culicines:** rest with their **body angled** and their **abdomen** directed towards the surface

✓ the **proboscis** is **directed down perpendicular** to the insect body.

2. their maxillary palps size:

✓ female ***Anopheles***: palps are as long and straight as the proboscis

✓ female Culicines: palps are usually about ¼ of the length of proboscis

3. their abdomen: Anopheline bears hairs but not scales

Culicidae---

Life cycle

➢All mosquitoes undergo **complex metamorphosis**.

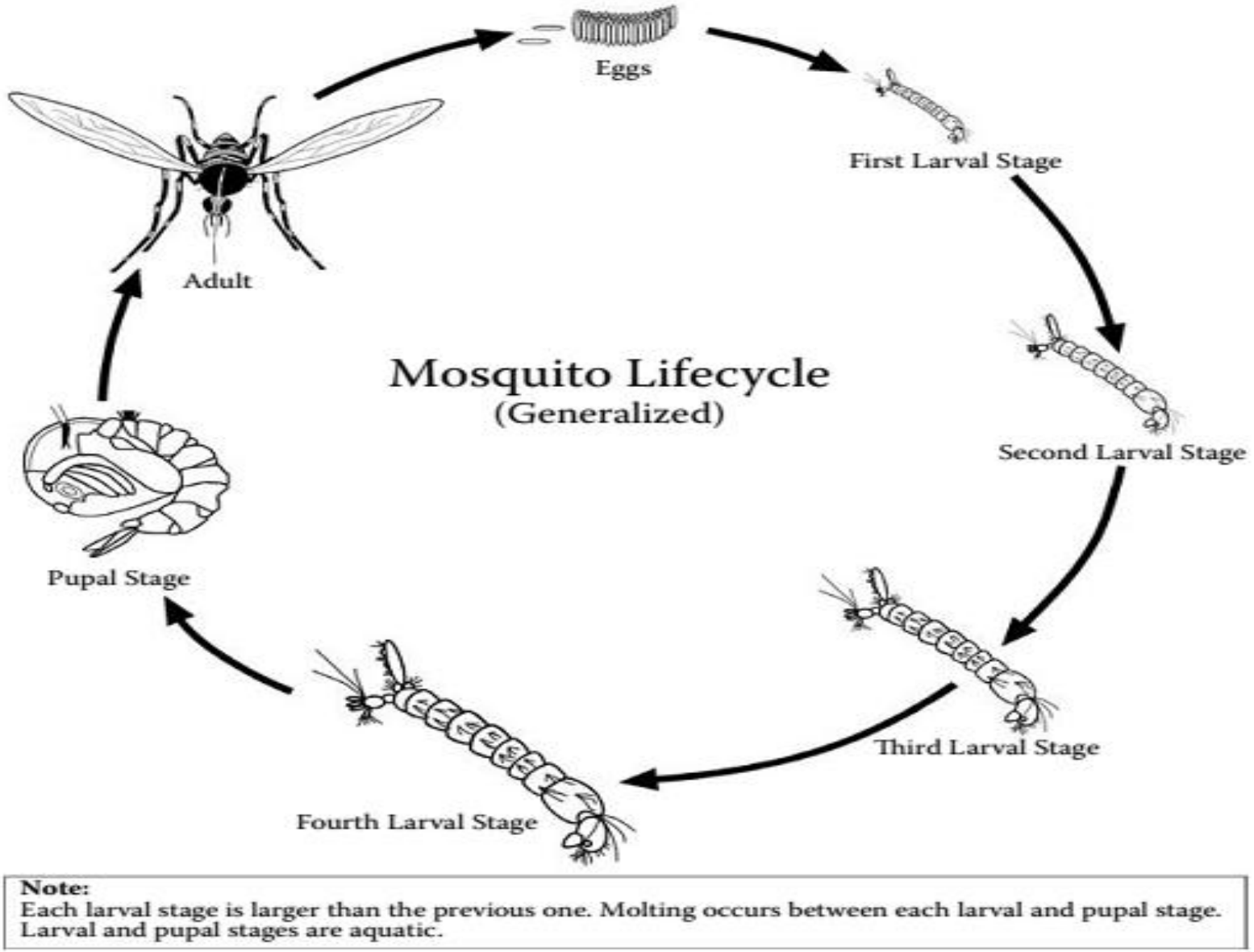
➢Gravid female lays eggs **on the surface of water** either **singly** or, in case of ***Culex***, in groups forming **egg-rafts**

✓In ***Culex***, the eggs are **dark-colonred**, elongate or **ovoid**.

✓In ***Anopheles***: the eggs are boat-shaped;

- **All four larval instars** are aquatic
- **Mature larva:** has a distinct head with one pair of antennae, compound eyes and prominent mouth brushes, used in feeding on organic material.
- **Maturation of larvae** can extend from one week to several months
- All mosquito pupae are aquatic, motile and comma- shapcd with a distinct cephalothorax which bears a pair of respiratory trumpets
- The life cycle is completed in 7-16 days depending on moisture and temperature conditions.

Mosquito Lifecycle



Culicidae---

Pathogenic significance

- Only female mosquitoes suck blood
- Most species of mosquitoes are **nocturnal feeders**
- very important as **annoying pests** of man and animals
- Considerable **swelling** may occur at the site of the bite, and marked **erythema**, **pruritus**, **scratching**, and secondary infection may follow.
- Serve as vectors of disease agents

✓**Transmit:**

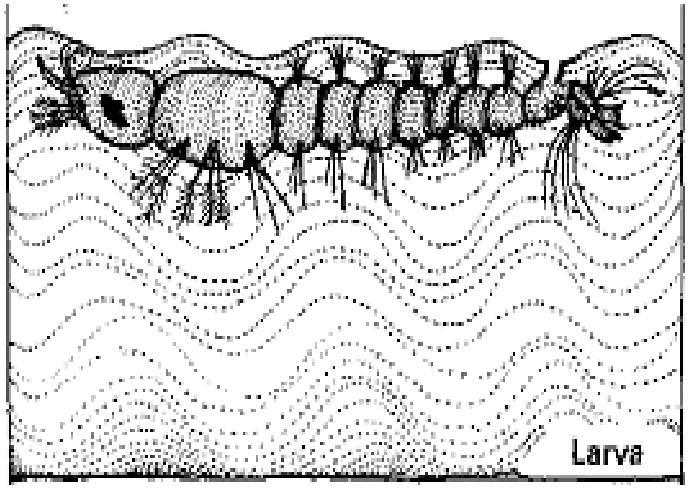
- ➢**filarial nematodes: *Dirofilaria immitis***(dog heartworm)***; Wuchereria bancrofti*** (human elephantiasis) and *Burgia*; and
- ➢one form of **avian malaria** caused by *Plasmodium species*
- ➢**viral diseases:** equine encephalitis, fowl pox; rift valley fever and infectious equine anaemia, yellow fever.
- ➢In human: ***Anopheles*** transmit **malaria pathogens**: ***Plasmodium*** sp.

Control

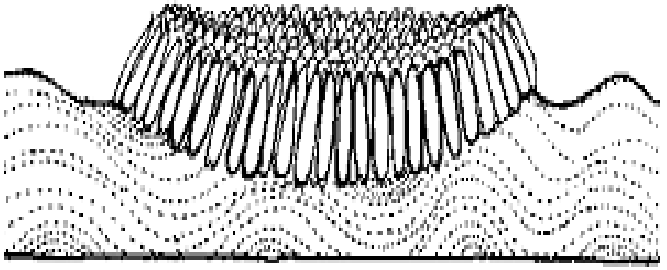
- directed either against the developing **larvae or adults**, or both:
  - ✓**drainage** of available breeding sites.
  - ✓repeated application of **insecticides** to breeding sites.

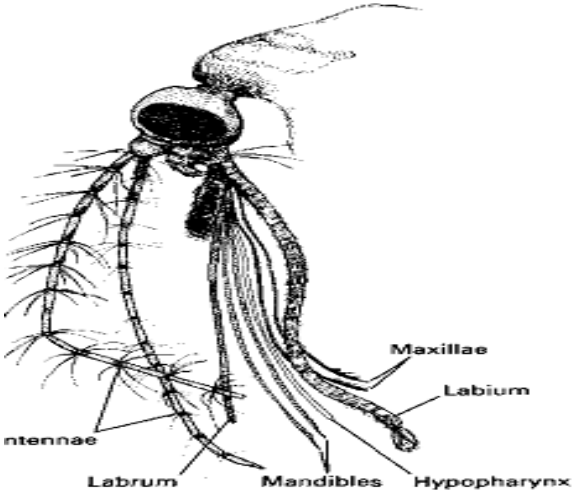
✓**Biological control**: introducing predatory fish into **marshy areas**

Eggs of Aopheles



Culex egg -rafts





116 Piercing and sucking mouthparts of a mosquito.

Suborder Brachycera

❖Family Tabanidae

- ➢Commonly known as "**horseflies**"
- ➢**Only females** are parasitic: feed on blood
- ➢very common pests of livestock and companion animals, especially **cattle and horses.**
- ➢The **pain** caused by their bites lead to interrupted feeding.
- ➢three genera of veterinary importance: *Tabanus, Haematopota* and *Chrysops*.
- ➢Since these are closely related in behavior and pathogenic significance, they will be considered as a group.

Hosts: mammals, man, birds,

Species: over 3000 spp.

Distribution: Worldwide

Morphology:

- ➢ adults are medium to large in size, up to **2.5cm** in length, with **wing spans** of up to **6.5cm**.

Eyes: large prominent , holoptic in the **male** and **dichoptic** in the **female**.

Antennae: short, stout, three-segmented

- ➢They are generally **dark coloured**,

Mouthparts: short, strong, slashing/sponging and always **point downwards.**

- ➢Their **mouthparts** can cause deep, painful, bleeding wounds.

Tabanids---

Wings: colored and useful for generic differentiation:

- ***Tabanus:*** clear or brownish wings
- ***Chrysops:*** often have dark bands/stripes across the wings
- ***Haernatopota:*** grey brown or mottled or speckled wings

Horse fly, *Tabanus spp.*

Chrysops sp (left); ***Haematopota*** sp (right); **Horse fly larva (lower)**

Tabanids---

❖Life cycle

- After a blood meal the female lays eggs in muddy or marshy areas.
- The eggs hatch in 1-2 weeks releasing cylindrical larvae,
- Larvae have small black retractable heads
  - On the abdominal segments, there are three to four pairs of fleshy prolegs.
- Larval developrnent takes three months
- Mature larvae pupate partially buried in mud or soil and
- Tabanid pupae are brown in color with eyes, legs, and wing pads visible.
- Adult fly emerges after 1-3 weeks.

Pathogenic significance

- Most active during **hot, sunny days**.
- Their bites are deep and painful
- Cause **deep** and **painful bites** and **persistent nuisance** to animals.
- **Efficient mechanical vectors** of the organisms of anthrax, pastcurellasis, trypanosomosis, anaplasrnosis and the human filarial disease, loaosis.

Control: insecticidal spray with a **residual effect** are used: in animal houses and

- ✓on the animal themselves

Order Cyclorrhapha

- small to medium in size, with **short, three-segmented antennae**
- **3rd segment** of antennae often has an **arista**: a feather or bristle like structure

Maxillary palps: are small and have only one segment

- Their wings have **fewer cross-venation** than other groups
- Both sexes may **feed on animals**, but many of them are **not parasitic as adults**
  - have either **vestigial** or **sponging** mouthparts

E.g. House flies, keds, bot-flies

- Important as **parasites** or as **vectors** of diseases in animals.
- They tend to **breed in decaying plant and animal tissues, manure, carrion**
- Undergo **complete metamorphosis**
- Includes four major families as veterinary importance:
  - ✓**Muscidae**(house and stable flies); **Calliphoridae**(blowflies); **Hippoboscidae**(keds); **Oestridae**(bot-flies); **Glossinidae**(tsetse flies)

Family Muscidae

❖General features

❖Comprises **biting** and **non-biting** flies

- •**Not blood feeders**: non biting flies; they have **vestigial mouthparts**
- •**Not obligatory parasite**: periodic parasite, but **annoyance to animals**
- •Can feed on **animal secretions**: mucous, saliva and tears, and especially attracted to wounds

❖**Genus *Musca*** (house and face flies flies)

Host: wide variety of animals, including humans

Species: *M. domestica*(house flies) and *M. autumnalis*(face flies)

Distribution: WW

Morphology:

- •Medium sized flies: about 5-8mm long
- •have **four distinct black longitudinal stripes** on their thorax
- •have **sponging mouthparts**, and **small rough spines** on their mouthparts that can irritate host eye tissue.
- •Have **sticky hairs** at the end of the **clawed legs**.

Colour: variable from light to dark grey

Eyes: reddish; females are dichoptic and males are holoptic

Musca spp---

- **Antennae**: short, **three-segmented** with **arista**
- **Thorax**: usually grey with four distinct **dark longitudinal strips**
- **Abdomen**: grayish/yellowish-brown in color with various light and dark markings/strips; but in female *M. autumnalis* it is **darker**

M.Domestica

***M.autumnalis,* adult flies on face**

House fly, *Musca domestica*

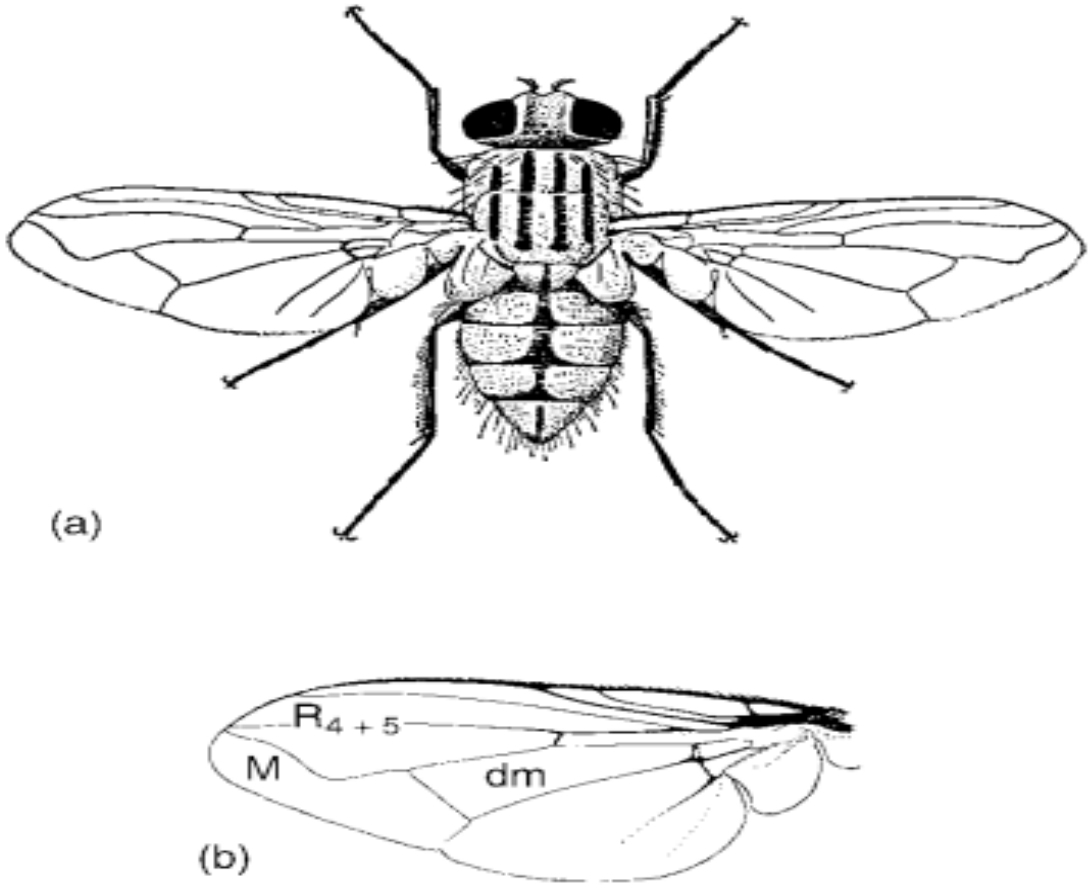


Fig. 4.10 (a) Female house fly, *Musca domestica* (reproduced from Eidmann & Kuhlhorn, 1970) and (b) wing venation typical of species of *Musca*, showing the strongly bent vein M ending close to R_{4+5} (after Smart, 1943).

Musca spp---

Life cycle

- Separate sexes
- Both house and face flies undergo **complex metamorphosis** with eggs, larvae, pupae, and adults
- Adult females lay batches of **creamy-white**, **banana-shaped** eggs in **decaying organic matter**(house fly) or on **fresh animal manure** (face fly)
- Eggs hatch under **optimal temperatures**, in 12-24hrs to produce whitish, **segmented larvae**(**maggots**) that feed on decaying organic matter
- Then larvae mature, and **pupate** at **drier areas** around larval habitat
- Adults emerge after 3-26 days depending on **temperature**
- Whole cycle may take from 8-49 days

***M. domestica* larvae**

Musca spp---

Pathogenic significances

- Houseflies arc closely associated with **buildings inhabited by animals and man**.
- **source of annoyance**: feeding activity is **irritating to the host**
  - **interrupt feeding**/grazing and lead to **decreased production**
- **spread of diseases (mechanical vector):** such as **mastitis**, **conjunctivitis** and **anthrax**, due to their habit of **visiting faecal** and **decaying organic matter**
  - pathogens are either carried on **hairs of the feet** and body or **regurgitated** in saliva during feeding
- **Intermediate host** (helminths): *E.g.*
  - *Thelazia spp. (eye worms)*; *Parafilari bovicola of* cattle;
  - ***Habronema* spp** (deposition of larvae of it in wounds cause **summer sores or skin lesions in horse**) and
  - *Raillitina* spp.

