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Myiasis causing flies

By:

Zewdu Seyoum(DVM, MSc, MTAH)

<http://www.uog.edu.et>



Learning objectives

- At the end of this lesson students will be able to:
 - ✓ explain what mean by myiasis
 - ✓ identify those flies/larvae that cause myiasis
 - ✓ explain their pathogenic and economic significances
 - ✓ design treatment, control and prevention techniques of myiasis



Myiasis

- Is the **infestation** of living organs and tissues of host animals by the **larvae of dipteran flies**, usually known as **maggots or grubs**
- The fly **larvae feed** directly upon the **host's living or dead/necrotic tissue** or, in the case of **intestinal myiasis**, on the **host's ingested food** for at least a period
- **Host:** mammals, birds, amphibians or reptiles



Myiasis

- **Myiasis:** could be classified into different groups based on:
 - ✓ **Anatomical localization/site of infestation:** in or on the animal
 - ✓ **Host-parasite relationship:** biological interest
- Based on anatomical/site of infestation, it could be:
 - ✓ **cutaneous/dermal** or **sub-dermal**(example: *Lucilia*)
 - ✓ **nasal:** e.g., *Oestrus* in nasal
 - ✓ **somatic:** e.g., *Hypoderma*

Myiasis

- Based on host-parasite relationship, it could be:
 - ✓ **Facultative/optional:** e.g., Calliphorids
 - ✓ **Obligatory/strict parasite:** e.g., Oestridis
 - ✓ **Accidental:** e.g., Muscids- *Musca* group
- **Accidental or Pseudomyiasis:**
 - invade inappropriate host by chance
 - insects in the family Muscidae
 - **Larval stage** is the problem stage
 - enteric, accidental, rectal, and urinary



Types of Myiasis

- **Facultative:**
 - Can develop in both **living and dead organic matter**
 - maggots are free-living, but can become parasitic
 - attack carcasses, may attack living host
- **Obligatory:** must have **living** host to complete their development
 - maggots live on a live host for part of their life
 - are always parasitic; unable to survive without living host



Life cycle of myiasis producing flies

- **Complex metamorphosis** with egg, larval stages (instars), pupa, and adults;
- **Separate sexes:** with adult females laying eggs or larvae on host or in environment;
- Larvae hatch from eggs; three larval stages (maggots);
- Third larval stage pupates with adults emerging from pupae.



Myiasis Producing Flies

- Three families of flies are involved in myiasis occurrence:
 1. Calliphoridae
 2. Oestridae
 3. Sarcophagidae



Family of Oestridae

- Contains flies commonly known as **bots** and **warble**
- Are **obligate** parasites
- most show a high degree of **host specificity**
- Adult flies: are **large**, usually **hairy**, have **primitive non-functional mouthparts** and **short lived**
- Larvae: **highly host** and **site specific**, and obligatory parasites
 - ✓ spend considerable time: in feeding and developing in their host



Family of Oestridae

- develop in the **nasopharyngeal cavities or skin boils(warbles)** of mammals
- include four important genera:
 - ✓ Hypoderma
 - ✓ Oestrus
 - ✓ Gastrophilus
 - ✓ Dermatobia



Hypoderma: warble flies/cattle grubs

- Larvae live as **subcutaneous parasites**; **are relatively host-specific**
- **Host**: primarily cattle and sometimes equines, sheep, man
- **Species**: *Hypoderma bovis* and *H. lineatum*: affect cattle
- **Life cycle**: egg → maggot (L1 → L2 → L3) → pupa (on leaves)
→ adult: **complete metamorphosis**
- **Distribution**: WW

Morphology

1. Adults: *H. bovis* and *H. lineatum*

- **Body:** is covered with **dense yellow-orange hairs** with a broad **band of black hairs** around the middle
- **Mouthparts:** non-functional or vestigial



Adult *Hypoderma* fly or warble fly

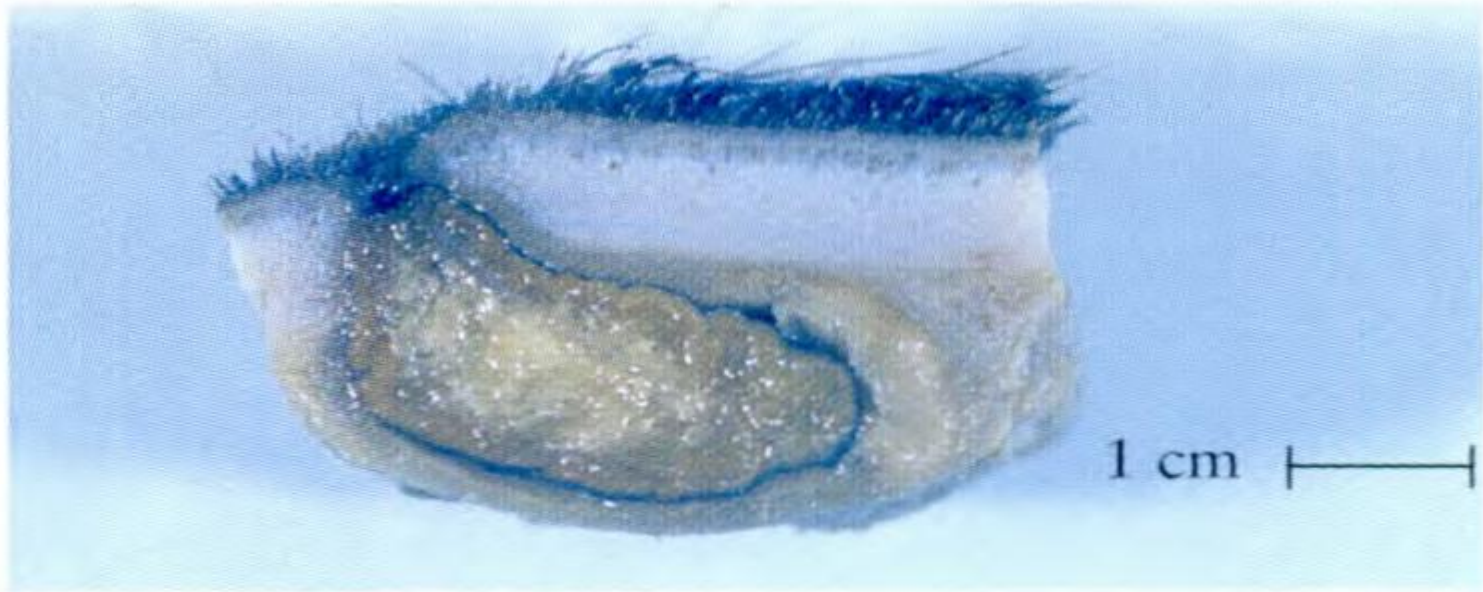


Morphology

2. Larvae: mature/third stage larvae:

- ✓ are **thick** and somewhat **barrel shaped**, tapering anteriorly
- ✓ have **hooks** and **posterior spiracle plate** that completely surrounded by **small spines**
- ✓ **Segmented**: most segments bear **short spines**
- ✓ **Colour**: **dirty white** when newly emerged from host; then turns to **dark brown**

