Insects of Veterinary Importance

Introduction:
Insects are six-legged arthropods that develop via simple or complete metamorphosis in a wide variety of ecological niches, including vertebrate animal tissue. A number of species require feeding upon vertebrate blood or tissue fluid to complete their life cycles, and some of these have evolved as more or less permanent ecto- or endoparasites of vertebrate animals, including domestic species. Insects, so evolved, have a profound impact on human and animal health as transmitters of pathogens (eg. arboviruses, malaria parasites, filariae), as agents of diseases of the skin and other tissues (eg. mange and flea allergy dermatitis) and as sources of blood loss, annoyance and accompanying loss of production in food animals and of well-being in companion animals.

Objectives:
This lab is designed to help you diagnose infestations with the major groups of insects of veterinary importance. In a few instances you may be asked to recognize a specimen on site, but in the majority of instances you should strive to learn the morphologies of the different groups to the extent that you can use the keys printed in the lab handout to make the identification.

Checklist of Objectives

Be able to recognize:

- the suborders of flies by antennal type (Nematocera, Brachycera, Cyclorrhapha)
- *Melophagus ovinus*
- Adult flies of the family Tabanidae
- Chewing lice and the two subgroups: Amblycera and Ischnocera
- Sucking lice

Using a pictorial key be able to:

- prepare posterior spiracles of muscoid fly larvae and make a genus diagnosis
- identify flea adults to species
At the Bench

1.) **Muscoid larva identification exercise.** Refer to Fig. 5 and locate the posterior end of one of the muscoid fly larvae provided in the dishes on the center bench. Use a scalpel blade to cut off a thin section, containing the spiracles, from the posterior end of a larva. The slice you make should be thin enough to transmit a little light but thick enough to include the posterior spiracles. Transfer the resulting slice, cut side down, to a microscope slide and view the spiracles with your compound scope. A coverslip is not necessary, and it may help to carefully blot excess fluid from the spiracular plate with the corner of a Kimwipe. Use the shapes of the spiracular slits, the overall shape of the peritreme and placement of the button relative to the other structures as diagnostic characters to identify the larva to genus using the key provided in Fig. 6.

Figure 5.
2.) **Flea identification:** The diagram below (Fig. 9) depicts the main landmarks of flea external morphology. The features indicated may be used to identify fleas to species using keys such as the chart in Figure 10.

![Figure 9](image)

There are several different fleas on the center bench as well as *Ctenocephalides felis*, the cat flea and *Xenopsylla cheopis*, the oriental rat flea, in your student slide box (slides #75 and #76 respectively). Key them out using the key in Figure 10.

*C. canis* is a rare flea in the United States and is almost never seen in routine practice. *C. canis* adults (Slides on the center bench) have heads which are more bluntly rounded than *C. felis* (Fig. 11). Also, the first tooth of *C. canis*’ genal comb is half the length of the second (Fig 11). **Hint:** You may have to focus up and down on the first tooth of *C. felis* in order to appreciate its length.

![Figure 11](image)

*Echidnophadga gallinacea*, the sticktight flea of poultry (adults, center bench). Recall that this flea has an atypical life history in that it remains attached to the skin of the host throughout much of its adult stage. Referring to Figures 9 and 12, examine the preserved specimen and note:

- a. the angular head,
- b. the absence of ctenidia (combs) and
- c. the piercing/sucking mouthparts.

3.) Examine the following slides from your student slide box:
A. *Ctenocephalides felis*, the cat flea - Student Slide #75. Use this slide to practice keying out fleas using the key in Fig. 10. This is the most common flea seen in both dogs and cats in the US. Its life cycle is typical of most species of flea in that they move about freely in the host hair coat and have a reservoir of immature stages in the environment. Observe the following:

a. General structure - head, thorax, abdomen; laterally flattened; 3 pairs of legs (Fig. 9).

b. Both genal and pronotal combs present (Figs. 9 and 11).