Stomoxys---

Genera of **non-biting muscid flies**:

- ***Fannia, Morellia*** and ***Muscina***: in some areas, make a substantial contribution to '**fly-worry**' in livestock
- the **life cycles** and **control** of these are similar to that described for ***Musca*** spp.

Control

- Regular application of **insecticides** to animals and **fly-breeding sites: malathion, coumaphous, diazinon**
- **Insecticidal ear tags** can be effective fly control aids
- **Pour-on avermectins** are effective against the flies
- **Improving sanitation** and **reducing breeding places(source reduction)** can reduce fly population

Genus *Stomoxys*

- Commonly known as **stable flies** or **biting house flies**
- Have **biting/piercing mouthparts**: resulting in painful biting
- Both sexes are **blood feeders**: haematophagous
- **Vector** of several **protozoal and helminth** diseases of animals
- **Host**: most animals and man
- Important species: *Stomoxys calcitrans*
- **Distribution**: WW

Morphology

- Resembles the house fly; *M. domestica*: similar in size and grey in color with four longitudinal dark stripes on thorax
- Size: about 5-8mm in length
- Abdomen: shorter and broader than *M. domestica* and with three dark spots on the 2nd and 3rd abdominal segments
- Proboscis: conspicuous/long, pointed and projecting forward (distinguish the stable fly from *Musca* and non-biting muscid flies.
- Antennae: short, 3-segments with sparse setae/hairs on the arista
- Maxillary palps: shorter than the proboscis
- Wings: at rest they are shining and held wide apart and contrast to the dark body
- Stable flies have larger size and shorter palps than the genus *Haematobia, a* biting muscid fly as well as feeding behavior
- Larvae of *Musca* and *Stomoxys* can be differentiated by examination of the posterior spiracles.

Life history

- Resembles to the **Face fly**, but stable flies prefer **decaying organic materials** with a **very damp condition**
- Undergo **complete metamorphosis**
- **Both male** and **female** flies feed on blood
- females lay batches of 25-50eggs, resembling those of **house flies** in **moist, decaying vegetable matter** (hay, straw) contaminated with urine.
- Larvae hatch from eggs in 1-4 days and feed on vegetable matter
- larvae resemble house fly larvae, mature in 6-30 days
- Final larval stage **pupates** and then **adult fly** emerge
- Complete life cycle may take: **12-60days** depending mainly on temperature
- Pathogenic significances
- Both sexes are blood feeders causing anaemia in heavy infestation
- Painful bites are annoying and destructive: results in feeding/grazing pattern interruption: leading to decreased production and loss of live weight gain
- Cause stress, which reduces condition and inability to resist diseases

Stomoxys---

- Their salivary secretions cause toxic reactions with an immunosuppressive effect
- mechanical vectors of several pathogens: protozoa: (*T. evansi* and *T. vivax)* causing trypanosomosis in horses, donkeys, camels and cattle; anthrax, *Dermatophilus congolensis*
- intermediate host: for stomach nematode, *Habronema microstoma* of horses

Control

- Application of insecticides: pyretrins, pyrethroids, coumaphous
- Destruction of potential breeding sites: good sanitation practices
  - Regular removal and stacking of moist bedding, manure, hay and food wastes from stables or decaying matter and cattle accommodation: makes successful in chemical approaches
- Insecticide sprays in and around stables and farm buildings: good local control approaches

Muscidae---

❖**Genus *Haematobia***

- ➢Commonly known as **horn flies** or buffalo flies
- ➢Biting **blood sucking** muscid flies
- ➢A serious **nuisance** on cattle: **obligatory** parasites of cattle

Host: cattle and buffalo; rarely horses, sheep, dogs
Habitat: Spends most of its adult life on cattle.
species: *Haematobia irritans* and *H. minuta*
Distribution: WW
Morphology:
Dark-colored, small flies (3–6 mm long) with **piercing-sucking mouthparts.**
Maxillary palps: **stout** and **long** enough to reach the tip of proboscis (unlike to *Stomoxys)*
Proboscis: **projected forward (**unlike *Musca* species)
Thorax: bears two to several **dark stripes**

Haematobia irritans (adult)

…. Muscidae---

Life cycle

- Undergo **complex metamorphosis**: eggs, larvae, pupae, adults
- The eggs are deposited on the **side of a fresh cow manure** or **on the grass or soil beneath** it.
- In warm weather the egg hatches in **24 hours.**
- the larva reaches maturity in **4-8 days.**
- Mature larva pupates and adults emerge in **6-8 days.**
- **In hot**, humid weather the **life cycle** can be completed in **10-14 days**

Pathogenic significance

- It **feeds and rests** on the animal between feedings, leaving the host only to **oviposit**.
- **Irritation** and **annoyance:** cause disturbed feeding, improper digestion, loss of flesh, and reduction in production.
- **Intermediate host** for filarid nematode of cattle (*Stephanofilaria stilesi*).

Control

- Application of **insecticides** on animals(sprays, pour-on or spot-on)
- Application of Insecticide-impregnated **ear tags**;

Family Hippoboscidae

- The family contains about **200 species**.
- They are **dorsoventrally** flattened
- They are **permanent**, obligate, blood-feeding ectoparasites of **birds** or **mammals**
- All species are **larviparous**, rearing one larva at a time, **internally**
  - When fully developed each larva is released and **pupates immediately**.
- Have **indistinctly segmented abdomen** which is generally **soft** and **leathery**.
- have **piercing blood sucking** mouthparts (biting flies)
- **Both sexes** feed exclusively on the blood of their hosts,
- **Mating** occurs **on the host** and may be **prolonged**
- The claws are strikingly **curved** and **strong** to cling to hair or feathers.
- Importance genus: ***Melophagus***

Hosts: Sheep

Species: ***Melophagus ovinus* :**

Commonly called the '**sheep ked**'

Distribution: WW

Morphology

M. ovinus is a **hairy, wingless** insect with **piercing mouthparts**

5-8 mm long with a **short head**

Leathery, broad, **flattened** and somewhat **tick-like** in appearance;

Melophagus ovinus ---

- **Eyes are inconspicuous**
- **Abdomen**: enlarged, soft and leathery
- **Legs**: **strong provided with claws** at the end; they help them to cling to wool and hair.
- It is a **permanent** ectoparasite.
- ***Melophagus*** can only transfer between sheep by **direct contact**.
  - ✓ **long-wooled breeds** appear to be particularly susceptible.

FIGURE 17.5 Sheep ked, *Melophagus ovinus* (Hippoboscidae), female, dorsal view. (Courtesy of Cornell University Agricultural Experiment Station.)

Life cycle

- **Entire life cycle** spent on sheep or goats
- A **single egg** is ovulated **at a time** and then **hatches inside the body** of the female.
  - The larva is **retained and nourished** within the female during its **three larval stages** until its is fully developed and **ready to pupate.**
- Only **one larva** is produced by each female every 10-12 days, up to a total of 15 larvae.
  - *So, Ked populations **build up slowly***
- The **released larvae** are attached to the **wool** and soon pupate as a **brown capsule**, emerging as adults in about 3 weeks.
- **The long brown pupae (**3.0-4.0mm) is easily **visible on the fleece.**
- Adults and pupae can only live for **short periods off their hosts**.

Pathological significances

- Sheep ked feed on blood which may cause anemia and loss of condition;
- bites are pruritic leading to scratching, and rubbing which damages wool;
- Inflammetion leads to pruritus, biting, rubbing, wool loss and the vertical ridging/folding of the skin known as 'cockle'.
- ked feces stains wool, decreasing value.
- Cause allergic dermatitis, characterized by small nodules and darkened patches at the affected sites
- open wounds are susceptible to bacterial and parasitic (myiasis) infections
- Transmit the non-pathogenic *Trypanosome melophagium* in sheep

Control:

- Shearing: removes pupae and adults
- Chemical control: spraying, pour-on or dipping with insecticides

Family *Glossinidae*

- The **sole genus** in the family Glossinidae is ***Glossina***, species of which are known as "**tsetse flies** ".
- **Both sexes** are exclusively feed on blood of vertebrates.
- Generally, they feed on a **wide variety of animals**.
- **They** are **biological vectors** of **African trypanosomosis** in **domestic animals** and **man,** thus causing sleeping sickness in people, and nagana in cattle.
- Affect severely the **economy of Africa**
- **Host:** various mammals, fish, reptiles and birds;
- **Species:** around 30 species and sub-species
- The species are restricted to **various geographical** areas according to habitat.
- Different species of tsetse flies have **different habitat preferences** and are classified into **3 major ecological groupings** on the basis of habitat preferences:
  - ***Palpalis* species group**: Found along the **watercourses** (**riverine**) and feed primarily on reptiles and ungulates.
  - ***Morsitans* species group**: Found in open **savanna /grassland areas** and feed mainly on **large animals**.
  - ***Fusca* species group**: Live in dense humid **forest areas**.

....

- There are five *Glossina* species found in Ethiopia:
- Palpalis group: *G. f. fuscipes* and *G. tachinoides*.
- Morsitans group: *G. m. submorsitans* and *G. palidipes.*
- Fusca group: *G. longipennis*

Distribution:

Tsetse flies are entirely restricted to **sub-Saharan Africa**

- ✓They are confined to a belt of **tropical Africa over 10 million** square km (Lat. 15^{o}N and Lat. 30^{0}S**).**

Morphology:

❖The following morphological features are useful for identification of tsetse flies:

➢When the fly is at rest, the wings are held over the abdomen like a closed pair of scissors, fully overlapping one another

➢They have a long, rigid, forward-projecting piercing proboscis/mouthparts

➢Compound eyes in both sexes are widely separated (dichoptic eyes).

➢the discal medial cell (dm) of the wing is shaped like a butcher's cleaver (ax, chopper) and is referred to as the 'hatchet cell'.

……..

➢The **antenna** has a **large third segment**, with an **arista** that bears 17–29 **dorsal branching hairs**.

the adults are **narrow**, **yellow** to **dark brown** flies with 6-15mm in length,

There are **no maxillae or mandibles** in the mouthparts of tse-tse flies and

the **long proboscis** is adapted for **piercing and sucking**.

Abdomen:

- ✓ The abdomen is **brown**, with **six segments** that are visible form the **dorsal aspect**

The **male abdomen** has an extra structure, **hypopygium,** that **folded** beneath the last two segments.

- ✓*It is the **male genital organ**; rounded structure.*

The **3rd larva** is **creamy white**, **segmented** and

- ✓**posteriorly** the **3rd larva** has a **pair of dark ear-shaped protuberances** with a **respiratory function** similar to the posterior **spiracles** of other muscid larvae.

Life cycle

Under go **complete metamorphosis**

females usually **mate once in their life** during or after taking their **first blood meal.**

The **sperm** stored in **spermathecae** lasts for their lifetime

The **males** remain sexually **active throughout life**

The females deliver a **mature larva** (ready to pupate) after **gestation of about 10 days.**

Maturation of larva to 3rd stage takes place **in the uterus** from fertilized egg

During gestation, the larva is fed on a **secretion in the mother's uterus**.

- They ovulate a **single egg at a time**.
  - ✓produce only **one mature larva** at a time, **one larva** about every **9-11 days** and up to a total of **8-12 larvae**.
  - ✓**juvenile mortality** is low

After hatching, the **larva** passes through **three stadia.**

the larva is **mobile** and 8.0- l0mm long,

After deposition the larva forms **dark brown**, **barrel-shaped puparium** deep in the soil.

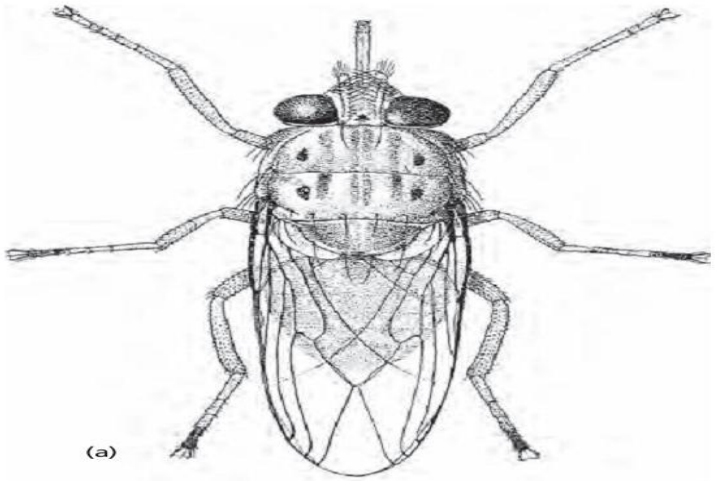
The **pupal period** is relatively long, taking 4-5 weeks and adult fly emerges

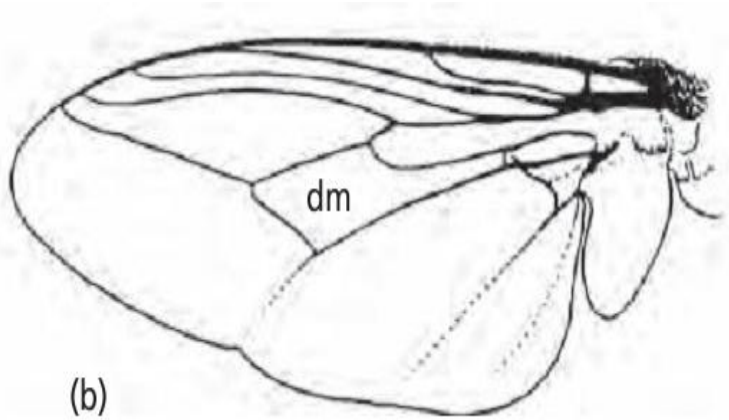
Breeding generally continues **throughout the year** with **peak fly numbers** occurring at the **end of the rainy season**.

The **life-span of adult flies** in nature is **3-4months** depending on the climatic condition.

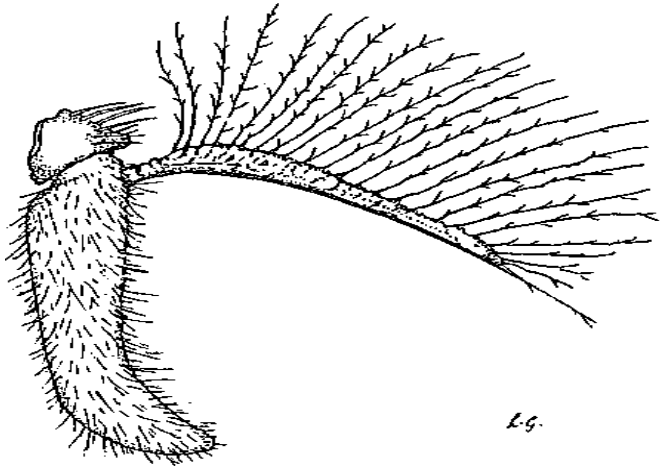
Female(left) Male(right) genital organs

Glossina wing showing typical 'cleaver' cell





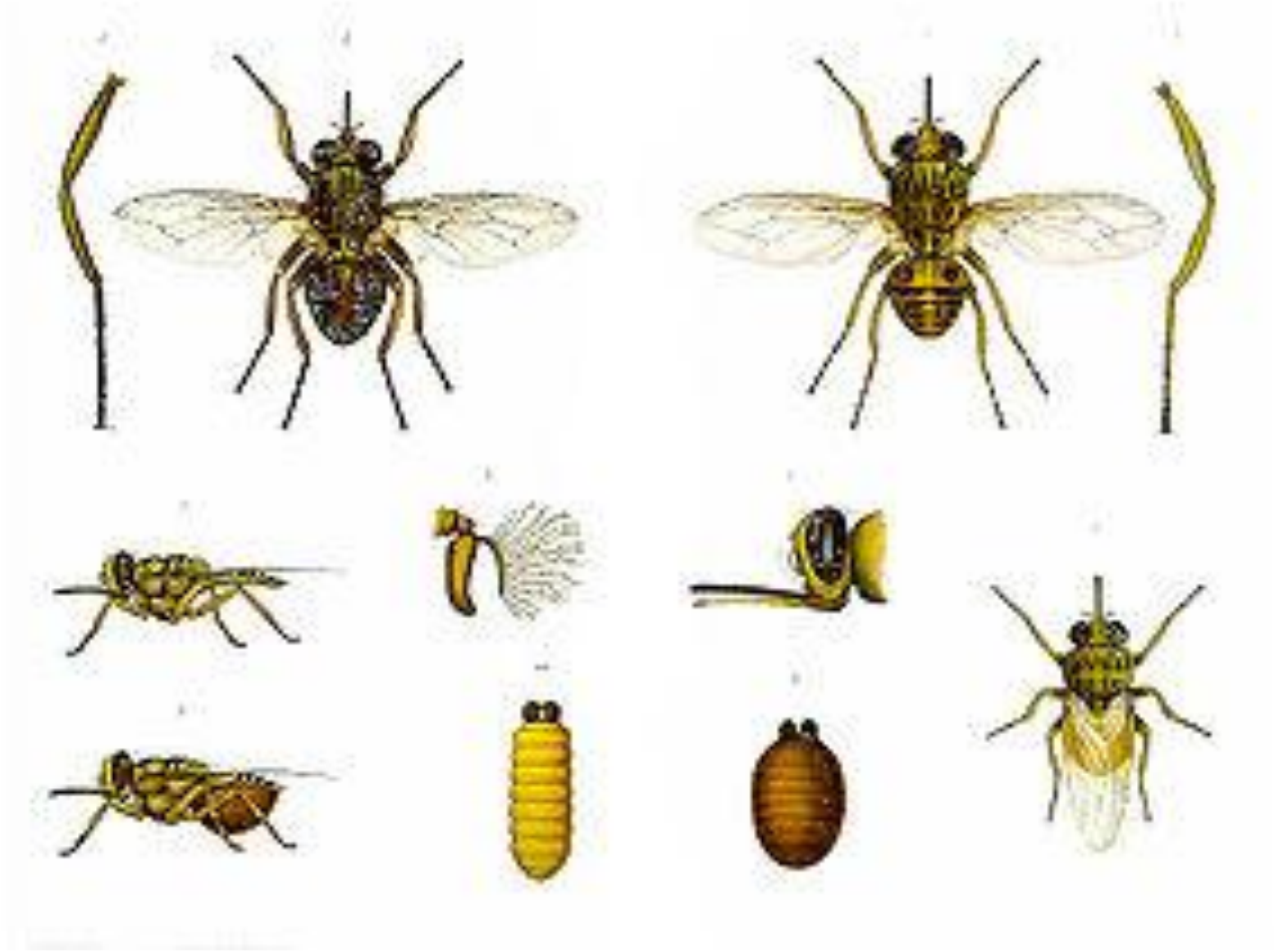
Branched hairs of the arista,
a characteristic feature of tsetse flies



Adult fly deposit the larva

mature larva of *Glossina*

Life cycle of tsetse fly



Glossina---

Pathogenic significance:

- tsetse flies biting causes **painful irritation**.
- Important in the transmission of **animal and human trypanosomosis**.
- The normal hosts of tsetse flies are **African wild, large mammals and reptiles (reservoir hosts).**

Control

❖**Vector control:**

Spraying of insecticides: on the ground or by aircraft.