Larvae of warble fly in skin section



Newly emerged larvae



Life cycle

- **Adult females:** deposit their eggs on **hairs of the lower regions of the legs** and lower parts of the body;
- Eggs hatch and release **L1** → then the larvae crawl down the hairs and enter into skin or hair follicles → then migrate through connective tissue towards the region of the diaphragm by the aid of a **pair of mouth hooks** and **secretion of proteolytic enzymes** ;

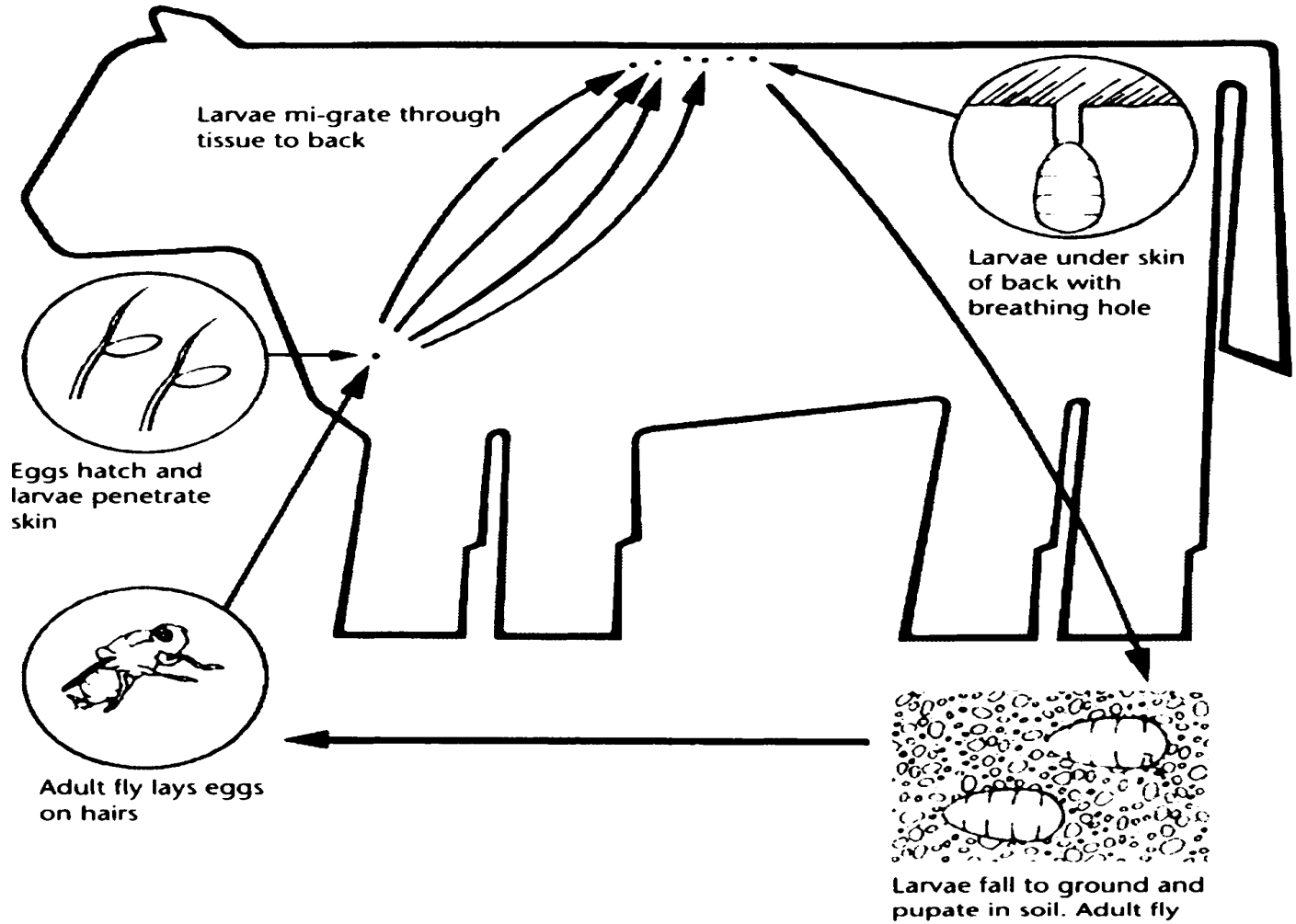


Life cycle

- The L1 feed as they travel to the **resting sites: wall of oesophagus and epidural fat in the spinal canal** → here L1 moult in to **L2** → L2 then migrate to **underneath of skin of the back** → here L2 moult to L3, which cause **swellings('warbles') of skin** → L3 then make **cutaneous opening for breathing activities by inserting its spiracles into opening** → after 4-6 weeks L3 emerge and fall to the ground → then the larvae pupate → adults emerge



Life cycle of *Hypoderma* species



Pathogenic significances

- **Economic loss:** down-grading values and condemnation of hides perforated by larvae, reduction of milk yield and weight gain
- Migratory behavior of larvae via tissue causes yellow or greenish, gelatinous, oedematous areas due to eosinophils infiltration: known as 'butchers jelly'
- **Reduced carcass value:** due to tissue inflammation

Pathogenic significances

- **Hypersensitivity reaction**: may cause **anaphylactic shock** particularly if the **larvae die in the animal tissue**
- Egg laying activity of the fly produces **self buzzing noise**: results in **avoidance behavior** of the host known as 'gadding' or panic or running away aimlessly to escape