B. *Gasterophilus* sp. Eggs - Student Slide #70. Recall from lecture that the larvae of these flies are obligatory parasites in the stomachs of equids. In most species, the eggs are attached to the hair coat of the host. These eggs may be identified based on their shape (see Fig 7), but you just have to recognize them as *Gasterophilus* eggs (you can speciate them based on where they are located on the horse).

C. *Melophagus ovinus*. - Student Slide #68. Recall from lecture that this is an atypical fly which has evolved a completely ectoparasitic life history. It ranks as an important parasite of domestic sheep. *(Foreyt, Pg. 108)*

NOTE: a.) the indistinct segmentation of the abdomen,
b.) the strong legs and claws;
c.) this is a wingless fly.

D. *Musca* sp. And *Lucilia* sp. - Student slide #73. These and other muscoid flies are sometimes involved in facultative myiasis. Note the mouth hooks (Fig. 5a, pg 2) and the paired posterior spiracles (Figure 5c, pg 2). Compare the shapes of the spiracular slits and peritremes of *Musca* and *Lucilia*. (See Figure 4 as an aid.) This type of morphological variation can be used to identify otherwise rather featureless fly larvae as in #1 above.

![Musca](image) ![Lucilia](image)

E. *Menopon gallinae* - Student Slide #84. This is the shaft louse - a chewing louse of poultry. This louse is an example of the *Amblycera* which contains many chewing lice.
of domestic and wild birds. Examine the slide and note:

a. the chewing mouthparts (opposing mandibles) (Fig. 13),
b. the flat broad shape of the head,
c. unlike Ischnocera, the antennae are recessed into lateral depressions on the head. On most of these specimens the palpi are visible on either side of the head (Fig. 13).
d. the dual claws on each leg.

F. *Trichodectes canis* - Student Slide #77. This is a common chewing louse of dogs, which will serve to convey the morphology of the group called **Ischnocera**, so named because of its protruding antennae (Figure 14). Note the following features, which exemplify this group of the Mallophaga. *(Foreyt, Pg. 39)*

a. Chewing type mouthparts seen as large opposing mandibles (Fig. 14)
b. General structure - head, thorax and abdomen dorsoventrally flattened.
c. Antennae are visible - 5 segments (Fig 14)
d. 3 pairs of legs, each armed with a strong claw.
e. Palpi not visible. (Fig. 14)

G. *Damalinia caprae* - Student Slides #81 and 80. *Damalinia* is a common genus of chewing louse in livestock. *D. caprae* is from goats, but looks identical to the other members of the genus. The *Damalinia* spp. are also in the **Ischnocera** group and show the same general morphological features as *Trichodectes canis*. 
H. *Haematopinus* sp. - Student Slide #83. This is the hog louse. This important ectoparasite of swine provides a good example of the morphology of the sucking lice (*Suborder Anoplura*). Examine the slide in your slide box and note: (Fig. 15 and Foreyt, pg. 149)

a. Sucking mouthparts are retracted within the head. They may not be visible in your specimen.
b. The general structure – head, thorax and abdomen are dorsoventrally flattened.
c. The head is narrower than the thorax (unlike the chewing lice).
d. The antennae are visible and 5-segmented.
e. There are three pairs of legs each armed with a claw.

I. *Linognathus* sp.- Student Slide #78. This genus (*Foreyt, pg. 39*) includes a common sucking louse of dogs, *L. setosus*. The general morphology of this genus is similar to that of *Haematopinus*.

**Demonstrations**

Checklist Material

**THE ORDER DIPTERA**

1. **Suborder Nematocera (the “long-horned” flies)**

Fam. Culicidae (Mosquitoes). Mosquitoes are tiny delicate flies with long multisegmented antennae (Fig. 1). Their larval and pupal stages are aquatic, and the females of most species require a meal of vertebrate blood to initiate egg development. Mosquitoes constitute a source of blood loss and annoyance but more importantly act as vectors of some important pathogens of vertebrate animals. Glance at the Lucite block museum mounts to get a general impression of the appearance of the adults.