- ✓spraying of residual insecticides that persist in the environment for at least 2-3 months

Trapping: Use of targets and traps:

- ✓*The advantage:* ***no contamination of the environment with insecticide.***

❖**Sterile insect technique (SIT):** breeding up thousands of male *Glossina* which are **sterilised** using radiation and then **released at regular intervals**,

- ✓*thus* ***swamping the population*** *with* ***males*** *that are* ***unable to fertilise*** *females successfully.*

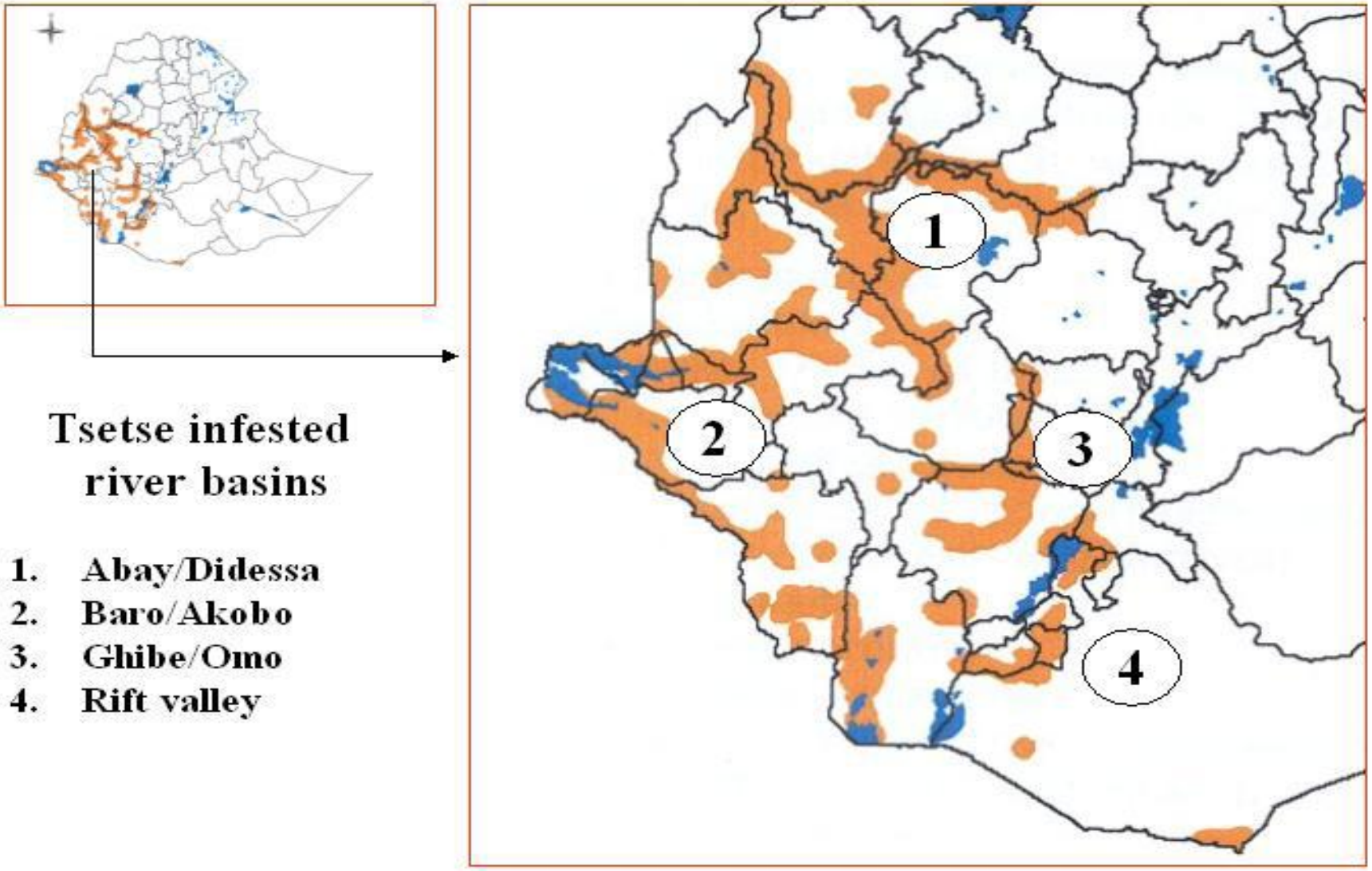
Clearing of habitats/vegetation where the adults are found

Treatment of infected animals with trypanocidal drugs

Killing of wild animals. to remove reservoirs of infection in the wild animal populations.

❖Breeding resistant breeds of cattle

Glossina species covered regions of Ethiopia



Tsetse infested river basins

1. Abay/Didessa
2. Baro/Akobo
3. Ghibe/Omo
4. Rift valley

Table 1: Tsetse infested regions and river basins of Ethiopia

Region	Major River Basin	Tsetse fly
Amhara	Abay (Blue Nile)	*G. m. submorsitans* *G. tachinoides*
Beneshangul-Gumuz	Abay (Blue Nile)	*G. m. submorsitans* *G. tachinoides*
Gambella	Baro/Akobo	*G. m. submorsitans* *G. tachinoides* *G. pallidipes* *G. f. fuscipes*
Oromiya	Abay/Didessa Upper Ghibe/Omo Baro/Akobo	*G. m. submorsitans* *G. tachinoides* *G. pallidipes* *G. f. fuscipes*
SNNPR	Ghibe/Omo Rift Valley	*G. pallidipes* *G. f. fuscipes* *G. longipennis* *G. pallidipes*

Family Oestridae (botfly)

- Contains flies commonly known as **bots** and **warbles**.
  - The word "**bot**" in this sense means a **maggot/larva**.
  - A **warble** is a skin lump/swelling
- the **larvae** of all species are **obligate parasites** of mammals,
- some species growing in the **host's flesh** and others within the **gut/cavities** causing a disease condition known as **myiasis.**
  - **Myiasis** is the invasion of organs and/or tissues of living vertebrates by the **larval stages** of flies (Diptera).
  - The adults have primitive , usually **non-functiona**l mouthparts and **short-lived**
- **General morphology**
- They are **hairy flies**.
- Adult oestrids have a **broad head**, with relatively **small eyes**
- **Small**, **three segmented** antennae are sunken into a pit on the face.
- The **adults** have primitive, **non-functional mouthparts** and **do not feed.** They are **short lived** (live for about 2 weeks);
- **Legs** are short, stout, and **hairy.**

…Oestridae---

- Larvae have **functional** mouth parts and **long** life span
- The larvae are characterized by **posterior spiracular plates** containing **small pores**.
- **Impact on the host can be categorized into:**
  - d**isturbance**: **oviposition/larviposition activities** of adult females.
  - **Inflammatory reaction: migration** and **development** of **larvae** and subsequent host response
- There are 3 major genera of economic importance: ***Oestrus,*** ***Hypoderma,*** and ***Gastrophilus.***
- **Genus *Oestrus* (nasal bot):** economically important.
- Larvae are parasitic in the **air passages** of the hosts
  - commonly referred to as **'nasal bots'.**
- **Hosts:** Sheep and goats and rarely man.
- **Species: *Oestrus ovis***
- **Distribution:** Worldwide.

Morphology

Adults:

- a **stout**, greyish-brown fly covered with **short hairs**.
- 10-12mm in length
- Have small **black spots** on the abdomen
- The head is **broad** with **small eyes** and
- the **mouthparts** are **reduced to small knobs** and **do not feed.**
- The segments of the **antennae** are small and the **aresta is bare**

Larvae:

- Each segment of the mature larvae has a **dark transverse band dorsally.**
- The **ventral surface** of each segment bears a **row of small spines.**
- have **no head**, but with prominent **mouth hooks**,

Oestrus ovis---

Adult *O. ovis*

Mature larva (above); Imature larvae (below)

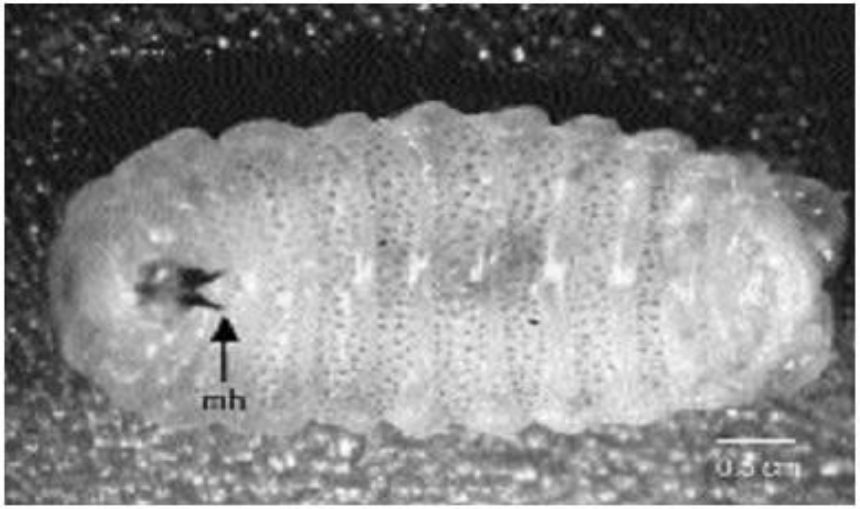
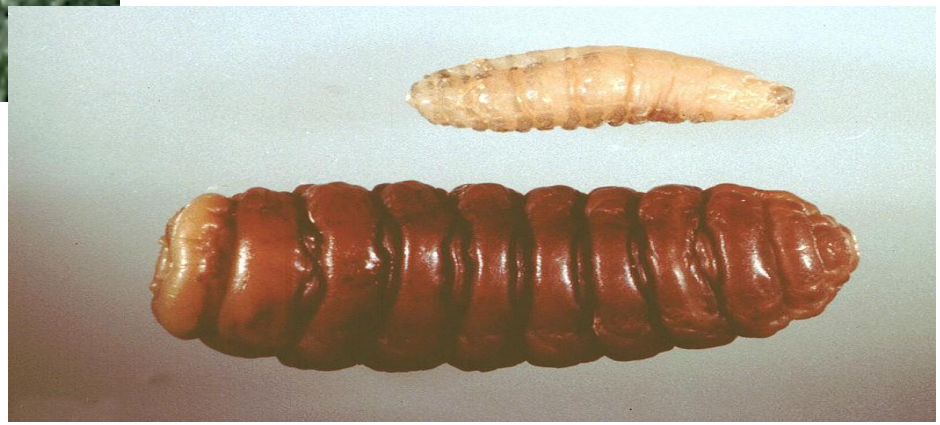
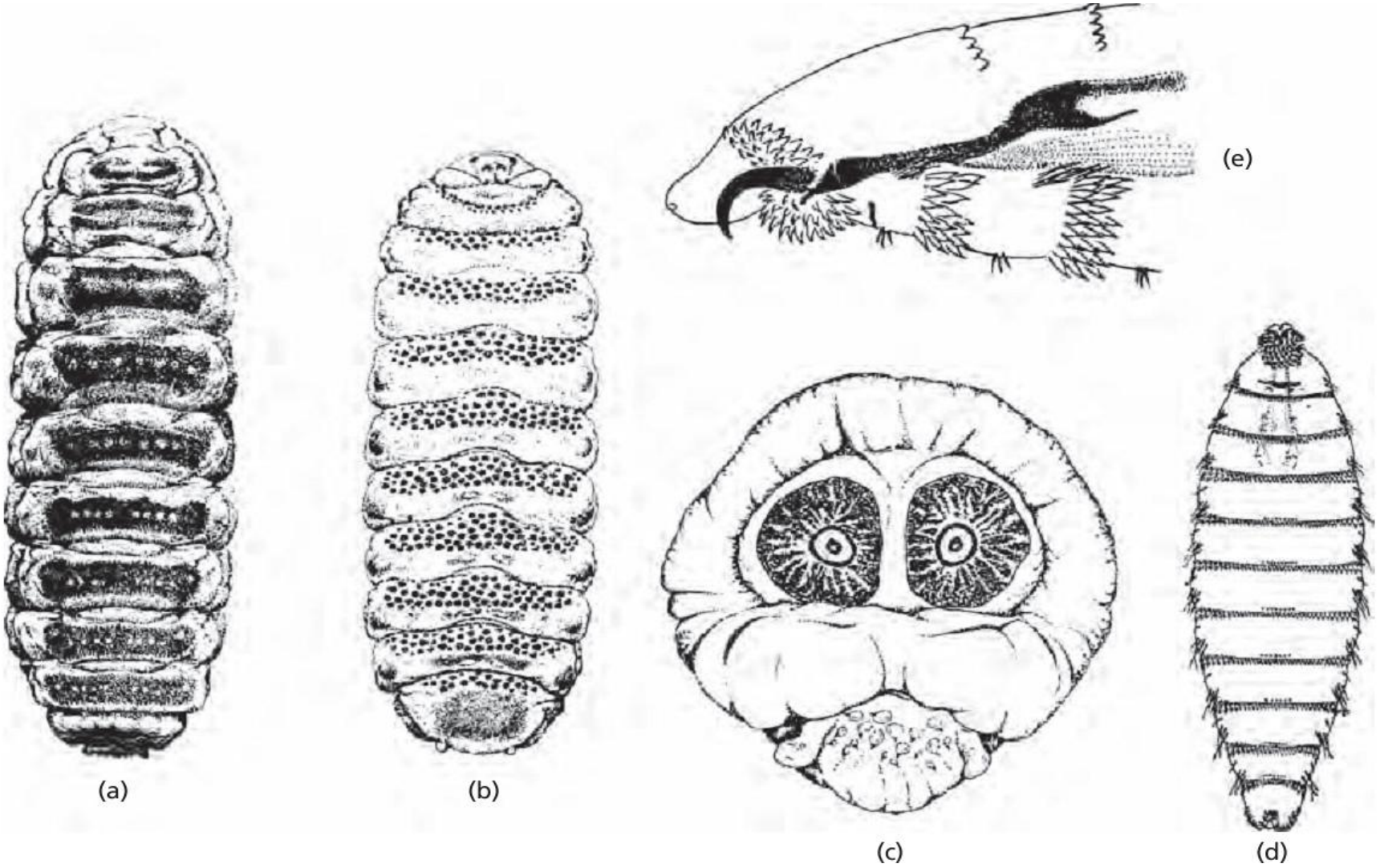


FIG. 3.6—Dorsal view of third instar *Oestrus ovis*, recovered from naturally infested sheep (*Ovis aries*). Note the prominent mouth hooks **(mh)**. (Photograph by P. J. Scholl, Fort Dodge Animal Health, New Jersey.)