Pathogenic significances

- **Gadding behavior**: resulting in **self-inflicted wounding**: since animals injure themselves on posts, barbed wire and other obstacles
- **Flies noisy behavior**: also results in **animal feeding interruption**: results in **spontaneous abortion, retarded growth, reduced milk yield and reduced weight gains**



Clinical signs and diagnosis

- **Signs:** nodular lesion on back area; running away aimlessly
- **Diagnosis:** clinical signs: larvae in cysts or lumps under skin of the back indicate warble infestation; eggs may be found on hair of the animal's legs



Nodules on the back due to Hypoderma larvae



Treatment, Control and Prevention

- **Mechanical removal of 3rd stage larvae:** mature larvae may be squeezed out of the warble swelling
- **Insecticide treatment:** Use active organophosphorous and ivermectin systemically
- **Local fly eradication:** SIT, chemicals
- **Use vaccine**
- **Integrated management:** SIT, insecticide,



Oestrus ovis

- Commonly known as ‘nasal bots’;
- **Larvae:** are **obligate parasites**; spend their **parasitic period** in the **air passage of hosts:** nasal passages, frontal and nasal sinuses;
- Have high degree of **host and site specificity**;
- have **posterior spiracular plate** with numerous **small pores**
- **Adult flies:** have **non-functional mouthparts**, and are **viviparous** (lay larvae: L1)



Oestrus ovis

- **Host:** sheep, goat, rarely human beings
- **Site:** nasal passages and nasal sinuses
- **Species:** *Oestrus ovis*: have veterinary significance
- **Distribution:** WW



Morphology

1. Adults flies:

- ✓ **Body:** greyish-brown, with many **small black spots** on the **thorax** and **abdomen**
- ✓ **Head:** broad, with small eyes
- ✓ **Mouthparts:** reduced to small knobs: nonfunctional

Morphology

2. Mature larvae: L3

- ✓ Found in **nasal passages**
- ✓ **Colour:** yellow-white, tapering anteriorly
- ✓ **Segmented:** each segment has a dark transverse band dorsally
- ✓ Ventral surface of each segment bears a **row of small spines**

Adult *Oestrus ovis*



Oestrus ovis: larva in the sinus



Oestrus ovis larvae



Larvae that penetrate into the gingival sulcus



Life cycle

- ✓ Undergo **complete metamorphosis**
- ✓ Female flies are **viviparous**, depositing/squirting a jet of liquid containing **first-stage larvae** at the nostrils at a time in or on the nostrils of the host, during the hottest part of the day when flies fly
- ✓ Then the larvae crawl up the **nasal cavity to nasal sinuses** and attach to the **mucous membranes with its hooks; feeding on mucus**: this secretion is stimulated by their movement

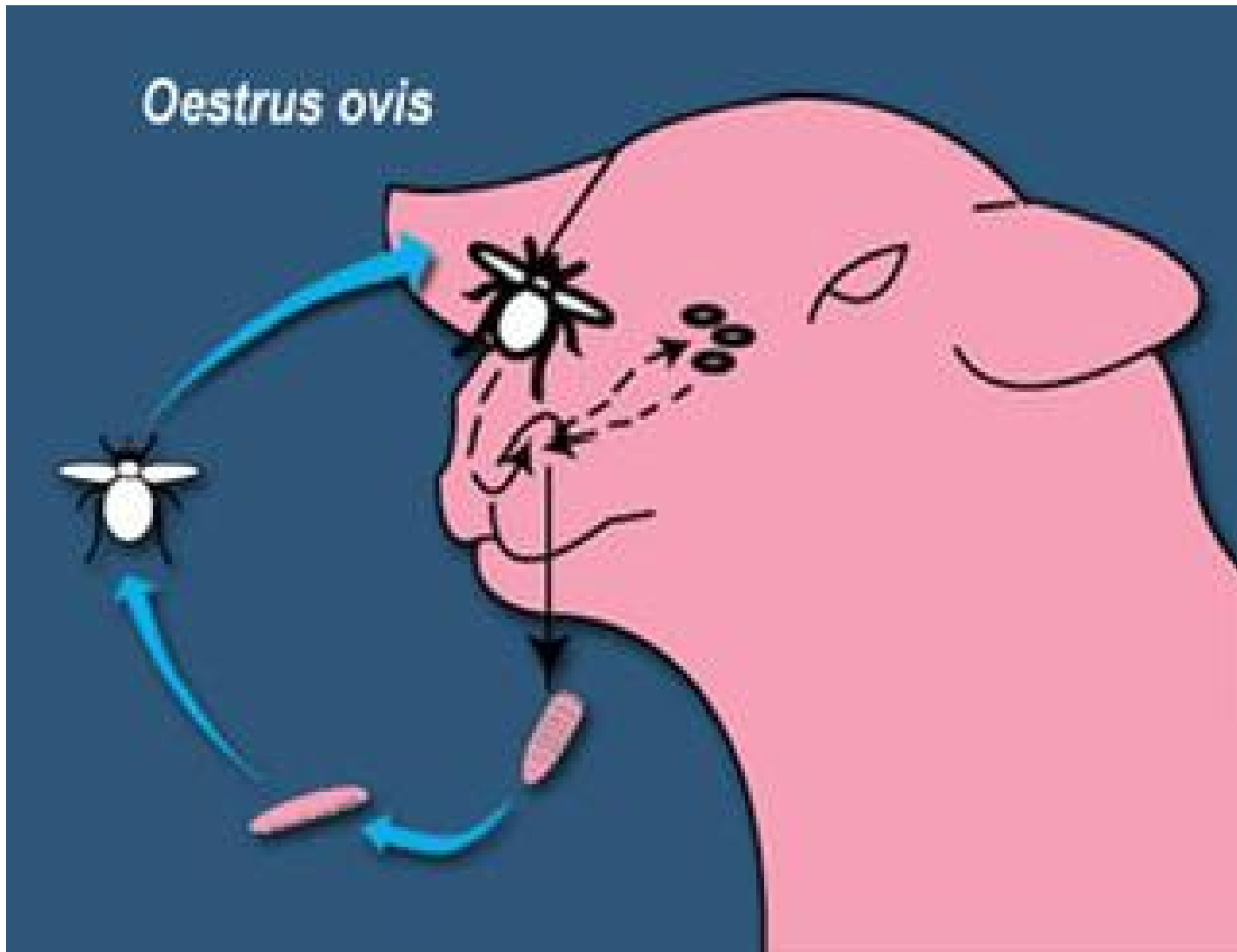


Live cycle

- Then the larvae enter the **frontal sinuses** where they develop into **2nd and dark brown third-stage larvae**
- Subsequently, the third-stage larvae crawl out of the **nostrils** or are **sneezed out by the host; pupate** in the ground; **adults** emerge 3–6 weeks later