Fam. Simuliidae (Black flies). Black flies constitute a serious cause of blood loss and annoyance to humans and domestic animals. They also transmit a few pathogens of veterinary importance. Get a feeling for the general morphology of these tiny flies, in particular note the long multisegmented antennae.
2. **Suborder Brachycera** (the “short-horned” flies)

   This group includes the horse flies and deer flies. A good example is the horse fly, *Tabanus* sp. Note the overall size and morphology of the antenna of the adult fly (Fig 2a,b) and the general shape of the larva.

3. The Tabanidae - This family of Brachyceran flies includes the horse flies (*Tabanus* spp.) and deer flies. These are robust, large-headed flies. They have large eyes, which are often iridescent. The females (which are the ones that feed on blood and thus will be found around animals) have heavy mandibles for tearing skin in order to provide the blood pool from which they feed. You should be able to recognize the flies of this family (“tabanids”) on sight.

4. **Suborder Cyclorrhapha** (the “muscoid” flies)

   The morphology of flies in this suborder is typified by the house fly, *Musca domestica*. Therefore, as a group they are sometimes referred to as “muscoid” flies. Antennae of adult cyclorrhaphans are reduced to a club-like structure, lying flush with the frons or “face” of the fly and bearing a feather-like chemosensory structure called the arista at its tip (Fig. 3.)

Cyclorrhaphan flies may be serious pests in intensive indoor rearing facilities such as poultry houses and dairy barns. They are usually seen clinically as mature third-instar (-stage) larvae infesting the tissues of living animals either as obligatory or facultative parasites.

5. *Melophagus ovinus* - The Sheep Ked. Recall from lecture that this is an atypical fly
which has evolved a completely ectoparasitic life history. It ranks as an important parasite of domestic sheep. You should be able to recognize this wingless fly found in the wool of sheep on sight. Note that it is often mistaken at first glance for a tick, but closer inspection will reveal the 3 body parts and 6 legs of an insect.

6. ORDER PTHIRAPTERA (The Lice)

Lice are so host specific that a species diagnosis may often be made if the host is known and the specimen can be assigned to the correct suborder.

A. The Chewing Lice - Mallophaga

These lice have opposing mandibles with which they chew off bits of food. The head is wide to accommodate these mouthparts. They are broken down into 2 groups based on the placement of their antenna.

i. Amblycera - Antenna in pits on side of head. The Amblycera group contains many chewing lice of domestic and wild birds.

For example: *Menopen gallinae*, the shaft louse - a chewing louse of poultry. Note the chewing mouthparts (opposing mandibles) (Fig. 13), and the flat broad shape of the head which put it into the Mallophaga and the antennae that are recessed into lateral depressions on the head, the key characteristic of the Amblycera group of chewing lice.

ii. Ischnocera - Antenna stick out from head.

For example: *Trichodectes* spp., which include the common chewing louse of dogs (*T. canis*) and horses (*T. equi*). Note the chewing mouthparts (opposing mandibles; Fig. 14) on the flat broad shape of the head which put it into the Mallophaga and the antennae that are easily visible sticking out from lateral aspects of the head, the key characteristic of the Ischnocera group of chewing lice.

B. Suborder Anoplura (the sucking lice)

These lice have sucking mouthparts that are retracted within the head, which is narrower than the thorax (unlike the head of the Mallophaga).

For example:

*Haematopinus* sp., the hog louse. This important ectoparasite of swine provides a good example of the morphology of the sucking lice.

*Linognathus* sp. This genus (*Foreyt, pg. 39*) includes a common sucking louse of dogs, *L. setosus* which has the same features you in all the sucking lice.
7. THE ORDER SIPHONAPTERA- Fleas

These ectoparasites are of great importance to the owners of small animals and you should be able to recognize an adult flea on sight and be able to use a key to determine the species of flea that you are dealing with. Adult fleas are small laterally flattened insects that feed on their host's blood. Their habit of taking many small meals makes them severe annoyance to the host.