Oestrus ovis : (a) dorsal view and (b) ventral view of third-stage larva; (c) posterior view of third-stage larva; (d) first-stage larva; (e) mouthparts of first-stage larva in lateral view. (From Zumpt, 1965.)

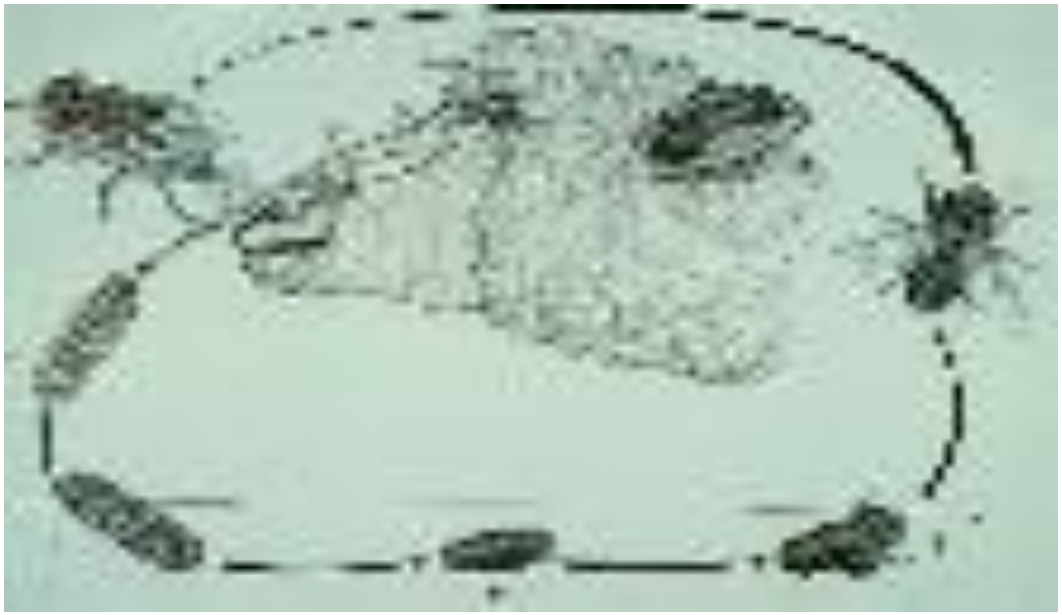


Oetrus ovis infestation causing nasal discharge

O. ovis---

Life cycle

- The females are **viviparous** and deposit larvae in or near the **nostrils** of the host during flight.
- The newly deposited **L1** migrate through the nasal passages to the **frontal sinuses** where they develop into **2nd and 3rd** stage larvae.
- The matured **3rd stage** larvae migrate **back to the nostrils**, crawl out of the nostrils or are sneezed out; pupate in the ground; adults emerge.
- The females survive only 2 weeks **(do not feed)** and each can deposit **500 larvae**



O. ovis---

Pathogenic significance

- **Annoyance:** when Adult flies approach the sheep to deposit larvae.
- **irritation and excessive mucous secretion: migration of larvae** in the nasal cavities of sheep (**oral hooks** and **ventral spines).**

Clinical signs

- Mild discomfort, sticky, mucoid nasal discharge, sneezing,
- Nose rubbing, head shaking, circling (CNS involvement)

Diagnosis

- Sometimes a large, dark brown larvae may drop out of nostrils at sneezing
- Postmortem examination of the nasal cavities for the **detection of larvae**.

Treatment

- ivermectin (200µg/kg, Sc.) Is highly effective

Oestridae---

❖ **Genus *Hypoderma***

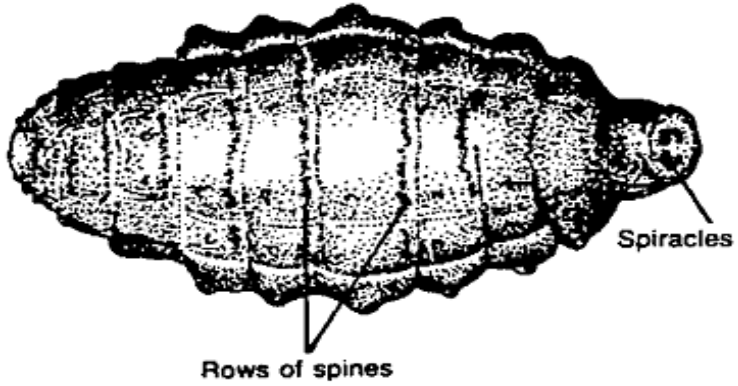
- Commonly known as "**Warble Flies**" or " **cattle grubs**")
- Cause great economic losses due to **extensive damage** of the skin.

Hosts: cattle

Species: ***Hypoderma bovis*** and ***H. liniatum***

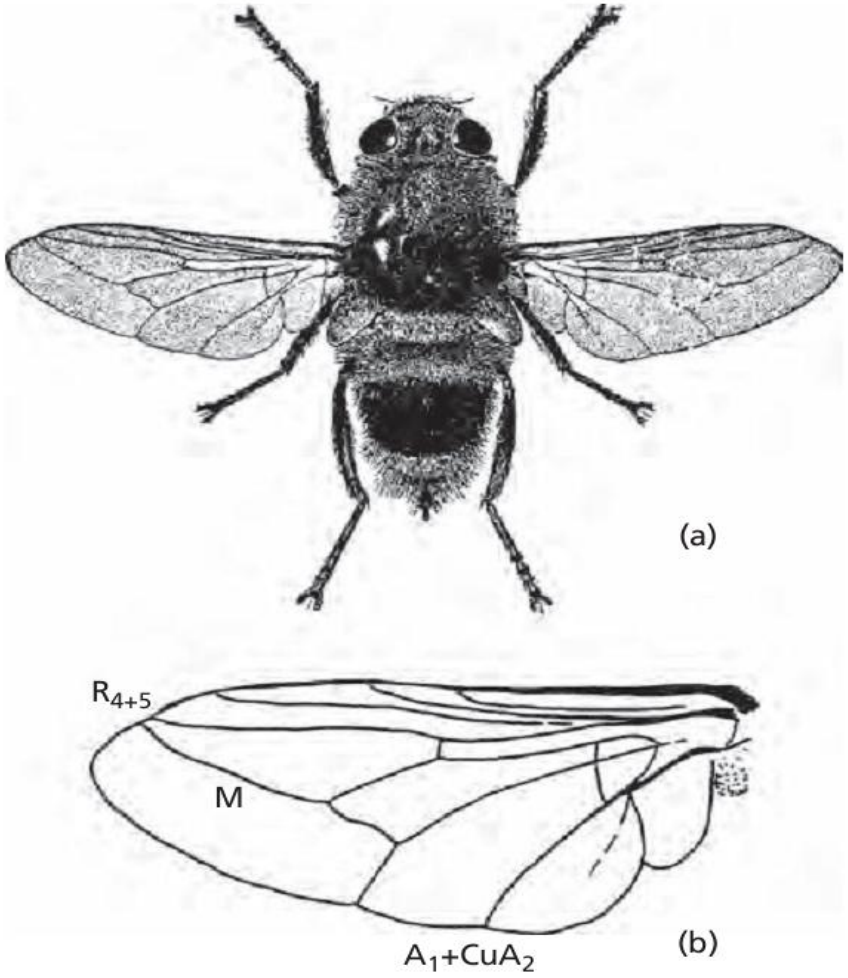
Morphology

- The adults are large and the **abdomen** is covered with **yellow–orange hairs** giving them a **bee-like appearance**
- **Mouthparts** are **small** and **nonfunctional**
- **Mature larva** is **dark brown, barrel-shaped** tapering anteriorly with **segmented body**.
  - ✓ Each segment bears small **spines** and **tubercles**.
- the **posterior spiracular plate** is completely surrounded by **small spines.**



Hypoderma larva showing segmented appearance, **short spines** and **posterior spiracle**

(a) Adult female of *Hypoderma bovis*
(b) Wing venation typical of *Hypoderma* showing the strongly bent vein M not joining R 4+5 before the wing margin and vein A1+CuA2 reaching the wing margin



Hypoderma---

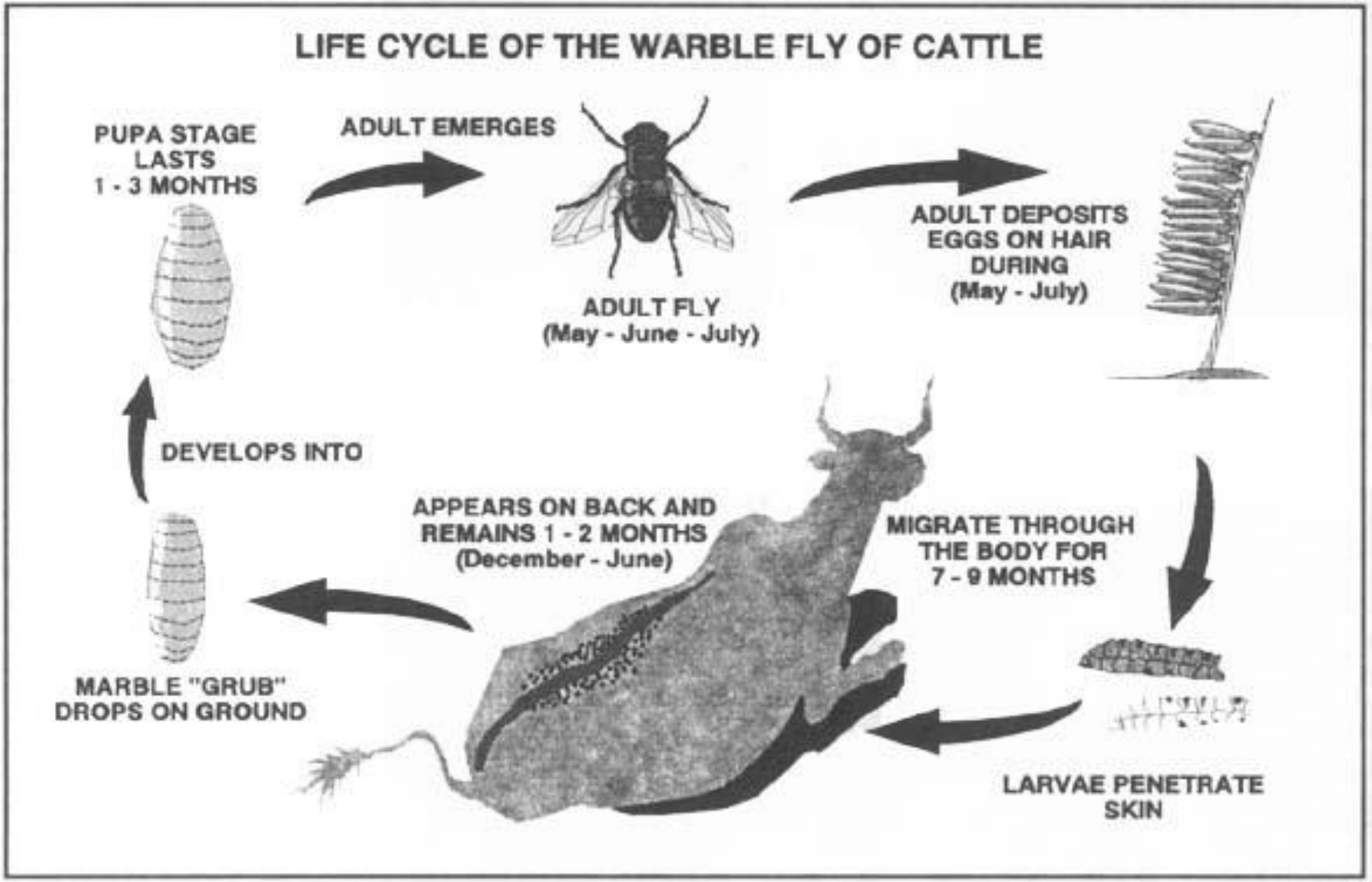
Life cycle

- The **females** attach their **eggs** to hairs on the **lower parts** of the body

and on the **legs** above the hocks.

- Eggs hatch and **1st stage larvae penetrate host's skin** and migrate within connective tissue and appear in the **subcutaneous tissues** of the back **developing to L3**, forming distinct swellings ('**warbles**').
- **L3 come out of the skin** and fall on the ground and pupate with adult flies emerging.
- Adult copulate, female lay eggs and then **die within 1-2 weeks**.

Life cycle of warble fly



Hypoderma---

Pathogenic Effects

- **Economic losses: hide downgrading** and **carcass** trimming from the holes cut by the larvae and reduced weight gains,
- **self-injury:** panic cattle running to escape ovipositing adult female flies which result in dramatic **avoidance behaviour** known as '**gadding‘**

Clinical signs: **nodules** with an openings in the skin of the back.

Diagnosis: finding either the **eggs on hairs** of the legs or the larvae in the back.

Treatment & Control

- **Ivermectin**…. (1ml/50kg B.W subcutaneously)
- Use insecticide as **'pour-on'** to the backs of cattle

Oestridae---

❖ **Genus *Gasterophilus***

- commonly referred to as **'gut bot fly'.**
- Their **larvae** spend most of their time developing in the **stomach of equine**
- They are **obligate parasites of equine.**

Hosts: Horses and donkeys

Major species:

- *Gasterophilus intestinalis, G. nasalis, G. haemorrhoidalis , G, pecorum*

Morphology

Adults:

- Bot flies are **robust dark flies** 1-2 cm long
- The body is covered with **yelowish hairs**.
- In the female the **ovipositor** is strong and **protruberant**.
- The wings have **no cross-vein dm-cu.**
- *Gasterophilus intestinalis*, has irregular, **dark, transverse-bands** on the **wings**,

Larvae:

- When **mature** and **present in the stomach** or **passed in faeces** are:
  - ✓ **cylindrica**l, 16-20 mm long and **reddish-orange** with **posterior spiracles**,
  - ✓ **Differentiation of mature larvae**: can be made on mouth hooks and the **numbers** and **distribution** of the **spines** present on various segments.

Gasterophilus---

❖ ***G. haemorrhoidalis***

- The **spines** on the **ventral surface** of the larval segments are **arranged in two rows.**
- The **mouth hooks** are **uniformly curved dorsally** and **directed laterally**, and the **body spines** are **sharply pointed**.

❖ ***G. intestinalis***

- The **mouth hooks** are **not uniformly curved dorsally**, and have a shallow depression.
- The **body spines** have **blunt tips**

❖ ***G. pecorum***

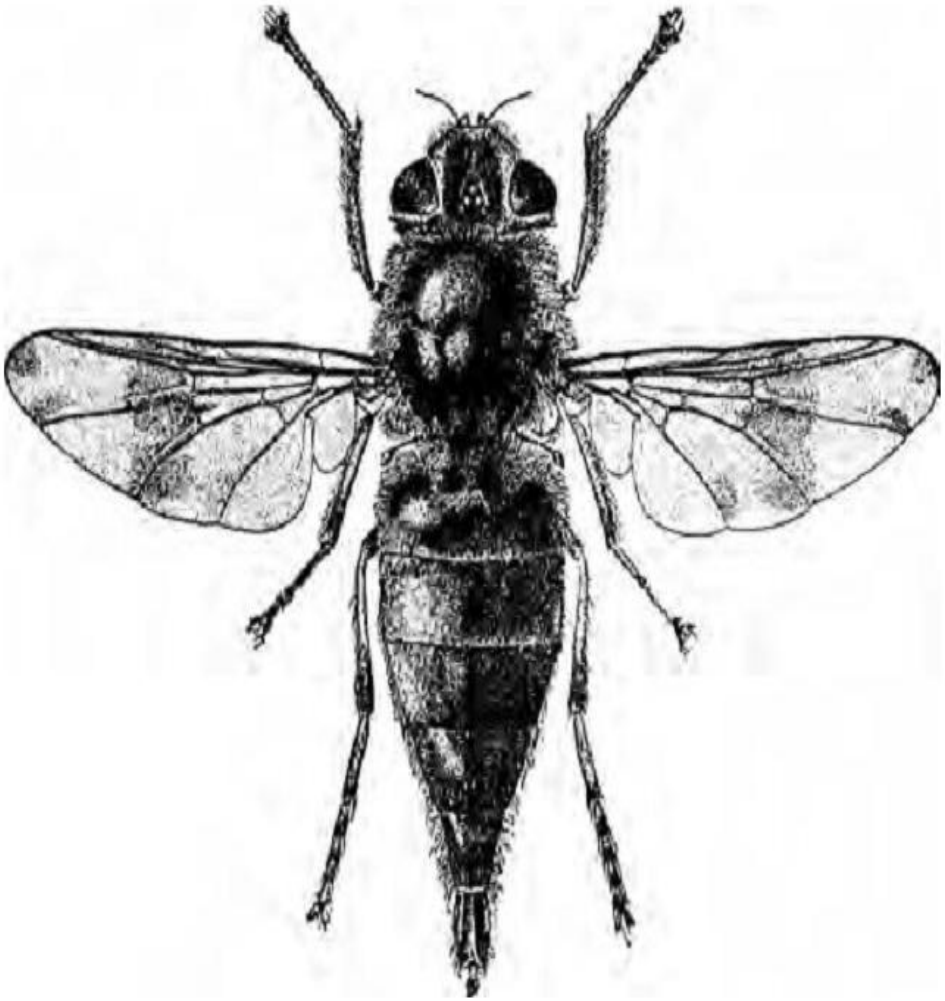
- The **spines** on the **ventral surface** of the larval segments are **arranged in two rows.**
- Segments 10 and 11 have **no spine**