Life cycle of *Oe. ovis*



Pathogenic significances

- **Adults flies**: egg laying activity can be lead to considerable **disturbance and panic in a flock**
- **As adult flies deposit larvae**: the activity of adult flies may **annoy or panic sheep**: stamp their feet, bunch together and press their nostrils into each others' fleeces and against the ground: leading to a **loss of grazing time, reduced weight gain, loss of condition**
- Most infections are **light**: sheep showing **nasal discharge, sneezing. and rubbing their noses on fixed objects**



Pathogenic significances

- **Heavy infections**: unthriftiness and sheep may **circle** and show **in coordination**: often termed as '**false gid**'
- **Dead larvae in the sinuses**: allergic and inflammatory responses: sneezing and 2^ory bacterial infection: cerebral involvement
- Larvae cause **irritation and excessive secretion**: oral hooks and spines effect
- Larvae cause **purulent rhinitis or sinusitis** leading to head shaking, restlessness, snorting or sneezing



Clinical signs

- mild discomfort, nasal discharge, sneezing, nose rubbing or head shaking, circling, in coordination, head pressing
- Decreased appetite, restlessness, weight loss, fly worry
- **Impaired respiration:** by larvae and the thickening of the nasal mucosa
- Larvae may penetrate nasal plate and subsequently enter the brain: causing injury, ataxia, circling/stagger and head pressing

Nasal discharge due to *Oe. ovis* infestation



Diagnosis

- **Clinical signs:** sneezing and nasal discharges; CNS disorders: restlessness, false gid, head shaking; season, keeping their muzzle near to the ground
- **Observation:** of dark brown larvae dropping out of nostrils after severe sneezing attack
- **Postmortem examination:** by sawing skull and separate it in to half part longitudinally, then rinsing key areas with water: examine the water for larvae with lens

Management

- In heavy infection: use nitroxylnil, tricleabendazole, rafxanide and ivermectin are highly effective as are the organophosphates, trichlorfon and dichlorvos
- **Strategic treatment:** at the beginning of summer to kill newly deposited larvae and midwinter to kill overwintering larvae
- Fly repellent as prophylaxis



Gasterophilus: bot flies

- **Learning objectives:** at the end of this lesson students will be able:
 - ✓ illustrate their morphology
 - ✓ identify and distinguish them using their morphology
 - ✓ describe their life cycle and factors that influence breeding and survival of them
 - ✓ explain their pathological effect and economic significance
 - ✓ design their control and prevention mechanisms



General features

- Are commonly referred to as '**bot flies**': **horse stomach bot**
- Are **obligate parasites** of horses, donkeys, mules, zebras, elephants and rhinoceroses
- **Larvae, termed 'bots'**: spend most of their time developing in the **stomach of equines**, but they are generally considered of **little pathogenic significance**



General features

- **Host:** horses, donkeys, mules, zebras, elephants and rhinoceroses
- **Major species:** *G. intestinalis*, *G. nasalis*, *G. haemorrhoidalis*
- **Distribution:** WW



Morphology

- Adult bot flies:
 - ✓ resemble to honey bee with a **long curved ovipositor** carried beneath the abdomen
 - ✓ have **non functional** mouthparts
 - ✓ are **robust dark/brown flies**; about 1-2cm long
 - ✓ Body: is densely covered with **yellowish hairs**
 - ✓ Wings: in most common species, there are **transverse bands** or **dark patches**; have **no cross-venation**

Gasterophilus species: adult fly



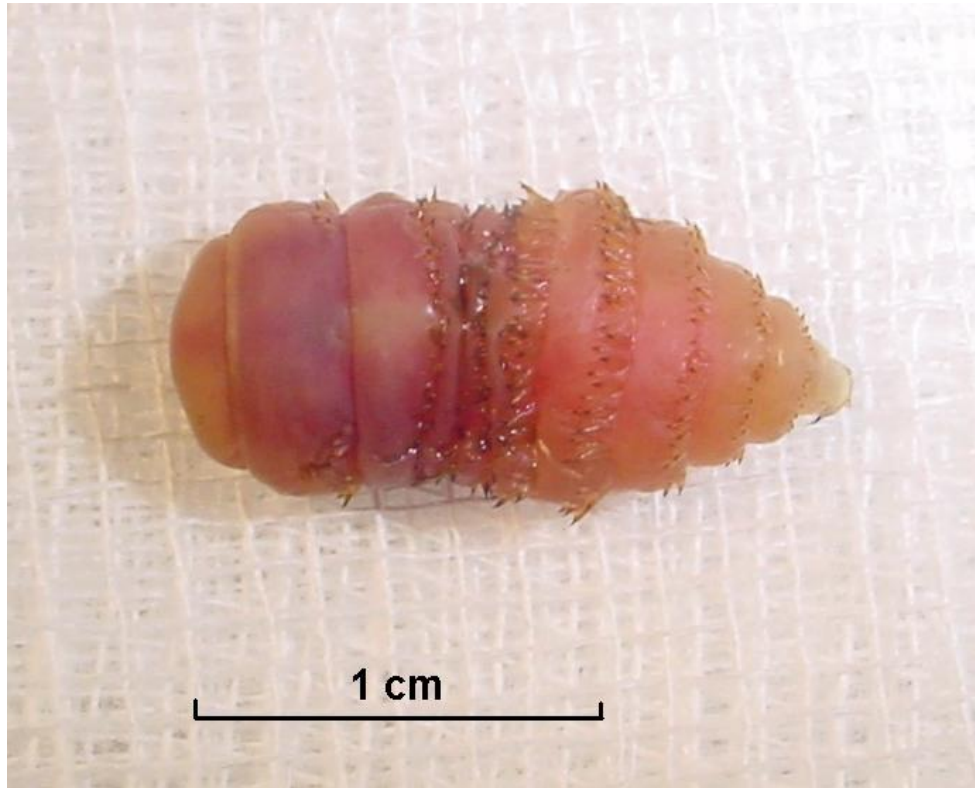
Adult flies of *Gastrophilus*



Morphology

- **Mature /third stage larvae:**
 - ✓ present in the **stomach or passed in faeces** :
 - ✓ are cylindrical, 1.6-2cm long and feed on tissue not on blood
 - ✓ **reddish-orange** with posterior spiracles
 - ✓ segmented: bears spines

Larvae of *Gastrophilus*



Life cycle

- Undergo **complete metamorphosis**
- Females deposit eggs on hairs of legs or face of horses.
- After hatching, larvae enter through the mouth and spend a period of development on the tongue and gums before moving to the stomach.
- After a period of 8–11 months in the stomach, bots pass out in the feces and pupate on the ground.