For example: *Ctenocephalides felis* and *C. canis*: *Ctenocephalides felis*, the cat flea is the most common flea seen in both dogs and cats in the USA. Its life cycle is typical of most species of flea in that they move about freely in the host hair coat and have a reservoir of immature stages in the environment. In the prepared specimens observe: *(Foreyt, pp 40)*

a. General structure - head, thorax, abdomen; laterally flattened; 3 pairs of legs (Fig.9).
b. Both genal and pronotal combs present (Fig. 9).
c. *C. canis* is a rare flea and is almost never seen in routine practice. *C. canis* adults have heads which are more bluntly rounded than *C. felis* (Fig. 11).

Also, the first tooth of the genal comb is half the length of the second (Fig 11).

NOTE: You may have to focus up and down on the first tooth of *C. felis* in order to appreciate its length.

**Other Insects**

1. The life cycle of a dipteran. The typical fly will have the following stage in its life cycle: egg, larva, pupa and adult. Look at the demonstrations of the life cycles of mosquitoes and black flies. These flies have a life cycle associated with water and thus the larva and pupa are adapted to their aquatic environment. Adult flies are identified based on their morphology (body type, coloration, wing veination, etc.).

2. Bot fly larvae (Bots).

   *Gasterophilus* sp. Recall from lecture that the larvae of these flies are obligatory parasites in the stomachs of horses. Look at the demonstrations of larval *Gasterophilus in situ* and also identify the specimens provided using the characteristics of the spines on the larval integument as pictured in Figure 8. *(Also, Foreyt, pg. 129).*

![Image of Gasterophilus larvae]
**Oestrus ovis**  This third-stage larva is the only such parasite to be found in the nasal cavities of sheep. Note the characters highlighted in the demonstration.

**Hypoderma** sp.  This fly larva causes cutaneous myiasis in livestock. Note the characters in the demonstration. You will not be responsible for differentiating the two species, we are just showing you how a parasitologist would go about speciating these larvae.

**Cuterebra** sp.  This parasite causes cutaneous myiasis in rodents, rabbits and, occasionally, in dogs and cats. In rare cases the first larval instar may be found in the brain of dogs and cats.  Note the spiny integument in the third instar larva in the demonstration.  (Foreyt, pg. 41)

3. Flea larvae.  Eggs, larvae and pupae of fleas are found in the environment. Since the adult female flea lay between 25 and 50 eggs a day (and 80% of adult fleas are females) the environmental stages vastly outnumber the adult fleas on the pet. Since eggs and pupae are non-motile, it is the larval flea that sometimes attracts the attention of the pet owner. The larvae feed on flea feces (dried blood) and will move to where they can find it. This means you will find the larvae in the area where the pet spends most of its time (the pet’s bed, favorite chair, etc). In rugs the flea dirt gets worked into the fiber, thus the larvae are deep into the carpet and usually not noticed. Sometimes the pet will have a sleeping mat, bed, etc that is on a solid floor, and when the owner finally moves it, they will notice hundreds of larvae on the floor (normally reported to the veterinarian as “small maggots”!). Notice the long hairs coming from each segment of the otherwise typical insect larva.

4. Lice eggs.  The eggs or nits of lice are operculate and are cemented onto the hairs at their bases. When the eggs hatch, the operculum is lost and the larva emerges through the opening.

5. The sucking lice of humans: **Phthirus pubis** and **Pediculus humanus**.  These lice have the general morphology of the sucking lice; however, note the distinctive shape of *Phthirus pubis*. Remember, these lice are generally very host specific and survive poorly in the environment. The overriding route of transmission is host-to-host contact. Also, because these lice are so host specific, dogs and cats are not able to act as reservoirs for human lice (despite what the owner or the family physician might claim).
Figure 6.

The posterior spiracles of the larvae of various species of Cyclorrhapha.

a. Calliphora erythrocephala  b. Lucilia sericata  c. Stomoxys calcitrans

d. Cynomyia cadaverina  e. Muscina stabulans  f. Chrysomyia megacephala

g. Chrysomyia bezziana  h. Cochliomyia macellaria  k. Phormia regina

l. Sarcophaga sp. (Figures are not drawn to the same scale.)

From Smart, J., 1948