❖ **Gasterophilus nasalis**

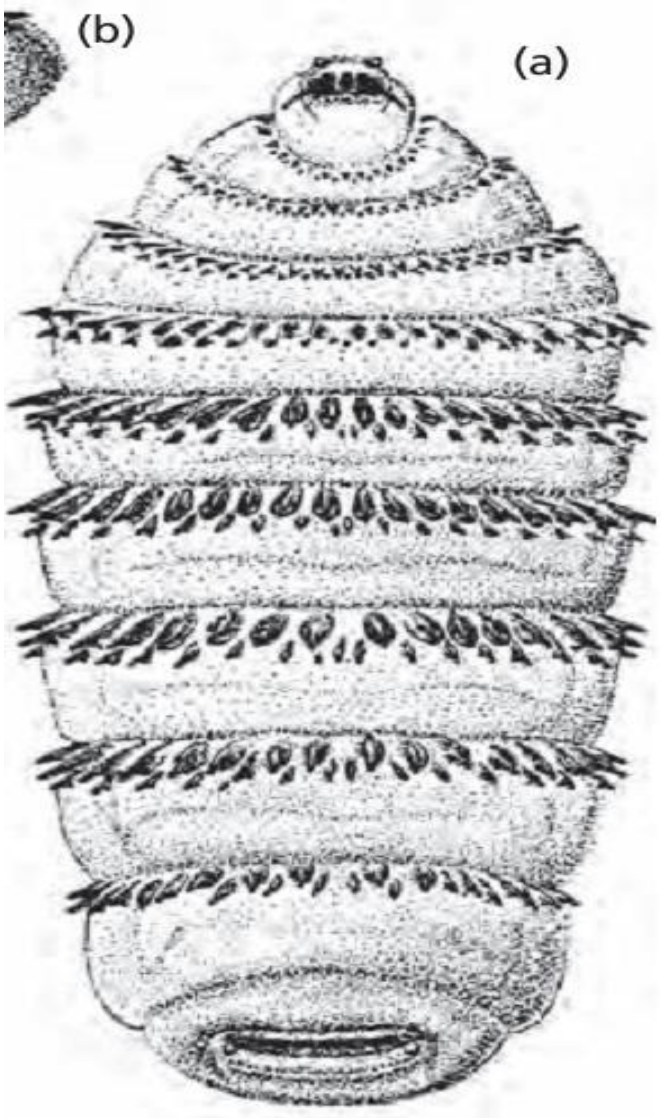
❖ The **spines** on the **ventral surface** of the larval segments are **arranged in** a **single row.**

❖ The **third segment** has a **dorsal row of spines**

Adult female *Gasterophilus intestinalis*



Third-stage larva of *Gasterophilus intestinalis*



Gasterophilus---

Life cycle

- ***G. intestinalis*,** eggs are laid on the **hairs of the fore legs** and **shoulders.**
- ***G. nasalis***, lay their eggs in the **intermandibular area**
- ***G. haemorrhoidalis***, lay their eggs around the **lips.**
- The **eggs** are easily seen being **1 mm long** and usually **creamy white** in colour;

❖ ***G. pecorum* lays eggs on pasture** and are ingested by **horses during grazing.**

- they either **hatch spontaneously** or are stimulated by **warmth** during **licking** and **self-grooming**
- **Larvae** either **crawl into the mouth** or are **transferred to the tongue** during **licking**
- These then penetrate the tongue or buccal mucosa and passing via the pharynx and **oesophagus** to the **stomach** and attach to the gastric epithelium.
- Larvae remain and develop in this site for periods of **10-12 months** and **when mature** they detach and are **passed in the faeces.**
- **Pupation** takes place **on the ground** and after **1-2 months** the adult flies emerge.
- **Adults do not feed** and **live for only a few days** or weeks during which time they mate and lay eggs.

Gasterophilus---

Pathogenic significance

- **Annoyance :** when they approach horses to lay their eggs**,**
- The presence of larvae in the **buccal cavity** may lead to **stomatitis** with **ulceration of the tongue**
- **inflammatory reaction** with the formation of **funnel-shaped ulcers:** On attachment by their **oral hooks** to the stomach lining,

Control

- **Treatments:** the broad spectrum insecticidal anthelmintics: **ivermectin** is very effective against bots/larvae.
- vigorously **sponging** with **warm water** containing an insecticide.
  - ✓ The warmth stimulates hatching and the insecticide kills the newly-hatched larvae

❖ **Genus *Cephalopina***

❖ Important specis:***Cephalopina titillator***

- The **nasal bot** fly of **camel**

Adult: The adult fly measures 8–10 mm in length and has a **powdery grey appearance**.

- The head is large, orange above and yellow below.
- The **eyes** are **broadly separated**, especially in the female.
- The **thorax** is **reddish-brown**, with a black pattern.
- The **abdomen** has irregular **black blotches** and **white hair** and the **legs are yellow**.

Cephalopina---

- The fly deposits its larvae **in the nostrils**, from which they migrate to the nasopharynx and nasal sinuses.
- The **larval phase** usually occupies about **11 months**.
- Cause **inflammation**, sometimes **purulent**, of the nasopharyngeal mucosa.

Larvae:

- The **first-stage larvae** have **long spines** on the lateral edges of the segments
- **Third instars** are about 25–35 mm in length, and characterised by smooth fleshy **lobes** on each segment and **large mouth hooks**

Life cycle:

- **Eggs** are laid around the **nasal area**.
- **Larvae** hatch and **migrate into the nasal cavity**, frontal sinus and pharynx of their host,
- When **mature**, the larvae make their way **back to the nose**, considerably irritating the host
- As a result they are **sneezed out onto the ground**, and from here the larvae burrow into the ground and **pupate**.
- Pupation takes about 25 days.

Cephalopina---

- **Camels** snort and sneeze and are **restless**, especially during the **emergence** of **mature larvae** from the nostrils.
- Adult **do not panic** the animals (unlike other oestrids)
- Recognized by the irregular blotches/spots of **black** and **white hairs** on the abdomen.

❖ ***Rhinoestrus purpureus***

Adult: A relatively small fly, 8–11 mm in length.

- The **anterior thorax** is characterized by a number of **shiny black stripes**.
- The **head, thorax** and **abdomen** are covered with small **wart-like protruberances** and a covering of **short yellow–brown hairs**.
- The **head** is **broad**, **with small eyes**.
- The **legs** are **red and yellow–brown**.
- The **mouthparts** are reduced to **small knobs**.

Larvae: The larvae resemble those of **Oestrus ovis** ex-cept that they have strongly **recurved mouth hooks** and a single row of 8–12 **terminal hooklets**.

Life cycle:

- The female fly produces 700–800 larvae which are expelled in batches of up to 40 into the **nostrils of the hosts**.
- **First-stage larvae** remain in the nasal cavities and move to the **pharyngeal area** where they moult to become **second**- and then **third-stage larvae**.
- **Third-stage larvae** are expelled and **pupate in the ground**.

Family Calliphoridae

- Commonly known as " ***blowfly***"
- responsible for **myiasis** of domestic animals and man.
- These species are found largely in **five important genera**: ***Cochliomyia , Chrysomya, Cordylobia, Lucilia***, ***Calliphora***, ***Protophormia*** **and** ***Phormia***
- The **screwworms**, *Chrysomya bezziana* and *Cochliomyia hominivorax*, *Cordylobia anthropophaga* and *Cordylobia rodhaini*) are the only species that are **obligate agents of myiasis**.

Morphology

- **Calliphorids** are medium to large flies,
- almost all of have a **metallic blue or green** sheen/shine.
  - ✓ ***Lucilia*** is **greenish** to bronze,
  - ✓ ***Phormia*** is **black** with an overlying blue-green sheen, while
  - ✓ ***Calliphora*** is **blue**
  - ✓ *Chrysomya* **bluish-green.**
  - ✓ Identification of individual species: according to **local colour** differences mainly on the thorax and abdomen

Calliphoridae---

Larva:

- Larvae are measure 10- 14 mm in length.
- The **larvae** are usually clearly **segmented**, **pointed anteriorly** and **truncated/**shorten **posteriorly.**
- The **cuticle** is typically **pale and soft**, but is often covered by **spines or scales** arranged in **circular bands**.
- There is a **pair of anterior spiracles** immediately **behind the head**, and a pair of **posterior spiracles** on the **12th segment.**
  - ✓ The **arrangement of the spiracles on these plates** serves to differentiate the species.
- The **functional mouth** is at the inner end of the pre-oral cavity, from which a **pair of darkened mouth hooks** protrudes.

Calliphoridae---

Life cycle

- The **gravid female** blowfly lay eggs on **wounds**, **soiled fleece** or **dead animals**,
- the eggs hatch into larvae in about 12 hours;
- the larvae then feed, grow rapidly and **moult twice** to become fully **mature maggots.**
- As **maggots mature**, they move away from the carcass to **pupate**
- The pupal stage is completed in 3-7 days and the adult fly emerges
- Adult flies can live for about 30 days
- The **entire life cycle** usually requires between **10 and 25 days**.

Pathogenic significance

- The larvae **lacerate the skin** with their **oral hooks**, and secrete **proteolytic enzymes** which digest and liquefy the tissues.
- The **irritation** extremely debilitating and sheep can **rapidly lose condition**.
- In body strike the **fleece** in the affected area is **darker**, has a **damp appearance** and a **foul odour** (in advanced cases).
- Diagnosis can be made based on the **clinical signs** and r**ecognition of maggots in the lesion.**

Calliphoridae---

CONTROL

- **Treatment:** the lesion dressed with a suitable insecticide.
- **Prophylactic treatment** of sheep by hand **spraying, dipping** with insecticides
- prevention of **diarrhoea** by effective worm control and
- the **removal of excess wool** from the groin and perineal area to prevent **soiling**
- **Burial** or burning of carcasses (breeding site)

❖ **Screw-worm myiasis**

- The name **screw-worm** is given to the larvae of certain species of ***Cochliomyia*** (syn. Callitroga) including:
  - ✓ *C. haminivorax* and *C. macellaria*, and to that of
  - ✓ a single species of ***Chrysomya***, ***C. bezziana***, cause **myiasis** in animals and occasionally man.
- These **bluish-green** flies have **longitudinal stripes** on the thorax and **orange-brown eyes**

Screw-worm myiasis---

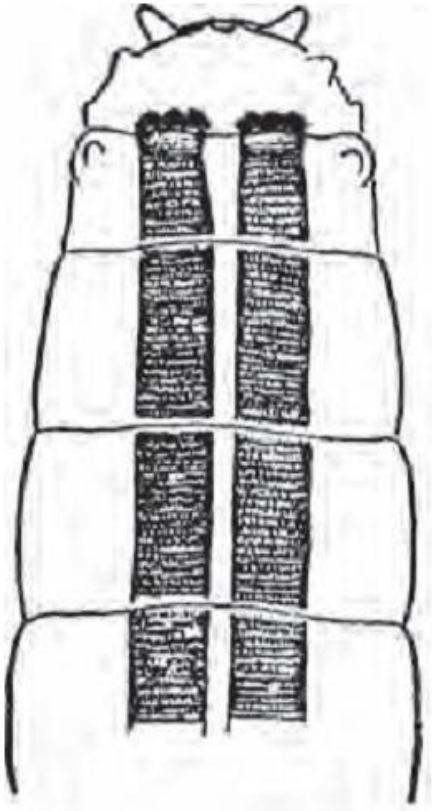
- They lay their **eggs on wounds** and penetrating the tissues create a large and **foul-smelling lesion**
- female fly mates **only once**, and control proved very successful

❖ ***Cochliomyia hominivorax* (*C. hominivorax*)**

- The adult fly has a deep **greenish-blue metallic colour** and **three dark stripes** on the dorsal surface of its thorax.

❖ **Larvae:**

- The **mature larvae** measure 15 mm in length and
- have bands of **spines** around the body segments.
- Have **darkly pigmented tracheal trunks** leading from poster extending forwards



Pigmented dorsal tracheal trunks of larvae of

***C. hominivorax* .**

C. hominivorax---

Life cycle:

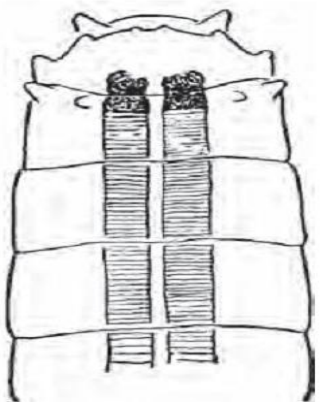
- *C. hominivorax* is an **obligate parasite** and cannot complete its life cycle on **carrion**.
- Female flies **oviposit** at the edge of **wounds** or in **body orifices**,
- **Shearing, castration** or **dehorning wounds and** navels of newly born calves are common oviposition sites,
- The **larvae** hatch in 10–12 hours and **penetrate into the tissues**, which they **liquefy** and extend the lesion
- The **wound** may begin to emit a **foul-smelling liquid** attracting other female C. hominivorax and secondary agents of myiasis.
- The larvae become **mature** in 5–7 days, and leave the host to **pupate** in the ground.
- The **entire life cycle** may be completed in **24 days** in optimum conditions.

❖ ***Cochliomyia macellaria*** (act as secondary screwworm fly)

- **Adults** are extremely **similar in appearance** to
- ***C. hominivorax***, but possess a number of
- **white spots** on the abdomen.

❖ **Larvae: absence of pigmented tracheal trunks**

❖ leading from small posterior spiracles (unlike *C. hominivorax)*



Screw-worm myiasis---

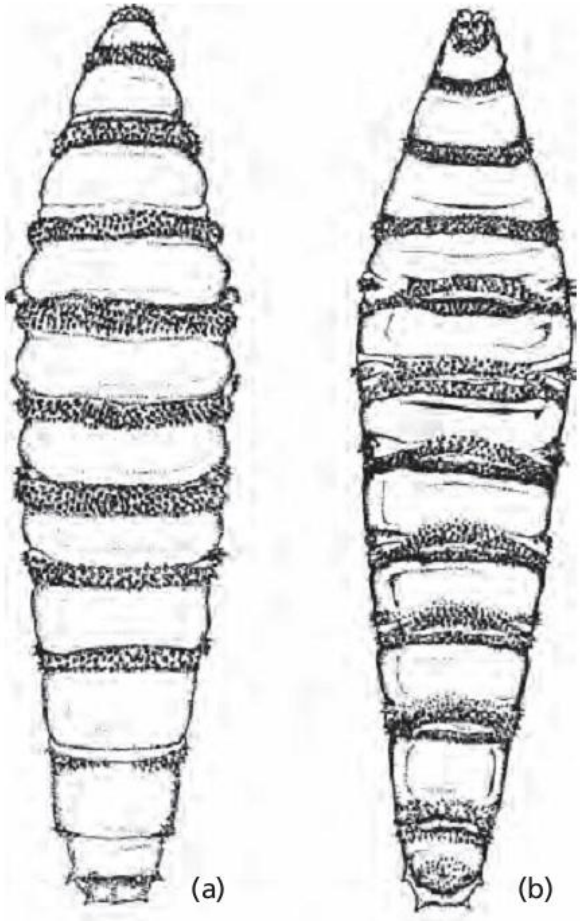
❖ ***Chrysomya bezziana***

- **adult:** stout **blue–green** flies with **dark legs**
- The adult flies measure 8–10 mm in length.
- have **four longitudinal black stripes** on the orange–brown eyes and a **pale coloured face**
- **larvae:** The first-stage larvae are creamy white.
- The **second- and third-stage larvae** are similar in appearance, each segment carrying a **broad encircling belt of strongly developed spines**

Life cycle

- *Chrysomya bezziana* is an **obligate agent** of myiasis.
- **Gravid females** are attracted to **fresh open wounds** and **body orifices** on any warm-blooded animal.
- It commonly infest the **umbilicus** of newborn calves.
- The female lays batches of **eggs** around the wound
- The eggs hatch and **first-stage larvae** begin to feed in the open wound or moist tissue, often **penetrating deep** into the host tissue.

Third-stage larva of *Chrysomya bezziana*: (a) dorsal view; (b) ventral view



Screw-worm myiasis---

❖ ***Cordylobia anthropophaga***

Adults:

- The adult fly is known as the **tumbu fly**)
- It is stout, **yellow–brown** and 8–12 mm in length.
- It has a **yellow face** and **legs** and **two black marks** on the thorax.
- have large, **fully developed** mouthparts and feed on decaying fruits, carrion and faeces
- The **arista** of the antenna has **setae on both sides**.

Larvae:

- Third-stage larvae are 12–28 mm in length and are

densely **backwardly directed, single-toothed spines.**

Third-stage larva of *Cordylobia anthropophaga*

Cordylobia anthropophaga---

Life cycle:

- The eggs are deposited in areas particularly **contaminated with host urine or faeces.**
- The eggs hatch and the **first-stage larvae** wait in the **dry substrate** for a host.
- They attach to the host and immediately **burrow into the skin**.
- Larvae develop **beneath the skin** and produce a **swelling approximately** at the point of entry.
- The swelling has a **hole in the centre** through which the **larva breathes**.
- The **three larval stages** are completed in the host
- the mature larvae emerge out of this hole and **pupate on the ground** in surface debris.
- **Adult flies** emerge from the pupae after 3–4 weeks.