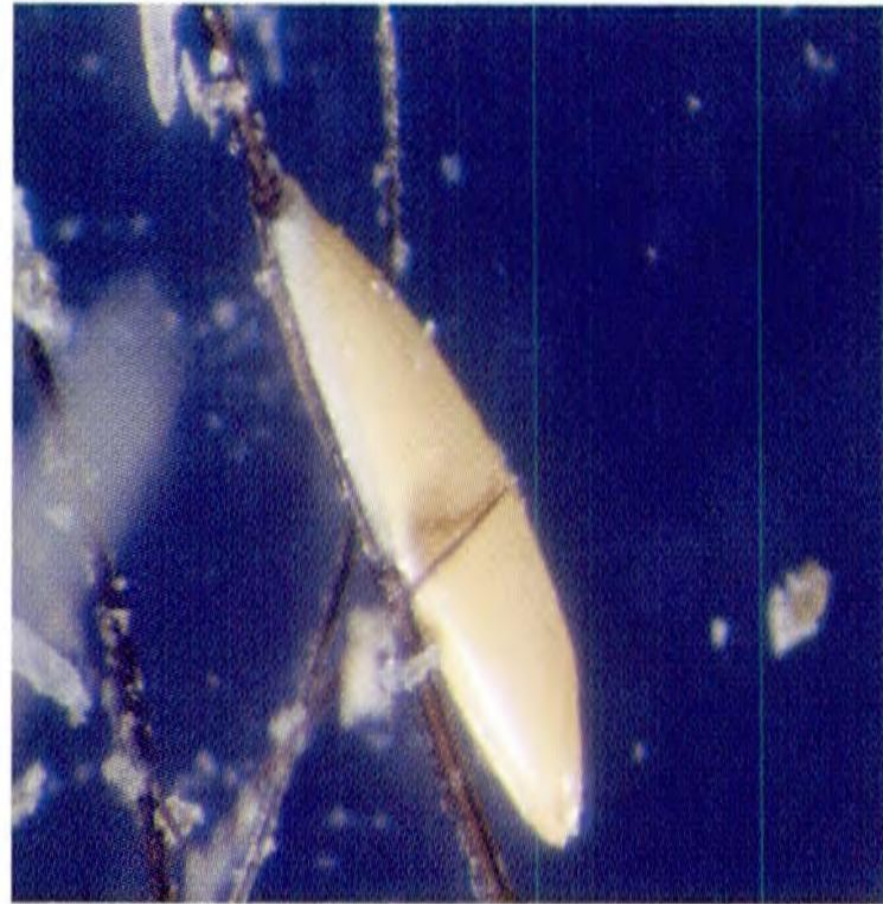
Eggs that glued on the hairs of horse



Horse bot eggs deposited on the skin of the legs and chest



Eggs attach to hair; larvae to gastric mucosa



Gastrophilus larvae that attach to the mucosa of horse

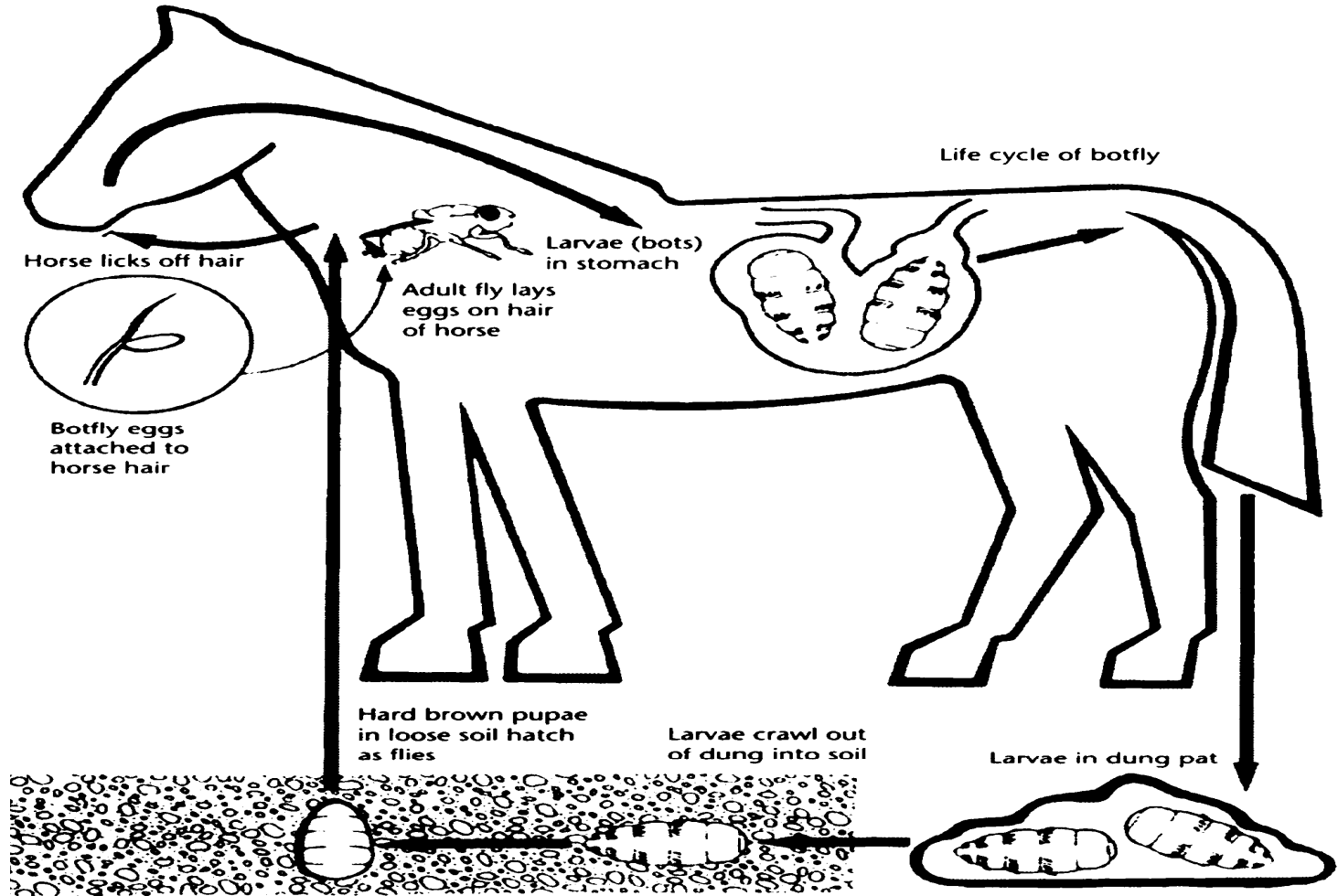


Horse stomach bots



FIGURE 16.37 Common horse stomach bot, *Gasterophilus intestinalis* (Oestridae, Gasterophilinae); larvae attached to mucosa and inner surface of stomach of heavily infested horse. (Photo by Martin Hall, © The Natural History Museum.)

Life cycle of horse bot fly



Pathogenic significances

- Induce **great annoyance or panic to horses** when adults approach horses to lay their eggs
- **Bots(larvae)**: may cause **obstruction to the food passing from the stomach to intestine,**
- **Irritation by the larvae during migration**: dermatitis, inflammation of the pharynx, oesophagus, stomach or rectum(rectal prolapse)



Pathogenic significances

- **Larvae penetration with its hooks** at the site of attachment: may result in **stomatitis with ulceration of the tongue, erosions, ulcers, nodular mucosal proliferation, stomach perforation, gastric abscesses, peritonitis: inflammatory reactions**
- **Heavy infections:** can cause **general debilitation** and even **rectal prolapse**
- Light infections are tolerable well



Clinical signs and diagnosis

- **Signs:** mild gastritis, stomatitis, pain on eating , annoyance
- **Diagnosis:** difficult, so it could be made by demonstration of larvae in the faeces; observation of the cream-white bot eggs on the animal's hair



Management

- **Insecticide application:** carbon disulphide and trichlorfon; the broad spectrum insecticide/anthelmintics
- **Dichlorvos and ivermectin** are also very effective against bots
- **Fly repellent and frequent grooming**
- **Integrated management:** stimulate the eggs on the hair coat with warm water containing insecticides during summer and autumn; strategic treatment

Family Calliphoridae

- Are medium to large flies
- Almost all have a **metallic-blue or green sheen**
- Majority of the species are **saprophages**: living in decaying organic material
- Important genera that cause myiasis under this family include:
 - ✓ *Cochliomyia*, *Lucilia* and *Cordylobia*



Life cycle

- All are **oviparous** and except *Cordylobia* species, eggs are laid in **wounded, infected or faecally soiled skin of warm blooded vertebrate hosts**
- Larvae pass through **three instars** while feeding on the **host tissues,**
- causes **cutaneous or traumatic myiasis**
- Mature larvae drop on the ground and pupate in substrate → adult emerge

Cochliomyia: Screw worm

- Are **green to violet /bluish-green** blowflies with **three prominent black, longitudinal stripes on the thorax, short palps and orange-brown eyes**
- Are **obligate** ectoparasite
- Infest almost **all warm blooded** livestock, wildlife and humans
- Important species: *C. hominivorax* and *C. macellaria*



Cochliomyia: Screw worm

- **Host:** wild and domestic animals and humans;
- occur primarily in tropical areas;
- lay their eggs **on wounds**;
- Larvae characteristically feed as a **colony** and **penetrate** the tissues; creating a **large and foul-smelling lesion**.



Morphology

- **Adult fly:**

- ✓ **Colour:** deep greenish-blue metallic with a yellow, orange or reddish face and **three dark stripes** on the dorsal surface of thorax between the wings

- **Larvae:**

- ✓ tapered
- ✓ **segmented:** swollen ridges encircle each segments: hence the larvae look somewhat like **screws**



Cochliomyia homnivorax, the New World screw-worm fly.

Chrysomia putoria, one of the Old World screw-worm fly.

Cochliomyia homnivorax, la lucilie bouchère du Nouveau Monde.

Chrysomia putoria une des lucilies bouchères de l'Ancien Monde.

Larvae and adult fly of *Cochliomyia*



Larvae of Screw worm



Life cycle

- Undergo **complete metamorphosis**
- Female flies lay eggs on the **skin of the host near open wounds**: scratches, sores, barbed wire cuts, scabs, injuries from brand marks, dehorning/castration
- Eggs then hatched and release larvae/maggots
- Larvae start to **feed invasively on secretions and living tissue**
- **Following completion of development, larvae fall to the ground and pupate in soil** and adult emerge after 7-12 days



Pathogenic effects

- If untreated, repeated infestations may quickly lead to the **death of the host**
- **Economic loss**: use of insecticide, damage and disfigurement of skin
- Putrefied smelling discharges and ulcerations
- Treatment should be immediate
- Irrigate infested areas with ethanol + veggie oil
- May require surgery



Clinical signs

- Ragged, foul-smelling lesion containing larvae (maggots)
- Constant licking of the lesion by the animal
- Secondary infections and strikes are common
- Fever
- Lethargy and loss of appetite
- Debilitation
- Decreased growth rate
- Mortality rate in newborn calves from navel strike may be as high as 30-50%



Management

- Use insecticide: spraying or dipping livestock with coumaphous against the larvae
- Ivermectin
- Eradication: SIT



Blow flies: *Lucilia*

- Cause **cutaneous myiasis** and are **scavenger on dead animals**, decaying vegetable matter or garbage
- Important species: *L. sericata* and *L. cuprina*
- Are **facultative ectoparasites**: strike living wild and farm animals (sheep) that **have sores or wounds or are soiled with manure**
- Larvae infest and feed **on living tissues of warm blooded vertebrates**: sheep