❖ ***Lucilia sericata*** and ***Lucilia cuprina***

Adult*:* measure up to 10 mm in length and are characterised by a **metallic greenish to bronze sheen**

They are characterized by the presence of a **bare stem vein**, **bare squamae** and the presence of **three pairs of post-sutural, dorso-central bristles** on the thorax.

Lucilia spp---

Larvae:

- They are **smooth, segmented** and measure 10–14 mm in length
- They possess a **pair of oral hooks** at the anterior extremity, and at the posterior peritremes bearing spiracles

Life cycle:

- the **gravid female** lays eggs in clusters on **wounds, soiled fleece** or dead animals,
- The eggs hatch into larvae in about 12 hours.
- The larvae then feed, grow rapidly and **moult twice** to become fully mature maggots in 3 days.
- The mouth hooks are used to macerate the tissues,
- Mature larvae drop to the ground and pupate.
- The pupal stage is completed in 3–7 days in summer.
- Adult flies can live for about 7 days.
- The time required to complete the life cycle from egg to adult between 4 and 6 weeks.

Screw-worm myiasis---

Genus *Calliphora*

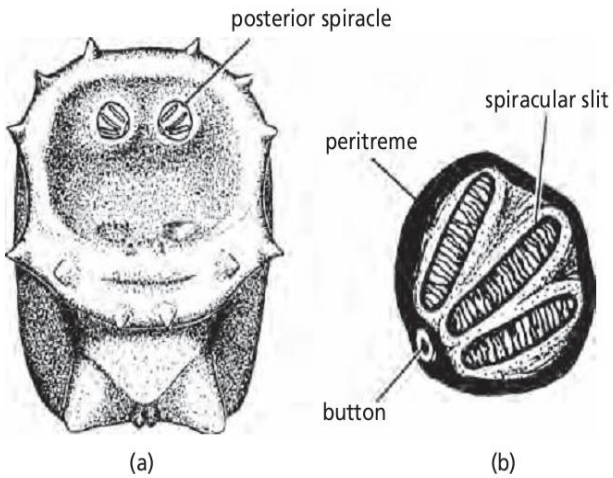
- Members are known as '**bluebottles**'.
- The two most important species: ***Calliphora vicina*** and ***C. vomitoria.***

Life cycle: flies act as **secondary invaders of myiases** on live mammals.

- The gravid female lays clusters of eggs.
- The eggs hatch into larvae and the larvae then feed, grow rapidly and **moult twice** to become **fully mature maggots**.
- **third-stage larvae** migrate to the ground and **pupate** and adult fly emerge

Larvae: Larvae are smooth, segmented and measure 10–14 mm in length.

- The **posterior spiracles** are in a **closed peritreme**

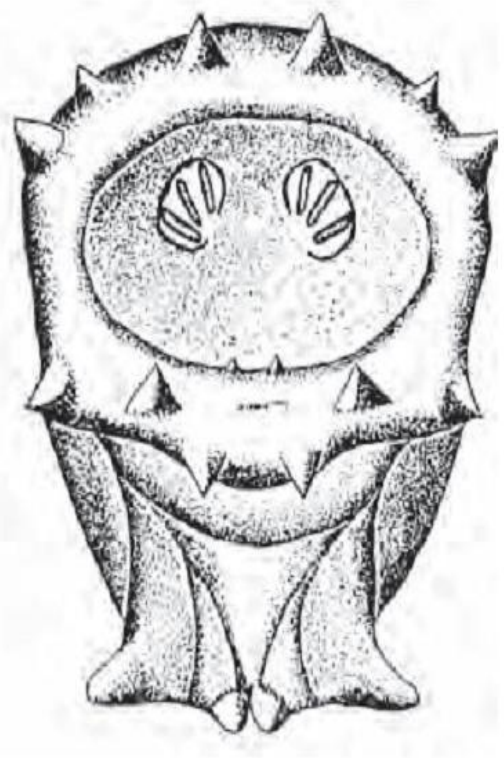


(a) Posterior view of the last abdominal segment of ***Calliphora vicina*** and
(b) detail of the posterior spiracles of a third-stage larva of **Calliphora vomitoria**.

Screw-worm myiasis---

❖ ***Phormia*** and ***Protophormia***

- They are known as '**blackbottles**', because, adult flies are **black in colour**
- Each genus contains a **single species of interest**:
  - ✓ ***Phormia regina*** and ***Protophormia terraenovae***.
- The **third-stage larvae** of both species are characterised by strongly developed, fairly **pointed tubercles** on the **posterior face** of the last segment.

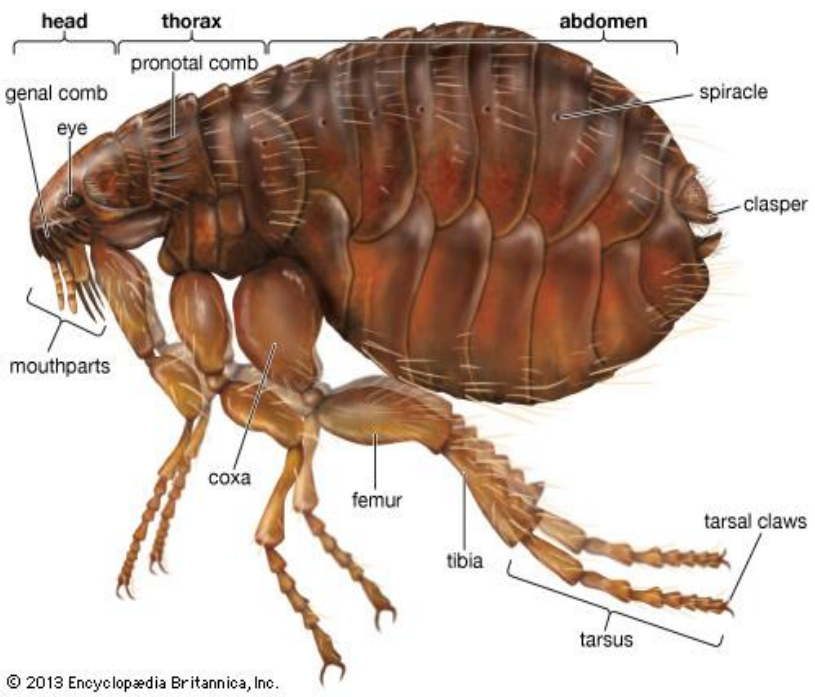


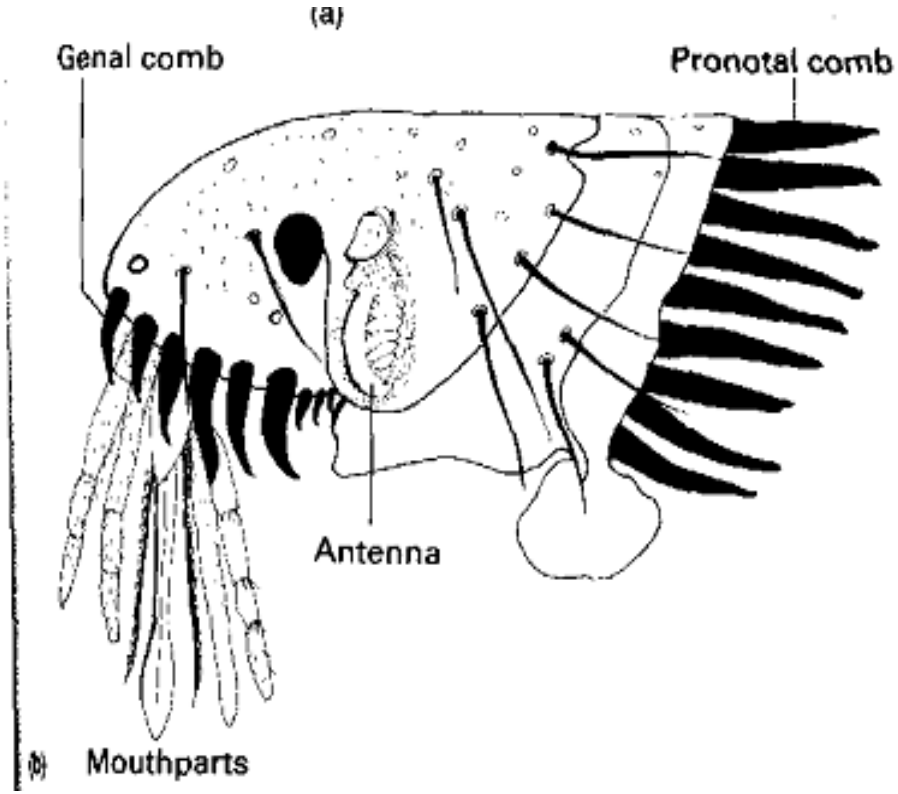
Order Siphonaptera (Fleas)

Morphology

- Fleas are **dark brown**, **wingless** insects, with **laterally compressed** bodies
- Fleas are 1-6mm long
- The antennae, which are short and club-like, are recessed/depressed into the head.
- The **3rd pair of legs** is much **longer** than the others, and is **adapted for jumping** on.
- The **head** may bear at its **posterior** (pronotal) or **ventral** (**genal**) borders **rows of dark spines** called **ctenidia** or 'combs',
  - ✓ *these are the most important features used in identification*
- Fleas have **piercing** and **sucking** mouth parts for taking blood meals.
- **Both sexes** are blood suckers, and only the **adults are parasitic**.
  - ✓ ***Only the adult stages*** *are found on the host .*
  - ✓ ***eggs*** *and* ***immature stages*** *are found in the ground.*
- Most adult fleas feed on a **wide range of mammals and birds** particularly important in **dogs, cats** and **poultry**,
- **Ruminants, horses** and **pigs** do not have their own **species of fleas**.

Flea Morphology

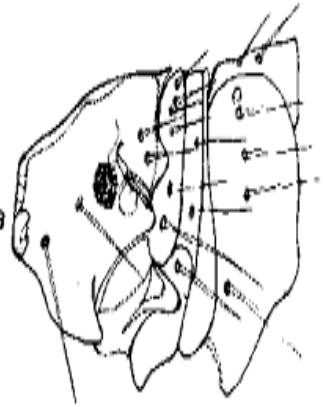




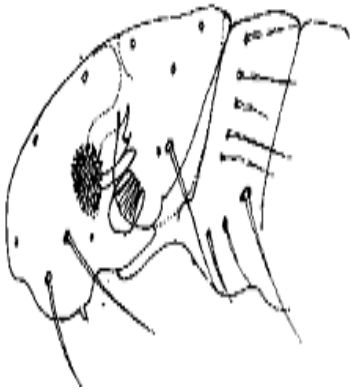
Key to the differentiation of fleas of veterinary importance

WITHOUT CTENIDIA

Frons ('forehead') angled anteriorly.....*Echidnophaga*



Frons rounded anteriorly.....*Pulex*

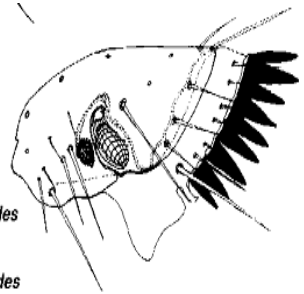


WITH CTENDIA

Pronotal ctenidium only.....*Ceratophyllus*

Both genal and pronotal ctenidia.....*Ctenocephalides*
Spilopsyllus

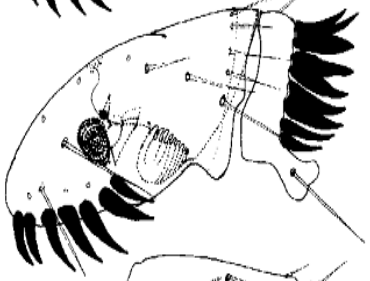
Genal ctenidium horizontal.....*Ctenocephalides*



Head length *less than twice* height.
Spine 1 of genal ctenidium *shorter than* spine 2

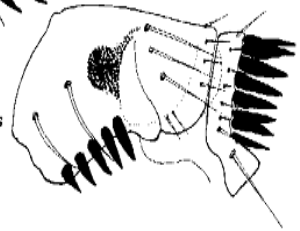
C. canis

Head length *twice* height.
Spine 1 of genal ctenidium *equal to* spine 2



C.felis

Genal ctenidium oblique,
with 4–6 elements.....*Spilopsyllus*



Flea---

Life cycle

- Fleas are **holometabolous** and go through **four life-cycle stages**: egg, larva, pupa and adult
- Adults **mate on the host** and females **lay eggs on the ground** or on the host from which they soon drop off and hatch.
- The larva **moults twice** and pupate, then the adult emerges.
- The larvae feed on debris such as flea faeces in the environment and develop through **three larval stages**.
- Once fully grown, the larvae spin a cocoon and **pupate.**
- **There are no appendages.**
- Larvae have **chewing mouthparts** and feed on organic debris
- The usual life span of adult fleas is **1-2 years**
- Only two families contain species of veterinary importance: the Ceratophyllidae and the Pulicidae
- A few genera remain **permanently attached throughout adult life**.
  - ✓ *These are the **burrowing**, or '**stickfast**', fleas, whose females are emhedded in the skin, within **nodules**.*
  - ✓ *Only the **posterior part of these fleas communicates** with the surface, allowing the **eggs or larvae to drop to the ground** and develop in the usual manner.*

Fleas of mammals

- 'The following are the more important genera occurring on **domestic mammals and birds**

❖ ***Genus Cenocephalides***

- Only important genus in **dogs and cats**

Species: ***C. canis*** and **C. felis** occur on the dog and cat,

- Both species can act as **intermediatce hosts** for the common **tapeworm** of dogs and cats, ***Dipylidium caninum***, and for the **filarioid of dogs**, ***Dipetalonema reconditum.***
  - ✓ *Ingestion of the eggs of Dipylidium: by the **flea larvae** (has chewing mouth)*
  - ✓ *Development of the cestode occurs **concurrently with that of the flea**, so that the **adult contains the cysticcrcoid**.*
  - ✓ *Crenocephalides is the genus can provok **allergic flea bite dermatitis** in dogs and cats*

❖ ***Genus Pulex***

Species: ***Pulex irritans:*** is primarily parasitic on **man**, and also common on **dogs and cats**.

- It can act as **intermediate host** of ***Dipylidium caninum***, and involved in **flea-bite dermatitis**.

Fleas---

- **Genus *Xenopsylla***
- **Species: *Xenopsylla cheopis***
- It is a **rat flea**
- the main **vector** of *Yersinia pestis*, the cause of **bubonic plague** in man.
- **Genus *Spilopsyllus***
- **Species: *Spilopsyllus cuniculi***
- it occurs on the **ears of rabbits** and is the main vector of **myxomatosis**.
- It is quite commonly found **near the edges of the ear pinna** of dogs and cats which frequent rabbit habitats.

❖ **Genus *Tunga***

Species: *Tunga penetrans*

- **burrowing feas** and occurs in **man** and rarely **pigs**.
- The female burrows into the skin, where its abdomen becomes enormously distended and tilled with eggs, forming a **distinct nodule**.
- This flea occurs mainly **on the feet of humans**, causing severe irritation.

❖ **Genus *Echidnophaga***

Species: *E. gallinacea :* burrowing fleas

- After fertilization **the female burrows into the skin** of the fowl, usually on the **comb and wattles**, resulting in the formation of **nodules** in which the eggs are laid.
- **Hatching occurs within the nodules**, and the **larvae drop to the ground** to complete development.
- The skin over the nodules often becomes **ulcerated.**
- *Echidnophaga* also attacks **mammals,** principally **dogs**, the nodules being formed
- around the **eyes** and **between the toes**.

Fleas----

- **Pathogenic significance of fleas**
- **flea-bite allergy**: a hypersensitive reaction to the **flea saliva** released into the skin during feeding.
- **Annoyance:** through their biting activities(pruritus, scratching)
- Vector/ intermediate hosts of parasites

Pathogenic significance

- Both adult male and female fleas **feed on blood** from their host.
- Annoyance: Flea bites are **irritating** and can cause **inflammation** and **pruritus** at bite site.
- Flea bites can cause **allergic reactions** in their host, particularly in dogs.
- fleas are **vectors** or **intermediate hosts** of several pathogens, including viruses, bacteria, rickettsiae, and helminthes.

Order Phthiraptera (Lice)

- Lice found on domestic animals are **host-specific**, **permanent obligatory** ectoparasites.
- They spend their entire life on their host.
- Lice are **hemimetabolous**, having egg, nymph, and adult stages.
- There are three nymphal stages.
- Adult lice are small, about **0.5 to 8 mm long**, dorsoventrally flattened, and wingless, and
- their **legs and tarsi** are adapted for maneuvering through fur, hair, and feathers.
- The legs terminate in **claws**, the lice of **mammals** having **one claw** on each leg, while those of **birds have two**
- Adult female lice **cement their eggs** individually to the hair or feathers of their hosts

Lice---

❖ There are two suborders:

- **Anoplura:** the **sucking lice**; these occur **only on mammals**.
- **Mallophaga:** the **biting lice**; these occur on **both mammals and birds**

❖ **Suborder Anoplura (**sucking lice)

- The sucking lice are usually are up to **5mm** with small, **pointed heads** and **terminal mouthparts**.
- The **head** is **small**, **narrow**, and **elongated**.
- Their mouthparts are modified for **piercing the skin**.
- They are generally **slow-moving**, and have **powerful legs**, each with a **single large claw**.
- They occur exclusively **on mammal.**

Biting lice of mammals :

❖ ***Haematopinus:***

- The **short-nosed louse**.
- This is the **largest louse** of domestic mammals, up to **0.5cm** in length.
- It is **yellow or grayish-brown** with a **dark stripe on each side**

Hosts: Cattle, pigs, equines

Lice-Anoplura

❖ ***Linognathus:***

- This, the '**long-nosed**' louse with **bluish-black** colour
- the eggs are exceptional in being **dark blue**, and are less easy to see on hair.

Hosts: Cattle, sheep, goats, dogs.

❖ ***Solenopotes*:**

- Small **bluish lice**, which tend to occur in clusters.

Hosts: Cattle.

Suborder Malophaga

- Adult Mallaphaga lice are **adapted for chewing**, possessing **chewing mandibles**.
- They are generally **small lice** (2 to 3 mm long)
- The head is **very large**, occupying the **width of the body**, and is **rounded anteriorly**, with the **mouthparts ventral**.
- These lice feed on a variety of skin fragments, hair, or feathers on their host.
- The **claws are small**, the genera on mammals having one on each leg, and those on birds, two.
- Both **mammals** and **birds** are fed upon by chewing lice

Biting lice of mammals

❖ ***Damalinia:***

- These lice are a **reddish-brown** colour

Hosts: Cattle, sheep, goats, equines.

❖ ***Felicola:***

- Distinctive among the mallophagans in having a **pointed head**, somewhat resembling the anoplurans.
- It is a **true biting louse**, with **ventral mouthparts** .

Host: Cat.

❖ ***Trichodectes***:

- This louse is **short**, **broad** and **yellowish**,
- Important as a **vector** of the tapeworm, ***Dipylidium caninum***

Lice-Malophaga

Host: Dog.

- ***Heterodoxus:*** A slender, **yellowish louse**, confined to **tropical and subtropical regions.**

Host: Dog

Biting lice of Birds

- Many of these have **acquired names**, relating to their **preferred sites on the body.**

Major genera: In domestic fowl

- ***Lipeurus*** **: 'wing louse'**
- ***Cuclotogster :*** **'head louse'**
- ***Menacanthus:*** **'hody louse'**

Minor genera:

- ***Goniocotes:*** **'Fluff louse'**
- ***Menopon:*** **'shaft louse'**

In wild birds

Goniodes

- ***Columbicola:*** pigeons and doves
- ***Holomenopon:*** ducks.

General life cycle of lice

- Lice of the two suborders (Anoplura & Mallophaga) have very similar life cycle.
- During a life span of about a month the female lays 200-300 operculate eggs ('nits').
- Eggs are usually whitish, and are glued to the hair or feathers where they may be seen with the naked eye.
- There is no true metamorphosis and from the egg hatches a nymph, similar to, though much smaller than, the adult.
- After three moults the fully grown adult is present.
- The whole cycle from egg to adult takes 2-3 weeks
- The anoplurans, with their piercing mouthparts, feed on blood,
- The mallophagans, equipped for biting and chewing, have a wider range of diet.
  - ✓ The mammals lice ingest the outer layers of the hair shafts, dermal scales, and blood scabs;
  - ✓ the bird lice also feed on skin scales and scabs, feathers and down (can digest keratin)

Louse infestatlon (pediculosis) in cattle

- ***Damalinia bovis*** (biting lice): the solitary biting species
- ***Linognathus vituli and Solenopotes capillatus (***sucking lice)
- ***Haematopinus eurysternus*** and ***H. quadripertusus*** *(*sucking lice)
- *H. eurysternus* and *L. vituli* are **gregarious in habit**, forming dense, isolated cluster

Pathogenic significance:

- **Biting lice**, in large numbers**, cause intense irritation leading to rubbing against objects, with loss of hair, and extensive hide damage.**
- **Sucking lice, and especially *H. eurysternus*, can cause serious anaemia** and **loss of weight.**

Clinical signs

- In heavier infestations there is **pruritus**, more marked in ***Damalinia*** infestation, with **rubbing and licking**, while if **sucking lice** are present in large numbers there may be **anaemia and weakness**.
- the **lice** and **eggs** are easily found by **parting the hair**, the **lice being next to the skin** and the **eggs** scattered like coarse powder throughout the hair

Louse infestatlon in cattle

Treatment and control

- **Insecticides** application: **pour-ons,** are effective in killing **all lice.**
  - ✓ *A **second treatment** is recommended **two weeks later** to kill newly emergent lice.*

❖ **Louse infestation in sheep**

- ***Linognathus pedalis***, the **'foot louse'**: inhabits mainly the lower region of the hind limbs,
- ***L. ovillus***, the **'face louse'**: occurs on the face and ears, spreading from there to the cheeks, neck and body,
- ***Damalinia* ovis**, the **biting louse** of sheep, sometimes called the **'bodv louse'** , roam in the wool over the whole body.

Pathogenic significance:

- ***Linognothus spp*** can cause anaemia in heavy infestations.
- ***Damalinia:*** Being **highly active,** it cause **great irritation**, leading to **restlessness grazing interruption**, with consequent **loss of condition.**
- the sheep rub against objects with **damage to fleece and skin**.
- **In warm countries** the **fleece** and **skin damaged** by rubbing and **soiled by louse faeces**, is an attractant for **blowflies**, and places the animal at risk from strike.

Louse infestation in sheep---

Clinical signs

- sheep with **light to moderate infestations** show **no signs**, and lice are usually only detected when **wool is being removed**.
- In **heavy infestations**, the intense **pruritus** causes **restlessness** and **scratching**, the fleece showing **bare patches** and being stained.
- **On parting the wool** the **reddish** *Damalinia* and the bluish ***Linognathus*** will be found,
- The **louse eggs** appearing as a **powder,** will be found attached to the **wool fibres** close to the skin.

❖ **Louse infestation in equines**

Two species are common on equines:

- ***Haematopinus asini:*** the **sucking louse**
- ***Damalinia* equi**: the biting louse
- **Equine pediculosis** spreads by **contact** and **via** contaminated grooming equipment, blankets, rugs and saddlery

Pathogenic significance: intense irritation, resulting in **rubbing** and **scratching**, with matting and **loss of hair**

- Animals are **restless** and **lose condition** and, in heavy ***Haematopinus*** infestations, there may also be **anaemia**.

Louse infestation in equines---

Clinical signs

- **Restlessness, rubbing**, and **damage to the coat** would suggest that lice are present
- when the **hair is parted** the parasites will he found.
- ***Damalinia*** appears as **small yellowish specks** in the hair and
- the **small pale eggs** are readily found, scattered throughout the coat.

Control

- Treatment with insecticides
- **Grooming equipment** should be scalded, **blankets** and **rugs** thoroughly **washed**, and **saddlery** thoroughly **cleaned**.
- **Regular and thorough grooming** is the essence of control

❖ **Louse infestation in the dog and cat**

the commonest and most widespread:

In **dogs**: ***Trichodectes canis*** (the biting louse) and ***Linognathus setosus*** (the sucking louse)

In **cat**: ***Felicola subrostratus*** (the biting louse)

Louse infestation in the dog and cat

Pathogenic significance:

- In **dogs *Trichodectes*** is **more harmful**, though ***Linognathus*** is a cause of **anaemia.**
- ***Trichodectes*** is very **active louse**, moving rapidly through the coat and causing **intense pruritus**
    - ✓ *it provokes **self-inflicted injury** by **scratching**, with **loss of hair** and **excoriation of the skin**.*

Clinical signs

- animals are **restless** and scratch almost continuously
- The **louse eggs** are easily seen in the coat
- **Differentiation: *Trichodectes*** being **small** and **yellow**, while ***Linognathus*** is bluish and larger.

Control

- Treatment with powder, washes or shampoos or sprays of insecticides
- Treatment is often repeated at an interval of 14 days to kill newly hatched lice

Louse infestation in birds

- **All mallophagan**, occur on domestic birds.
- ***Lipeurus*** and ***Menacanthus*** contain the **most pathogenic** species of poultry lice.

❖ ***Lipeurus*** spp: are grey, slow moving lice and found **close to the skin**.

- **L. caponis**, the **'wing louse'**, prefers the bases of the **wing and tail feathers**,
- ***Cuclotogaster*** (Lipeurus) ***heterographus***, thc **'head louse'**, occurs on the head and neck;
- These lice can infect **all domestic fowls** including turkeys, game birds, and ducks
- ***Menacanthus stramineus***, the **'yellow body louse'**, infects domestic fowls and lavours the **skin surface** as a habitat,
  - ✓ It is the most pathogcnic louse of adult birds,
  - ✓ It is a **very active louse**, and lays its eggs in **clusters** mainly in the anal region.
  - ✓ Though a **biting louse** it can cause **severe anaemia** by **puncturing small feathers** and feeding on the **blood which oozes out**
  - ✓ **Being active**, and a **voracious feeder**, it causes **severe irritation**, and the skin is inflamed and eventually covered by **scabs**,

Louse infestation in birds---

❖ **Minor genera:** Common, but less pathogenic, genera of bird lice

- ***Goniocotes gallinae***, the '**fluff louse**',
  - ✓ occurs in the fluff at the bases of feathers,
  - ✓ its preferred sites being the **back and rump**.
  - ✓ It is one of the **smallest lice** of poultry.
- ***Goniodes***
- ***G. gigas*** and ***G. dissimilis*** in the **domestic hen**
- ***G. meleagridis*** in turkeys and guinea fowl and ***G. pavonis*** in peacocks**.**
- These are **all very large lice**, inhabiting the **skin surface** and **body feathers**
- ***Menopon gallinae*****,** the '**shaft louse',** is a **pale yellow,** rapidly moving louse
- It feeds only on **feathers,**
- Its **main host** is the **domestic hen**, but it will spread to other fowl, such as **turkeys and ducks**, which are in contact

Pathogenic significance:

- The bird lice can **digest keratin**, biting off pieces of feather,
- They will ingest not only the sheaths of growing feathers, but also down and skin scabs
- Birds are **unable td rest**, **cease** feeding and may **injure themselves** by **scratching** and **feather plucking**,

Control: dusting the **litter** or providing insecticide-treated laying boxes

Flies

- Flies belong to the order Diptera, a large, complex order of insects.
- Flies can be divided into:
- Flies with biting mouthparts
- Flies with nonbiting mouthparts/Nuisance flies
- Flies with biting mouthparts:
- Only the females feed on vertebrate blood, which is required for egg laying
  - e.g. black flies, sand flies, biting midges, mosquitoes, horse flies, and deer flies.
- Both male and female flies feed on vertebrate blood
  - e.g. stable flies, horn flies, buffalo flies, tsetse flies, sheep keds, and hippoboscid.
  - Flies with non-biting mouthparts/Nuisance flies
- Face flies, head flies, filth-breeding flies and eye gnats.
- Flies where larval stages result in damage – Myiasis:
- Screw-worm, warble flies, flesh flies, blow flies and sheep nasal bot.

.....

- **Non-biting flies** may feed on the **secretions** from the **eyes, nose** and any **small wounds.**
  - ✓ This **distracts animals from grazing**, causing a **reduction in growth** and **productivity**.
- Non-biting flies are **not key vectors** of any specific disease organisms, but because of their **feeding and reproduction habits**, and the **structure of their feet and mouthparts**, they can act as **mechanical vectors** for a whole range of pathogens, from viruses to helminthes (16).
- **Biting flies** can cause even greater **irritation to domestic animals**, and they too are **vectors** for bacteria, viruses, spirochetes and chlamydiae etc.
  - ✓ However, because they **feed on blood**, they can also cause **anemia** and **hypersensitivity**.
- As **larvae**, flies may develop in the **subcutaneous tissues** of the skin, **respiratory passages**, or **GI tract** of vertebrate hosts and produce a condition known as **myiasis**.
- The **growth** and **performance** of nearly all farmed animals are adversely affected by flies, especially when they are present in **high numbers**.
  - ✓ **Infested animals** become harassed and **feed intake is drastically reduced** .
  - ✓ The result: significant reductions of meat and milk production and serious economic losses

Vectoral potenitial of flies

Flies	Diseases transmitted/vector of
• Black fly	*Onchocerca* spp.
• Sand fly	*Leishmania* spp.
• Biting midges	Blue tongue virus and *Onchocerca cervicalis*
• Mosquitoes	Equine encephalomyelitis, Japanese B encephalitis, Rift valley fever, African horse sickness
• Horse fly	Equine infectious anemia, African horse sickness,
•	Anthrax, *Trypanosoma evansi*, *T. vivax* and *Bovine leukosis virus*
• Stable fly	Anthrax, Surra, Equine infectious anemia,
•	Lumpy skin diseases and Anaplasmosis
• Horn fly	*Stephanofilaria stilesi*
• Tse tse fly	*Trypanosoma brucei*
• Louse fly	*Haemoproteus* spp.
• Face fly	*Moraxella bovis, Thelazia* spp. and *parafilaria bovicola*
• Eye gnats	*Actinomyces pyogenes* (summer mastitis) and *Moraxella bovis*

iraptera (Lice)

- They are **ectoparasites** of **mammals** and **birds** throughout the world.
- **Lice** are **dorso-ventrally flattened, wingless insects.**
- **Eyes** are reduced or absent in most lice,
- Lice are of variable size and color.
- Legs end in **claws.**
- The **lice of mammals** have **one claw** on each leg, while those of **birds** have two.
- They are **permanent obligatory** ectoparasites
  - ✓ complete their entire life-cycle on a host.
- **Lice are highly host-specific**
- Lice feed in one of two ways depending on the species:
  - ✓ **chewing lice** feed on **skin debris** while
  - ✓ **sucking lice** have **piercing mouthparts** and **feed on blood.**
- Lice typically are transferred from animal to animal by **direct contact**.

Classification

The order Phthiraptera is divided into two suborders:

- **Anoplura:** sucking lice
- **Mallaphaga:** chewing or biting lice

❖ **Anoplura (sucking lice)**

- they have **piercing-sucking** mouthparts
- The head is small, **narrow**, and **elongated**.
- Feed exclusively on **mammals.**

- **Lice**

- Lice are small, wingless and flattened insects, with stout legs and claws for clinging tightly to fur, hair and feathers. They spend their entire lives on their host animal and are generally highly host-specific.
- They feed on epidermal tissue debris, parts of feathers, sebaceous secretions and blood. Mature adult female lice generally deposit one to two eggs per day, cementing them firmly to individual hairs or feathers (nits). Nymphs hatch from the egg and then feed and moult through three to five stages, eventually moulting to become a sexually mature adult. The entire egg-to-adult life-cycle can be completed in as little as 4-6 weeks (1).
- Heavy louse infestations may cause pruritus, alopecia, excoriation and self-wounding. Severe infestation with sucking lice may cause anaemia. Lice can be divided into blood sucking (Anoplura) and biting (Mallophaga).