Blow flies: *Lucilia*

- Infestation by these species known as **blowfly strike**
- **Host:** mainly sheep(mainly **diarrheic sheep**), sometimes wild and domestic animals and humans
- **Distribution:** WW

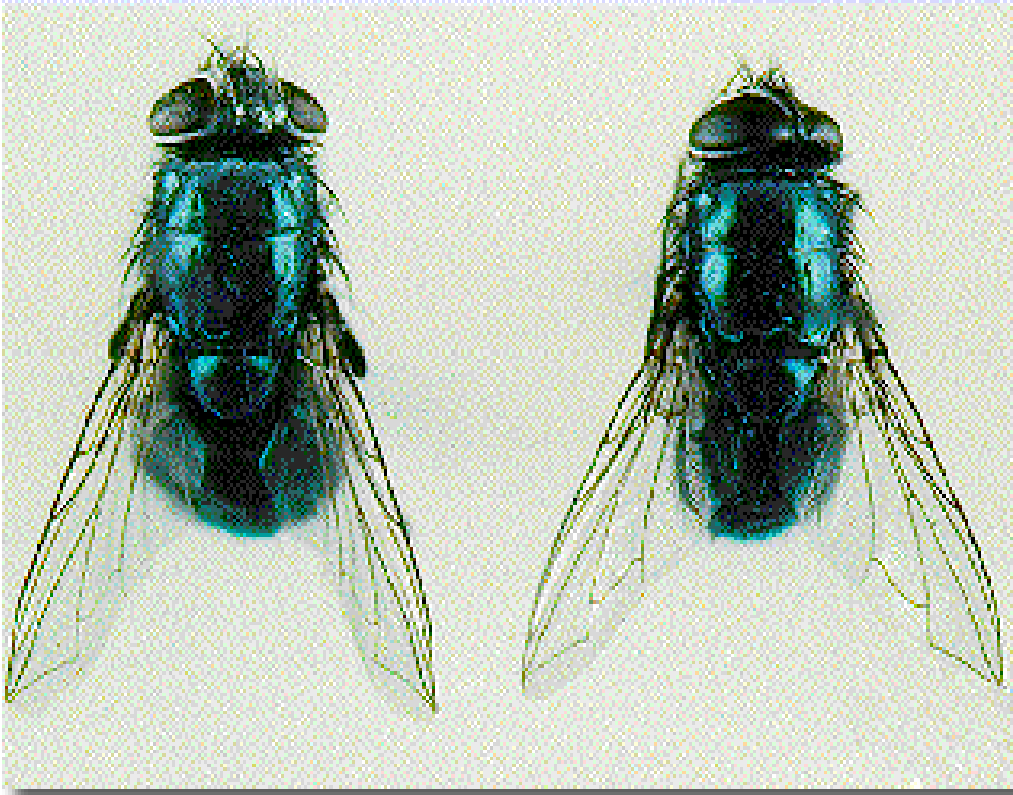


Morphology

- **Adults:** - up to 1cm in length; have **black legs**
 - all have a **metallic blue or green sheen** on the body
- **Larvae:**
 - ✓ Are **white to yellowish, smooth, segmented** and **blunt at the rear and tapers towards the head**
 - ✓ possess a **pair of black oral hooks** for tearing flesh, **spiracles on the anterior segment**, and **stigmatic plates also bearing spiracles**