Lice---

❖ **The Mallaphaga (chewing or biting lice)**

- have **large heads**, almost as wide as the rest of their body.
- have **chewing** mouthparts,
- Feed on skin fragments, hair, or feathers on their host.
- Feed on both **mammals** and **birds**

Louse eggs or "nits" (9)

Anoplura:

- *Haematopinus eurysternus:* short-nosed cattle Louse
- *Linognathus vituli*: Long-nosed cattle louse
- *L. stenopsis*
- *L. africanus*: sucking Lice on sheep
- *L. pedalis:* Sheep foot louse
- *Solenopotes capillatus:* short broad head
- *Linognathus setosus:* dog sucking Louse

Haematopinus eurysternus on skin (9)

Haematopinus eurysternus on skin (9)

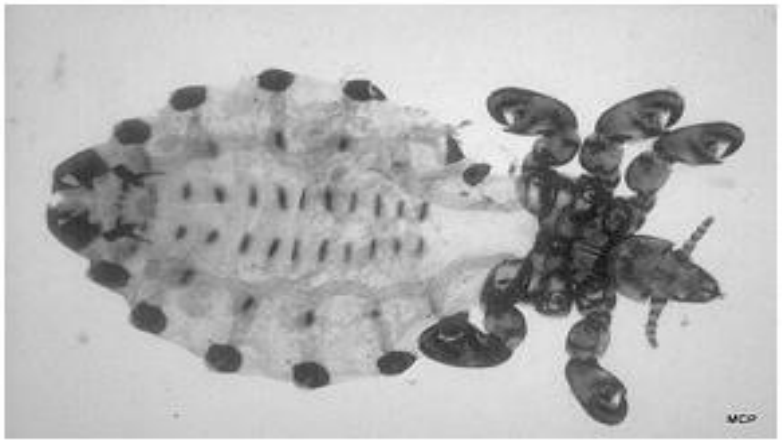
Mallphaga:

- *Bovicola bovis*: cattle biting Louse
- *B. caprae:* goat biting louse
- *B. equi:* Horse biting louse
- *B. ovis:* Sheep biting louse
- *Heterodoxus spiniger:* dog biting louse
- *Menopon gallinae:* Shaft louse (Domestic fowl)
- *Mencanthus stramineus:* Chicken body louse
- *Lipeurus caponis:* Wing louse (Domestic fowl)
- *Trichodectes canis:* dog biting Louse

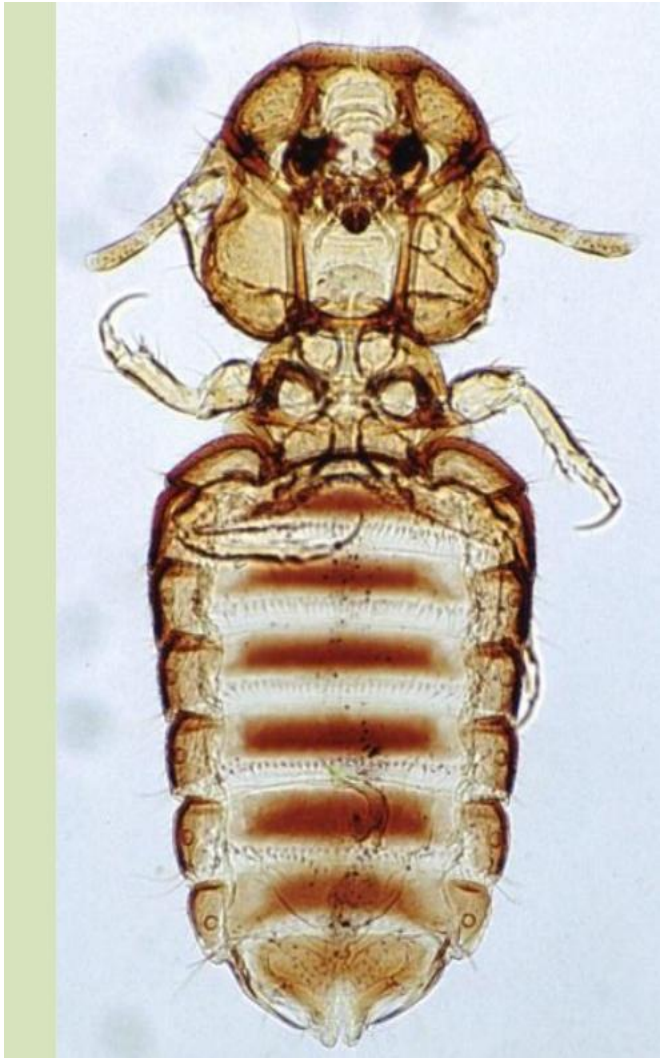
Lice---

Affected animals	Sucking lice	Biting lice
• Cattle	*Linognathus vituli,* *Haematopinus eurysternus*	*Damalinia bovis*
• Sheep	*Linognathus pedalis, L. ovillus*	*Damalinia ovis*
• Goats	*Linognathus stenopsis*	*Damalinia caprae*
• Pigs	*Haematopinus suis*	-
• Horses	*Haematopinus asini*	*Damalinia equi*

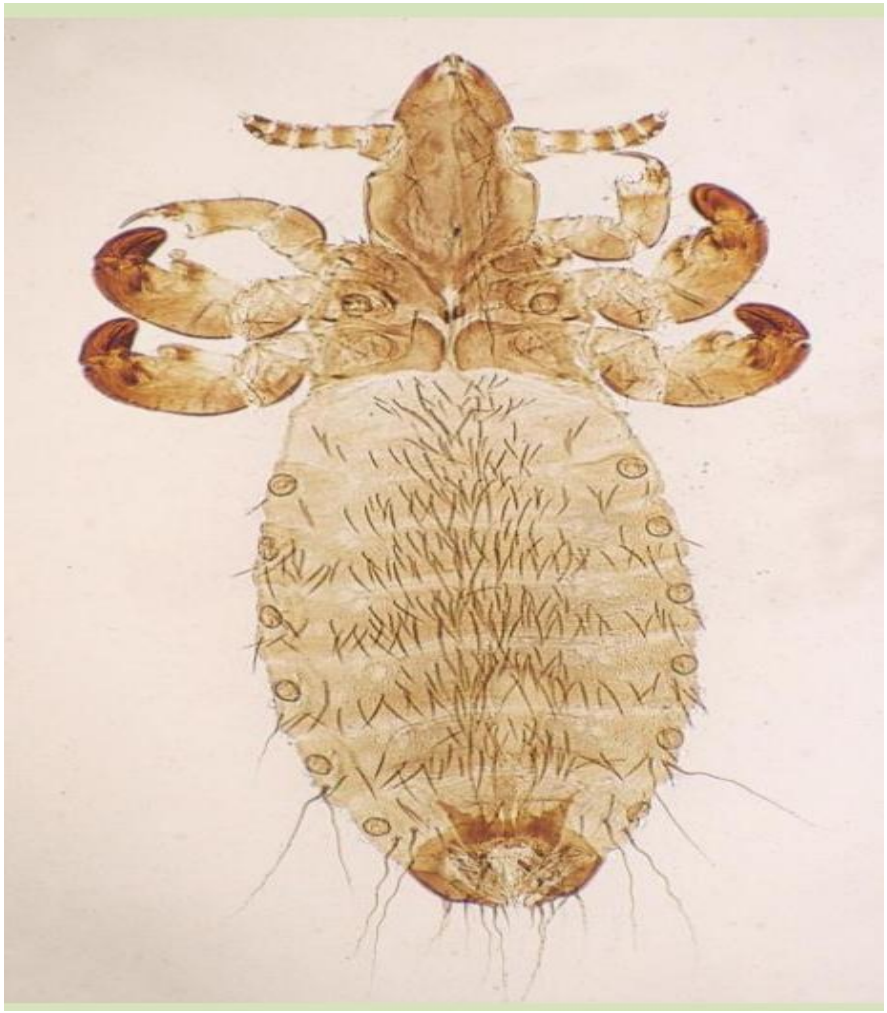
Figure 5.2
Short-nosed cattle louse, Haematopinus eurysternus.



A chewing louse of cattle, *Bovicola bovis*



A sucking louse of cattle, *Linognathus vituli*



Lice---

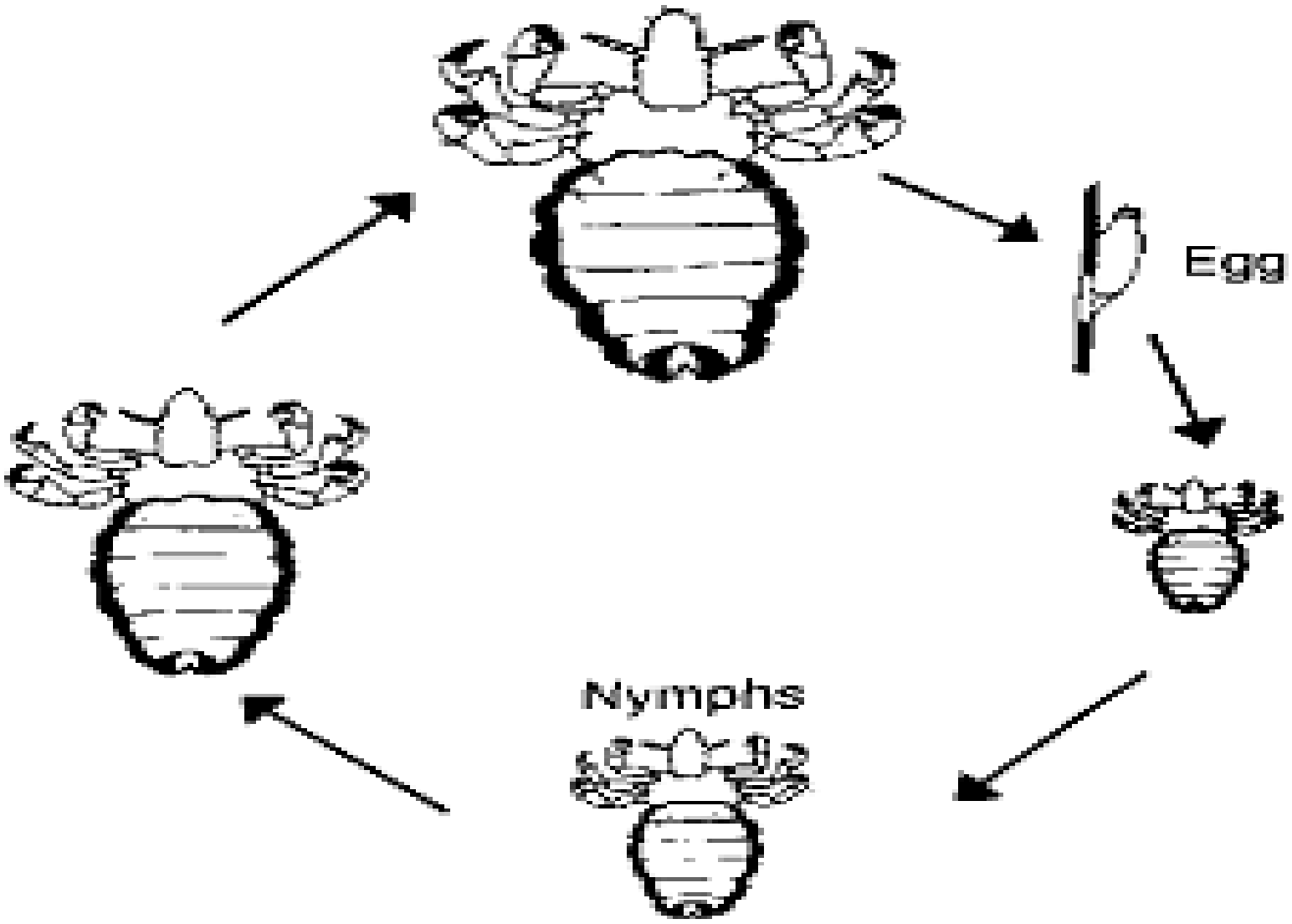
Life cycle.

- The entire life is spent on the host.
- Adult female chewing and sucking lice lay individual eggs, called **nits**, and cement these to hair shafts.
- Lice have **hemimetabolous** life cycle, having egg, nymph, and adult stages.
  - ✓ There are three nymphal stages.
- Female lice **glue their eggs onto the hair shafts** of their mammalian hosts.
- A **nymph**, which closely **resembles the adult**, hatches from an egg and its size increases through a succession of nymphal moults until the adult stage is reached.
- **Nymphs** are **smaller** and **lack genitalia**
- Adult stages of most lice can live **~30 days**
- Mating occurs on the host.
- A few species of chewing lice in the genus ***Bovicola*** are **parthenogenetic.**
- The **entire life cycle** takes approximately **4-6 weeks**.

❖ **Host associations**:

- Lice cannot survive more than a few hours away from their host.
- Lice are intimate ectoparasites live **permanently** in the host pelage.

Louse life cycle



Lice---

Pathologenic significance

- Transfer of lice between animals or herds is usually by direct physical contact.
- They cause **direct damage** to the skin of affected animals: cause anemia, **dermatitis**, **pruritis** (itching), **allergic reactions**, alopecia (fur loss), and **scaly skin**,
  - ✓ **sucking lice** can cause **anaemia**.
  - ✓ The dog chewing louse, ***Trichodectes canis***, can also act as an **intermediate host** for the tapeworm ***Dipylidum caninum***.
- **fur/hide damage** from intense **grooming responses** (scratching, biting, and licking)
- **secondary infections** at bite sites,
- Lice serve as **vectors** of pathogens and as **intermediate hosts** of parasites

Diagnosis:

- **close inspection** and detection of lice or their eggs (nits) within the hair coat.
  - ✓ presence of **eggs** or "nits" on the hair, or **adult** lice within the hair coat
  - ✓ The **lice** are present **next to the skin** and the **eggs** are scattered like coarse powder **throughout the hair**.
- skin combing or brushing for searching lice
- Infested animals can be **restless**, **bad tempered** and show **excessive itching** and **rubbing**.
- Heavy infestation may cause **eczema** with **crusts and alopecia**.

Treatment: insecticides- diazinon, malathion, Avermectins, etc.

Control

- maintaining animals in **uncrowded conditions** to prevent the rapid spread of lice
- **shearing wool** from sheep prevents host grooming responses
- **Insecticide** applications

Public health concerns Lice

- **zoonotic importance:** ***Trichodectes canis,*** the dog chewing louse, is an **intermediate host** of ***Dipylidium caninum*;**
  - ✓ if i**nfected lice** are ingested (by children playing with dogs, etc.), this helminth can parasitize humans.
- Humans are parasitized by the following three host specific lice, none of which characteristically parasitize any other host species:

✓ *Pediculus humanus humanus:* the body louse,

✓ *Pediculus humanus capitis:* the head louse, and

✓ *Pthirus pubis:* the pubic louse,

❖ **Lice** are conveniently divided into **two functional groups**:

- ✓ **chewing** lice and **sucking** lice.
- ✓ Chewing lice feed on skin and hair, while
- ✓ sucking lice have piercing mouthparts and feed on blood.

External parasites

❖ External parasites are important because:

- They may cause cutaneous lesions
- They can induce immunopathological responses
- They can transmit pathogens
- They may be zoonotic or transmit zoonotic infections
- They may interfere with the human – animal bond
- Their control is part of maintaining healthy pets

Principles of Arthropod Management

The **primary reasons for pest control activities** in veterinary entomology are to:

- **reduce or prevent** losses of food and fiber;
- **maintain healthy** livestock, poultry, and companion animals; and
- **reduce insects** associated with **animal production practices** as a source for public nuisance.

In carrying out any **successful control program**, certain principles need to be followed:

- **Correct identification** should be made of the **pest species** involved.
- A basic understanding of the **biology, lifecycle**, and **habits** of the pest in order to assess at which **vulnerable stage** or stages of the pest direct control efforts should be applied.
- An assessment should be made of the **magnitude of damage** done by the pest.
  - ✓ For determining the economic threshold level of the pest for deciding **when control action** should be taken.
- **Estimates** should be made as to the **amount that can be spent profitably** in reducing the damage caused by the pest.
- **Determination** then needs to be made on the execution of the **most efficient approach to controlling the pest**.
- **Effective control** must be economically sound for both immediate results and long-term effects.

Principles of Arthropod Management---

- The **goal of a sound pest control program** in veterinary entomology is to strive for an **integrated approach** to reduce pest populations below the economic threshold level.
- So, various control components (**biological, cultural, chemical, mechani-cal)** are utilized in harmony to:
  - ✓ **maximize profitability** and
  - ✓ minimize environmental impact.
  - ✓ It is the **selection** of and **integration** of arthropod **control methods** on the basis of anticipated **economic, ecological,** and **sociological consequences**.
- **Consequences of sound integrated pest management programs** in animal production include several benefits:

✓ Safer and more effective pesticides and control techniques are utilized.

✓ There is resultant less pollution caused by indiscriminate pesticide usage.

✓ More, **cheaper, higher quality**, and **efficiently produced meat,** poultry, and dairy products are made available for the consumer with less potential chemical contamination.

✓ A **reduction in veterinary services** and **expenses** is realized. And,

✓ overall, there are **healthier livestock, poultry**, and companion animals.

Principles of Arthropod Management---

- There are various **tools and methods** that make up **integrated pest management** programs for animals:
  - ✓ Start with **proper surveillance techniques** for assessing pest population levels present and damage done.
  - ✓ establish the **extent of pest infestation** and **damage levels** in animals.
  - ✓ **Surveillance efforts** are made to:
    - **identify species** of arthropods present,
    - assess their **distribution**,
    - establish **host associations**, and
    - determine **pest population densities** at specific **times** and **locations**.
- **Surveillance** will range from arthropod:

✓ trapping methods,

✓use of insect nets,

✓direct animal examinations, and even

✓observation of animal behavior in reaction to arthropod attack.

- various **methods** of carrying out pest management include:
  - ✓ cultural, mechanical, physical, biological, chemical, genetic, and regulatory methods

Principles of Arthropod Management---

❖ Cultural Methods

- Proper cultural practices in animal production can serve **not only to reduce** actual pest populations but to **minimize situations** where pest species can **reproduce**.
  - ✓ **waste management practices** can effectively **reduce fly breeding** and **fly activity** *(Musca domestica* and *Stomoxys calcitrans)*

1. Regular waste removal and **keeping moisture levels down** can prevent major concerns for nuisance fly populations:

- ✓ preventing **water leaks**,
- ✓ **designing proper floor grade** to allow adequate **moisture drainage**,
- ✓ **providing adequate ventilation** for waste drying and animal comfort,
- ✓ **avoiding high temperatures** to **reduce animal need** for excessive water intake, and
- ✓ using absorbent litter where feasible.

2. **timely rotate pasture grazed** livestock from one pasture to another
3. **proper timing of calving** to minimize attack by flies and
4. proper timing of **dehorning, castration,** and **wool shearing** practices to prevent fly **attack of wounds**.
5. **Proper outdoor water management** practice to reduce mosquito breeding and the incidence of horse flies, deer flies, black flies, and other blood-feeding aquatic insects prevalent during warmer weather months

Thursday, April, 23/2020

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THANK YOU!!!