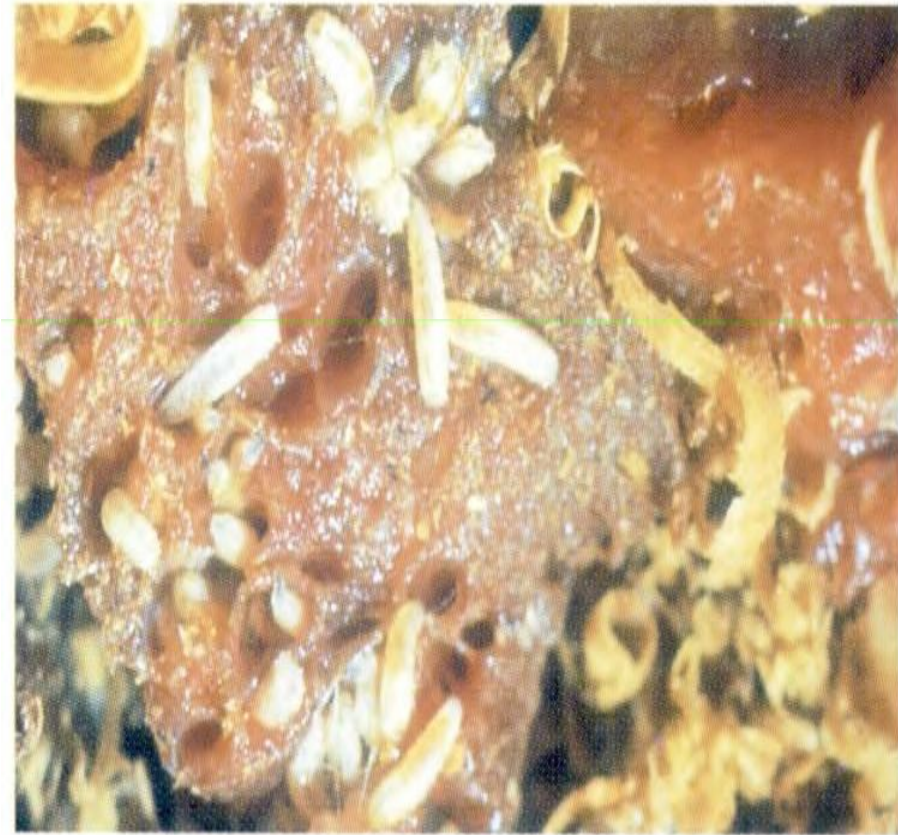
Colour of adult blow flies



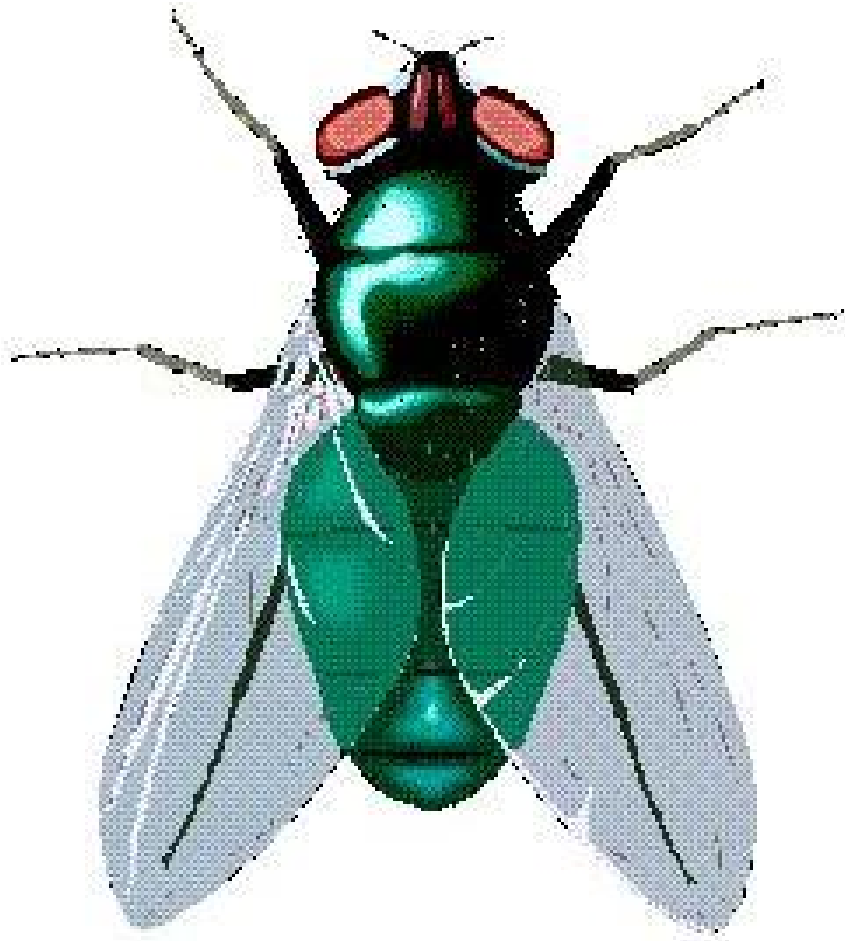
Lucillia(R) and *Calliphora*(L)



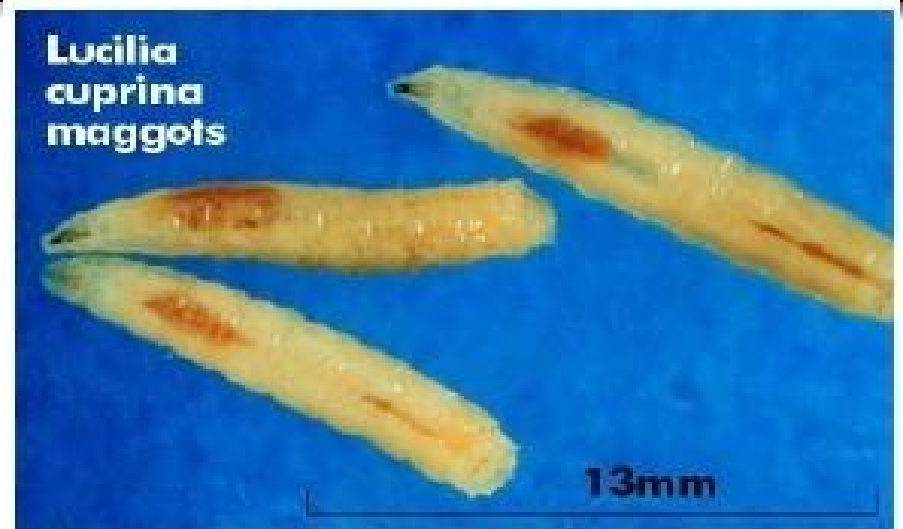
Lucilia species causing myiasis of skin wound; larvae in skin wounds



Colour of adult blow fly; Larvae of it in skin wound



Larvae of blow flies



Life cycle

- Undergo **complete metamorphosis**
- Gravid female flies lay **eggs on wounds, soiled fleece or dead animals**, being attracted by the **odour of the decomposing matter**
- Then the eggs hatch and release larvae
- The larvae **feed on necrotic tissue, grow rapidly** and **moult twice to become fully mature maggots** in 3-10days → then drop to the ground and pupate → adults emerge in 3-7days

Epidemiology

- Occurrence of cutaneous myiasis in sheep depends on:
 - ✓ **temperature; flock size; stock density, rainfall**
 - ✓ **host susceptibility:** if the host has got **putrefactive odours on the fleece due bacterial decomposition of organic matter**. It can be caused by **soiling of the hindquarters** due to **urine or diarrhoea** and injuries due to shearing, fighting or barbed wire
 - ✓ **Breed type:** example Merino sheep
 - ✓ **sex:** ram with narrow penile sheath



Pathogenic significances

- **Larvae lacerate skin with their oral hooks and proteolytic enzymes**, which digest and liquefy skin tissues
- **Secondary blow fly strikes**: can occur and are strongly associated with faecal soiling, bacterial dermatophilosis and bacterial fleece rot(superficial dermatitis)
- **Secondary bacterial infection** can happen
- **Extreme irritation and distress** can happen when larvae **crawl** over animals' skin or into wounds: extremely debilitating and sheep can rapidly lose condition

Clinical signs and diagnosis

- **Increase body temperature and respiratory rate; weight loss and anorexia**
- **Anaemia and suffer toxaemia; inflammatory reaction**
- Loss of fertility
- If untreated death
- **Diagnosis:** based on the clinical signs and recognition of maggots in the lesion

Management

- ✓ **Good management:** separate infected animals; avoid/clip hairs that surrounding the lesion; infested animals should be treated promptly
- ✓ Use **suitable insecticides**
- ✓ **Control:** prophylactic insecticide; sanitation or proper disposal of organic matters; worm management and wound management;
- ✓ **Buried dead animals and other organic matter** since blow flies can be attracted to dead animals
- ✓ **Avoid injury** during shearing, performing docking and castration



Sarcophagidae: flesh-flies

- Read morphology, lifecycle, pathogenic effects, management

